SPATIAL ANALYSIS OF MESOLITHIC SITE PATTERNING IN ENGLAND AND WALES

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ABSTRACT

This is a study of Mesolithic settlement in England and Wales. Using a site gazetteer database, all known Mesolithic sites were plotted in relation to large scale environmental features using an abitrary site size typology.

The main objectives were to (i) investigate the number of sites and differential density rates across England as a whole, (ii) examine site patterning in selected areas using techniques of point pattern analysis and (iii) investigate some of the spatial and environmental correlates of the technological inventory of a large sample of the largest known sites from England and Wales. Quadrat Analysis was used in (ii) and Discriminant Function Analysis was used in (iii). A general regional interpretation was then attempted in which overall patterns of settlement are discussed in relation to broad environmental features and the tests undertaken.

The main findings were that (i) site density levels were highest in the Pennines and Southeast England, and that eastern England had a generally far higher incidence of sites than anywhere else; (ii) Quadrat analysis revealed the presence of non-random clustered site patterns in all the areas subjected to spatial analysis. This was most pronounced in low-lying areas, but was only tentatively accepted for the one upland area tested; (iii) Discriminant Function Analyis revealed that tool kits can be differentiated with respect to inland and coastal location.

Problems with the lines of evidence and their effect on the validity of the findings were discussed. The general conclusion was that site patterning is heavily influenced by major environmental factors such as rivers, upland areas and littoral zones.

Finally, suggestions for further research are discussed.

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PREFACE

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Chapter I

INTRODUCTION

Overview

By way of introduction to this study I first define the issues investigated and state the overall objectives. I then outline the theoretical context of both the phenomena under investigation and the analytical techniques employed and close with a statement of expectations.

(I) Research Objectives

This study was an attempt to investigate the spatial distribution of sites and associated technologies of the Mesolithic period in England and Wales. Although there is some debate on the definition of the Mesolithic (Castleford 1986), in general terms the Mesolithic in northern Europe can be regarded as that temporal period extending from the beginning of the Holocene to the introduction of agriculture, (c. 8,000 - 4000 bc).[1]

---

[1] By convention in Old World archaeology lower case letters (bc, bp [before the present, baseline 1950]) denote radiocarbon estimates; upper case letters (BC, BP) denote calibrated calendar dates (Antiquity 1970). A number of calibration schemes are in current use, and the reader is referred to Pearson (1987) for a recent review.

The material data of archaeology have three attributes: form, space and time (Spaulding 1960). The spatial dimension is therefore particularly important in archaeological research (Clarke 1968, 1977; Hodder and Orton 1976).

My main objectives were to

1. Provide an overall picture of the distribution of Mesolithic sites in England and Wales, by plotting the locations of as many sites as possible and thereby produce a comprehensive set of site distribution maps.
2. Interpret the nature of the distribution of the patterns discerned using both (a) rigorous methods of analysis with respect to (i) spatial distribution of sites, (ii) the distribution of certain specified technological complexes and (iii) some of the ecological correlates of the spatial patterns revealed, and (b) subjective interpretation and assessments, based on the results of the analysis and the revealed site distribution patterns.

Methods and materials will be discussed in detail in the next chapter, but it should be pointed out at this stage, that because of some important reservations and constraints associated with the data, the overall perspective of this study was largely general and exploratory rather than definitive. Consequently the main objective was to assess the nature of Mesolithic occupation in England and Wales in general terms.

(II) Theoretical Background of The British Mesolithic

In order to provide a suitable context for a discussion of the specific problems being entertained I first review the general nature of Mesolithic adaptations. This primarily centres on the interrelationship of a number of environmental variables (topography, climate and biota) and cultural factors (ecology, economy, social organisation, technology and chronology).

Environment

Following climatic amelioration, the withdrawal of the Pleistocene ice sheets after about 20,000 bp produced a series of wide ranging physical effects in northern Europe (Butzer 1971; Clark 1936, 1952). Figure 1 depicts a summary of the main environmental sequences.

Sea levels rose as a result of an increase in glacial melt water (eustasy), and, freed from the enormous downward pressure of the ice, surficial tectonic plasticity caused isostatic recovery from its previously depressed state (Butzer 1971). Although eustatic changes were a world wide phenomenon, isostatic rebound was a localised event (Clark et al. 1978).

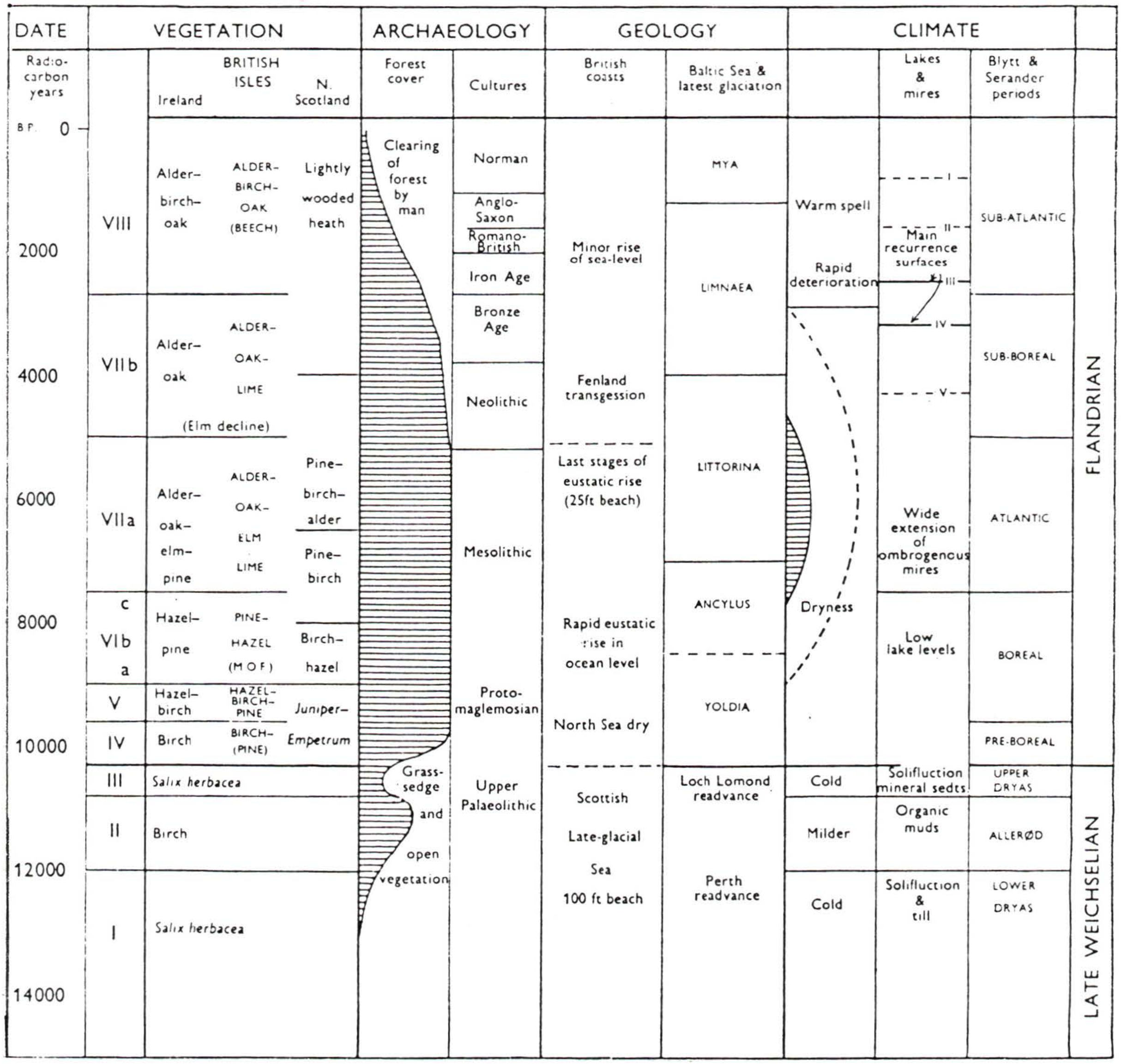

Figure 1: Environmental Chronology in Northern Europe. (From Godwin [1975:52], and used with permission)

Isostatic change was most extensive in the northwest of Britain, but somewhat less pronounced in southern areas; sea levels rose more quickly in the southwest and East Anglia was subject to some down-warping of the southern North Sea area (Wymer 1981).

During the early Mesolithic a contiguous terrestrial area extended from Britain through the Baltic area to Scandinavia and the North European plain resulting in a considerable degree of cultural uniformity (Clark 1975; Dennell 1983). Subsequent marine transgression has destroyed much of the archaeological evidence, however.

Climate

Climatic changes are inferred from oxygen isotope analysis, macrofossil remains and palynological studies (Godwin 1975; Williams 1985). The Mesolithic period extends across three distinct climatic phases.

In the Pre-Boreal period (c. 10,500 - 8,500 bp), climatic amelioration saw temperatures approximate those of the present, although seasonal contrasts were more pronounced. Two alternating climatic cycles followed the Pre-Boreal. The Boreal phase (c. 8,500 to 7,500 bp) was characterised by a warmer and dry continental climate. The succeeding Atlantic period from 7,500 bp to the end of the Mesolithic coincided with higher sea levels, and as a result was characterised by warm and wetter climatic conditions (Simmons 1979:114).

Biota: (i) Flora

The sequence of floral changes has been dealt with extensively by Godwin (1975) and Simmons et al. (1981), and is only briefly summarised here.

During the Pre-Boreal period there was a gradual replacement of late glacial steppe-tundra and open parkland by a forest cover of birch (Betula) and pine (Pinus). Such genera as hazel (Corylus), oak (Quercus) and elm (Ulmus) appeared in the Boreal period. Towards the end of the period both lime (Tilia) and some alder (Alnus) occurred with increasing frequency. The Boreal-Atlantic transition was characterised by a sharp decline in pine and a concomitant increase in the frequency of alder, lime and elm.

At their maximum extent the Boreal forests covered virtually all of Britain except for the most westerly Atlantic islands such as the Hebrides and Orkneys, and indeed, most of northwest Europe (Clark 1952).

Biota: (ii) Fauna

Much of the faunal evidence has been derived from archaeological sites and may therefore reflect cultural influence (Aaris-Sørensen 1983; Gifford 1981). In general, however, the cold adapted herds of reindeer (Rangifer tarandus), and horse (Equus przewalski) upon which Upper

Palaeolithic cultural communities had relied had all but disappeared from Northern Europe following the replacement of the open tundra parkland by the Neothermal forests. This resulted in the expansion of forest adapted fauna such as red deer (Cervus elephas), roe deer (Cervus capreolus), aurochs (Bos primegenius), elk (Alces alces), wild boar (Sus scrofa) and woodland horse (Equus caballas), among others (Clark 1936, 1952; Simmons et al. 1981).

A variety of birds and fish were also important resources found in assemblages. Marine fauna are known from Scottish sites relatively early at c. 7000 bc (Coles 1971), but maritime resources generally tended to become more important culturally in Atlantic times (Dennell 1983).

The character of Mesolithic fauna remained constant to the Neolithic except that the elk disappeared at the end of the Boreal period, possibly as a result of over hunting. The mixed deciduous forests of the early Atlantic period were seemingly more suited to roe deer and red deer as these species gradually replaced the declining populations of aurochs and elk (Simmons et al. 1981).

The question of the role of fish in the Mesolithic is an interesting one. In the European context, Mesolithic communities are often described as hunter-fishers (cf. Clark 1952), yet very little evidence of fish has been recovered from British Mesolithic sites (Jacobi 1978). By analogy with the continent, anadromous and catadromous fish such as salmon (Salmo salar), trout (Salmo sp.) and eels (Anguilla sp.) would have been important resources (Clark 1952). In inland waters pike (Esox lucius), and other species of fish are likely to have been exploited, but there is little direct physical evidence. In some cases this may have been due to geomorphological factors in Pre-Boreal times (Wheeler 1978), but this is also likely to be an artefact of excavation techniques.

Cultural Factors

Because the data on Mesolithic life-ways are differentially preserved, most of what we know of Mesolithic society has been inferred from archaeological assemblages dominated by lithic technology and faunal remains. Consequently, economy and subsistence tend to receive more extensive treatment in the literature than do other issues such as social organisation (Clark 1936, 1975, 1980; Clarke 1976).

The Mesolithic Economy

Economy can be defined as the structured provision of material needs (Bailey and Sheridan 1981). The general character of the Mesolithic economy has been treated seminally by Clark (1952), but has received considerable attention from others (e.g. Clarke 1976; Cohen 1977; Dennell 1983; Jochim 1976, 1979).

The role of ungulates has been examined by Barth (1983), Ingold (1980), Mellars (1975) and Sturdy (1975). It would appear that while certain species such as red deer are more frequently encountered in assemblages, no single species dominates (Clark 1952).

The importance of marine resources has been discussed by Bailey (1978, 1983), Clark (1946, 1947, 1948, 1952), Coles (1971), Deith (1983, 1986), Mellars and Wilkinson (1980) and Schalk (1977). It seems that marine resources played an increasingly important role during the later stages of the Mesolithic, notwithstanding that marine transgressions have destroyed much of the evidence.

The economic importance of plants has been reviewed by Clark (1952), Clarke (1976), Dennell (1976), Edwards (1979, 1985), and Vaquer et al. (1986). Although animal bones survive relatively well in assemblages, plant materials do not. It seems likely that their absence from the record relates more to excavation techniques and taphonomic factors rather than an economic reality (Clarke 1976; Williams 1985).

A number of Mesolithic sites, especially in Scandinavia, have better than average preservation of organic remains

(Clark 1952, 1975), which has been conducive to detailed examination of specific resources.

Occasional instances of rock carvings can also provide additional information (e.g Dams and Dams 1977).

The general replacement in early post-glacial times of herd animals by less gregarious species living in less open habitats necessitated a considerable change in subsistence strategy. This serves to largely differentiate the hunting way of life so dominant in the Palaeolithic from the Mesolithic subsistence strategy which largely took the form of a broad spectrum economy involving a range of resources exploited through hunting, fishing and gathering (Childe 1931; Clark 1952, 1962).

Abundances were seasonal in nature, and the main pattern of subsistence seemed to have involved a transhumant strategy of nucleated activities in lowland zones in winter, and dispersal in upland areas in summer (Clark 1972; Jacobi 1978; Mellars 1975, 1976b).

Human Manipulation of the Environment

A favoured notion regarding European prehistory is that cultural groups were not able to effect major and irreversible changes to the environment until the technological advances of the Neolithic period (Simmons 1979). A steadily expanding body of palynological data now indicates that Mesolithic communities were able to effect large scale changes to their environment, including use of fire (Jacobi et al. 1976; Mellars 1976a; Simmons 1979; Simmons et al. 1981), use of such plants as ivy (*Hedera helix*) as fodder (Simmons and Dimbleby 1974) and the encouragement of beaver (*Castor fiber*) activity (Coles and Orme 1983).

There is evidence from France that incipient domestication processes were well advanced with respect to sheep (Geddes 1985) and plants (Vaquer et al. 1986), and there seems little doubt that the food production techniques of the succeeding Neolithic period were largely facilitated by the developed nature of Mesolithic subsistence (Clark 1980).

Social Organisation

There is very little definitive evidence which permits confident assertions to be made about Mesolithic social organisation. Until relatively recently, the consensus in the literature seemed to favour the notion of small, mobile, egalitarian, family-based groups aggregating in winter and dispersing in summer (Clark 1936, 1962, 1972; Mellars 1975, 1976a, 1976b).

However, there seems to have been a pervasive tendency in recent years to plug the gaps in the archaeological record with ethnographic analogues (Lewthwaite and Rowley-Conwy 1980). There is now increasing disquiet regarding the uncritical use of such analogues, and with the egalitarian band model itself (Bender 1978, 1985; Lewthwaite and Rowley-Conwy 1980; Price and Brown 1985; Rowley-Conwy 1981; Schrire 1980).

There now seems to be general recognition that later Mesolithic communities in some parts of northern Europe developed quite complex hierarchic social systems (O'Shea and Zvelbil 1984; Price and Brown 1985). To what extent this manifested itself in Britain remains unclear at present.

Mesolithic Industries.

The technology of this period was of a highly variable order which reflected changing resource bases (Clark 1936, 1978). Many of the early Mesolithic industries in Britain were clearly influenced by the Maglemosian tradition of adaptation to the forest but these cultural influences seemed to decline following the separation of Britain from the European continent (Clark 1932; Jacobi 1973, 1976; Palmer 1980).

The British Mesolithic industries are characterised by a diagnostic non-geometric "broad blade" microlith tradition which extended into the seventh millennium bc, after which a "Narrow Blade" type appears, and both types co-existed for much of the remainder of the Mesolithic period (Mellars 1974, 1976b). Other implements included axes, scrapers, cores, gravers, picks and perforated pebble stones.

Mesolithic Chronology

A variety of dating schemes are in use in Mesolithic research. Radiometric dating and pollen zone data are the most widely used techniques. A list of 35 dates for 25 sites is provided in Appendix A together with a map of the dated sites.

Although there were changes in technology and economy over the duration of the period, specifically with respect to microlithic industries, constraints of space do not permit a detailed consideration of temporal factors. However, reference to the list of dates in Appendix A will show evidence of Pre-Boreal occupation in both northeastern and southern England. Coastal occupations occurred in the south and west of England by 5,000 bc, and the Pennine uplands were somewhat continuously occupied from the Boreal Period, c. 7,500 bc, until the end of the Mesolithic. According to Wainwright (1963) there was occupation in southwest Wales in the early Boreal period, and this seems to reflect continuity from Later Upper Palaeolithic times, when most of southern England and south Wales was occupied (Campbell 1977; Roe 1968).

Summary

It is currently recognised that the Mesolithic not only represented a period of cultural development worthy of study in its own right, but also holds the key to an understanding of the processes which led from broad spectrum hunting, fishing and foraging to incipient food production and farming as well as stratified society and sedentary settlement (Clark 1980; Gramsch 1980; Price and Brown 1985).

Because of the close relationship between Mesolithic communities and their environment, the nature of Mesolithic settlement patterns is an area of primary interest.

Not all aspects of the prehistoric past are amenable to empirical investigation, of course, and considerable efforts are presently being expended in the search for methods which will permit a greater understanding of less tangible aspects of prehistoric society such as social organisation and ideology (cf. Price and Brown 1985).

Settlement patterns are amenable to empirical inquiry however, and there are a number of techniques which can be used to increase our comprehension of the processes which influenced Mesolithic settlement in Britain.

The Investigation of Settlement Patterns

Having reviewed the Mesolithic context, I now consider the nature of the issues investigated in this study.

Rationale

Discerning the nature of settlement patterns in prehistoric times is a complex undertaking and the first step necessarily involves a consideration of the distribution of archaeological sites of known Mesolithic age. For the present, 'site' can be defined as anywhere Mesolithic artefacts have been found.

Britain represents a definable geographical area over which numerous archaeological sites are distributed. A number of factors are posited to condition, constrain or otherwise influence patterns of settlement, and these may variously include subsistence strategies and carrying capacity, political and social organisation, ideology, territoriality, the location of subsistence resources and sources of raw materials (Clarke 1977; Hodder and Orton 1976; Mellars 1976b). Analysis of Mesolithic site distribution patterns are intended to contribute towards a greater understanding of the nature of some of these interrelationships, some of which I briefly reviewed above.

Literature Review

Even though there are numerous individual Mesolithic site reports (cf. the references in Wymer 1977), there has been relatively little work at the regional level. Wainwright (1963) has examined the distribution of the Mesolithic in Wales, Jacobi (1978) has summarised the early Mesolithic in northern England, and with others has discussed settlement in the Pennine uplands of central England (Jacobi et al. 1976). Settlement in Northwest Britain has been discussed by Bonsall (1980), and despite the broader title of her book, Palmer (1978) examined Mesolithic settlement in southern counties in England. Mellars (1976b) attempted to correlate industrial variability and settlement patterns, and the geological correlates of site location in southeast England were discussed by Mellars and Reinhardt (1978), and more recently by Mellars and Haynes (1986).

The only known national survey is Grahame Clark's The Mesolithic Age in Britain (1932), which was largely a typological study of lithic technology based on a relatively small number of known sites. This is not to imply that there have been no synoptic treatments of the Mesolithic in Britain. Valuable summaries of Mesolithic developments generally have been provided by Jacobi (1973, 1976, 1978), and, with special reference to radiocarbon chronology, by Mellars (1974).

There is a broad literature on the European Mesolithic, and this permits a comparison of developments in Britain with those on the continent. This becomes particularly important with respect to those areas where archaeological preservation is superior, especially in relation to organic data (cf. Blankholm 1980; G. Clark 1971, 1983; Cullberg 1980; Jennsen 1982; Larsson 1980; Newell 1973; Petersen 1973; Price 1973, 1980, 1983; Rowley-Conwy 1981, 1983; Ryan 1980; Welinder 1978, 1980; Zvelbil 1983; Zvelbil and Rowley-Conwy 1984).

(III) Expectations

Given the contextual framework reviewed above there are many indications as to the likely nature of settlement patterning in England and Wales.

During much of the Pre-Boreal and Boreal the land-bridge between Britain and the continent extended from Yorkshire to Sweden in the north, and from southeast Britain to France in the south (Jacobi 1973, 1976). Consequently, all other things being equal, we can expect that these areas would have been the first to be occupied by communities moving into Britain from Europe to join those communities that had remained since late glacial times. This then suggests there will be a higher incidence of site locations in the east and southeast of Britain.

Britain is a relatively small country. As parts of Scotland were occupied by 6,000 bc (Mellars 1974:85) we can expect that there will be evidence of Mesolithic occupation throughout England and Wales.

We can further adduce a number of likely ecological correlates of site distribution. As Britain was largely forested, it seems logical that rivers would have been an important focus for subsistence resources and provision of a permanent water supply, as well as facilitating enhanced mobility.

One of the most important factors influencing site location is likely to have been economic, and many sites would almost certainly have been located for the optimal exploitation of resources (Clark 1936, 1952; Hardesty 1980; Jochim 1976, 1979; Vita-Finzi and Higgs 1970).

Resource scheduling seems to have been a central feature of the Mesolithic economy and optimal site locations are likely to be found in ecotones (the intersection of two contiguous ecological zones) (Clark 1952; Gramsch 1980; Woodman 1978, 1980).

Because the Mesolithic economy was one based on hunting, gathering and fishing (Clark 1952), with hunting providing the mainstay of economic data, one of the major factors influencing site location is based on the seasonal migration patterns of red deer which, assuming uniformitarian behaviour, tended to congregate in lowland winter stands but dispersed into more diffuse upland territories in the summer (Clark 1936, 1952; Jacobi 1978; Mellars 1975, 1976b:382). Because of higher frequencies of barbed antler points in northern areas of Britain (Clark 1932; Jacobi 1973; Mellars 1976b), there seems to have been a more intensive hunting focus here than elsewhere due to proximity to the then-North Sea Plain, which was likely an extremely rich resource area (Clark 1936, 1975; Jacobi 1976).

In general, the warmer climate of Mesolithic times was conducive to more open settlement patterns in comparison with the Upper Palaeolithic (Clark 1932:29). I therefore expected settlement patterns to extend beyond known cave systems and rock shelters.

Comparison of the relative degree of site clustering and absence of occupation was expected to provide some interesting indications of which areas of the country were more densely occupied and those which were not. This may additionally indicate direction of settlement trends. The differential occupation of specific upland and lowland zones, and association with riverine areas represent ecological foci that are posited to correlate with Mesolithic settlement.

A major portion of the study was devoted to spatial analysis of selected areas to determine whether site patterns tend to be randomly or non-randomly distributed. I began with the null hypothesis that sites are distributed at random across the landscape. I tested the null hypothesis by comparing observed distributions to those predicted by an independent random process generation model. The null hypothesis would be retained if no significant differences resulted. If there were differences, then it follows that there existed specific influences which ordered the patterns. It then becomes necessary to investigate the nature of such influences of spatial dependence.

The possible role of littoral zones as an influence on settlement patterns is an interesting question. Settlement in, and exploitation of coastal zones is considered to be a diagnostic characteristic of the later Mesolithic (Binford 1968; Clark 1952; Czarnick 1976; Palmer 1978, 1980). This question was examined by comparing relative occupation in inland and coastal areas.

Additionally, following Mellar's (1976b) study of the possible relationship between settlement patterns and industrial variability, I compared the differential nature of selected techno-complexes and configurations of tool types in different ecozones, using the statistical technique of Discriminant Function Analysis in order to determine whether inland and coastal technologies could be differentiated.

These issues were also addressed by subjective consideration of site distribution maps which show river systems, upland zones, and the existence of present and previous coastlines.

<u>Format</u>

In successive chapters I present a statement of the methodology employed, results of (a) quadrat analysis, (b) Discriminant Function Analysis of technological configurations, and (c) a regional interpretation of Mesolithic site distribution. I conclude with a discussion of the issues investigated.

Chapter II

METHODS

In this chapter I discuss the nature of the data base and then give details of the methods of data collection and analysis with respect to: (i) obtaining site distribution maps and associated data, (ii) spatial analysis, (iii) Discriminant Function Analysis of tool type distributions, and (iv) a regional interpretation of the site distribution.

The Data Base

The main data base used is the Council for British Archaeology (CBA) Gazetteer of Mesolithic Sites in England and Wales (edited by Wymer 1977), (hereafter The Gazetteer). This represents an attempt at a comprehensive survey of the Mesolithic for England and Wales with the specific aim of (a) providing researchers with a guide to available material, sites and collections, and (b) indicating the extent of Mesolithic sites in England and Wales (Wymer 1977:viii-ix).

The primary data sources utilised by the CBA survey include collections in museums and private hands, together with published and unpublished reports.

The Gazetteer lists site locations by county,[2] parish, six figure Ordnance Survey (OS) map grid reference, locations of Mesolithic material, numbers and types of associated artefacts, bibliographic references and occasional annotations.

Production of Site Distribution Maps

The basic technique in producing site distribution maps was to trace OS grids from a 1:625,000 scale OS map of England and Wales. I then plotted site locations directly onto these grids using the grid references (i.e. coordinates) given for each site in The Gazetteer. This scale of operation provided for a working accuracy of ± 250 m. Because of the large number of sites and collaborative effort of many individuals involved in the compilation of the The Gazetteer, some site locations are inevitably erroneous, and indeed, a number of obvious errors were detected during the plotting phase. Where I felt confident in correcting these, I did so; otherwise, clearly erroneous site locations were ignored.

Site locations were then plotted on a map outline of England and Wales on which I show major river systems taken from a 1:625,000 scale OS Hydrographic Survey map. The overall distribution map (Figure 2) is provided in the rear

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[2] Prior to the 1973 reorganisation of county boundaries

cover pocket.

Site Size

Although The Gazetteer defines a site as anywhere a Mesolithic artefact has been found it is clear that more importance should be attached to larger sites because of the greater extent of potential information. Accordingly, I decided to discriminate between sites of varying size in the plotting phase. Each site in The Gazetteer has an associated listing of the number of artefacts recovered and held in one or more collections. I adopted an arbitrary system of site size based on the total number of artefacts associated with each site:

Site size	Symbol	Number of artefacts
Small	.	1 - 10
Medium	●	11 - 100
Large	▲	101 - 1000
Major	■	> 1000

Not all site entries in The Gazetteer have complete data, and an asterisk (*) denotes unknown numbers of (a) given artefact(s). I have assumed a minimum value of one (1) in all such cases, unless site entry notes provide additional information.

It was not always possible to achieve a full resolution of closely clustered sites in the plotting phase as different sites may have the same grid reference. I therefore used one symbol to denote the total number of artefacts at such a location. Site locations as plotted may therefore indicate both individual sites as well as clusters of sites.

Typological Validity

Obviously site size is problematic and the size typology should endeavour to accurately reflect actual site size. Excavated sites likely provide greater numbers of artefacts than sites known only from surface scatters. To control for the possibility that large and major sites are not merely those which have been excavated, I enumerated the site entries in The Gazetteer which had been given an excavation annotation and listed these on a county-by-county basis.

In the majority of cases a reasonable percentage of sites have been excavated, and as excavations range across all four site size types, I consider the size typology was reasonable in the circumstances. However, these data are taken from column notes in The Gazetteer and may thus represent a very conservative assessment of the extent of Mesolithic excavations. Even though all the data cited in The Gazetteer are referenced, many of the reports are published only locally and are not generally available. This therefore precluded a more precise examination of the extent of excavations conducted. So although the ultimate validity of this site size typology is problematic, as constituted it may prove useful in the interim as some measure of the relative distribution of differing scales of Mesolithic activity.

My treatment of the overall distribution of sites therefore simply took the form of enumerating the number of sites of given size by county, and producing summary statistics.

Differential Density of Sites

I attempted to determine the differential density of site distributions for the country as a whole in two ways. In the first instance I used counties as natural sampling units by enumerating the number of sites per county. I compared county totals to the size of the counties using data from Whittaker's Almanac (1972) by rank ordering both sets of data. I then calculated a Spearman's Rho product moment correlation coefficient which measures the degree of association between the ranks. The formula for this statistic is:

$$Rs = 1 - [(6\Sigma D^2) / N(N^2 - 1)] \qquad (1)$$

where D is the difference between ranks and N is the total number of ranks. The resulting value is expressed within the range +1.0 (perfect correlation) to -1.0 (perfect inverse correlation).

Although it was expected that these data will give an approximate idea of the differential site densities, more precise results were obtained by controlling for county area, and calculating the ratio of sites to unit area. This then provided the second method of determining density levels.

As stated above, county area was obtained from the data in Whittaker's Almanac (1972) (converting the acreage given to Km^2). The number of sites per unit area was then calculated for each county, and the data expressed as a reciprocal in order to show the area/site ratio. Thus, the lower the ratio, the less area between sites, and the greater the density. Conversely, in less densely settled areas, the greater the distance between sites, and the higher the ratio of area to site. Because of the variation in the site densities, these were converted to logarithmic scales.

Although it might seem more appropriate to calculate site/area ratios, this in fact produced some very small fractions which proved difficult to tabulate in the case of large county areas with few sites. In any event, both ratios are inversely related to each other; thus both ratios will have identical absolute logarithmic values. However, the logarithms of the area/site ratio are always positive, while those for site/area ratio are negative.

Spatial Analysis

The question of whether site distribution patterns are random or non-random can be addressed by application of techniques of spatial analysis (Clarke 1977; Hodder and Orton 1976). Point Pattern Analysis was used to examine the spatial relationships between sites in selected areas.

Point Pattern Analysis

This technique is useful for determining whether a given array of points on a map (sites plotted in this case) exhibits a random or non-random distribution pattern (Hodder and Orton 1976; Taylor 1977; Thomas 1977; Unwin 1981).

In the quadrat method, a grid of contiguous quadrats of uniform size was superimposed over the study area and the number of points occurring within each quadrat recorded. The observed distribution was then compared to the theoretical distribution generated by the Poisson independent random process model, following Taylor (1977:133).

Mathematically the Poisson model takes the form:

$$p(x;\lambda) = (e^{-\lambda}\lambda^{x})/x! \qquad \text{for } x = 0, 1, 2....n \qquad (2)$$

where e is the exponential constant[3] and the parameter is the mean number of points per quadrat for each case of x. Applying this formula, I calculated the probability of 0 points per quadrat, probability of 1 point per quadrat, and so on. Multiplying each of the derived probabilities by the total number of quadrats provided an expected frequency of 0, 1, 2 . . . n points per quadrat in a random process of point generation. The exected frequencies were then compared to the observed frequencies.

A chi-square test was used to compare goodness-of-fit between the observed frequency array and that of the theoretical random distribution produced by the Poisson process model (Taylor 1977; Thomas 1977; Siegel 1956; Unwin 1981). The formula for this test is:

$$X^2 = \sum [(O - E)^2/E] \qquad (3)$$

where O is the observed frequency and E is the expected frequency. The alpha level specified was 0.05.

I additionally present histograms of the observed and expected frequencies to facilitate visual comparison of the data.

The nature of the patterns can be further investigated by considering the degree of clustering/dispersion using Variance and Mean ratios (VMR) (Taylor 1977; Thomas 1977;

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[3] 2.7183

Unwin 1981). The variance for N - 1 degrees of freedom is calculated by:

$$S^2 = \sum [fi(mi - \overline{m})^2/(N - 1)] \qquad (4)$$

where fi is the frequency of ith points in mi quadrats and mi is the number of quadrats containing i points, $\overline{m}$ is the mean frequency of points per quadrat and N is the total number of quadrats. The variance/mean ratio is simply the variance (S^2) divided by the mean ($\overline{m}$).

The test is based on the property of the Poisson theoretical distribution that the mean and variance are equivalent. Thus, if the observed distribution is random, the observed VMR should approximate the value of unity (1.0) (Thomas 1977:17). It further follows that if the VMR is <1.0, a dispersed pattern is indicated, while a ratio of >1.0 indicates a clustered pattern (Taylor 1977; Thomas 1977; Unwin 1981).

A two tailed Student's t-test was used to determine whether the VMR derived from the quadrat censusing was statistically significantly distinct from the VMR of 1.0 that indicates a random pattern. The value of t is calculated by:

$$t = (VMR - 1.0)/ \text{ Standard Error} \qquad (5)$$

for N - 1 degrees of freedom, where the standard error is $[2/(N - 1)]^{0.5}$ (Thomas 1977:17).

Two sets of tests were therefore employed. The chi-square test was used to assess the degree of correspondence between the observed frequency array and that predicted by the Poisson model. Calculating the VMR enabled comparison with the VMR of unity for a random distribution, and additionally had the advantage of determining whether non-random patterns were clustered or dispersed.

There are, of course, a variety of other tests of spatial analysis that could have been used, such as nearest neighbour analysis. Because of some particularly problematic issues associated with this test (boundary problems especially, see Hodder and Orton [1976] and Unwin [1981] for a review), I eschewed this test in favour of those described above.

<u>Problems in Point Pattern Analysis</u>

As with all quantitative and statistical techniques there are a number of potential problems, and choice of quadrat size is particularly problematic. Changing the size of the quadrats will produce a higher or lower degree of clustering or dispersion. For example, a large scale map of the distribution of mail boxes in a town and surrounding countryside would likely show that most of the mail boxes were clustered in the town. If we reduce the scale, and examine the distribution of mailboxes in just the town we would likely find a much more uniform distribution. The degree of clustering or dispersion therefore changes with the scale of analysis (Taylor 1977:146; Thomas 1977:18-20, 27).

Recourse can be made to two remedies: an optimum quadrat size and repeated tests using quadrats of different sizes. The optimum quadrat size is defined by 2A/N, where A is the area and N is the total number of points in the study area, such that there are twice as many quadrats as there are points, giving a mean allocation of 0.5 (Taylor 1977:146). However, it is recommended (Hodder and Orton 1976; Taylor 1977; Thomas 1977; Unwin 1981) that a variety of quadrat sizes be employed for each test. Consequently both optimal and repeated methods were employed here.

Test Area Selection

In the interests of a more balanced picture, the areas selected for detailed spatial analysis were selected from those regions which have not been subject to very much areal research.

Among the more intensively studied areas are the Pennine uplands and northern England (Clark 1932, 1972; Jacobi 1973; 1978; Jacobi et al. 1976; Spratt amd Simmons 1976; Switsur and Jacobi 1975), northwest England (Bonsall 1980), the southern coastal counties of England (Palmer 1978), Wales (Wainwright 1963), and southeast Britain (Clark 1932; Mellars and Haynes 1986; Mellars and Reinhardt 1978; Palmer 1978).

By way of contrast, very little areal research seems to have taken place in eastern, central and southwest England, and these therefore formed the focus for the application of techniques of spatial analysis. Detailed rationales for delineating areas for testing will be provided below, but suffice it to say here that two larger areas (East Anglia, and Central England), a river valley (The Avon Valley, Wiltshire) and an upland area (The Cotswold Hills, Gloucestershire) were selected for quadrat analysis.

The results of the analyses described thus far appear in chapter three.

Analysis of Tool Type Distributions

The spatial distribution of specific artefacts and technological complexes is also an interesting problem which I considered. Following Mellar's (1976b) attempt to demonstrate a relationship between settlement patterns and industrial variability, I examined the proposition that the configurations of Mesolithic tool kits in Britain may exhibit either a coastal or inland focus in an attempt to establish whether there was a relationship between technology and spatial-ecological factors.

I distinguished between coastal and inland by means of an arbitrary 10 Km distance from the present coastline. This is based on the view that there is a limit to mobility in a subsistence context, and that 10 km, a two hour walk, represents an approximate limit (cf. Vita-Finzi and Higgs 1970). This criterion assumes a uniform topography, and may be therefore be considered an arguable concept in this context. However, I consider it to be reasonable in an exploratory study such as this.

The Gazetteer lists the number of artefacts associated with each site within a set of given tool categories (axe, pick, core, blade/flake, scraper, graver, microlith, micro-burin, perforated mace head, and "other".[4] I abstracted the artefact configurations for the major sites and subjected them to Discriminant Function Analysis (DFA).

DFA is a technique for statistically differentiating two groups of cases (Klecka 1980; Norusis 1985), in this case, site artefact configurations as defined by location (interior or coastal). DFA separates these out by weighting and linearly combining the discriminating variables (tool

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[4] These tool types are described in more detail in Appendix B.

frequencies for each site) such that the two groups are forced to be as statistically distinct as possible. In discriminating the data, DFA provides a single dimension on which one group will be clustered at one end, with the other group at the opposite end (Klecka 1980). Although DFA theory requires the variables to have a multivariate normal distribution, "in practice the technique is sufficiently robust such that this assumption need not be strongly adhered to" (Klecka 1980:61).

Discriminant functions are of the form:

$$D = B_0 + B_1X_1 + B_2X_2 + \ldots + BnXn \qquad (6)$$

where D is the discriminant function score, B's are weighting coefficients calculated from the data and X's are the values of the independent variables (Norusis 1985). The functions are formed to maximise the separation of the groups (Klecka 1980).

DFA was computed using SPSS[5] software and the substantive results appear below in chapter four, with additional data appended (Appendix B).

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[5] Statistical Package for the Social Sciences.

Regional Distribution.

The final task was to examine the overall distribution of Mesolithic sites in England and Wales and attempt an overall interpretation, which is presented in chapter five. This was undertaken on a region-by-region basis by discussing the site distributions relative to such topographical features as upland areas, river systems and, because of changed coastlines, submarine contours (using information from an OS Physical Relief map of Great Britain).

Chapter III

RESULTS I: SPATIAL ANALYSIS

In this chapter I present the results of the analysis of (i) the overall distribution of sites in the study area, and (ii) point pattern analysis of site patterns in selected areas.

I: Overall Distribution of Sites

The total number of sites per county was enumerated using the site size typology discussed above. A map showing county boundaries is provided in Figure 3.

The data showing the number of sites per county are given in Figure 4, and tabulated in Table 1 (England) and Table 2 (Wales), together with the number of sites excavated in each county. A summary of these data is presented below in Tables 3 and 4.

From the summary tables we see that there are 5,123 sites in England and 203 sites in Wales for a grand total of 5,326. Based on my site size typology, for England and Wales as a whole there are 3758 small sites (70.6%), 1,109 medium sites (20.8%), 350 large sites (6.6%) and 109 major sites (2.0%).

Figure 3: Map of County Boundaries for England and Wales. (For key to abbreviations see Appendix C)

Table 1: No. of Sites and Excavations per County (England)

County	Small	Med.	Lge.	Maj.	Total	Excav.
Beds	19	7	0	0	26	1
Berk	137	41	14	8	200	24
Buck	58	8	4	2	72	7
Camb	56	7	3	0	66	2
Ches	17	9	3	0	29	2
Corn	69	52	20	2	143	2
Cumb	4	0	3	6	13	2
Derb	34	11	2	1	48	7
Devo	63	38	17	2	120	12
Dors	89	24	7	10	130	10
Durh	75	26	14	2	117	6
Esse	84	17	15	2	118	14
Glou	48	11	2	0	61	1
Hamp	204	68	14	5	291	11
Here	52	8	0	0	60	1
Hert	61	3	6	6	76	1
Hunt	18	8	0	0	26	0
IoMa	19	3	1	0	23	4
IoWi	41	14	3	1	59	2
Kent	175	60	16	4	255	19
Lanc	105	36	8	4	153	4
Leic	28	3	0	0	31	2
Linc	72	20	9	1	102	3
Lond	202	36	6	0	244	11
Norf	124	25	7	1	157	9
Norp	23	2	2	0	27	1
Norl	20	14	6	2	42	3
Nott	12	1	0	1	14	1
Oxfo	74	10	2	0	86	2
Rutl	3	0	0	0	3	1
Shro	33	2	0	0	35	0
Some	56	20	7	1	84	8
Staf	28	2	0	0	30	6
Suff	130	33	11	5	179	15
Surr	245	61	25	5	336	17
Suss	293	112	40	16	461	22
Warw	33	12	5	0	50	3
West	9	1	0	0	10	0
Wilt	188	29	4	2	223	10
Worc	20	5	0	0	25	0
YoER	97	13	1	1	112	6
YoNR	186	43	13	3	245	7
YoWR	313	170	50	7	540	25

Table 2: No. of Sites and Excavations per County (Wales)

County	Small	Med.	Lge.	Maj.	Total	Excav.
Angl	3	1	0	1	5	2
Brec	3	1	0	0	4	0
Caer	6	1	0	1	8	1
Card	6	0	1	1	8	2
Carm	2	3	0	0	5	1
Denb	2	0	0	0	2	1
Flin	4	1	1	2	8	2
Glam	28	3	1	0	32	1
Meri	0	0	0	0	0	0
Monm	2	0	0	0	2	1
Mont	1	0	0	0	1	1
Pemb	70	33	7	3	113	5
Radn	14	1	0	0	15	1

Table 3: Statistical Summary of Site Data: England

Statistic	Small	Med	Lge	Maj
Mean (County N=43)	84.1	24.8	7.9	2.3
Std.Error	78.0	31.8	10.3	3.1
Range	3-313	0-131	0-50	0-16
Total (N)	3617	1065	340	101
Total (%)	70.6	20.8	6.6	2.0

Table 4: Statistical Summary of Site Data: Wales

Statistic	Small	Med	Lge	Maj
Mean (County N=13)	10.8	3.4	1.5	0.6
Std.Error	18.5	8.6	3.2	0.9
Range	0-70	0-33	0-7	0-3
Total (N)	141	44	10	8
Total (%)	69.5	21.7	4.9	3.9

Excavations

The number of sites excavated was determined from The Gazetteer in order to establish whether my arbitrary definition of large and major sites did not merely define those sites which had been excavated, and which therefore have more associated artefacts. Perusal of the site entry notes in The Gazetteer suggests that excavations have been conducted for a range of site sizes. However, it does appear that, exceptions notwithstanding, the majority of major sites are those which have been excavated. This does not necessarily invalidate my site size typology, but, following on from the discussion in chapter 2, it does perhaps restrict the inferences which can be made.

Site Density: Sites per County

Having enumerated the number of sites per county it becomes possible to investigate differential density rates. Even though county areas are somewhat artificial as natural sampling units they do afford some indication of differential site density levels.

I rank-ordered the English counties by area (highest to lowest) and then rank ordered those counties by number of sites (most to least). I then calculated a Spearman's Rho product moment correlation coefficient and the resulting score of 0.4518 indicates a moderate degree of association between the size of a county and the number of sites contained therein. But, as noted above, county boundaries are something of an artificial construct, and while we would expect the largest counties to have the most sites, this does not account fully for the pattern of the distribution.

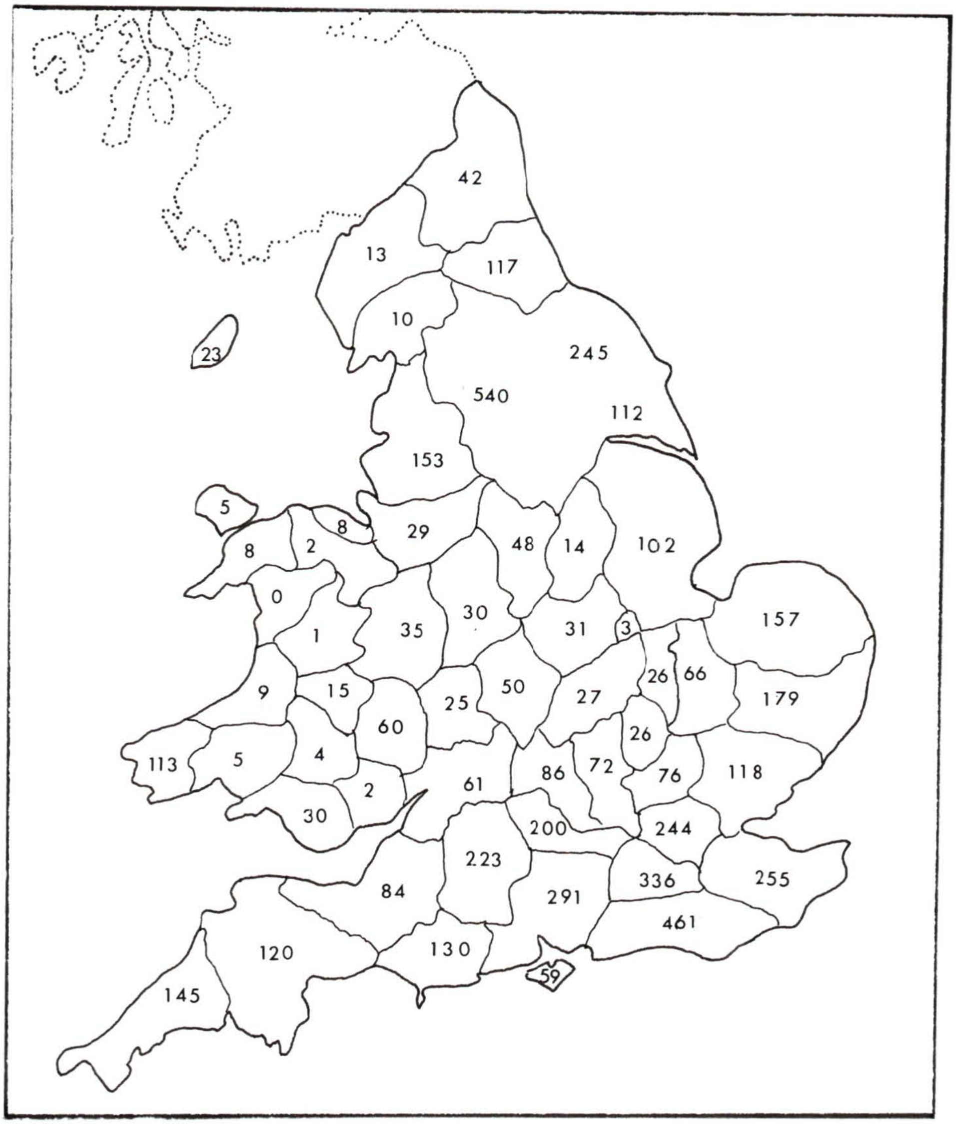

Figure 4: No. of Sites per County

Site Density: Sites per Unit Area

The ratio of area to site density for each county was calculated from the total number of sites in each county and area of each county. The resulting area/site ratios were then converted into a logarithmic scale to facilitate standardised presentation. These data appear in Table 5. Figure 5 depicts the data in map form. Because of the small number of sites in the Welsh counties overall, I confined my attention to the data for England only.

Having controlled for unit area we can see that some clear trends are evident. The two largest concentrations are in the Pennine region and in the southeast of England. By grouping the data, using arbitrary class widths as depicted in Figure 5, several density bands are distinctly evident, with a general trend for density to decrease with distance from both of the "core" areas of major concentrations, southeast England and the Pennines. There appears to be only one instance of a reversal to this trend, and that concerns the extreme southwest of England.

It does appear that, on the basis of differential densities, the country appears clearly divided into two distinct areas, above and below the less dense band running SW to NE seen in Figure 5.

However, although these density measures are superior to site count per county, it should be recognised that there are limitations. Reference to the various maps presented below will show that localised site concentrations may often extend across county boundaries. For example, the majority of the Lancashire sites are concentrated in the Pennine uplands, and a density figure for the county as a whole may not necessarily be an effective discriminant overall. However, the data as presented do provide some degree of measure of differential densities.

Table 5: Site Densities, (by County), England

Co.	Area (KM^2)	Sm	Log Den	Med	Log Den	Lge	Log Den	Maj	Log Den	All	Log Den
Beds	1235	19	1.81	7	2.24					26	1.67
Berk	1877	137	1.14	41	1.66	14	2.12		2.37	200	0.97
Buck	1933	58	1.52	8	2.38	4	2.68	2	2.98	72	1.42
Camb	2151	56	1.58	7	2.49	3	2.85			66	1.51
Ches	2629	17	2.19	9	2.46	3	2.94			29	1.96
Corn	3562	69	1.71	52	1.83	20	2.25	2	3.25	143	1.39
Cumb	3938	4	2.99			3	3.12	6	2.82	13	2.48
Derb	2583	34	1.88	11	2.37	2	3.11	1	3.41	48	1.73
Devo	6711	63	2.03	38	2.24	17	2.59	2	3.52	120	1.74
Dors	2532	89	1.45	24	2.02	7	2.56	10	2.40	130	1.29
Durh	2628	75	1.54	26	2.00	14	2.27	2	3.12	117	1.35
Esse	3674	84	1.64	17	2.33	15	2.38	2	3.26	118	1.49
Glou	3260	48	1.83	11	2.47	2	3.21			61	1.72
Hamp	3894	204	1.28	68	1.76	14	2.44	5	2.89	291	1.12
Here	2182	52	1.62	8	2.43					60	1.56
Hert	1634	61	1.43	3	3.73	6	2.43	6	2.43	76	1.33
Hunt	1258	18	1.84	8	2.19					26	1.68
IoMa	1413	19	1.87	3	2.67	1	3.15			23	1.79
IoWi	369	41	0.95	14	1.42	3	2.09	1	2.56	59	0.79
Kent	3730	175	1.33	60	1.79	16	2.37	4	2.96	255	1.16
Lanc	4863	105	1.66	36	2.13	8	2.78	4	3.08	153	1.50
Leic	2159	28	1.89	3	2.85					31	1.84
Linc	6896	72	1.98	20	2.53	9	2.88	1	3.84	102	1.82
Lond	1866	202	0.96	36	1.71	6	2.49			244	0.88
Norf	3752	124	1.48	25	2.18	7	2.73	1	3.57	157	1.38
Norl	5319	20	2.42	14	2.58	6	2.95	2	3.42	42	2.10
Norp	1596	23	1.84	2	2.90					27	1.77
Nott	2367	12	2.29	1	3.37			1	3.37	14	2.28
Oxfo	1939	74	1.42	10	2.29	2	2.81			86	1.35
Rutl	394	3	2.12							3	2.12
Shro	3490	33	2.02	2	3.24					35	1.99
Some	4176	56	1.87	20	2.32					84	1.69
Staf	2996	28	2.09	2	3.17					30	1.99
Suff	3834	130	1.47	33	2.06	11	2.54	5	2.88	179	1.33
Surr	1683	245	0.84	61	1.44	25	1.83	5	2.52	336	0.69
Suss	3774	293	1.11	112	1.53	40	1.97	16	2.37	461	0.91
Warw	2524	33	1.88	12	2.32	5	2.70			50	1.70
West	2043	9	2.36	1	3.31					10	2.31
Wilt	3481	188	1.27	29	2.08	4	2.94	2	3.24	223	1.19
Worc	1821	20	1.96	5	2.56					25	1.86
YoER	3036	97	1.49	13	2.37			2	3.18	112	1.43
YoNR	5511	186	1.47	43	2.11	13	2.62	3	3.26	245	1.35
YoWR	7424	313	1.37	170	1.63	50	2.16	7	3.01	540	1.12

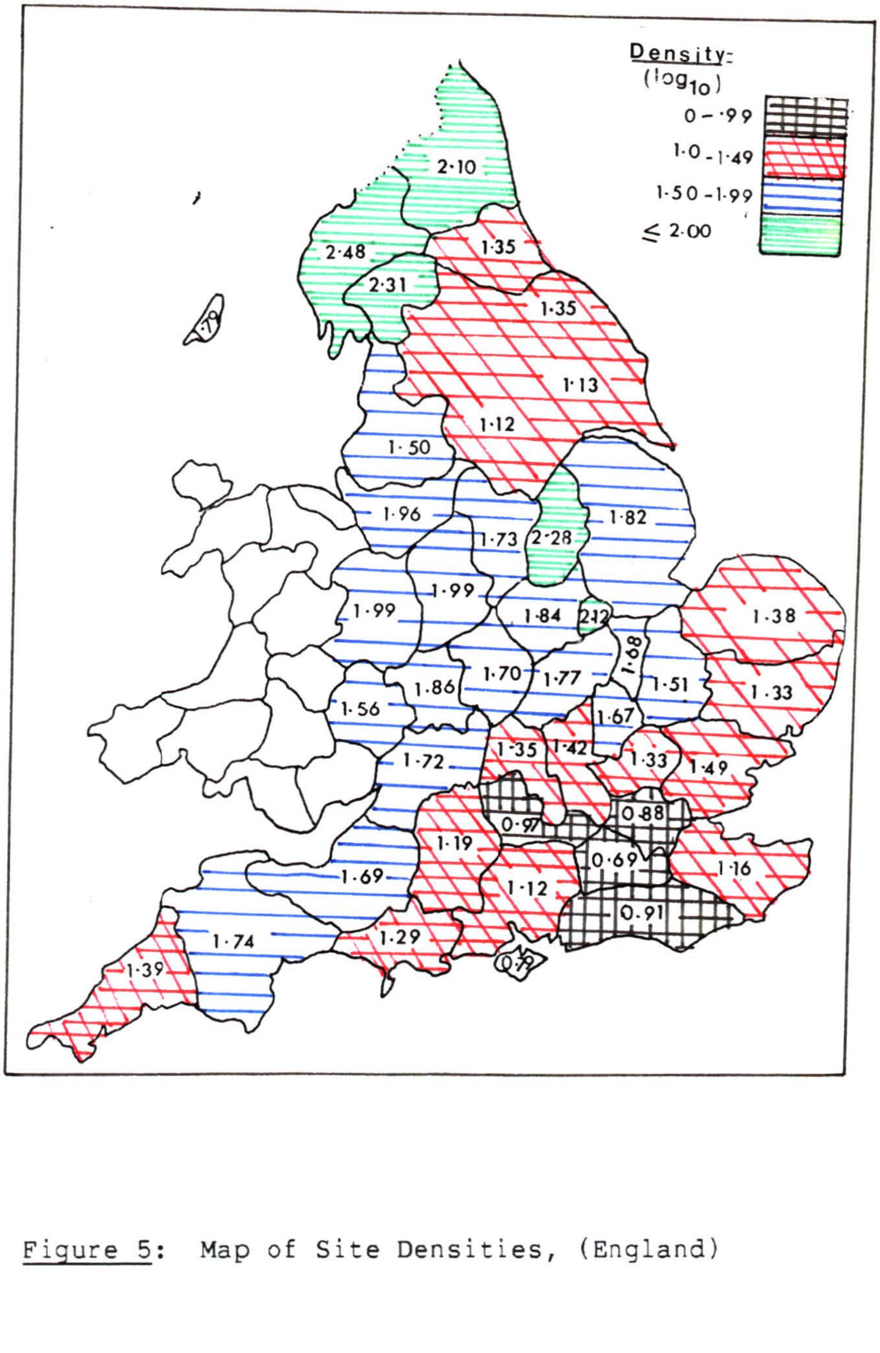

Figure 5: Map of Site Densities, (England)

II: Spatial Analyses of Selected Areas.

It seems quite evident that there are discernible variations in site density levels for the country as a whole. Spatial analysis of site patterns in selected areas was undertaken in order to determine whether random or non-random patterns are exhibited. As discussed above, point pattern analysis is an appropriate technique in these circumstances (Taylor 1977; Thomas 1977; Unwin 1981), and the quadrat method of point pattern analysis as described in chapter 2 was employed.

Several discrete areas were examined using this technique, East Anglia and Central England are two large regions that have not been subject to very much areal research. The Avon Valley, Wiltshire, and the Cotwolds Hills, Gloucestershire, represent a valley area and an upland area respectively. A map showing these areas is shown in Figure 6. The phenomena under investigation are medium, large and major sites in East Anglia and central England, and the full array of sites in the other test areas.

In the sections which follow, I present a rationale for delineating each test area, details of quadrats used and the test results. To facilitate presentation of the tables, numbers are often rounded up, but actual calculations were to four decimal places. I include the actual probabilities calculated from the Poisson model formula in the first test for illustrative purposes for the convenience of the reader, but omit these in subsequent tables of data.

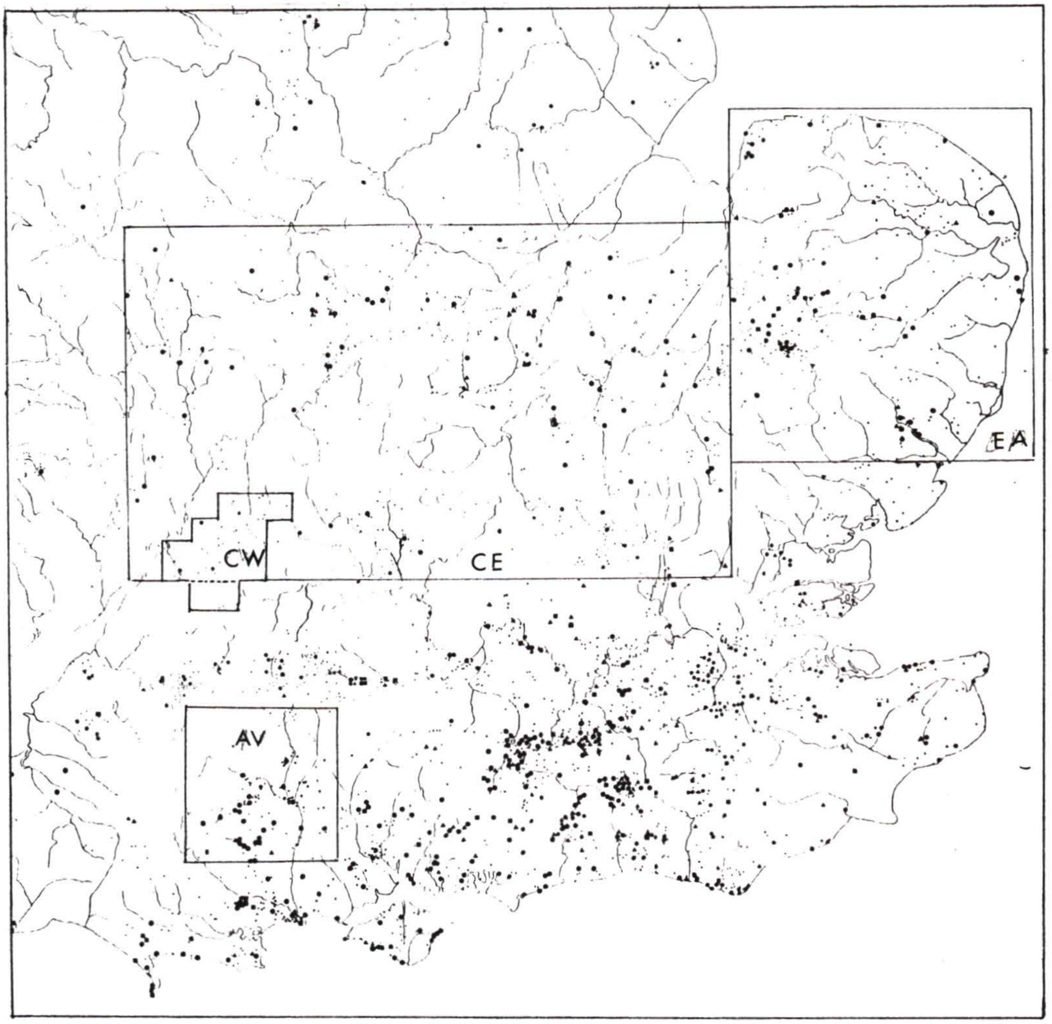

Figure 6: Areas selected for Point Pattern Analysis. (EA = East Anglia; CE = Central England; AV = Avon Valley; CW = Cotswolds)

East Anglia

Rationale for Delimiting Area.

East Anglia represents a sizeable natural area in the east central portion of England, which today largely consists of low-lying fenland, the hinterland of an extensive coastline extending continuously from the north to the east of the area (Figures 6, 26). The western boundary was delimited by an arbitrary line extending due south from the Wash, and the southern boundary was delimited by an arbitrary line extending due west from the River Stour estuary. The phenomena under investigation in this area were medium, large and major sites (N=67), i.e. those sites associated with more then ten artefacts. This provided for a manageable portion of the total number of sites.

East Anglia Test I

A grid of 7 x 6 one inch squares was superimposed over a 1/625,000 scale map of the study area containing the sites, providing 42 contiguous quadrats of uniform size. The grid extended beyond the coastline in places. One of the assumptions of the Poisson model is that in a random independent point allocation process each quadrat should have an equal chance of receiving a point. A violation of the test has therefore been identified as points will not be shown except on the land. One remedy would be to reduce the grid so that it could fit wholly within a terrestrial area, but because of the shape of the north eastern quadrant this meant losing sites located on the coast, thereby resulting in a loss of information.

Accordingly, I decided to compromise by accepting quadrats which show 50% or more land, and rejected those which show more than 50% sea. So instead of rejecting coastally located sites, the compromise retains these at the expense of what seems to be a minor violation of the Poisson model assumptions. In this instance, 2 of the 42 quadrats were rejected, neither of which contained any points.

Thus, there were 67 points in the test area contained within 40 quadrats, and therefore a mean allocation (m) of 1.675 points per quadrat.

The results are given in Table 6 and show the observed and expected frequencies, chi-square data, mean, variances, variance/mean ratio (VMR), chi-square scores and t-test scores together with significance levels. For the chi-square tests, classes of expected frequencies of less than 5 were combined into a contingency table. The number of degrees of freedom for the chi-square test is defined by the number of classes less one, with a further degree of freedom lost for the parameter used to calculate the theoretical distribution (Taylor 1977). For the first test only, I also provided the probabilities of the expected frequencies for illustration. Otherwise subsequent tables of results follow the same pattern. A summary table of results appears after individual tests, for each area.

I have also provided histograms of observed and expected frequencies for each test. It should be noted that the scale of presentation did not permit the depiction of very small frequencies; the absence of data on the baseline should not be taken to infer null categories when small frequencies are indicated in the tables. The shape of the histograms for the first test (Figure 7) suggests that there are differences between the observed and expected frequencies, e.g. a considerable proportion of the observed frequencies cluster (9 in one cell, 10 in another), when the expectation for this in a random allocation process is negligible.

Table 6: East Anglia Test I Results

mi	fi (Obs)	prob.	Exp	$(O-E)^2/E$	S^2
0	16	.1873	7.5	9.67	1.15
1	13	.3134	12.5	0.02	0.15
2	3	.2627	10.5	5.37	0.01
3	3	.1467	5.9		0.13
4	0	.0614	2.5		0.00
5	0	.0206	0.8		0.00
6	1	.0057	0.2	0.22	0.48
7	2	.0014	0.1		1.45
8	0	.0003	<.1		0.00
9	1	.0000	<.1		1.38
10	1	.0000	<.1		1.77

$\bar{m} = 1.675$

$X^2 = 15.283$ ($p < .001$ with 2 d.f)

$S^2 = 6.5327$ with 39 d.f.

VMR = 3.9

$t = 12.81$ ($p < .001$ with 39 d.f.)

Decision: Reject H_0

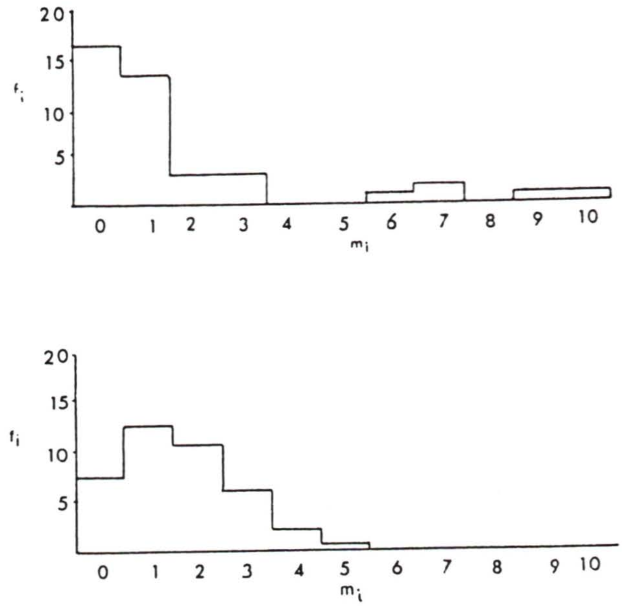

Figure 7: East Anglia Test I: Observed and expected frequencies. (Observed freq. shown above; Expected freq. below)

East Anglia Test II

A grid of 70 (7 x 10) quadrats was superimposed over the test area, (retaining the rows from test I and subdividing the columns to 0.6"). The same criterion for rejecting quadrats showing less than 50% land area was retained, and 6 quadrats are rejected, none of which contained points, for a total number of 67 points in 64 quadrats, giving a mean of 1.047 points per quadrat. The resulting data are shown in Table 7. Histograms of these data are given in Figure 8, where differences between observed and expected frequencies are evident.

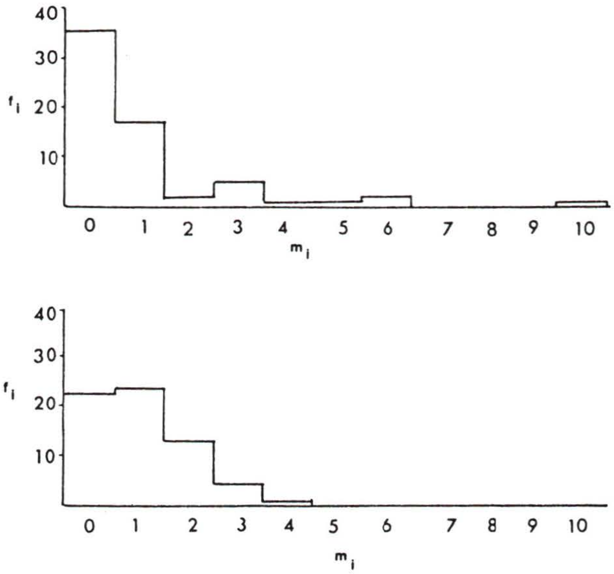

Figure 8: East Anglia Test II: Observed and expected frequencies. (Observed freq. shown above; Expected freq. below)

Table 7: East Anglia Test II Results

mi	fi(Obs)	Exp	$(O-E)^2/E$	S^2
0	35	22.5	7.00	0.61
1	17	23.5	1.81	0.00
2	2	12.3	8.63	0.03
3	5	4.3		0.30
4	1	1.1		0.14
5	1	0.2		0.25
6	2	0.4	3.23	0.78
7	0	<.1		0.00
8	0	<.1		0.00
9	0	<.1		0.00
10	1	<.1		1.27

$\bar{m} = 1.0469$

$X^2 = 20.67$ ($p < .001$ with 2 d.f)

$S^2 = 3.3787$ with 63 d.f.

VMR = 3.3273

$t = 12.5$ ($p < .001$ with 63 d.f.)

Decision: Reject H_0

East Anglia Test III

In this test the number of quadrats was doubled by subdividing the rows used in test II. This gave 140 cells, of which 15 were rejected (none of which contained points) because of the 50% land area criterion. The resulting 125 cells for 67 points gives a mean allocation of 0.536. The results appear in Table 8, with histograms of the data provided in Figure 9.

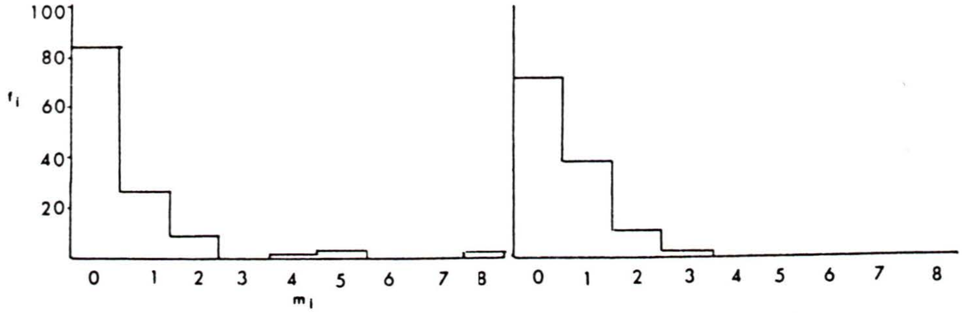

Figure 9: East Anglia Test III: Observed and expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 8: East Anglia Test III Results

mi	fi (Obs)	Exp	(O-E)²/E	S²
0	85	73.1	1.92	0.20
1	27	39.2	3.80	0.04
2	9	10.5		0.15
3	0	1.9		0.00
4	1	0.2	0.01	0.10
5	2	< .1		0.32
6	0	< .1		0.00
7	0	< .1		0.00
8	1	< .1		0.05

$\bar{m} = 0.536$

$X^2 = 5.73$ ($p < .02$ with 1 d.f)

$S^2 = 1.2678$ with 124 d.f.

VMR = 2.3635

$t = 10.736$ ($p < .001$ with 124 d.f.)

Decision: Reject H_0

East Anglia Test IV

In this test, the quadrats from test III were subdivided diagonally giving 280 cells. Of these, 35 were rejected for not satisfying the 50% land requirement, and 4 points were lost as a result, giving a distribution of 63 points in 245 cells for a mean of 0.247. The data are presented in Table 9. The histograms are shown in Figure 10, where visual inspection shows some degree of dissimilarity at this scale.

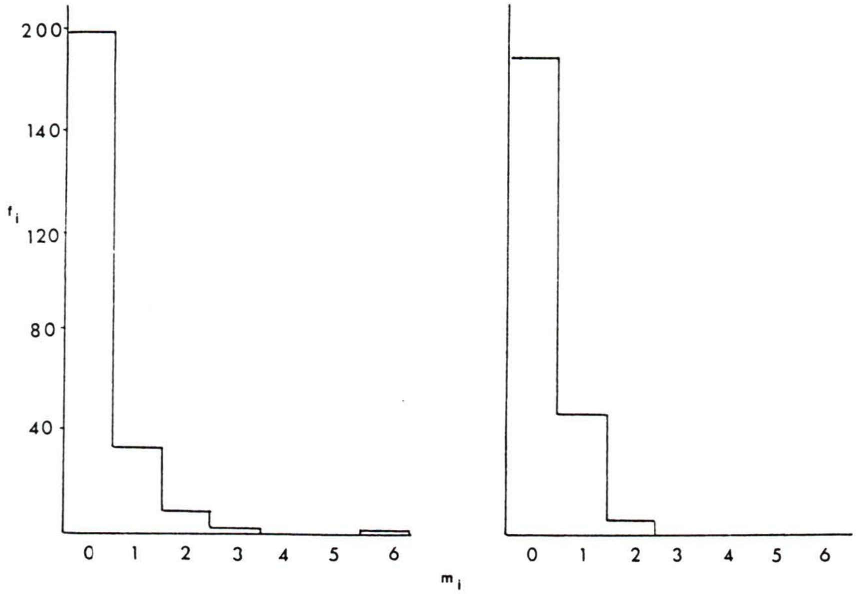

Figure 10: East Anglia Test IV: Observed and expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 9: East Anglia Test IV Results

mi	fi (Obs)	Exp	$(O-E)^2/E$	S^2
0	199	189.5	0.48	0.05
1	35	48.7	3.86	0.08
2	8	6.3		0.10
3	2	0.5		0.06
4	0	0.2	2.58	0.00
5	0	< .1		0.00
6	1	< .1		0.13

$\bar{m} = 0.2571$

$X^2 = 6.92$ ($p < .01$ with 1 d.f.)

$S^2 = 0.4295$ with 244 d.f.

VMR = 1.6706

$t = 7.4069$ ($p < .001$ with 244 d.f.)

Decision: Reject H_0

Summary of East Anglia Test Results.

To facilitate comparison, the data obtained in the four tests are given in Table 10.

The East Anglia tests involved a progressive reduction in quadrat size from tests I to IV. It appears from visual inspection of the histograms that the greatest differences between observed and predicted frequencies is evident in tests I and II, although differences are apparent in all four tests.

All chi-square test scores were significant, with highly significant scores in tests I and II, and very significant scores in the remaining tests.

The highest variances were found in the largest quadrats. In all four tests the VMR exceeded the value of unity for a random pattern, and this was confirmed by the t-tests, where highly significant scores obtained.

In view of visual assessments, the suite of chi-square scores and the consistent departure of the calculated VMRs from the VMR of unity expected for a random distribution, I quite confidently reject the null hypothesis of no difference between observed frequencies and those predicted by the Poisson process model, and therefore conclude the existence of a non-random clustered distribution.

Table 10: Summary of Results (East Anglia Tests I-IV)

Test	Pts.	Cells	Mean	X^2	df	p <
I	67	40	1.675	15.28	2	.001
II	67	64	1.047	20.67	2	.001
III	67	125	0.536	5.73	1	.02
IV	63	245	0.257	6.92	1	.01

Test	S^2	VMR	t	p <	df
I	6.5327	3.9000	12.81	.001	39
II	3.3787	3.3273	12.50	.001	63
III	1.2678	2.3635	10.74	.001	124
IV	0.4295	1.6706	7.41	.001	244

Throughout the tests a consistent pattern of non-randomness was indicated, and this confirms a subjective examination of the site distributions in the map in Figure 26, where obvious clusters of sites are evident.

Central England

Rationale for Delimiting Area

Inspection of the distribution of sites across Central England suggests a much more dispersed pattern with few obvious clusters. The study area was defined as the area west of the East Anglia test area to east of the Welsh foothills, north of the Cotswolds and Thames/Kennet valley, and south of the southern Pennine boundary and Lincolnshire wolds (Figure 20). The phenomenon under investigation was the array of medium, large and major sites (N=78).

Central England Test I

A grid of 40 cells (8 x 5) was superimposed over the study area producing a mean allocation of 1.95 points per cell.

The data are presented in Table 11. Histograms of these data are provided in Figure 11, visual inspection of which suggests the presence of discernible differences between the observed and expected frequencies.

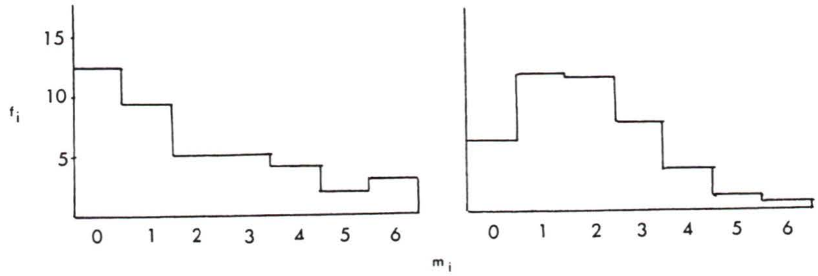

Figure 11: Central England Test I: Observed and expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 11: Central England Test I Results

mi	fi (Obs)	Exp	$(O-E)^2/E$	S^2
0	12	5.7	6.96	1.17
1	9	11.1	0.40	0.21
2	5	10.8	3.11	0.00
3	5	7.0	0.57	0.14
4	4	3.4		0.43
5	2	1.3	2.98	0.48
6	3	<.1		1.26

$\tilde{m} = 1.95$

$X^2 = 14.02$ ($p < .01$ with 3 d.f.)

$S^2 = 3.6897$ with 244 d.f.

VMR = 1.892

$t = 3.94$ ($p < .001$ with 244 d.f.)

Decision: Reject H_0

Central England Test II

In the second test the columns used in the test I grid were doubled to provide a grid of 20 cells (4 x 5), for a mean allocation of 3.9. The results data appear in Table 12 with histograms shown in Figure 12 which show that there are considerable apparent differences between the observed and expected frequencies.

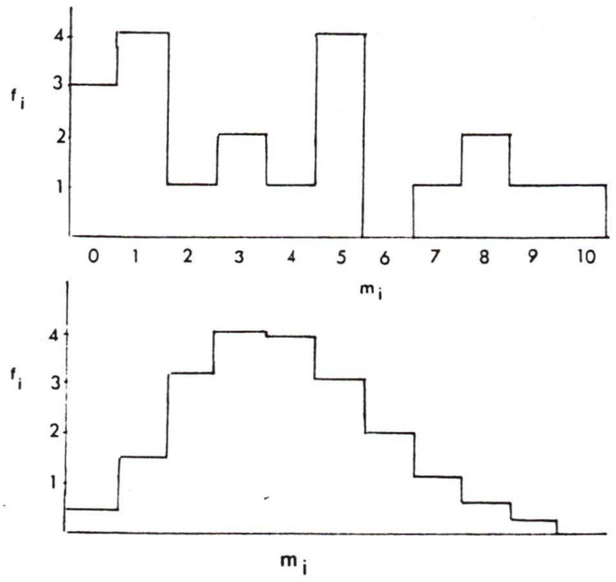

Figure 12: Central England Test II: Observed and Expected frequencies. (Observed: top; Expected: below)

Table 12: Central England Test II Results

mi	fi (Obs)	Exp	$(0-E)^2/E$	S^2
0	3	0.4		2.40
1	4	1.6	1.71	1.77
2	1	3.1		0.19
3	2	4.0	3.04	0.00
4	1	3.9		0.00
5	4	3.0		0.25
6	0	2.0		0.00
7	1	1.1	0.58	0.44
8	2	0.5		1.77
9	1	0.2		1.37
10	1	<.1		1.96

$\bar{m} = 3.9$

$X^2 = 5.33$ ($p < .05$ with 1 d.f).

$S^2 = 10.2421$ with 39 d.f.

VMR =2.6262

$t = 5.012$ ($p < .001$ with 39 d.f.)

Decision: Reject H_0

Central England Test III

In this test the cells used in Test II are subdivided diagonally to produce 80 cells for 78 points, and a mean allocation of 0.975. The reults of the tests appear in Table 13 with histograms provided in Figure 13, where differences are again apparent between the observed and expected frequencies.

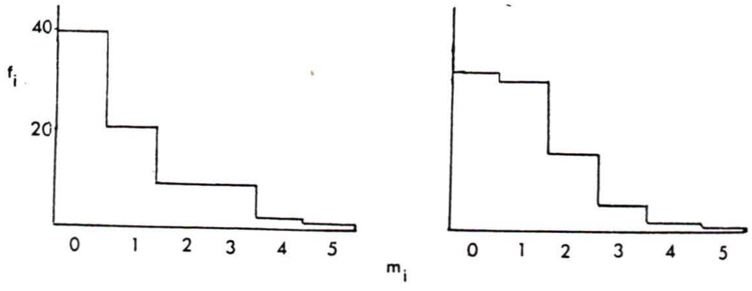

Figure 13: Central England Test III: Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 13: Central England Test III Results

mi	fi (Obs)	Exp	$(O-E)^2/E$	S^2
0	39	30.1	2.63	0.47
1	20	29.4	3.02	0.00
2	9	14.3	1.99	0.12
3	9	4.7		0.47
4	2	1.1	5.94	0.23
5	1	0.2		0.21

$\bar{m} = 0.975$

$X^2 = 13.57$ ($p < .01$ with 2 d.f).

$S^2 = 1.493$ with 79 d.f.

VMR = 1.5313

$t = 3.339$ ($p < .01$ with 79 d.f.)

Decision: Reject H_0

Central England Test IV

The final test was conducted by subdividing the cells used in Test I horizontally and vertically to produce a grid of 160 cells (16 x 10). This provided a mean of 0.4875. The test data appear in Table 14. Histograms are provided in Figure 15, visual inspection of which again indicates the presence of differences between the observed and expected frequencies.

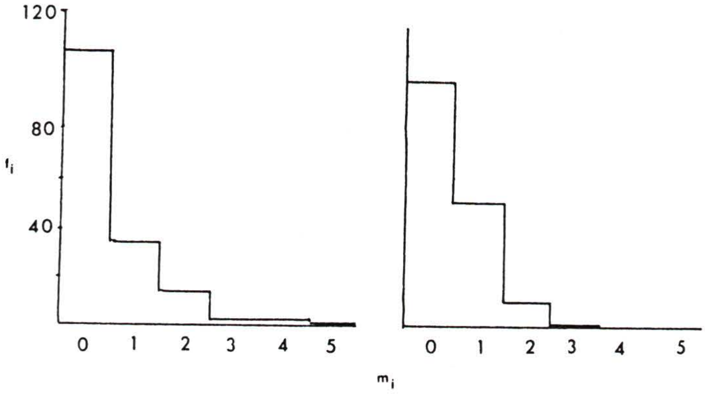

Figure 14: Central England Test IV Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 14: Central England Test IV Results

mi	fi (Obs)	Exp	$(O-E)^2/E$	S^2
0	109	98.3	1.17	0.16
1	33	47.9	4.63	0.05
2	13	11.7		0.19
3	2	1.9	1.26	0.08
4	2	0.2		0.15
5	1	<.1		0.13

$\overline{m} = 0.4875$

$X^2 = 7.068$ ($p < .01$ with 1 d.f).

$S^2 = 0.7671$ with 39 d.f.

VMR = 1.5737

$t = 5.116$ ($p < .001$ with 39 d.f.)

Decision: Reject H_0

Summary of Results: Central England Tests I-IV

The test results are summarised in Table 15. Visual inspection of the histograms suggests that the largest differences between observed and expected frequencies are found in tests I and II, where again, the largest quadrat sizes were employed. However, differences were discerned acrosss all four tests.

Statistically significant chi-square scores were obtained in all tests.

All the VMRs exceed unity, and this is confirmed by very significant t-test scores. Thus, on the basis of the range of test procedures conducted, I confidently reject the null hypothesis of no difference between observed and expected point frequencies and conclude the existence of a non-random clustered pattern of sites in Central England.

Table 15: Summary of results (Central England Tests I-IV)

Test	Pts.	Cells.	Mean	X^2	$p <$	df
I	78	40	1.950	14.02	.01	3
II	78	20	3.900	5.33	.05	1
III	78	80	0.975	13.57	.01	2
IV	78	160	0.4875	7.06	.01	1

Test	S^2	VMR	t	df	$p <$
I	3.6897	1.892	3.94	39	.001
II	10.2421	2.6262	5.012	19	.001
III	1.4930	1.5313	3.339	79	.01
IV	0.7671	1.5737	5.116	159	.001

Avon Valley, SW England

Reference to the map of this area (Figures 2 and 23) suggests that there appear to be several clusters of points around a number of rivers (Avon, Test. Nadder, Wyle) and their tributaries. Consequently I posited an expectation that clustering will be evident from point pattern analysis, and therefore only two tests were undertaken.

Rationale for Delimiting Area

This area was delimited by the 2500 km^2 region north and east of OS grid reference point SU800100 (Figure 6). The boundaries of the area are: North: the area south of the Kennet Valley; South: the area some 20 km north of the coastal zone; East: the western limit of the Salisbury Plain, a chalkland plateau; and West: The North Dorset Downs, a region showing few sites.

Avon Valley Test I

The tests here involved the full array of sites (N = 121). A square grid of 25 (5 x 5) quadrats of 10 km^2 size was superimposed over the study area at scale 1/625,000 (being retained from the plotting phase). The rows were subdivided by 4, and the columns subdivided by 3 producing 300 cells (15 x 30), which provides a mean allocation of 0.4033 points per cell. The results of the tests are presented in Table 16. Histograms are given in Figure 15, where visual inspection suggests some degree of difference between the observed and expected frequencies.

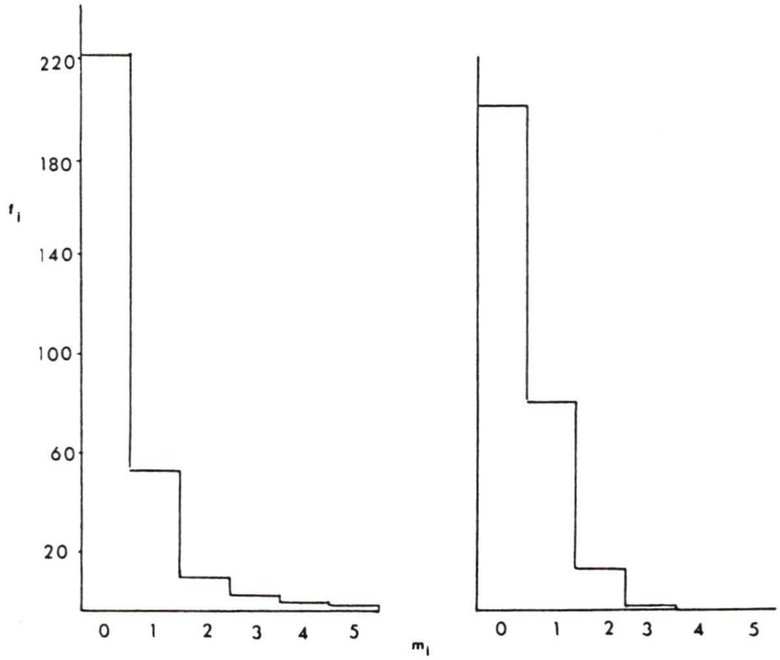

Figure 15: Avon Valley Test I: Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 16: Avon Valley Test I Results

mi	fi(Obs)	Exp	$(O-E)^2/E$	S^2
0	221	200	2.12	0.12
1	55	81	8.24	0.06
2	13	16		0.11
3	6	2.1	1.48	0.13
4	3	0.2		0.13
5	2	<.1		0.14

$\bar{m} = 0.4033$

$X^2 = 11.84$ ($p < .001$, with 1 d.f.)

$S^2 = 0.703$ with 299 d.f

VMR = 1.7431

$t = 9.086$ ($p < .001$ with 299 d.f.)

Decision: Reject H_0

Avon Valley Test II

In test II a grid of 225 (15 x 15) cells was superimposed over the 121 points in the study area, giving a mean allocation of 0.5378 points per cell. The data are presented in Table 17, with histograms presented in Figure 16.

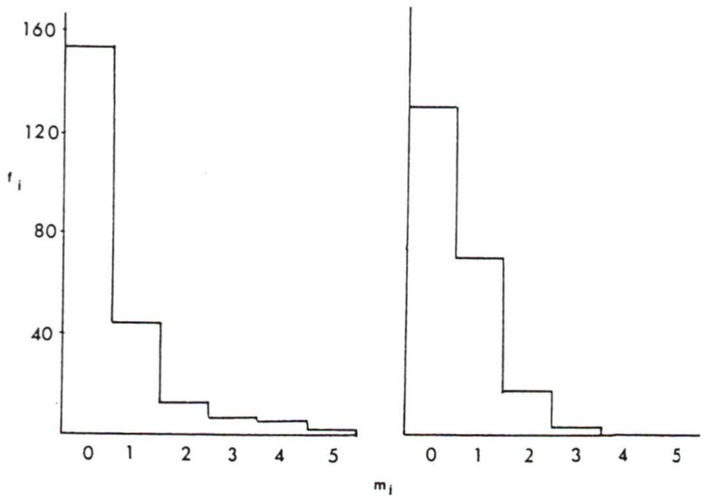

Figure 16: Avon Valley Test II: Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

It will be seen that there are discernible differences, with fewer expected empty cells than are encountered, fewer observed frequencies of one point per cell than are expected, and higher frequencies of two or more points per cell than are predicted under random allocation processes.

Table 17: Avon Valley Test II Results

mi	fi(Obs)	Exp	$(O-E)^2/E$	S^2
0	154	131	3.88	0.20
1	44	71	10.08	0.04
2	13	19		0.12
3	7	3	0.73	0.19
4	5	.5		0.26
5	2	<.1		0.18

$m = 0.5378$

$X^2 = 14.70$ ($p < .001$ with 1 d.f.)

$S^2 = 0.9935$ with 224 d.f.

VMR = 1.8473

$t = 8.9675$ ($p < .001$ with 244 d.f.)

Decision: Reject H_0

Summary of Results: Avon Valley

As a riverine association seems quite evident here it it would be quite surprising if a random pattern were indicated by the tests.

Although there are discernible differences between observed and expected point frequencies in both of the histograms, the differences are not overly pronounced.

There was concordance between all test results. Both chi-square scores are highly significant, even though a visual assessment of the data might suggest there to be differences of a small order. Both VMRs exceeded the value of unity, and this was supported by the highly significant t-test scores.

I therefore have no hesitation in rejecting the null hypothesis of no difference between the observed and predicted patterns, and in view of the VMRs, I conclude the existence of a non-random clustered pattern in this area.

The Cotswolds

Whereas there seems to be no evidence of random patterns in the three lowland areas considered thus far, the question of whether this trend extends to upland areas was examined. The initial expectation was that perhaps randomness was more likely in upland areas with few predominant topographical features other than altitude.

Rationale for Delimiting Area

The test area was selected from several upland areas in the southwest because it contains a fairly discrete cluster of sites identified from the distribution maps. The test area boundaries were taken from the grids used in the plotting process described above. The full array of sites (N = 49) was used.

Cotswolds Test I

An asymetric grid of 12 contiguous 10 km^2 quadrats at a 1/625,000 scale was superimposed over the test area, producing a mean allocation of 4.08 sites per cell. The test results appear in Table 18. The histograms of the observed and expected data are given in Figure 17, and it may be noticed that there are very different distribution frequencies at this scale.

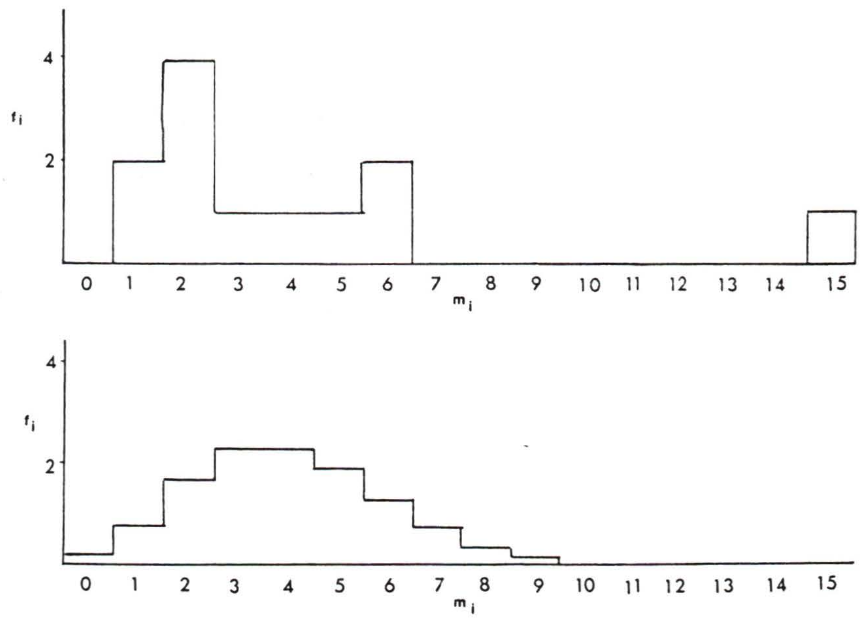

Figure 17: Cotswolds Test I: Observed and Expected frequencies. (Observed freq. shown above; Expected freq. below)

Ensuring that all classes of expected frequencies sum to at least five meant that only two classes remain. Therefore, no degrees of freedom are available to facilitate a chi-square test. It was possible to overcome this difficulty by violating the lower bound of expected data: combining classes 0-3, 4-5 and 6-15 produced a contingency table with expected values of 4.8, 4.2 and 2.7. This facilitates a score of 2.36, which is significant only at the $p < .20$ level.

Table 18: Cotswolds Test I Results

mi	fi(Obs)	Exp	(O-E)²/E	S²
0	0	0.0		0.00
1	2	0.8	4.8	1.73
2	4	1.7		1.58
3	1	2.3	4.2	0.11
4	1	2.3		0.00
5	1	1.9		0.08
6	2	1.3		0.67
7	0	0.8		0.00
8	0	0.4		0.00
9	0	0.2	2.7	0.00
10	0	<.1		0.00
11	0	<.1		0.00
12	0	<.1		0.00
13	0	<.1		0.00
14	0	<.1		0.00
15	1	<.1		10.83

$\bar{m} = 4.0833$

$X^2 = 2.36$ ($p < 0.2$ with 1 d.f.)

$S^2 = 14.99$ with 11 d.f.

VMR = 3.6716

$t = 6.2655$ ($p < .001$ with 11 d.f.)

Decision: Reject H_0 (but see text).

Cotswolds Test II.

In the second test, the grids from test I were subdivided horizontally and vertically, giving 48 cells for the 49 points, and a mean allocation of 1.02 points per cell. The results appear in Table 19. The histograms of these data are given in Figure 18 where we again see apparent differences between the observed and expected frequencies.

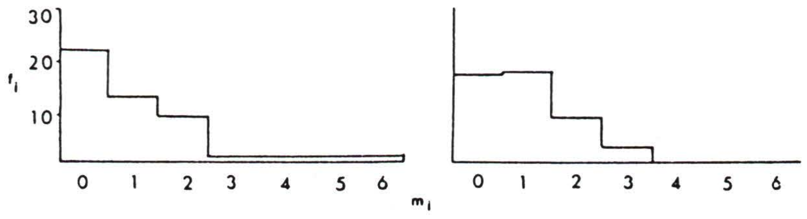

Figure 18: Cotswolds Test II: Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 19: Cotswolds Test II Results

mi	fi(Obs)	Exp	$(O-E)^2/E$	S^2
0	22	17.3	1.28	0.49
1	13	17.7	1.25	0.00
2	9	9.0		0.18
3	1	3.1		0.08
4	1	.8	0.0	0.19
5	1	.2		0.34
6	1	<.1		0.53

$\overline{m} = 1.02$

$X^2 = 2.52$ ($p < .2$ with 1 d.f.)

$S^2 = 1.8081$ with 47 d.f.

VMR = 1.7708

$t = 3.7369$ ($p < .001$ with 47 d.f.)

Decision: Reject H_0 (but see text).

Cotswolds Test III

A final test was conducted by diagonally subdividing the cells of Test II, producing 96 cells and a near optimum mean allocation of 0.5104. The results of this test appear in Table 20. The histograms of these data are presented in Figure 19. Visual inspection suggests that the observed and expected frequencies correspond quite closely, although some small differences can be detected.

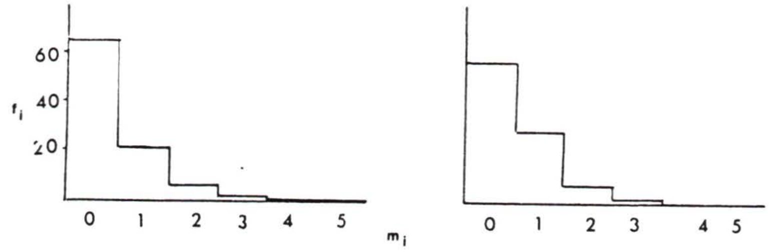

Figure 19: Cotswolds Test III: Observed and Expected frequencies. (Observed freq. shown left; Expected freq. right)

Table 20: Cotswolds Test III Results

mi	fi(Obs)	Exp	$(O-E)^2/E$	S^2
0	64	57.6	0.71	0.17
1	22	29.4	1.86	0.05
2	6	7.5		0.14
3	2	1.3	0.11	0.13
4	1	0.2		0.13
5	1	<.1		0.21

$\bar{m} = 0.5104$

$X^2 = 2.68$ ($p < .2$ with 1 d.f.)

$S^2 = 0.842$ with 95 d.f.

VMR = 1.6497

$t = 4.47$ ($p < .001$ with 95 d.f.)

Decision: Reject H_0 (but see text).

Summary of Cotswolds Tests I-III

Visual inspection of the histograms suggests the greatest differences between the observed and expected distribution frequencies are those in test I, but those for tests II and III are not dissimilar.

None of the chi-square tests produced statistically significant results in view of the specified 95% significance level.

In all three tests the derived VMR exceeds unity, which therefore indicates a non-random clustered pattern is evident for all quadrat sizes employed, and this is again confirmed by the t-test scores, all of which were again statistically highly significant.

In view of the lack of agreement between the two tests I am less confident in rejecting the null hypothesis of no difference between the observed and expected distributions. However, on the basis of the visual data and the VMRs derived, I do reject the null hypothesis, and conclude, somewhat tentatively, that a non-random clustered pattern exists in this study area.

Table 21: Summary of results (Cotswolds Tests I-III)

Test	Pts.	Cells	Mean	X^2	p <	df
I	49	12	4.083	2.36	.2	1
II	49	48	1.021	2.52	.2	1
III	49	96	0.5104	2.68	.2	1

Test	S^2	VMR	t	p <	df
I	0.1499	3.6716	6.2655	.001	11
II	1.8081	1.7708	3.7369	.001	47
III	0.8420	1.6497	4.4700	.001	95

Spatial Analysis: Overall Summary of Findings

Although the approach may seem somewhat pedestrian some interesting results were obtained. The most noticeable finding was that non-random clustered patterns were consistently indicated by the VMR tests at a variety of operational scales.

However, less than significant chi-square scores were obtained in the Cotswold tests. There was agreement between the chi-square tests and the VMR tests in the first three test areas, all of which encompass low-lying terrain. I did state that the relative absence of major topographical features in an upland areas might have been more conducive to random site patterns.

There is surely little doubt that, in low-lying areas, non-random patterns are conclusively demonstrated by the tests as constituted. Whether we consider this also applies to the Cotswold Hills depends on how we view the lack of agreement between the tests.

The VMR tests do have one advantage. Whereas the chi-square can only lead us to accept or reject the null hypothesis of 'no difference', the VMR additionally has the capacity to identify clustered and uniform non-random patterns as well as random ones. However, the question of which, if any, tests of statistical significance are most appropriate in these test circumstances will be explored below.

Overall then, I conclude that the existence of non-random clustered patterns is demonstrated quite strongly. This presents no great surprise, as we expect there to be a number of influences which affect human settlement patterns and choice of settlement location can not therefore be considered a chance phenomenon. However, it was, of course, necessary to begin with a null hypothesis of no difference between observed and predicted distributions.

Nonethless, confirmation of broad expectations is always welcome and, on the basis of the tests as constituted, I confidently reject the null hypothesis of no difference between observed site patterns and those predicted by independent random process for low altitude areas, and tentatively do so for upland areas.

Chapter IV

RESULTS II: DISCRIMINANT FUNCTIONAL ANALYSIS OF TECHNOLOGIES

As discussed above, one of the few attempts to investigate the correlates of differential tool configurations was that by Mellars (1976b), who found correlations among percentage tool types, site area and altitude.

I examined tool type configurations (which, for want of a better term, I shall describe as "technature", as in the technological 'signature' of a site) within the proposition that technatures reflect environmental influences, and I specifically investigated whether a distinction might obtain with respect to coastal and interior sites.

The Sample

This took the form of a non-random availability sample of artefact entries for major sites, selected from The Gazetteer on the basis of the following criteria. Because I wanted as large and representative a sample as possible I used only artefact totals from sites with over 1000 artefacts extending across at least seven tool types. This permitted a sample of 89 site assemblages. Site assemblages rejected were generally those containing large numbers of blades and flakes but few other artefacts.

My tool type categories are based on those in The Gazetteer with a few modifications. I combined all varieties of axe into a single category, and if no axes were listed but there were one or more tranchet axe sharpening flakes (TASF) present, I used one of these to infer the presence of one axe, subsuming any remaining TASF into the "other" category.

In all cases where there was a reference to a given tool type, but no record of actual quantities, I assumed a minimum value of one. The classes of tools utilised here are: axe; blade/flake; core; scraper; graver; microlith; micro-burin; pick; and "other", the miscellaneous category. A description of tool types is presented in Appendix B, together with illustrations.

Tables of data were compiled, and the location of the site (coastal or interior) was determined by means of a 10 km distance criterion from the present day coastline, producing 51 interior sites and 38 coastal sites. Locations were coded as 1 (Interior) or 2 (Coastal) and added to the database, and these form the groups in the analysis. Tool types form the classes. A full suite of the relevant tables are provided in Appendix B.

Several DFA runs were executed using the SPSS DISCRIMINANT (SPSS INC 1983) program, and the results appear below.

Discriminat Function Analysis: Direct Method

In this process all classes are entered simultaneously. The means and standard deviations for the classes were computed for each group, and are presented in table form in Appendix B.

These data show that blades and flakes, gravers and microliths have much higher interior group means than the coastal group, and that "other" and picks have a much higher mean for the coastal group.

The canonical discriminant functions are calculated to measure the degree of difference among the cases as they are better determinants of the relationships among variables than are means or standard deviations. The canonical correlation therefore measures the degree of association between the discriminant scores and the groups and is expressed as a Pearson correlation coefficient, with a positive range from 0 to +1.0 (Klecka 1980: 20, 36; Norusis 1981:89).

Wilks' Lambda is calculated as a measure of the proportion of the total variance in the discriminant scores and has a range from 0 to +1.0, and the smaller the score, the greater the differences between the groups (Norusis 1985:90). The program also converts Wilks' Lambda to a chi-square as a measure of the probability that differences are not due to chance.

As will be seen from the data in Table 22 the canonical correlation coefficient shows a moderate degree of association between the discriminant scores and the groups, but the Wilks' Lambda is quite high, suggesting that the differences betwen the groups may be small.

Table 22: Table of Canonical Discriminant Functions (Direct Method)

CANONICAL CORR	WILKS' LAMBDA	CHISQUARE	DF	SIG
0.5070	0.7430	24.507	9	0.0036

The remaining data (i.e. the discriminant scores and the table of probability group membership scores) are presented in a suite of tables in Appendix B. In the probability group membership tables those cases with asterisks (**) are flagged to indicate that, on the basis of the statistics employed, they have been 'wrongly' assigned *a priori.* In other words, the process considers such cases to be more in accord with the scores of the alternate goup, and therefore are 'misclassified'.

Results: DFA Direct Method

The results of the DFA (direct) procedure are plotted in histogram form with an accompanying classification table of results in Table 23.

It will be seen that in the histogram a steep unimodal curve obtains. All group 1 cases (Inland) extend no further to the left-hand tail than -0.5 std. dev. from the overall mean, although group 2 extends almost a full deviation into the right tail.

The classification table of the degree of correct group prediction indicates that quite a high degree of separation has been detected by the analysis. It would probably be quite difficult to infer very much meaningful separation within the points of inflection of the distribution, but the outliers are of interest.

It is possible to identify individual cases by ascertaining relative position within the histogram, and then referring to the table of discriminant scores in Appendix B.

I examined some of the individual cases, and some interesting results emerged. The majority of coastal sites in the left-hand tail of the curve are those situated on the central southern coast of England with the Portland sites clearly evident. These are later Mesolithic sites. The

Table 23: Table of Results: DFA (Direct Method)

SYMBOL	GROUP	LABEL
1	1	INTERIOR
2	2	COASTAL

```
                    ALL-GROUPS STACKED HISTOGRAM
                 CANONICAL DISCRIMINANT FUNCTION 1
16I                                                                  +
  I                                                                  I
  I                                                                  I
  I                                                                  I
12+                                                                  +
  I                           2  2                                   I
  I                           22 1                                   I
  I                           22 1                                   I
 8+                           22 1                                   +
  I                           22 1                                   I
  I                           2221                                   I
  I                          21211                                   I
 4+                        2 21111                                   +
  I                        2211111221                                I
  I2                     222211111111     21        1          1     I
  I2 22      2     2 22  2 2211111111111 2 11   11  111 111    1     I
  X---------+---------+---------+---------+---------+---------X
 OUT      -2.0      -1.0        .0       1.0       2.0       OUT
     2222222222222222222222222221111111111111111111111111111111
                            CLASS CENTROIDS
                               2       1
```

CLASSIFICATION RESULTS -

ACTUAL GROUP		NO. OF CASES	PREDICTED GROUP MEMBERSHIP 1	2
GROUP	1	51	39	12
INTERIOR			76.5%	23.5%
GROUP	2	38	8	30
COASTAL			21.1%	78.9%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 77.53%

majority of the sites to the right of the inland section of the tail are early Berkshire sites, and the site to the extreme right is Star Carr, the classic early Maglemosian site.

This clearly indicates that the greatest technological differences occur between early Boreal interior adapted sites and later Atlantic phase sites situated in the littoral zones of southern England.

I then considered the question as to the better inland-coastal discriminants, and this was examined by using the STEPWISE variant of the DFA program.

Discriminant Function Analysis: Stepwise Method

In this procedure the program selects the best discriminating class of variables, and using built in tolerance levels[6] selects successive classes of variables until the tolerance levels are reached, and no further discrimination is possible (Klecka 1980; Norusis 1985). The substantive results appear below in Tables 24 and 25, with supporting data being presented in tables in Apppendix B.

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[6] Based on multivariate F statistics, see Appendix B

Results: DFA Stepwise Method

Two stepwise 'runs' were executed, but only the results of the second stepwise analysis are presented. In the first run it was found that the best discriminating category was "Other", but because of the unknown constituents of this category, further inquiry was somewhat precluded. The remaining best discriminating classes were microburins, cores, gravers, axes and picks respectively. Blades/flakes, scrapers and microliths had insufficient discriminating power to be included in the stepwise procedure.

There was a high level of discrimination for inland cases (86.3% correctly predicted) but only a 50.0% prediction rate obtained for coastal cases.

In the second run the "Other" category was excluded. The canonical discriminant functions appear below in Table 24 and it will be seen that, as was the case with the direct method, the value for Wilks' Lambda is quite high.

Table 24: Canonical Discriminant Functions: DFA (Stepwise Method)

CANONICAL CORR	WILKS' LAMBDA	CHISQUARE	DF	SIG
0.4067	0.8346	15.281	5	0.0092

Reference to the appended tables shows that, in contrast to the first stepwise run, the best discriminating categories were, respectively, pick, axe, core, blade/flake and microburin. There was insufficient discriminating power to enable scrapers, gravers and microliths to reach sufficiently high tolerance levels to be included.

The substantive results for the second stepwise run are presented in Table 25. This shows that quite a high degree of discrimination is indicated by the tool kits in the sample tested. A slightly lower overall percentage of "correct" classifications is evident here (overall "correct" prediction rate with the direct method was 77.53 %). A higher prediction rate obtains for inland cases compared to the direct method run, but there is a lower prediction rate for coastal cases with the stepwise II run.

Table 25: Table of Results: DFA (Stepwise Method)

SYMBOL	GROUP	LABEL
1	1	INTERIOR
2	2	COASTAL

```
                    ALL-GROUPS STACKED HISTOGRAM
                  CANONICAL DISCRIMINANT FUNCTION 1
16+                                                             +
  I                                                             I
  I                               2                             I
  I                             222                             I
12+                             221                             +
  I                             221                             I
  I                             221                             I
  I                             221                             I
 8+                             211                             +
  I                             2112                            I
  I                             2112                            I
  I                           2 1111                            I
 4+                           221111                            +
  I                       2   221111    2                       I
  I2                   2  222 121111   11     2                 I
  I2        2  2  2    1  212112111111 11 11111 1 1   1   1    1I
   X---------+---------+---------+---------+---------+---------X
   OUT      -2.0      -1.0        .0       1.0       2.0         OUT
   2222222222222222222222222222221111111111111111111111111111111
                           CLASS CENTROIDS
                            2         1
```

CLASSIFICATION RESULTS :

ACTUAL GROUP		NO. OF CASES	PREDICTED GROUP MEMBERSHIP 1	2
GROUP	1	51	42	9
INTERIOR			82.4%	17.6%
GROUP	2	38	14	24
COASTAL			36.8%	63.2%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 74.16%

Summary

It seems quite clear that there is an environmental correlation with Mesolithic tool kits on the basis of the tests conducted here, and that inland and coastal facies do appear present in the overall technatures of major sites.

Chapter V

REGIONAL SITE PATTERNING

In this chapter I present regional site maps together with a brief interpretation. This takes the form of a region-by-region consideration of site distribution and the main environmental features present. Because of the difficulty in depicting the full physical relief of the country in regional maps I have included a copy of a topographical map in Figure 20.

The maps that follow have been photo-reduced to facilitate economic presentation. Because of sparse distribution of sites in Wales (except southwest Wales) and northwest England I have not included regional maps for these areas, but their distribution can be examined from the composite map in Figure 2. The legend for all the maps in this chapter is provided in Figure 21.

Great Britain – Physical

Cornwall

Representing the extreme southwestern portion of England, the Cornish sites (Figure 21) show some interesting trends.

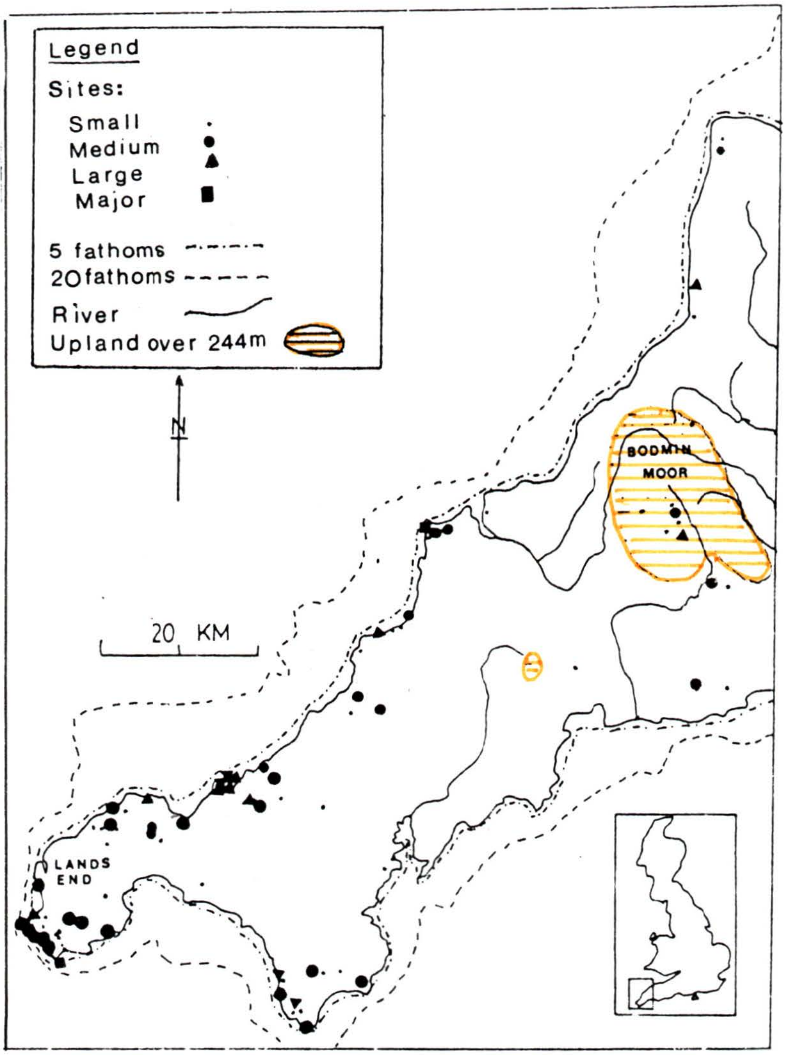


Figure 21: Map of Cornish Sites.

The majority of sites are situated within 10 km of the coast, and because of the peninsular shape, this is perhaps inevitable. The small cluster of inland sites is centred on Bodmin moor. It will be noted that where coastal locations are predominant, a restricted distribution obtains, with the southwest coast showing a notable absence of sites. This has been noted by Palmer (1978) who suggests that the rugged cliffs in the southern portion of the county represent preferred locations over sandy beaches.

Also noticeable is the fact that the 5 fathom contour hugs the present coastline, suggesting perhaps that the present patterns may reflect later Mesolithic settlement quite faithfully as marine transgressions appear minimal. It would be an interesting proposition to examine the economic implications of the effect of tidal action on the marine ecosystem: the northwest facing sites would be the first obstacle for currents approaching from the southwest.

Devon and Somerset

The sites in this region are shown in Figure 22.

Three main clusters are evident in this region. There is a concentration of sites in the Torridge estuary and the northwest Devon coast, which reflects coastal, estuarine and riverine ecozones. Quite large sites are evidently in the majority in this area. In the central portion of the region there is a cluster of sites on Dartmoor, an upland area, and

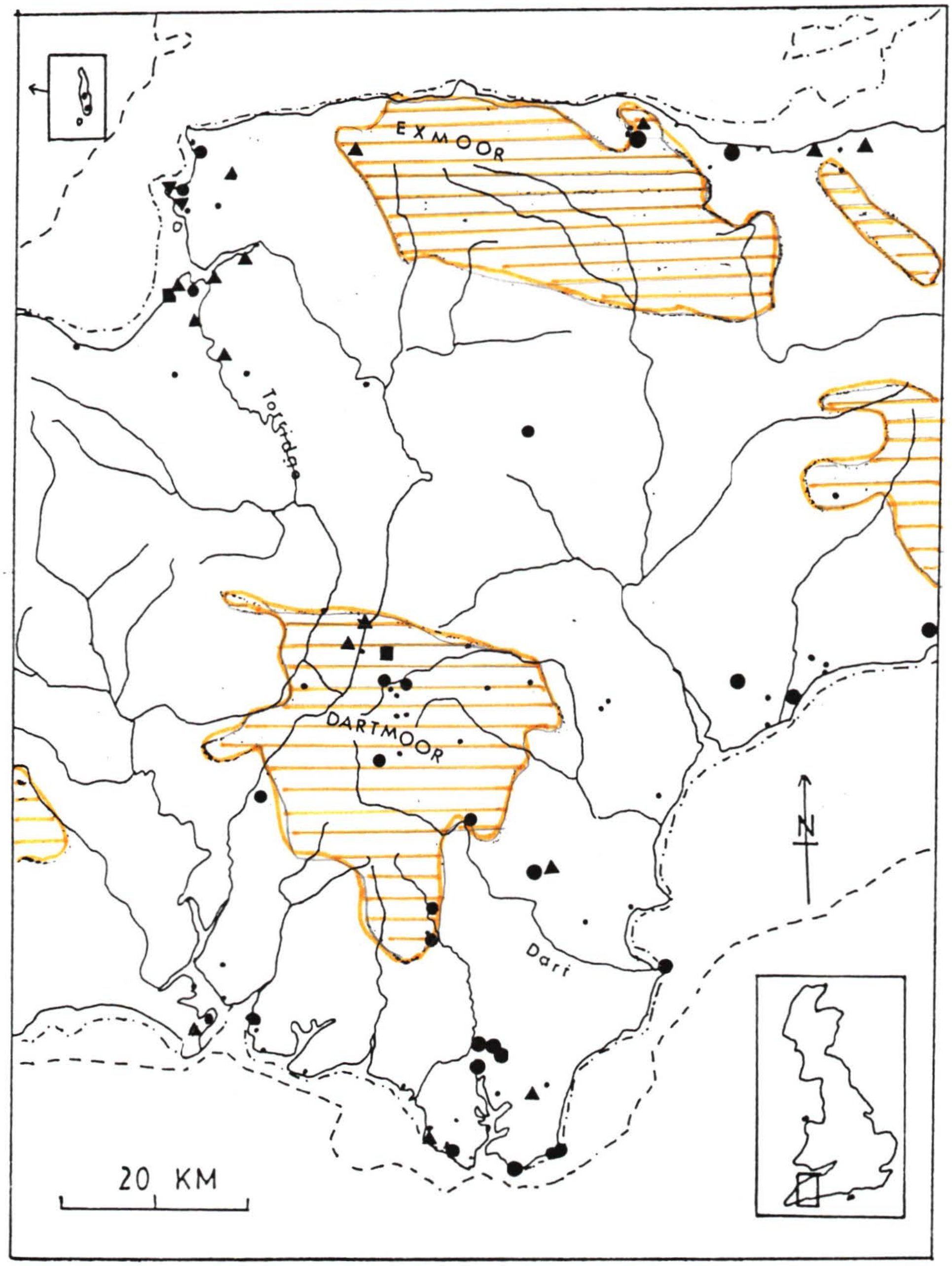


Figure 22: Map of sites in Devon and West Somerset

a wider range of site sizes is evident here. To the south of Dartmoor, a small coastal concentration will be noted surrounding an estuary. However, there are two estuaries to the west, with few sites, and the contrast is interesting, but no explanation can be attempted here. In the north, there is a noticeable absence of sites on Exmoor, although coastally situated sites are to be found in the northwest. It appears that all interior sites are closely associated with rivers, and the larger the site, the closer the association.

The 5 fathom contour begins to move away from the coastline in the northern reaches of this region, but hugs the southern coast quite closely. The island shown in inset in the northwest is Lundy Island, and two sites are noted here, which suggests either marine navigation, or settlement when sea levels were low.

In summary, it seems evident that either coastal or upland foci were the predominant influences on settlement here.

Southwest England

This region covers Dorset, east Somerset, south Wiltshire, west Hampshire, west Berkshire, and the western Isle of Wight. The appropriate map is shown in Figure 23.

There is a much more dense concentration of sites here than in regions to the southwest, and a variety of

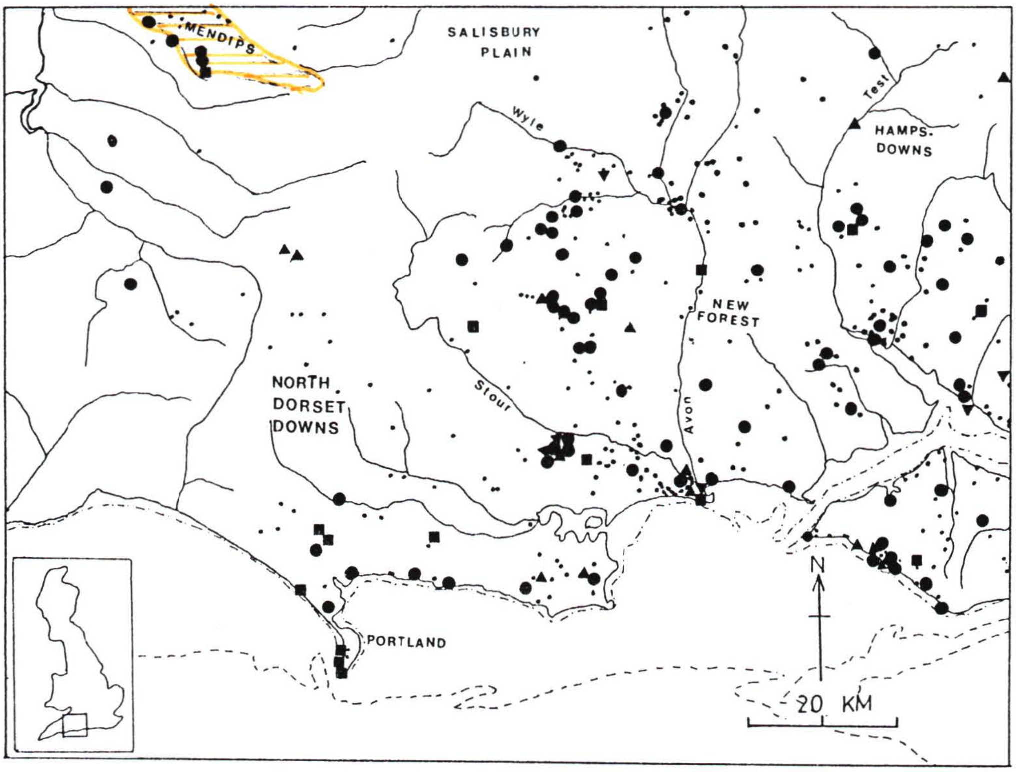


Figure 23: Map of Southwest England

environmental correlates are evident. The Mendips represents a particularly interesting area in that extensive limestone cave systems are found here, many of which formed a focus for Upper Palaeolithic settlement (Campbell 1977; Roe 1968). Most of the sites here are in caves or rock shelters.

South of the Mendips are the well watered lowland zones of Sedgemoor and the Somerset levels. These are apparently sparsely settled, but later become the focus of considerable activity in the Neolithic period.

A scatter of small sites are to be found on the North Dorset downs, and further to the south a coastal cluster of much larger sites is evident. The Portland sites are considered by Palmer (1978) to be the type sites for a Portland "culture". These sites are known to have produced large numbers of heavy industrial implements, especially picks, and the area is quarried even today, which attests to the quality of the stone.

A very dense concentration of sites is found for several kilometers inland from the Stour estuary, in contrast to the few sites associated with the southern reaches of the River Avon. Large sites are evident here, one of which is Hengistbury Head, a rare example of an Upper Palaeolithic open air site (Campbell 1977), which may demonstrate continuous occupation from late glacial times.

There is an interesting apparent absence of sites on the southwest coast, but a consistent coastal focus from Portland eastward. The Isle of Wight is particularly densely settled, with the largest sites evident in the western portion. It will be noted that the 5 fathom line extends to the north of the Island, and it is clear that it was part of the Mainland until the later stages of the Mesolithic

(Palmer 1978). This appears to account for the relative absence of sites situated on the coastline beyond the Isle of Wight.

North of the Avon-Stour confluence there is an interesting cluster of sites between these converging rivers which continues north to the southern reaches of the chalk plateau of the Salisbury Plain, and east to the Hampshire Downs. As will be seen from the composite map (Figure 2) and from Figures 24 and 25, this region represents the western limit of the dense southeast cluster. It will be noted that the larger sites to the east of the River Avon tend to be associated quite closely with rivers, with smaller sites interspersed more distantly.

Part of this area (the Avon Valley) was subjected to spatial analysis, and it may be recalled that non-random clustered site distributions were indicated by the tests undertaken.

Southern England

This region includes east Hampshire, Berkshire, London, parts of Essex, Surrey and Sussex (Figure 24). This region is one of the most densely settled areas, with several apparent correlates.

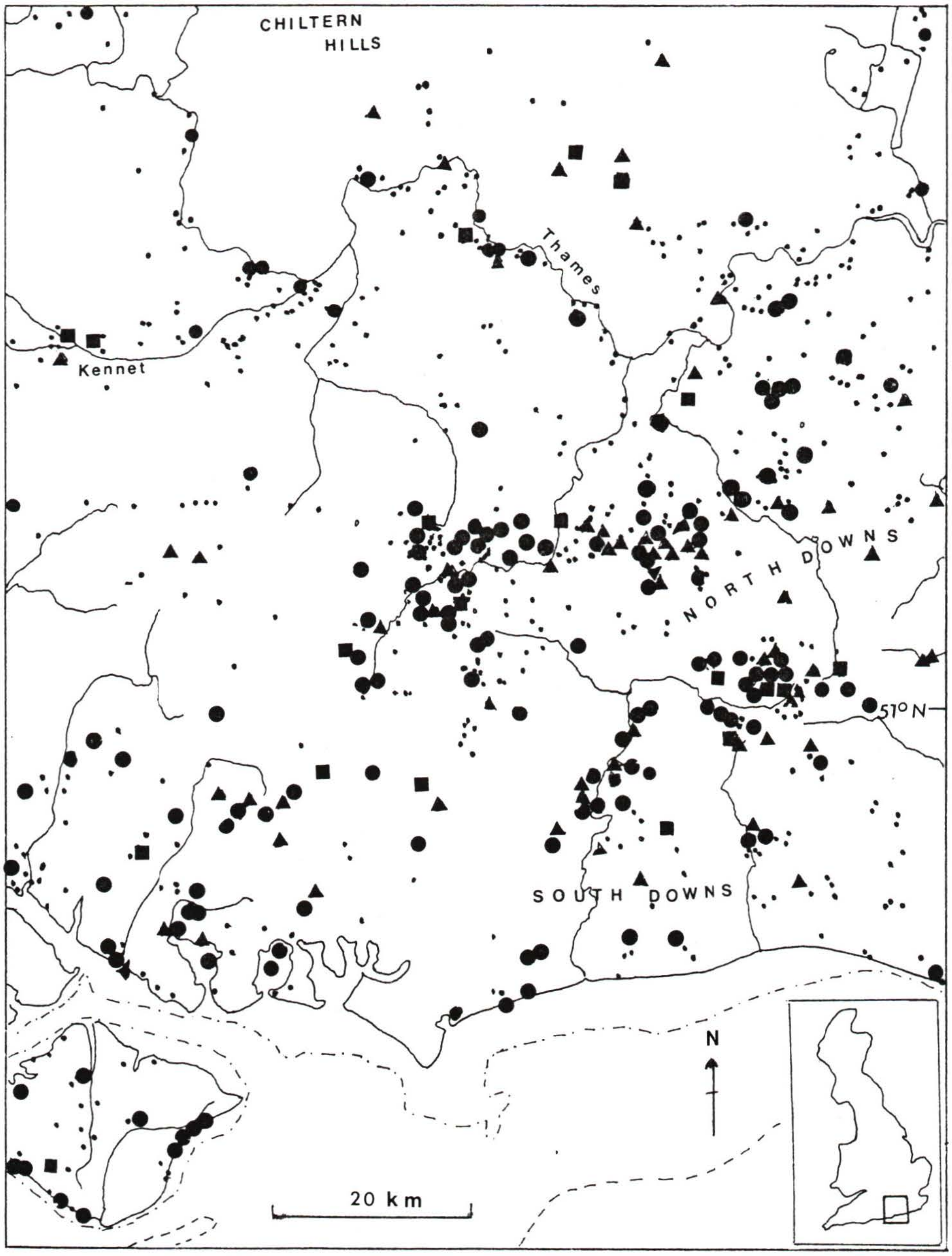


Figure 24: Map of Southern Central England

The greatest concentration is found on the North Downs. Mellars and Reinhardt (1978) have suggested that because of the correlation with Greensand geological deposits, the site patterning is associated with optimal raw material sources. A strong concentration of sites is found on the South Downs, but in apparent contrast to the sites on the North Downs, a stronger association with rivers is evident here.

There appears to be much less of a coastal focus than we have noticed thus far, although there are many coastally located sites. It may be noticed that both the 5 fathom and 20 fathom lines extend some way out from the present coastline, which suggests that marine transgressions have submerged many sites.

There is a strong riverine association, as will be noted for the western portion of the North Downs cluster and for the rivers draining the South Downs, and this trend also seems evident in the southwest portion of the region.

It may also be noticed that there is a continuous association of sites with the full extent of the River Thames in this region, and this association represents somewhat denser settlement than is otherwise the case in the northern portion. The pattern continues into the River Kennet valley, where some of the earliest known Mesolithic sites are to be found, c. 8,400 bc (see Appendix A). A more detailed consideration of dated sites will be found below, but suffice it to say at this stage that the Rivers Thames and Kennet may be considered to be one of the main avenues to the west of England (cf. Jacobi 1973).

In the Chiltern Hills, to the north of the region, there is a more dispersed pattern, although several larger sites are in evidence.

Southeastern England

This region is depicted in Figure 25, and covers east Surrey, east Sussex, parts of London and Essex, and Kent.

It may be noticed that the dense concentration on the North and South Downs reach their eastern limit in the western portion of this region, and a more dispersed pattern obtains elsewhere. A strong riverine association is also evident north of the Thames.

There is a small but noticeable coastal cluster in the southwest which appears correlated with the closeness of the 5 fathom contour. Where the contour moves away from the coastline the number of littoral sites decreases until a smaller cluster is reached on the north coast of Kent.

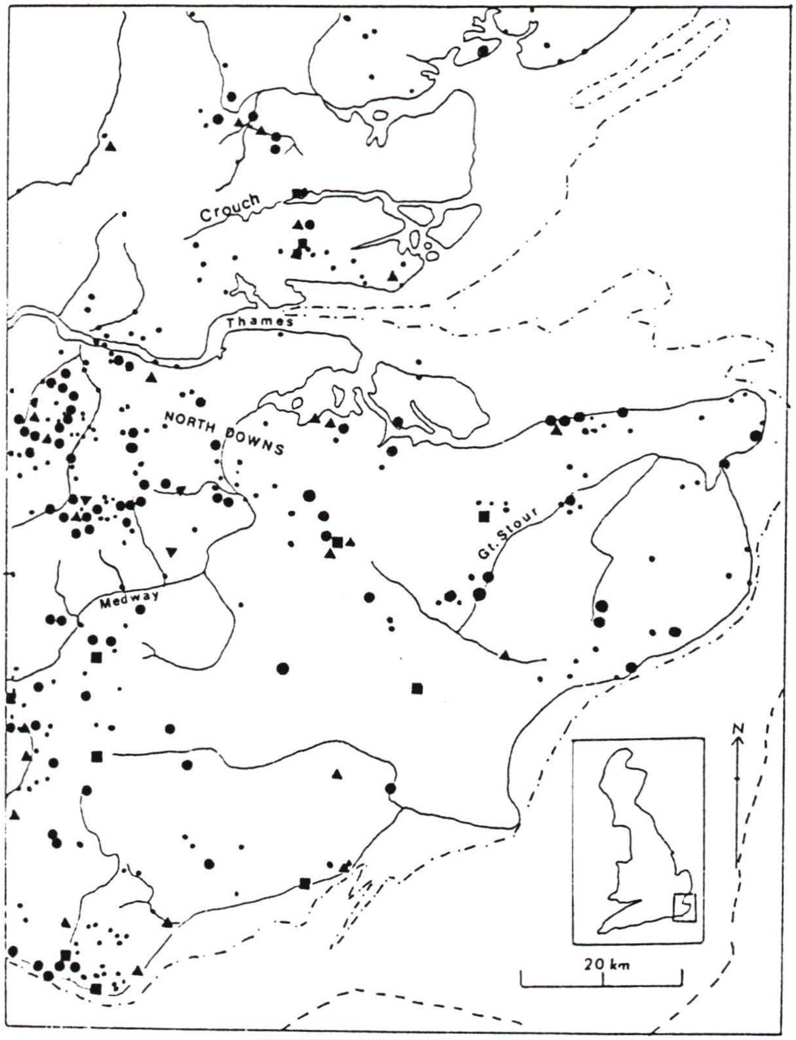


Figure 25: Map of Southeast England

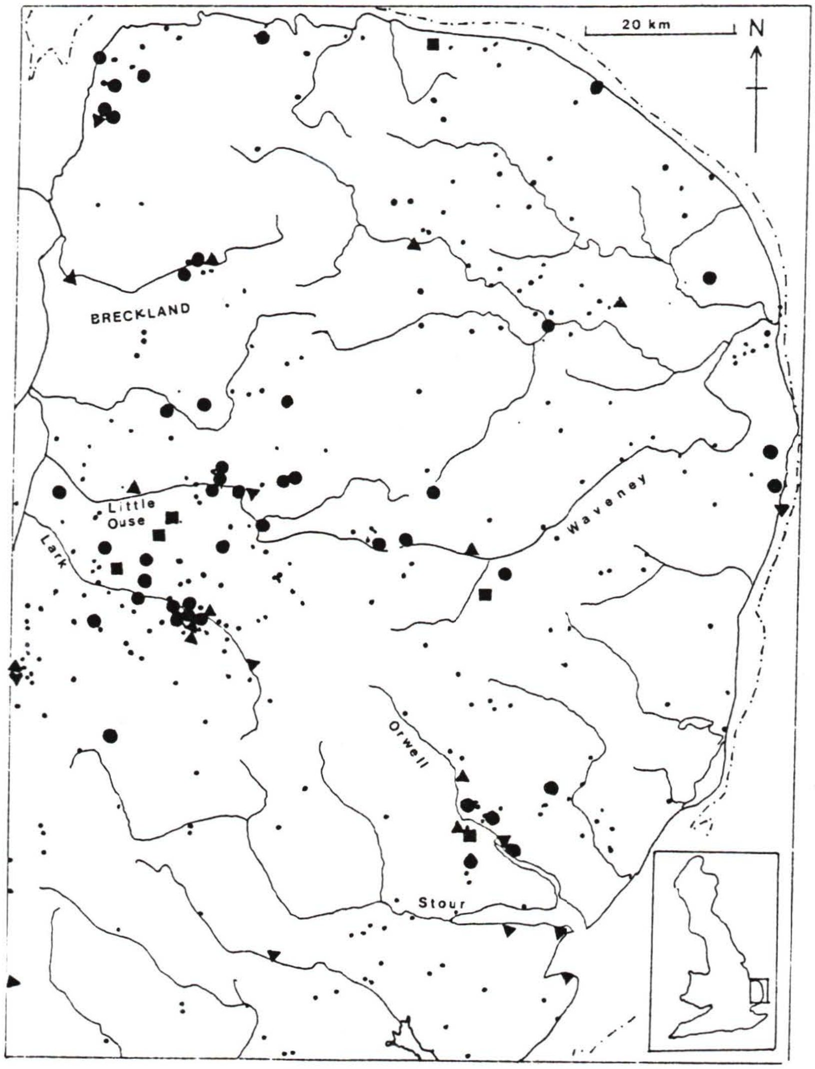
East Anglia

This region comprises north Essex, most of Suffolk and Norfolk, and is shown in Figure 26. This region is well watered, and consistently lowland. A relatively unbroken coastline extends from the northwest to the southeast of the region, but very little in the way of a coastal focus is evident, with perhaps the one exception of a small cluster in the northwest. There is a cluster of sites along the middle portion of the River Orwell, but very few sites in the estuaries of either the Orwell or its neighbour, the Stour, which represents an interesting contrast.

There is a very interesting contrast between small sites, which appear dispersed throughout the region as a whole, and larger sites, the majority of which appear clustered well inland on the Rivers Lark and Little Ouse.

The area north of the River Stour was subjected to spatial analysis, and it may be recalled that medium, large and major site distributions were found to exhibit a non-random clustered pattern.

The 5 fathom contour lies very close to much of the coast, but the 20 fathom line lies well offshore. It is known that the area to the northeast of the Norfolk coast was occupied prior to marine incursions, as evinced by the find of a Maglemosian barbed harpoon point which was dredged up some 40 km offshore (Clark 1936).



Central Southeast England.

This region extends from Lincolnshire in the north to East Anglia in the east, and from the Thames Valley in the south to the Northhampton Uplands in the west. The map is shown in Figure 27.

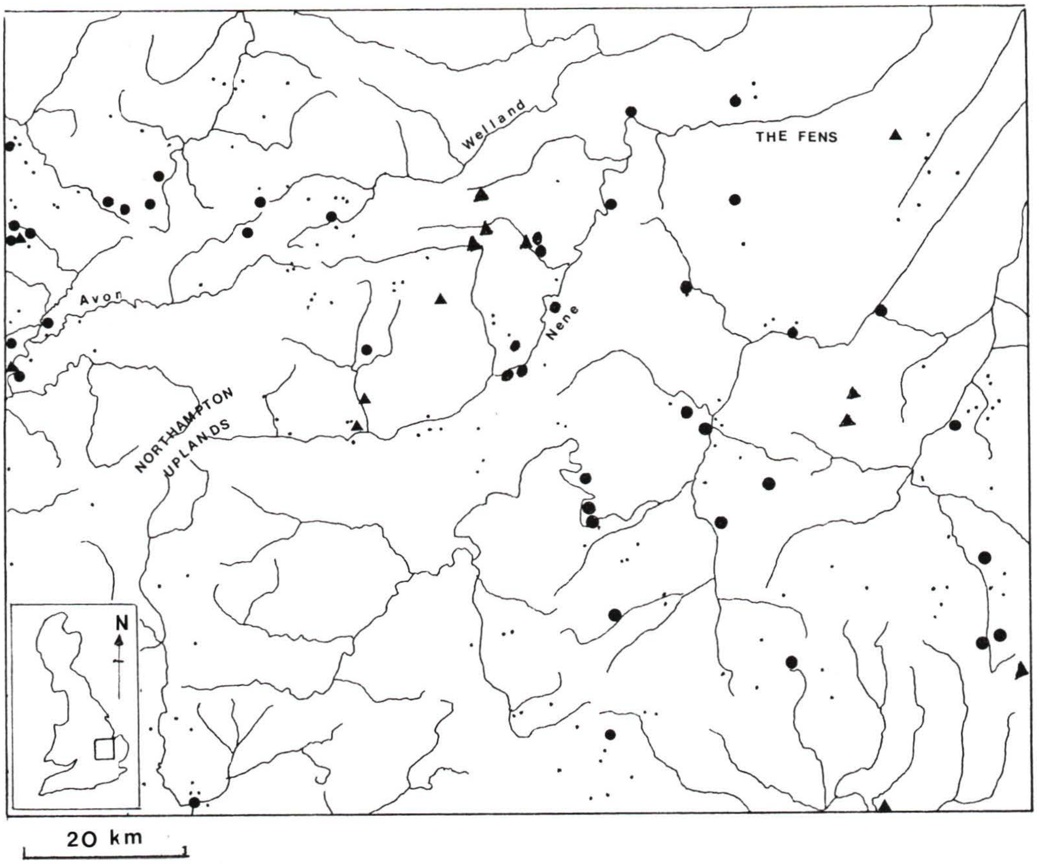


Figure 27: Map of Central Southeast England

This is a much more sparsely settled region than any encountered thus far. The region is well watered, and part of the Fens lie below sea level. Jacobi (1973) has suggested that the absence of sites here may be due to post-mesolithic alluviation.

The largest sites, of which there are few, tend to be found on the eastern fringes of the Northampton uplands. With very few exceptions, medium sites are all closely associated with rivers, with smaller sites often reflecting this trend, but also somewhat equidistant from rivers as well.

Western England

This area comprises the Severn Estuary and its extension into the Bristol Channel, parts of Somerset, Gloucestershire, Monmouth, Wiltshire, Berkshire and Oxfordshire. The appropriate map is shown in Figure 28.

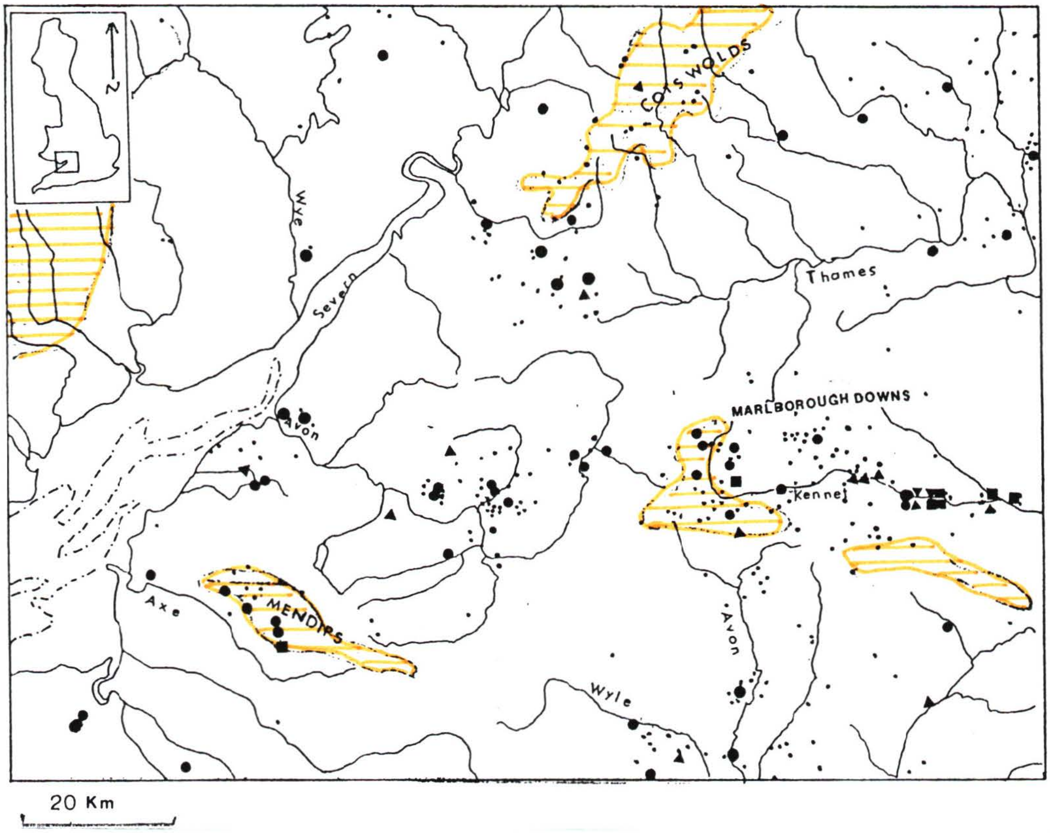


Figure 28: Map of Western England

There appear to be very few sites west of the Bristol Channel, but several clusters are found throughout the rest of the region. The cluster of sites around the Wyle and nearby rivers represents a northern extension of the concentrations to the south seen in Figure 23. The River Kennet rises in the Marlborough Downs, and an obvious concentration is found in this upland area. A scatter of smaller sites is found in the south Cotswolds as well as in the northeast around the rivers that drain into the Thames. To the west of the Marlborough Downs there is a fairly discrete cluster of sites in the (Bristol) Avon Valley.

The largest concentration of larger sites is found to the east of the Marlborough Downs, in Berkshire, where a very early occupation obtains (see Appendix A).

Spatial analysis of sites in the Cotswold Hills produced ambiguous results, but a case can be made for the presence of a non-random clustered distribution pattern in this upland zone.

Southwest Wales

Primarily Pembrokeshire, this area contains by far the largest concentration of sites in Wales, and an obvious coastal correlate is evident as will be seen from the map in Figure 29.

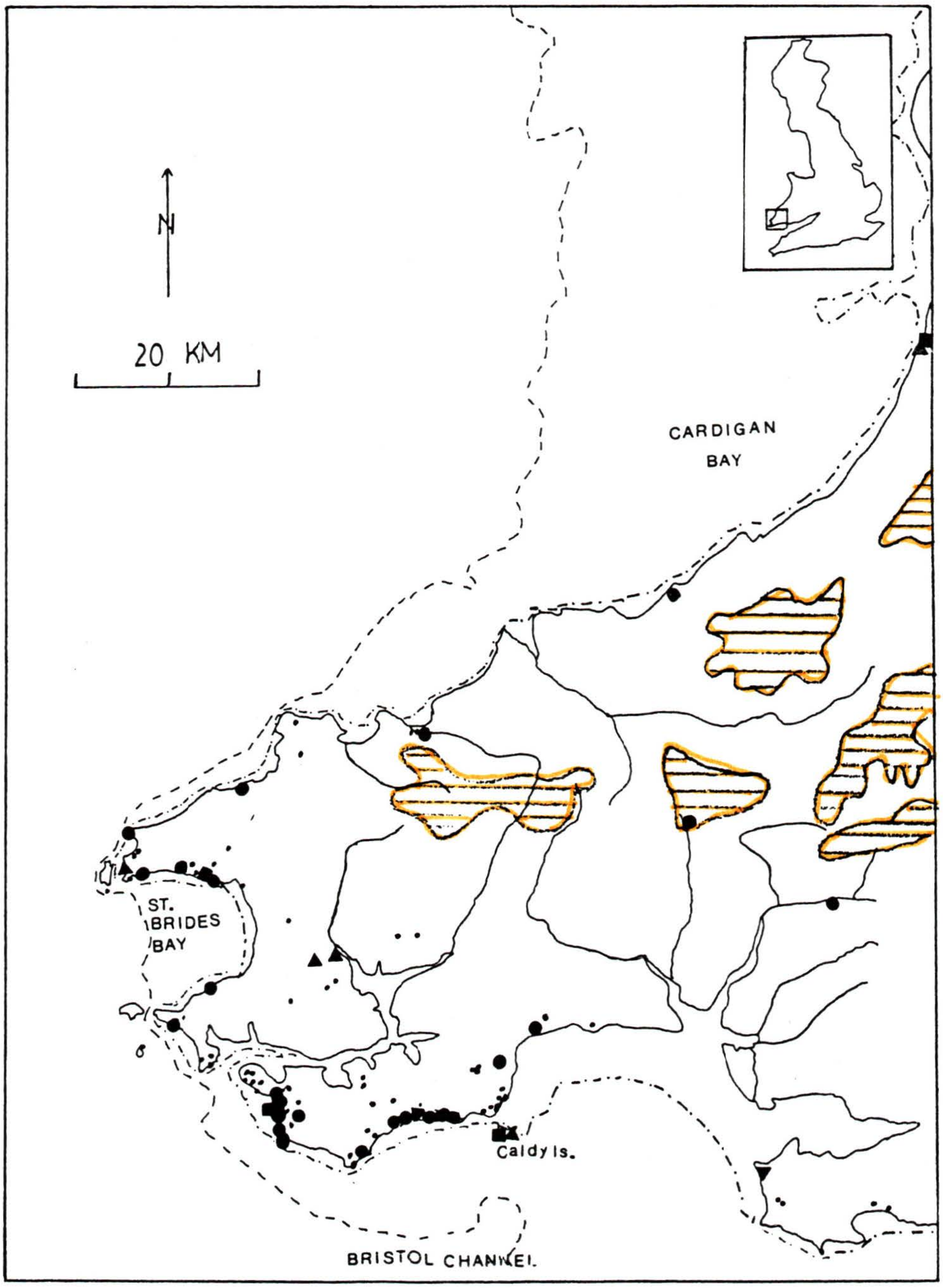


Figure 29: Map of Southwest Wales.

With the exception of the large sites at Aberystwyth in the north, a few sites in the interior and the northern and southeast coasts, the stretch of coastline from St. Brides Bay to Caldey Island appears to be the most densely settled area.

A review of settlement here has been provided by Wainwright (1963) as part of his overall study of the Welsh Mesolithic, the main point of which was that the interior is mountainous terrain, which possibly proved unattractive to Mesolithic communities. Wainwright further suggests that typological links can be established with industries in southeast England and North Dorset. On palynological evidence, an early (Boreal) occupation extends through to Atlantic times, and this no doubt reflects continuous occupation from late glacial times (Campbell 1977).

There appears to be very little settlement in either estuaries or upland areas, and even though a littoral focus is evident, this is not consistent along the coastline as a whole, and this contrast may be worth investigating. It may be noticed that the 5 fathom line swings away from the coast east of Caldey Island, and this suggests the submergence of many sites. In contrast, however, the 5 fathom line hugs the northern coastline, suggesting that the relative absence of littoral sites may reflect an actual absence of occupation in the later Mesolithic.

The West Midlands

This area comprises parts of the counties of Gloucestershire, Oxfordshire, Worcestershire, Warwickshire, Staffordshire, Derbyshire, Cheshire and Herefordshire (Figure 30).

Very few larger sites are in evidence here, but the smaller sites found here are dispersed throughout a number of contrasting ecological zones in this region. The upland areas comprise the Pennines to the north, the Welsh foothills to the west, and the Cotswolds to the south. Of these, only the Pennines exhibits a major degree of site clustering, although a scatter of smaller sites can be discerned in the southwest.

In the lowlands, two obvious riverine correlates are evident, with a number of sites associated with both the Severn system and the (Stratford) Avon. The denser clusters are associated with latter. The Vale of Trent is relatively unoccupied.

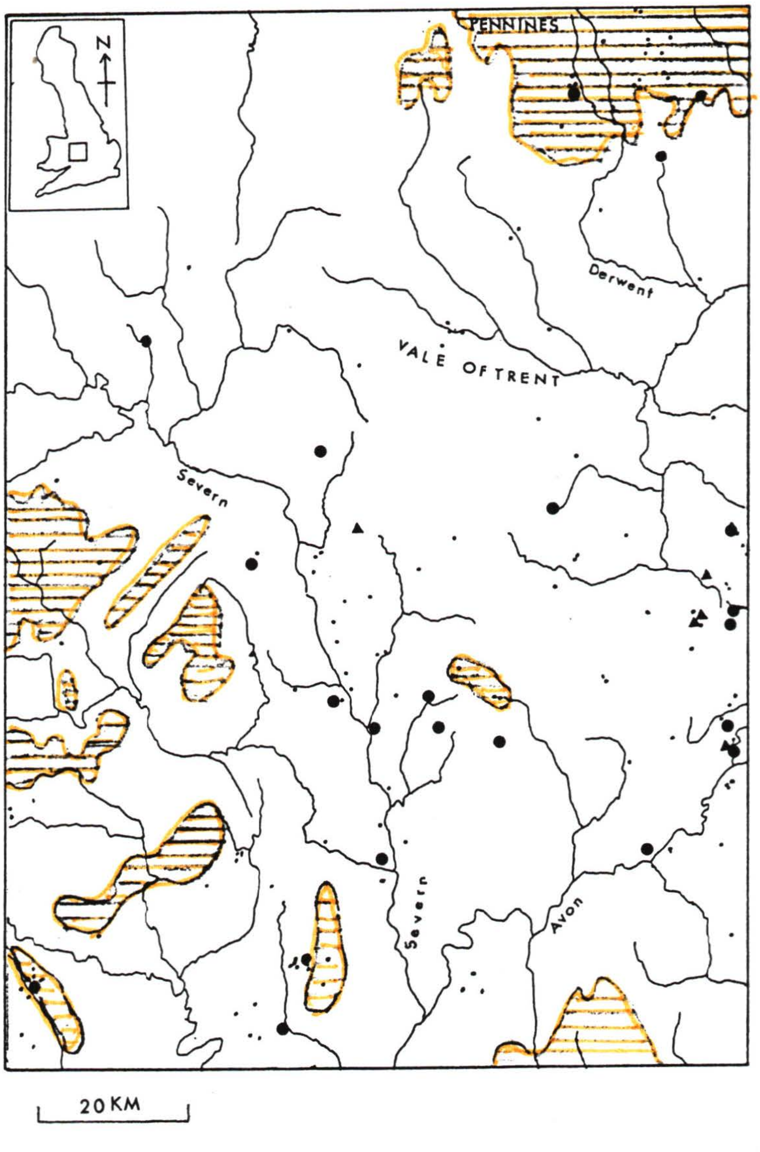


Figure 30: Map of the West Midlands.

The East Midlands.

Comprising parts of Lincolnshire, Northamptonshire, Rutland, Cambridge, Derbyshire and Nottinghamshire, this region (Figure 31) is essentially one of lowland.

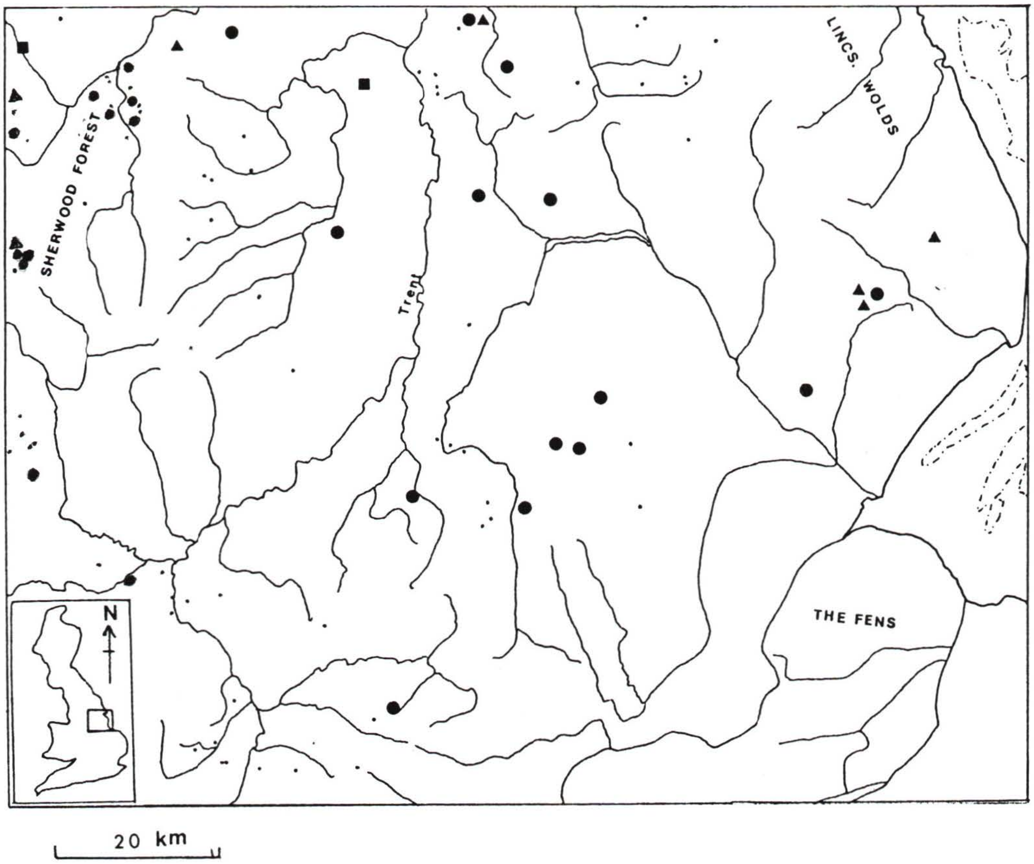


Figure 31: Map of the East Midlands

There is a very dispersed pattern of settlement here. No sites are recorded in the Fens, which as mentioned before may be an artefact of post-mesolithic erosion. A scatter of sites in the Sherwood Forest area can be discerned, with a similar pattern evident for the Trent river system.

There are a few larger sites dispersed across the central and northern reaches of the region, but only a few small sites in the Lincolnshire Wolds. No coastally located sites are recorded, with the larger and medium sites situated near the boundary of the coastal zone apparently reflecting the same trend as was evident in East Anglia to the southeast.

Both the East Midlands and the West Midlands comprise most of the area of Central England which was subject to spatial analysis. It may be recalled that non-random clustered site distributions were demonstrated quite strongly here.

Northwest Central England

This area comprises Lancashire, Derbyshire, the West Riding of Yorkshire and eastern Flintshire (Figure 32).

The central feature of this region is obviously the Pennine uplands, where perhaps the densest concentration per unit area in England is evident. Now largely high altitude peat moorland, it is noticeable that discrete clusters are evident throughout the region.

This area has attracted considerable attention from Mesolithicians (Clark 1932, 1972; Jacobi 1973, 1976, 1978; Jacobi et al. 1976; Mellars 1975; Mellars and Radley 1968; Switsur and Jacobi 1976; Williams 1985), and there is

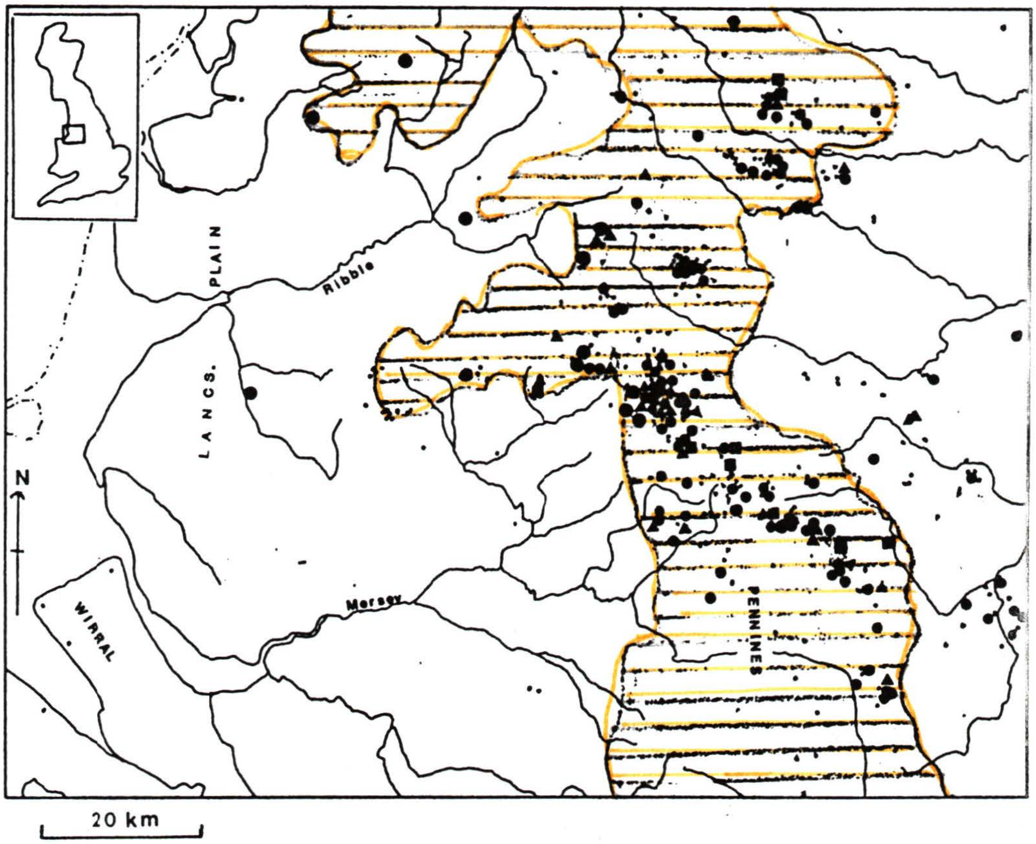


Figure 32: Map of Northwest Central England

agreement that the sites in this area mostly represented summer hunting activity.

In the lowland zones it will be noted that there are relatively few sites on the Lancashire plain, but larger numbers to the east of the Pennines, where a riverine association seems in evidence.

With the exception of the three small sites on the Wirral, no coastal occupation is evident, and because the 5 fathom line lies some way offshore, submergence is likely a factor.

Northeast England (Yorkshire and Humberside)

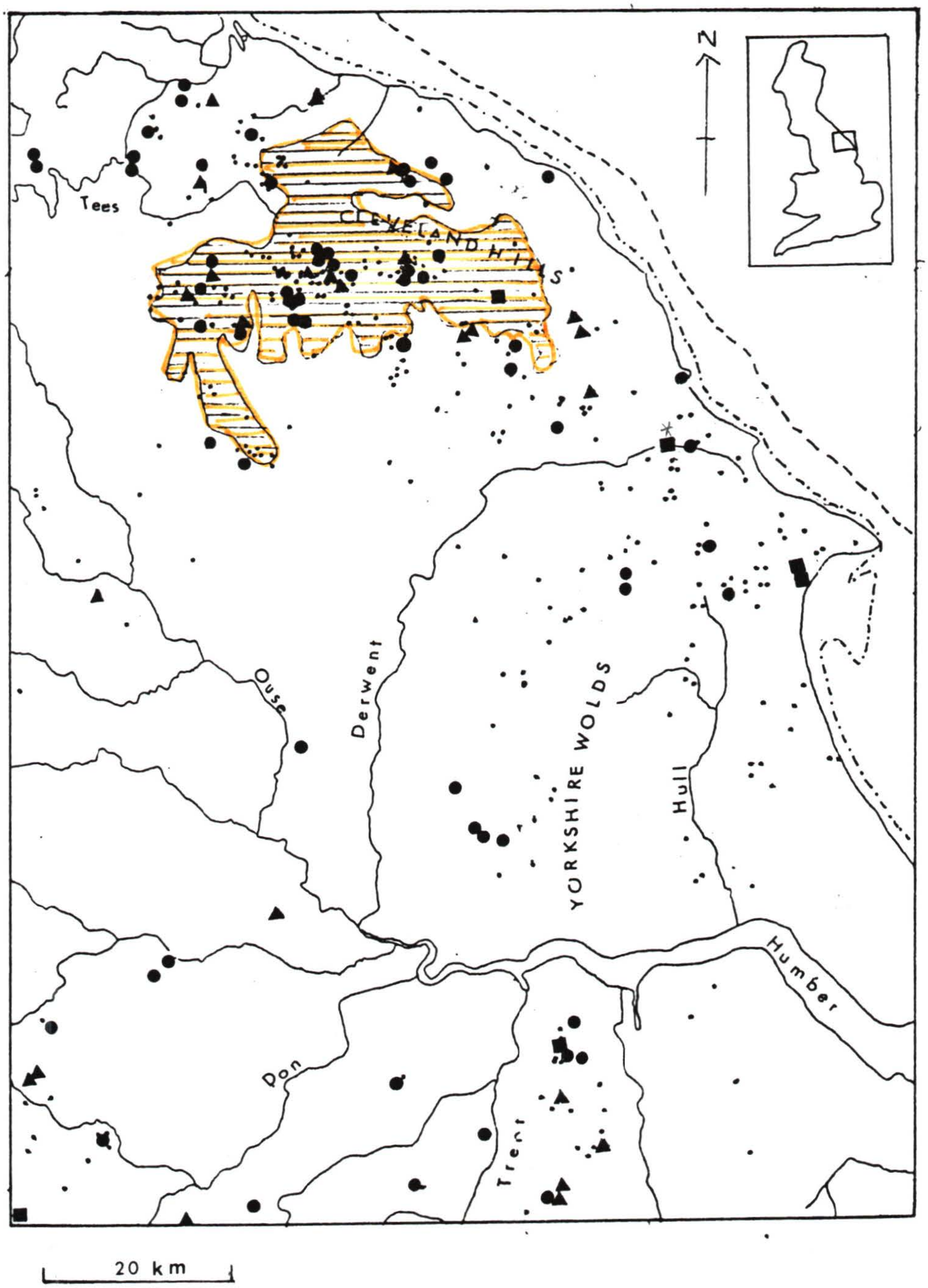
This area largely comprises the three Yorkshire ridings and northern Lincolnshire (Figure 33).

The densest concentrations are found in the Cleveland Hills, where a large number of sites of all sizes are located. It has been suggested (Clark 1972; Jacobi 1978) that this area represents winter settlements for groups that may have journeyed westwards to the Pennines in the summer. To the north of the Pennines, there is a cluster of sites in the Tees Valley. The Yorkshire Wolds seems to represent a focus for large numbers of smaller sites, but even though this area extends to the east coast, there is no discernible littoral focus.

Elsewhere in the region there are concentrations in the Trent Valley, and more dispersed settlement to the west of the River Don.

Both the 5 and 20 fathom contours come in quite close to the eastern shoreline, and the area to the east represents the northern limit of the then-North Sea plain. It would therefore seem that the present coastline approximates that in effect during the Mesolithic period and the relative absence of coastal sites may have been real.

The famous site of Star Carr is indicated by an asterisk (*) in Figure 33, and the findings from this site will be discussed below.



<u>Figure 33</u>: Map of Northeast England (Humberside)

Northeast England (Durham and Northumberland)

This area represents the extreme northeast of England, (Figure 34).

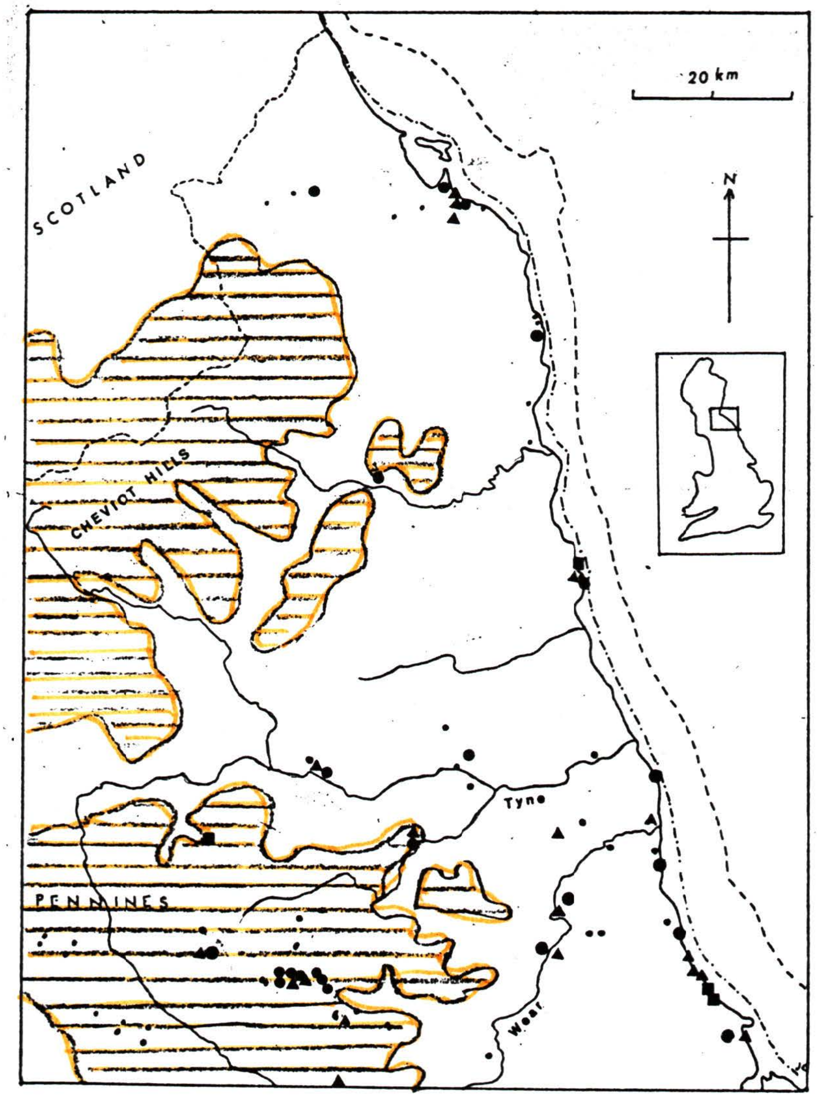


Figure 34: Map of Northeast England (Tyneside)

There appear to be two major correlates. A clear coastal concentration along much of the coastline is evident, in contrast to stretches of the east coast south of this region, and a number of large sites are represented here. Both the 5 and 20 fathom lines remain close to the entire coastline, and it seems as if the present distribution of coastal sites may be indicative of the original situation.

Of the two upland zones, only the Pennines show any sites, and of these only small sites are situated in the western reaches. Both the Wear and Tyne rivers have a scatter of associated sites. The southern portion of the region has considerably more sites than the northern area.

Other Areas

As stated above, because of the small number of sites involved, I did not include maps for most of Wales, nor for the northwest of England. Reference to the composite map (Figure 2) will show that in the northwest of England the majority of the sites present are coastally situated, and most of these are larger sites. The hinterland is mountainous terrain, and the few sites in the interior are associated with lakes.

With the exception of Southwest Wales, very few sites are to be found in Wales generally, and this may be due to the mountainous terrain (Wainwright 1963). The few sites found there are small, and this suggests itinerant occupation.

Summary

It can be seen that there are two major concentrations for England and Wales, in southeast England and the central Pennines, but there is evidence of occupation throughout the country as a whole, albeit with highly variable density levels. Settlement density tends to decrease with distance away from the southeast, until the Pennines are reached, although it increases somewhat in Devon and Cornwall.

A riverine focus is evident in many cases, and this appears to be the main environmental correlate of those considered thus far. This is partly to be expected as Britain has a large number of river systems, but close association with these rivers seems incontrovertible.

A coastal focus is evident for the southwest, southern and northeast coasts, but settlement is often concentrated only on certain stretches of coastline, and the greatest numbers of these appear correlated with close proximity of the five fathom submarine contour.

In the previous two chapters, the existence of environmental influences on spatial patterns was demonstrated quite clearly. In reviewing regional distributions, there seems to be no doubt that site distributions are closely correlated with environmental features. This will be discussed further in the next chapter.

Chapter VI

DISCUSSION

In this chapter I summarise the findings, consider how valid and accurate the methodology and lines of evidence are, and discuss what effect these have on the data. I conclude by suggesting additional research avenues.

Summary of Findings

After considering the overall nature of Mesolithic settlement in England and Wales, several conclusions can be drawn. I began the study by listing some expectations. I posited that eastern and northern England would exhibit the highest incidence of settlement on the basis of proximity to the continent of Europe. Reference to the density map will show that this expectation has been met.

I further suggested that as Scotland has evidence of settlement by Boreal times, because of its location to the south, there would be evidence of ocupation throughout England, and this was the case.

However, even though occupation is evident throughout England and Wales as a whole, highly variable density levels are evident. The heaviest concentrations of sites are to be found in southeast England and in the Pennines, and it is clear that there is a general decline in site concentrations the greater the distance from these two main regions. However, this trend tends to reverse itself in the southwest of England and southwest Wales.

Several environmental correlates are evident from qualitative inspection of the maps.

Prior to undertaking tests of spatial analysis I began with the null hypothesis of random site distributions. As a result of the test procedures undertaken I conclude that there was no real evidence of random site patterning, and this therefore implies the presence of ordering influences.

Additionally, examination of the technatures of the largest sites suggests that the configurations of the toolkits are influenced by spatial-environmental factors.

I therefore conclude that environmental correlates are an integral element in site patterning, and these can be discussed in turn.

The Riverine Factor

Perhaps the most significant finding is that a riverine association is particularly apparent throughout the country. Several of the larger rivers have sites in association for considerable distances, as exemplified by the River Thames and River Kennet. Even in areas of less dense settlement this association is very much in evidence, as is the case with the River Severn, which seems to represent an avenue northwards from the Bristol Channel.

With a densely forested environment, we can expect that rivers were vital foci, providing, among other things, stable water supply, enhanced mobility and a focus for subsistence resources.

We would therefore expect to have some independent evidence of river navigation. In fact, the only three references to watercraft in the literature for the European Mesolithic generally are wooden paddles found at Star Carr in England (Clark 1954, 1972) and Tybrind Vig in Denmark (Larsson 1983), and a single dug out canoe from Pesse, Holland (Clark 1952). However, little known though they appear to be, there are several references to boats in The Gazetteer.

From the site of Thurlestone Sand, Bigbury Bay, Devon, there is a reference to a dug-out boat in association with a submerged forest (Wymer 1977:65). A dug-out canoe was found in the River Wey, Wisley, Surrey, with a wooden paddle being found nearby (Wymer 1977:288). A little further north, at two locations near Hounslow, near London, Lawrence (1930) refers to three dug-out canoes at Isleworth and a square ended dug-out canoe at Strand on the Green (cited in Wymer (1977:191). As already noted, a wooden paddle was recovered from Star Carr by Clark's (1952) excavation, thus providing for a total of six watercraft and two paddles.

Given the extensive forest cover in England during the Mesolithic it is only to be expected that rivers would have been important thoroughfares permitting a higher degree of mobility. The relative scarcity of wooden boats is therefore a likely artefact of preservation rather than a reflection of their currency.

The Uplands Factor

The major focus of settlement in upland areas is obviously the Pennines, and I have already mentioned the general agreement in the literature that upland sites are considered associated with hunting, particularly deer. This leads to the expectation that sites tend to be smaller in area, and this is generally confirmed by Jacobi (1978) and Switsur and Jacobi (1975). Following a detailed palynological study of Soyland Moor in the Central Pennines, Williams (1985) concludes that there is perhaps more complexity in the Pennine settlement patterns than earlier Mesolithicians have considered, and that a simple "winter/lowlands/aggregation versus summer/uplands/dispersal" model is no longer tenable.

There are a number of obvious advantages to utilising upland areas, and in his essay on the early Mesolithic in northern England, Jacobi concludes that many upland sites cluster at or above 365 m where they

> overlook natural basins, reservoirs within which such artificial concentrations of deer, once established, could successfully be supervised. . . . Sites cluster at or above the ecotone between wooded and more open ground, precisely where the maximum aggregations might be expected to form. The sites are so situated also as to take into view the largest areas possible (1978:325).

Palmer also notes the tendency of coastally situated sites to occur on headlands or high cliff areas (1978:196). It might be interesting to speculate whether the key variable is only one of altitude, or whether other upland zone attributes apply.

<u>The Coastal Factor</u>

An arbitrary a priori delineation between coastal and inland zones was necessary to eliminate subjective bias, and the choice of a 10 km band from the coastline, approximately a two hour walk, is based on Vita-Finzi and Higg's (1970) suggestion that this generally represents a limit to mobility in a subsistence context. There is considerable evidence that coastal clusters are evident over much of the coastline suggesting that littoral influences were an important correlate of settlement patterns.

This has already been substantiated by Palmer (1978:216) as part of her study of Mesolithic settlement in the southern littoral counties of England (Cornwall, Devon, Dorset, Hampshire and Surrey). Palmer used almost the same criterion for delineating the littoral zone as I used (a 5 mile band from the coastline) and calculated that there were 430 sites in the 2291 square miles of the littoral zone, as against 378 sites in the 5734 square miles of the inland zone. She concluded that the probability of this distribution occuring by chance was less than 1%.

Summarising, there would seem little doubt that settlement patterns have a strong degree of association with broad based environmental factors, and that rivers, coastal zones and upland areas all influence settlement patterns.

However, it is clear that the findings of this study cannot be taken at face value, and it is important to consider how much confidence can be attached to them. To claim valid findings it is necessary to assess both the data and the methods used to reorder them.

Questions of Validity

The Database

As stated above, The Gazetteer was the main source of the data for this study, and because so much reliance was placed on this one source, any inherent problems will reflect themselves in the study as a whole. The Gazetteer was a collaborative undertaking involving some 17 regional coordinators and 56 others (Wymer 1977: vii). With 71 individuals involved there are bound to be some concerns with respect to consistency in the recording and compilation processes.

The survey obviously has to take what primary data are available, some of which are of highly variable quality (with the more dubious data taking the form of scribbled proveniences on bags of materials, or disorganized museum collections). The reader is referred to The Gazetteer for a full discussion of specific problems.

Being at arm's length from the primary data used, and in the absence of any reasonable means for verifying the data in The Gazetteer, I have to accept the data as they stand. Obviously my own effort represents a second potential source of error.

The main problem that arises is the extent to which the known data reflect the original Mesolithic situation. Much of modern statistical theory is based on assumptions of normal distribution and representative sampling and the data of archaeology are obviously problematic in this regard. Most archaeologists have to confine themselves to what limited material can be recovered, and therefore samples to hand have to be considered availability samples. The question therefore arises as to how representative of the original Mesolithic material can we consider these samples to be ?

Ethnographic studies conducted with archaeologists' needs in mind can prove useful in a cautionary sense. Thompson's (1939) study of the Wik Monkan groups of northeast Australia revealed that several seasonally defined cultural patterns could be observed in the annual round, but that not all of these would manifest themselves materially in such a way as to be preserved and become potential archaeological data. Obviously only a portion of cultural phenomena generally can be preserved, and of that, a range of taphonomic factors can affect what remains preserved and what is destroyed (Aaris-Sørenson 1983; Gifford 1981).

We therefore need to establish the potential extent of original Mesolithic data. Unfortunately there is very little demographic data for the Mesolithic period. Population estimates of 5,000 have been suggested for the end of the

Late Upper Palaeolithic period in Britain (Campbell 1977; Mellars 1974), and Meiklejohn (1978) has suggested there is little population growth for most of the Mesolithic. Taking this conservative population figure then, we can speculate on how much archaeological visibility the population may have had.

It has been suggested that hunter-gatherer bands rarely number(ed) more than about 50, and that smaller groups are more likely to have been evident in the Mesolithic (Clark 1972; Meiklejohn 1978). For the sake of argument let us suppose that there were 100 groups of 50 individuals. We know of no sedentary communities in the British Mesolithic, therefore mobility and camp changes were necessary throughout the year. Let us assume that each of the 100 groups changed their camps ten times in a year -- a conservative estimate. We can therefore deduce that 1000 camps would be established per year. No doubt many of these would be re-occupations, and, bearing in mind that overnight hunting camps were common, assume that a 50 % reoccupation rate obtains. This gives an estimated 500 camps per year. The Mesolithic period encompasses some five millennia, and we can therefore speculate that, potentially, there were some 2,500,000 original sites for the period as a whole. With about 5500 sites recorded archaeologically, this represents only 0.22 % of the estimated original number. As it appears that only 292 of the known sites have been excavated, this comprises only 0.01% of our estimated total -- a very small sample indeed.

However, small though the sample might be, it might be considered representative if it was derived from probability sampling procedures. The available data preclude further consideration of this question, but I rather suspect that most of the archaeological data did not come to light in this way.

The question of the "missing" data entails consideration of two factors: the number of sites that have since been destroyed, and the extent of archaeological fieldwork.

Site Destruction

The question of controlling for site destruction is an interesting one. In the six millennia following the Mesolithic period Britain has been subject to intensive land-use, with urban sprawl, road and rail networks and intensive farming all effectively combining to restrict the availability of potential Mesolithic archaeological data. Theoretically it could prove possible to estimate the net effects of six thousand years of land use to establish how much potential archaeological data remain to be recovered, but this would prove an onerous undertaking, except possibly at the regional level.

Differential Fieldwork.

A number of factors influence which areas are selected for excavation and survey. Obviously differential fieldwork will produce biased data, and it remains a problematic issue whether areas of scarce occupation merely reflect an absence of archaeological investigation or the original Mesolithic situation. Wainwright (1963) concludes that the relatively scarce occupation of inland Wales is due to an inhospitable mountainous environment, and presumably the same line of thinking can be applied to the equally mountainous northwest of England.

But obviously the question can be resolved only by devoting some archaeological attention to these supposedly inhospitable regions.

We therefore have to accept the limitations of the data as they stand, and endeavour to make the best use of what is available. However, even the best data are often subject to differences of opinion, with a classic example being the Boreal site of Star Carr. Even though this represents perhaps the best conducted and most extensive excavation of any Mesolithic site in Britain, Clark's (1954, 1972) conclusions have been challenged on a number of fronts by a number of researchers (Andresen et al. 1981; Dumond 1983; Pitts 1979). Perhaps the most important issue here is not the divergence of opinion as the fact that Clark's data were sufficiently extensive to permit detailed consideration after so many years. But, important though it is, individual site research does have its limitations as a basis for inferences to a wider universe. It therefore seems that any consideration of the nature of an individual site has to involve a wider areal context.

Spatial Analysis

A further consideration of validity demands a general discussion and examination of the methodology of point pattern analysis. It is important to remind ourselves of the theoretical context of spatial analysis, and the overriding principles are well stated by Taylor:

> The first research principle in many cases must be that we must never forget that every pattern is the result of some processes at a given point in time and space . . . . . Patterns are only abstractions because, in reality, time never stops; it is a continuous ongoing process. There are no patterns; there are only processes. It is imperative that we view our point patterns as simply the visual expression at one point in time of processes operating continuously in space (1977: 134, emphasis in original).

How these processes can be detected is, of course, a primary issue and the use of models of random independent process have been a basic part of this study.

"Random" is an attribute of the method of location of points, not the resulting patterns; it is therefore the process which contains the random element, not the distribution (Unwin 1981:49). Randomness is defined as a point generation process in which no influences arise to constrain allocations of points. Two features of the random process are evident then, the equal probability of a given area receiving a point, and the independence of point allocation, i.e. points are neither attracted nor repelled by other points.

As stated above, the testing framework is therefore one in which a comparison has been made between observed point patterns and the expectations generated by random independent process. Unwin considers this to be "mathematically elegant, relatively simple and forms a useful starting point" (1981:60). An observed departure from the independent random process therefore necessitates consideration of alternate hypotheses that treat spatial dependence.

The major problems in spatial analysis seem to stem from a compromise between "complex theories which are difficult to test and simple indices which are useful for comparative studies, but which have limited explanatory power" (Thomas 1977:37).

One of the major constraints on this study has been the use of manual techniques of analysis rather than those afforded by computer, which demand a digitised database. This therefore limits which techniques of spatial analysis can be used. Constraints of time did not permit the establishment of a computerised database, but it is firmly recognised that had this been possible, a number of advantages would have accrued, and a range of more complex tests undertaken, such as those noted below. However, while elementary techniques such as quadrat analysis have their virtues, there are some associated problems, particularly with regard to the statistical tests of significance and the scale of analysis.

Goodness-of-Fit Tests

Both chi-square and Student's t-tests were used to assess how significant the degree of departure was between observed and expected frequency arrays. Thomas indicates two problems with these tests when he notes that no tests provide

> sufficient measures of goodness of fit in their own right and it is common practice to apply a number of tests before deciding if a model gives a sufficiently good prediction of observed frequency distribution. Furthermore, the statistical theory for all these tests is based on the premise that the frequency data were collected by random quadrat sampling. If the data are derived by censusing then the tests are not really appropriate, although in practice they are often applied to census data as a guide to interpretation (1977:18).

The latter point is also made by Unwin (1981:40).

It will be recalled that the t-test was used as a measure of the statistical significance between the observed Variance/Mean ratio (VMR) and the ratio of unity for a random process. Strictly speaking this test is valid only when the observed VMR is derived from a random quadrat sample. However it is commonly used when samples were derived from censusing, as was the case here (cf. Thomas 1977:17). It should be noted that the t-test does not treat the distribution of the points, but acts on the relationship between the variance and the mean, which is assumed to be approximately normally distributed (cf. Mead 1974).

The chi-square test is a non-parametric test which has the disadvantage of sensitivity to low frequencies (Siegel 1956). It was therefore necessary to adopt the standard practice of combining classes with expected frequencies of less than five.

In his review of the chi-square test, Rogers notes that

> Grouping reduces power. Loss of power occurs because grouping is generally carried out on classes at the tails or extremes of a distribution. These are frequently the very places where the data deviate most closely from the hypothetical frequencies (1974:69-70).

As low frequencies inflate the chi-square values, the question arises of what the lower class limits should be. In his review of statisticians' opinion Rogers (1974: 68) notes that ten is the favoured bound by some, that five is the normal lower limit in practice, but that in quadrat analysis a lower class limit of one can be used without serious loss of power in "certain circumstances" (which are not specified).

I adopted standard practice and used a lower limit of five, but it may be recalled that I made recourse to lower class limits in the tests of spatial analyses for the Cotwold Hills sites.

It is worth noting that Mead (1974) is simply of the opinion that the difficulties associated with the chi-square test make it inappropriate in view of the alternative tests available, and on the basis of the tests conducted here I think I would tend to agree.

Discussion of Validity

Has the testing process been valid ? Repeat tests were undertaken to detect variation in patterns at different scales, and therefore prevent undue reliance being placed on one set of test results. One problem that remains is therefore one of type I and type II errors: have we erroneously rejected a null hypothesis and concomitantly embraced alternate hypotheses erroneously ? Thomas suggests a useful criterion:

> If the hypothesis of randomness in the observed pattern is to be accepted, it must be shown that the Poisson (model) . . . fits the observed frequency as a variety of different scales. If

> (this) model (does) not fit at any one scale, then the hypothesis of randomness must be rejected for all scales and an alternate model of dependence sought (1977:27).

Using this criterion we can conclude that there is no indication whatever of randomness appearing at all scales for any of the test areas. Consequently, following Thomas's suggestion an alternate model of spatial dependence is sought.

It is quite clear that despite its essential simplicity, quadrat analysis is not a straightforward means of achieving resolution to questions of spatial process. Even though Unwin was quoted above as describing the independent random process as elegant and simple, he goes on to say that "its use is often exceedingly naive and unrealistic" (1981:60). I hope this study does not qualify as an example.

In making use of these tests and techniques, it is important to note that they were never utilised as definitive indicators of spatial process, but used only as an aid to interpreting a revealed distribution.

Conclusions

A number of interesting results have been obtained from this study, and I think there can be little doubt that a number of influences manifest themselves in Mesolithic site patterning.

A subjective review of regional site patterning shows that some areas of the country were settled far more densely than others, and this has been confirmed with the application of more rigorous density measures. Elementary techniques of spatial analysis have been conducted in a number of areas using a variety of repeated testing at a number of operational scales, and a consistent pattern of non-random site clustering is exhibited.

I hope I have demonstrated that a number of environmental variables have been closely associated with much of the overall nature of site patterning, with rivers, coastline and upland areas being in strong association with site patterning generally. These are posited to comprise the major influences ordering the non-randomness of site patterns.

Further evidence of the existence of spatial dependence factors was evinced by the statistical analysis of the tool kits of a large number of the bigger sites.

I have not accepted the results at face value, but have endeavoured to assess how valid the study can be in view of the inherent limitations afforded by the database, the methodology employed and the validity of the testing procedures. Controls for the known areas of methodological weaknesses were adopted so as to minimise undue reliance being placed on one set of inquiry procedures.

All things considered then, it seems reasonable to reject the hypothesis that Mesolithic sites are distributed at random across the British landscape, and posit that (a) settlement patterns do not result from random processes, and (b) environmental correlates were an integral influence on site location and distribution.

These conclusions are clearly not radical, and do accord with the general tenor of the literature on the Mesolithic. But since this cannot be assumed a priori, it is necessary to establish the presence of non-randomness. Once this has been achieved, a search can begin for suitable models of spatial dependence.

I stated above that one of my objectives was to discuss some additional research areas for circumstances when better access to the primary data would be available. By way of conclusion then, I make suggestions for further research.

Suggestions for Further Research

In order to consider which research avenues might be usefully pursued, it is appropriate to consider general models of Mesolithic adaptation.

Models of Perspective

The Mesolithic period represents the terminal stage of a hunter-gatherer adaptation that evolved over hundreds of millennia (Bricker 1976; Clark 1962; Lee and DeVore 1968; Price and Brown 1985). It seems reasonable to expect then, that ecological studies hold the key to unresolved problems of the nature of Mesolithic adaptations.

An extensive literature has developed with respect to ecology and cultural adaptations generally (e.g. Bender 1978, 1981, 1985; Bettinger 1980; Binford 1980; Cohen 1977; Hardesty 1980; Ingold 1980, 1983; Jochim 1976, 1979; Kirch 1980; Lee and DeVore 1968; Price 1973; Renouf 1984; Testart 1982; Welinder 1978; Zvelbil 1983), and a variety of approaches are thereby represented.

Studies of specific aspects of Mesolithic culture are often useful in their own right as exemplified by research into technology (e.g. Clark and Thompson 1953; Kosłowski 1973; Odell 1980; Pitts and Jacobi 1979), and studies of the distribution of specific artefact types can prove particularly interesting with respect to spatial variables (cf. Care 1979).

However, following Gjessing's (1980) contention that archaeology should primarily concern itself with functioning societies in a social and physical environment, I think there can be little doubt that the most meaningful research is that which concerns itself with cultures, their relationships with each other, and with the environment of which they were a part. This has been advocated particularly eloquently by Flannery and Marcus when they call for "neither mindless ecology, nor a glorification of mind divorced from the land" (1976:382).

One major question is the extent to which Mesolithic adaptations were a homogenous cultural entity or whether different social groups developed separate and identifiable adaptations. The recent literature seems to suggest that a few large social groups were in evidence at the beginning of the Mesolithic period (Clark 1936, 1975) but that these gave way to smaller social groups as the period progressed. Recent studies by Gendel (1984), Newell (1978), Palmer (1980) and Price (1980) support this view.

The implications of territoriality is an interesting, if problematic, question, and recent reviews suggest that territoriality is a common feature in contemporary hunter-gatherer societies (Layton 1986), and that the defence of subsistence resources is a primary concomitant (Dyson-Hudson and Smith 1978).

Obviously, one of the major parameters in Mesolithic research is the extent to which adaptations manifest themselves in the archaeological record. On the basis of the considerations thus far it seems reasonable to consider the spatial-ecosystemic correlates of Mesolithic adaptations as having considerable explanatory potential.

Earlier in the chapter I questioned whether the major factor in upland zones was merely one of altitude, or whether other factors were involved. Williams (1985) contends that there is a degree of complexity in upland adaptations that needs exploring. Some interesting research has been conducted very recently by Attwell and Fletcher (1987) who found a correlation betweeen altitude and site size in some Scottish Neolithic sites.

There are, of course, a number of techniques of spatial analysis, and their application to the subject matter of archaeology has been discussed in some detail by Clarke (1977) and Hodder and Orton (1976). Spatial association is an area that should be investigated further, and spatial autocorrelation, which measures the degree of association between variables within a given set of areas (Hoddder and Orton 1976; Taylor 1977) could usefully be employed to examine the relationships between sites of differing size. This was somewhat precluded in this study because of the tentative nature of the site size typology.

One of the ecosystemic influences discussed in this study was that of the coastal factor. I believe that some of the most interesting research awaits in this area, and it is here that I wish to focus my attention.

It seems quite clear from the literature cited above that successful terrestrial strategies are those that maximise controls for environmental fluctatuation. Mobility is obviously a keynote feature and movement from areas of lesser subsistence potential to more bountiful regions is a hallmark of the hunting and gathering way of life. But there is a steadily growing awareness that littorally-based economies are not as subject to resource variability as those which are terrestrially focussed (Nash 1981; Rowley-Conwy 1981, 1983, 1984, Yesner 1980). As a result it is possible to distinguish considerable differences in the way of life between small groups of mobile hunters exploiting inland resources and more stable, larger groups living off littoral resources. So the "coastal factor" would seem to have tremendous potential interest.

To the best of my knowledge this "coastal factor" has yet to be defined in the literature, so I define it here as the effect generated on a social community by settlement in, and exploitation of, littoral zones. A rapidly expanding literature attests to the considerable interest in this issue, as I hope to show.

Binford (1968) cites the exploitation of coastal resources and associated settlement in coastal zones as being one of the hallmarks of the Mesolithic, and Clark (1936, 1946, 1947, 1948, 1952, 1975) devotes considerable space to this aspect of Mesolithic economy and settlement. The nature of coastal adaptations has been subject to considerable theoretical interest recently (Fitzhugh 1975, 1985; Nash 1981; Yesner 1980).

An essential component of the coastal factor centres on economy, and, as indicated above, there is an extensive literature which permits a detailed assessment of the potential value of maritime resources generally (eg. Ambrose 1967; Bailey 1978; Bowdler 1977; Bunt 1973; Deith 1983; G. Clark 1983; Schalk 1977; Straus 1970; Straus et al. 1980).

The sheer visibility of shell middens in the archaeological record has led to an intensive examination of the importance of molluscs as a resource (Bailey 1983; Deith 1984, 1985, 1986; J. Clark 1952; G. Clark 1983; Cohen 1977; Meehan 1975, 1977; Straus et al. 1980; Rowley-Conwy 1983, 1984; Zvelibil 1980), but factors affecting location have received research attention only in recent years. Bailey (1983:565) has shown that shell mounds are not continuously distributed along mollusc bearing coastlines and on the basis of Australian and Spanish research, highly localised groupings are demonstrated. Quite obviously the preservation of such mounds will reflect the incidence of localised eustatic or isostatic activity over time and the profiles of local continental shelves; steeply shelving coastlines will be less prone to land loss following marine regressions (Masters and Fleming 1983).

The study of the influence of coastal resources on Mesolithic settlement patterns is particularly problematic in view of marine transgressions. A variety of studies (Clark et al. 1978; Curray 1961; Duplessey 1981; Hassan 1985; Jelgersma 1966; Morner 1976; Ruddiman 1981) all indicate that even though eustatic activity was a global event, its local effect was determined by a number of factors. Determination of localised eustatic effects is, of course, a crucial consideration. Recent advances in underwater archaeology have done much to establish new lines of evidence for the Mesolithic and for archaeology generally (e.g. Easton 1986; Larson 1983; Masters and Fleming 1983; Price 1983), and what was once thought irretrievable may not always prove so. Excavation techniques that are sensitive to fragile data will also help to ensure that the full array of potential data can be recovered.

One point of interest is the direction of Scandinavian settlement patterns. It has been demonstrated (Blankholm

1980; Brinch Petersen 1973; Clark 1952, 1975; Jennsen 1982; Rowley-Conwy 1981, 1983, 1984) that in Denmark particularly, the Boreal Maglemosian was a predominantly inland adaptation that gave way to a predominantly maritime adaptation, the Ertebølle in the Atlantic stage. It would be interesting to establish whether a similar trend was evident in England and Wales. Most of the coastal sites in the south and west of England and Wales are dated to Atlantic times (see appendix A), although it remains unclear whether a coastal factor manifests itself in Britain to the same extent as is evident for Denmark.

I have shown that coastal occupation is differentially concentrated on the coastlines, with some of the more extensive concentrations of coastal sites being near where the five fathom submarine contour hugs the present coastline. I have already made reference to Palmer's (1978) observation that high cliff areas were particularly favoured. More detailed consideration of the varied facies of the littoral zone is very likely to reveal additional correlates of site patterning.

It has been well known for some time that marine ecosystems are some of the most productive of any in the world (Odum 1971). To what extent this was recognised by Mesolithic communities is, of course, unknown. Exploitation of littoral zones is not a subsistence strategy that was unknown before the Mesolithic. Palaeolithic communities are known to have exploited marine environments (Klein 1974; McBurney 1967; Lumley 1969) from at least 400,000 years ago. Recent developments in isotope analysis of skeletal material now permit direct assessments to be made of the extent to which marine or terrestrial resources figured in the diet (Tauber 1981).

Analysis of inland and coastal technatures has revealed that technology can be differentiated with respect to broad ecological zones, and the enigmatic "other" tooltype category was highlighted as being a major determinant of the discrimination. The available data unfortunately do not permit closer examination of the nature of the tool kits generally, but a future study may prove particularly informative when better data are available.

Suggested Working Hypotheses

In view of the foregoing the following working hypotheses are suggested.

1. The concept of a littoral economy should be expanded in terms of the different facies of the littoral zone, e.g. estuarine areas, open coastlines, etc., each of which should be examined in terms of the economic potential provided. Because estuarine areas have the

highest primary productivity (Odum 1971), all other things being equal, these zones will comprise the most extensively settled areas. The main factors affecting settlement patterns will be related to both provision of resources and of raw materials.

2. Because littoral economies may be conducive to year round settlement, they can be identified by sensitive seasonality studies.

3. Because a developed maritime way of life differs considerably from that of a terrestrial adaptation, cultural differentiation may manifest itself, with some communities preferring to maintain an inland way of life while others seek to develop a littoral existence.

4. A broad based littoral economy will comprise a central camp with a more dispersed network of more itinerant occupation manifesting itself in areas which permit the exploitation of seasonally available resources.

5. Because of the potential for increased production of both subsistence and raw material resources, trading systems will manifest themselves in those areas where extensive river systems extend into the interior permitting reciprocal contact between inland and littorally based groups.

6. The Mesolithic of Britain can be further subdivided from an existing Earlier-Later model to one related to a coastal and inland focus in the later stages of the period, with separate ecological foci being conducive to differential techno-complexes.

These then represent just a few lines of inquiry that I believe to be worth pursuing. It finally remains to draw attention to the cautionary cynicism of Cockburn (1972), when he points out that prehistory is essentially the "study of the unwarranted about the unverifiable about what never happened anyway." While is it quite true that prehistory has far more gaps than record, I am of the staunch opinion that prehistorians and archaeologists alike have a capacity for detective work that Sherlock Holmes would have envied, and the Mesolithic period represents a fascinating phenomenon to challenge those prepared to confront it.

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APPENDIX A: MESOLITHIC DATES

This list should be used in conjunction with the map which follows (Figure 35), where the earliest dated sites have been given the lowest reference numbers.

No.	Site	Date(s)	Lab No.
1	Thatcham	8415 ± 170 bc	Q659
		8090 ± 170 bc	Q658
		7890 ± 170 bc	Q651
		7830 ± 200 bc	Q677
		7220 ± 160 bc	Q650
		7530 ± 160 bc	Q652
		6140 ± 180 bc	BM65
2	Lominot III	7615 ± 350 bc	Q1187
3	Star Carr	7607 ± 210 bc	Q14
		7538 ± 350 bc	C353
4	Broxbourne	7408 ± 150 bc	[7]
5	Marsh Benham	7350 ± 150 bc	Q1129
6	Warcock Hill S	7260 ± 340 bc	Q1185
7	Greenham Dairy Farm	6829 ± 110 bc	Q973
8	West Hartlepool	6730 ± 180 bc	BM81
		6750 ± 180 bc	BM80
		6160 ± 180 bc	BM83
		6150 ± 180 bc	BM90
9	Warcock Hill III	6660 ± 110 bc	Q789

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[7] (Wymer 1977:129)

No.	Site	Date(s)	Lab No.
10	Broomhead site 5	6623 ± 110 bc	Q800
11	Broomhill	6590 bc	Q1192
		5680 bc	Q1191
		4585 bc	Q1128
12	Stump Cross	6500 ± 310 bc	Q141
13	Leman and Ower	6500 bc	[8]
14	Rishworth Drain	5600 ± 210 bc	Q1166
15	Peacock's Farm	5650 ± 150 bc	Q587
16	Cherhill	5280 ± 140 bc	BM447
17	Culver Well	5280 ± 135 bc	BM473
18	Westward Ho!	4635 ± 130 bc	Q672
19	Thorpe Common	4483 ± 115 bc	Q116
		3730 ± 150 bc	Q118
20	Blashenwell	4500 ± 150 bc	B89
21	Rickmansworth	4380 ± 80 bc	[9]
22	Oakhanger	4350 ± 110 bc	F67
		4430 ± 115 bc	F68
23	Freshwater West	4010 ± 120 bc	Q530
24	Frant High Rocks	3710 ± 150 bc	BM40
		3780 ± 150 bc	BM91
25	Wawcott	3310 ± 130 bc	BM449

[8] Wymer (1977:210)

[9] Wymer 1977:132

Figure 35: Location of Dated Sites

APPENDIX B: DISCRIMINANT FUNCTION ANALYSIS DATA

Appended below are the various data statistics and tables used in the Discriminant Analysis. I first provide a description of the artefacts that comprise the typology. A list of the sites from which the technological assemblages were taken is provided in Appendix D, together with a site map (Figure 37). The first tables list the data by site, and then by location. The remaining tables are of various data for both the direct method in which all the variables were entered simultaneously, and then for the stepwise method where the best discriminating variables were entered in sequence.

Categories of Mesolithic Artefacts.

Because my analysis of major site technological assemblages is based on the typology adopted in The Gazetteer I present the following artefact descriptions, based on those in Wymer (1977:xii), which may be used in conjunction with illustrations in Figure 36.

Axes

These are flake tools in which the cutting edge is obtained by radial flaking, or, in the case of tranchet axes (illustrated) by removal of one or more transverse flakes from the distal end. ALthough The Gazetteer distinguishes between tranchet axes of varying sizes, and other axes, I subsume all varieties into a single category. Where a site entry includes Tranchet Axe Sharpening Flakes (TASF), but no axes, I assume a minimum of one axe, irrespective of the number of TASF, and add the total numbers of TASF less one to the category of "other" artefacts.

Picks (Pk)

These are large crudely flaked tools, presumably hafted and used for digging.

Pebble Mace Heads

These are manufactured from naturally occurring pebbles, usually of quartzite, in which a centrally located hole has been laboriously drilled, or partly drilled. The function of these tools is enigmatic. Because only one example is associated with a major site I did not include this category in the analysis, but show an example for interest only.

Cores

These are nodules of stone with prepared surfaces from which blades and microblades can be struck. Cores represent an economic way of obtaining maximal numbers of blades.

Blades and Flakes (BlFl)

Blades are differentiated from flakes in approximately parallel sides and length of about twice the width. Often struck from prepared cores, they have a variety of applications as cutting implements.

Scrapers (Scr)

Often formed from larger flakes or blades, scrapers characteristically have secondary working at the distal end.

Gravers (Gr)

Also known by the French term "burin", these tools, of which there are many varieties, have a diagnostic working edge formed by the intersection of two flake removals, and were presumably used for extracting bone and antler blanks (See Clark and Thompson 1953).

Microliths (Ml)

These tools are made from blades or flakes, and are usually less than 2 cm in length. A variety of forms are known. They are known to have served as armatures in arrows and harpoons, but may have had other uses.

Microburins (Mb)

These are the waste products from microlith production, resulting from the notching of a blade and flake, and snapping it across obliquely.

"Other" (Oth)

This is a category of miscellaneous pieces, such as awls, denticulate tools (saws), and, in the typology used in the analysis here, bone and antler tools.

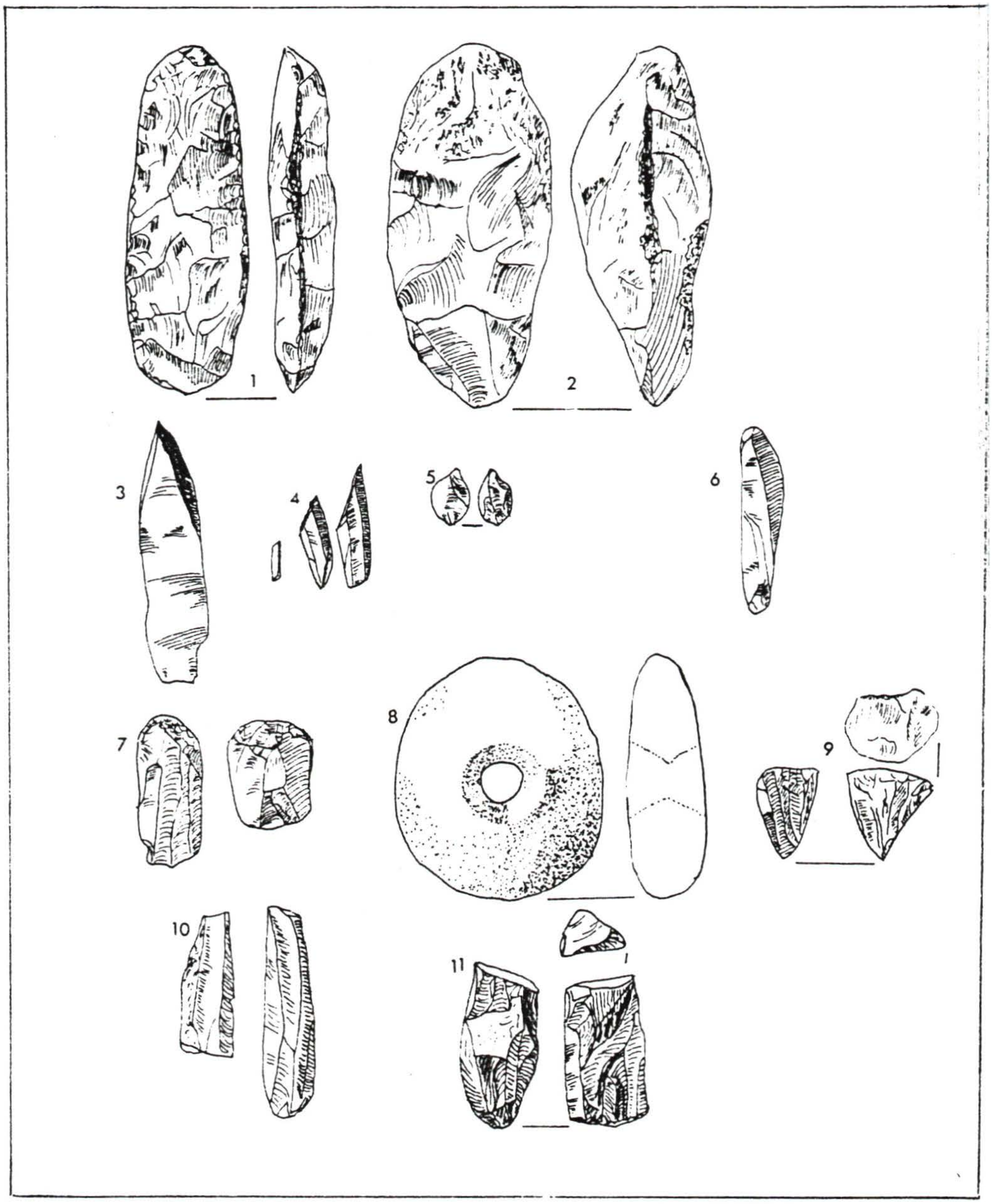

Figure 36: Mesolithic Artefacts. (Based on illustrations in Wymer 1977:ix) Key: 1 Tranchet Axe; 2 Pick; 3 Graver; 4 Microliths; 5 Micro-burins; 6, 10 Blade and Flake; 7 Scrapers; 8 Pebble Mace Head; 9, 11 Cores

Table 26: Table of Tool Types (All Sites)

For site codes see Key in Appendix C

NO	LOC	AXE	CORE	BLFL	SCR	GRA	OTH	ML	MB	PK	COUNTY
01	2		43	1742	5	31	49	55	11		Angl
02	1	1	90	1705	13	5	68	17	1		Berk
03	1	13	49	3369	5	5	45	51	46		Berk
04	1	1	85	2015	27	1	34	117	47		Berk
05	1	17	283	18365	132	61	54	285	72		Berk
06	1	1	40	2250	2	15	13	28			Berk
07	1	1	25	5129	2	1	3	3	1	1	Berk
08	1	6	1	9000	100	40	1	500	250	1	Berk
09	1	1	13	1000	1			11	10		Berk
10	1	3	79	1698	30	1	5	22	2		Buck
11	1	4	27	1857	20	1	9	3			Buck
12	2		24	1376	43	2	33	40	17		Card
13	2		40	1380	38		50	20			Corn
14	2	1	77	1647	9		3	11			Corn
15	2		116	2000	38		1	60	19		Cumb
16	2		76	1400	21		1	32	9		Cumb
17	2		600	5200	145		96	42			Cumb
18	2		90	896	9		25	8	2		Cumb
19	2		110	953	7		20	6	1		Cumb
20	2		720	6300	154		131	66		1	Cumb
21	1		106	1235	25	3	3	5			Derb
22	2		2134	1301	36		29	33	31		Devo
23	1	18	966	2000	378	2	28	129	13	12	Dors
24	2	1	500	10000	300	100	5019	400	400	200	Dors
25	2	24	700	20000	500	90	6036	161	125	700	Dors
26	2	3	200	10000	200	50	2005	200	200	1	Dors
27	2	1	0	1100	49	1	55	17	0	0	Dors
28	2	1	100	1500	150		304			2	Dors
29	2		30	1000	20		50				Dors
30	2	3	89	5050	1012		1000			52	Dors
31	1	24	50	3000	120	10	34	47	12	13	Dors
32	2		28	1677	15	1	32	73	1		Durh
33	2		230	8004				100			Durh
34	2	1	67	4000	15	8	10	58	16		Essx
35	2	5	198	1981	62	16	13	122			Essx
36	2	1	317	9087	147	7	276	97	10		Flin
37	2		47	3057	39	1	26	54	5		Flin
38	2	3	400	8000	1000	61	3500	44	7		Hamp
39	1	85	1589	2738	506	168	430	1653	63	14	Hamp
40	1	3	1500	200000	5000	600	16	3500	300		Hamp
41	1	5	100	2000	6		4	61	3	1	Hamp
42	1	2	50	2000	2	2	2	50			Hert
43	1	1	50	2000	6	1	50	35		1	Hert

44	1	1	1	1000	3	2	8	7	3		Hert
45	1	3	50	1000	1	1		20	1		Hert
46	1	1	30	1000	6			25	25		Hert
47	2	1	150	3000	60	2	302	6			IOWi
48	1	12	201	2006	54		55	15	7		Kent
49	2	1	13	2263	15	5	20	18	11		Kent
50	1	2	62	861	71	1	30	10			Kent
51	1		1	4610	1	1	1	150	1		Lanc
52	1		1	1000	1		1	35	9	1	Lanc
53	2		263	1739	277	2	139	161	15		Linc
54	2	13	1238	1976	216	12	165	370	3	2	Norf
55	1		19	1150	48		57	1			Norl
56	2		243	581	401	40	20	321			Norl
57	1	3	333	3253	144	17		54			Nott
58	2		250	2000	28	26	103	40	1		Pemb
59	2	1	37	1422	87	14	9	71	7		Pemb
60	1	1	50	3000	75	1	4	8		1	Suff
61	1		36	2779	43	19	65	18	13		Suff
62	1	2	132	1640	83		4	60	4		Suff
63	2	5	165	986	39					6	Suff
64	1	18	1144	37706	327	26	87	1926	450		Surr
65	1	5	131	3000	147	11	50	10	8	1	Surr
66	1	2	205	1001	51	11	9	1	1	6	Surr
67	1		100	1500	1		2	34	3		Surr
68	1		5	1461	3		3	49	43		Surr
69	1		28	1592	1		14	54			Surr
70	1		5	1000	4		2	22	4		Surr
71	1		31	1000	24	4	203	33	2		Surr
72	1		31	1600	106		320	245	126		Surr
73	1	2	110	2000	120	4	29	920	325		Surr
74	1		50	1000	12		100	300	200		Surr
75	2	1	131	3905	37	4	39	163	115		Suss
76	1	9		3000	2000	420	1310	205		5	Suss
77	2	2	41	2376	52	9	340	121	15	1	Suss
78	1	1	55	6000	10	7	35	108	26	1	Suss
79	2	11		6000	150	16	323	270	46		Suss
80	1	2	60	1600	21	8	23	26	9		Wilt
81	1	10	416	36529	382	3	422	125	74		Wilt
82	2	1	57	2147	37	7	19	33	1		YkER
83	2	2	131	907	165	19	237	78	32		YkER
84	1	1	4	4165	1	2	4	43	2		YkNR
85	1	7	179	13550	744	718	366	464	55		YkNR
86	1			1941	38	2	1	53	24		YkWR
87	1	1	17	13600	37	8	30	68	102		YkWR
88	1		3	1288	108	5	2	5			YkWR
89	1	1	8	1375	31	1	31	31	11		YkWR

Table 27: Tool Type Data (Inland Sites)

NO	LOC	AXE	CORE	BLFL	SCR	GRA	OTH	ML	MB	PK	CNTY
2	1	1	90	1705	13	5	68	17	1	0	Berk
3	1	13	49	3369	5	5	45	51	46	0	Berk
4	1	1	85	2015	27	1	34	117	47	0	Berk
5	1	17	283	18365	132	61	54	285	72	0	Berk
6	1	1	40	2250	2	15	13	28	0	0	Berk
7	1	1	25	5129	2	1	3	3	1	1	Berk
8	1	6	1	9000	100	40	1	500	250	1	Berk
9	1	1	13	1000	1	0	0	11	10	0	Berk
10	1	3	79	1698	30	1	5	22	2	0	Buck
11	1	4	27	1857	20	1	9	3	0	0	Buck
21	1	0	106	1235	25	3	3	5	0	0	Derb
23	1	18	966	2000	378	2	28	129	13	12	Dors
31	1	24	50	3000	120	10	34	47	12	13	Dors
39	1	85	1589	2738	506	168	430	1653	63	14	Hamp
40	1	3	1500	200000	5000	600	16	3500	300	0	Hamp
41	1	5	100	2000	6	0	4	61	3	1	Hamp
42	1	2	50	2000	2	2	2	50	0	0	Hert
43	1	1	50	2000	6	1	50	35	0	1	Hert
44	1	1	1	1000	3	2	8	7	3	0	Hert
45	1	3	50	1000	1	1	0	20	1	0	Hert
46	1	1	30	1000	6	0	0	25	25	0	Hert
48	1	12	201	2006	54	0	55	15	7	0	Kent
50	1	2	62	861	71	1	30	10	0	0	Kent
51	1	0	1	4610	1	1	1	150	1	0	Lanc
52	1	0	1	1000	1	0	1	35	9	1	Lanc
55	1	0	19	1150	48	0	57	1	0	0	Norl
57	1	3	333	3253	144	17	0	54	0	0	Nott
60	1	1	50	3000	75	1	4	8	0	1	Suff
61	1	0	36	2779	43	19	65	18	13	0	Suff
62	1	2	132	1640	83	0	4	60	4	0	Suff
64	1	18	1144	37706	327	26	87	1926	450	0	Surr
65	1	5	131	3000	147	11	50	10	8	1	Surr
66	1	2	205	1001	51	11	9	1	1	6	Surr
67	1	0	100	1500	1	0	2	34	3	0	Surr
68	1	0	5	1461	3	0	3	49	43	0	Surr
69	1	0	28	1592	1	0	14	54	0	0	Surr
70	1	0	5	1000	4	0	2	22	4	0	Surr
71	1	0	31	1000	24	4	203	33	2	0	Surr
72	1	0	31	1600	106	0	320	245	126	0	Surr
73	1	2	110	2000	120	4	29	920	325	0	Surr
74	1	0	50	1000	12	0	100	300	200	0	Surr
76	1	9	0	3000	2000	420	1310	205	0	5	Suss
78	1	1	55	6000	10	7	35	108	26	1	Suss
80	1	2	60	1600	21	8	23	26	9	0	Wilt
81	1	10	416	36529	382	3	422	125	74	0	Wilt

84	1	1	4	4165	1	2	4	43	2	0	YkNR
85	1	7	179	13550	744	718	366	464	55	0	YkNR
86	1	0	0	1941	38	2	1	53	24	0	YkWR
87	1	1	17	13600	37	8	30	68	102	0	YkWR
88	1	0	3	1288	108	5	2	5	0	0	YkWR
89	1	1	8	1375	31	1	31	31	11	0	YkWR

Table 28: Tool Type Data (Coastal Sites)

NO	LOC	AXE	CORE	BLFL	SCR	GRA	OTH	ML	MB	PK	CNTY
1	2	0	43	1742	5	31	49	55	11	0	Angl
12	2	0	24	1376	43	2	33	40	17	0	Card
13	2	0	40	1380	38	0	50	20	0	0	Corn
14	2	1	77	1647	9	0	3	11	0	0	Corn
15	2	0	116	2000	38	0	1	60	19	0	Cumb
16	2	0	76	1400	21	0	1	32	9	0	Cumb
17	2	0	600	5200	145	0	96	42	0	0	Cumb
18	2	0	90	896	9	0	25	8	2	0	Cumb
19	2	0	110	953	7	0	20	6	1	0	Cumb
20	2	0	720	6300	154	0	131	66	0	1	Cumb
22	2	0	2134	1301	36	0	29	33	31	0	Devo
24	2	1	500	10000	300	100	5019	400	400	200	Dors
25	2	24	700	20000	500	90	6036	161	125	700	Dors
26	2	3	200	10000	200	50	2005	200	200	1	Dors
27	2	1	0	1100	49	1	55	17	0	0	Dors
28	2	1	100	1500	150	0	304	0	0	2	Dors
29	2	0	30	1000	20	0	50	0	0	0	Dors
30	2	3	89	5050	1012	0	1000	0	0	52	Dors
32	2	0	28	1677	15	1	32	73	1	0	Durh
33	2	0	230	8004	0	0	0	100	0	0	Durh
34	2	1	67	4000	15	8	10	58	16	0	Essx
35	2	5	198	1981	62	16	13	122	0	0	Essx
36	2	1	317	9087	147	7	276	97	10	0	Flin
37	2	0	47	3057	39	1	26	54	5	0	Flin
38	2	3	400	8000	1000	61	3500	44	7	0	Hamp
47	2	1	150	3000	60	2	302	6	0	0	IOWi
49	2	1	13	2263	15	5	20	18	11	0	Kent
53	2	0	263	1739	277	2	139	161	15	0	Linc
54	2	13	1238	1976	216	12	165	370	3	2	Norf
56	2	0	243	581	401	40	20	321	0	0	Norl
58	2	0	250	2000	28	26	103	40	1	0	Pemb
59	2	1	37	1422	87	14	9	71	7	0	Pemb
63	2	5	165	986	39	0	0	0	0	6	Suff
75	2	1	131	3905	37	4	39	163	115	0	Suss
77	2	2	41	2376	52	9	340	121	15	1	Suss
79	2	11	0	6000	150	16	323	270	46	0	Suss
82	2	1	57	2147	37	7	19	33	1	0	YkER
83	2	2	131	907	165	19	237	78	32	0	YkER

Table 29: Means and standard Deviations: (Direct Method)

LOC:		
1	N=51	INTERIOR
2	N=38	COASTAL
TOTAL	N=89	

GROUP MEANS:

LOC	AXE	CORE	BLFL	SCR
1	5.29412	168.64706	8246.43137	217.11765
2	2.15789	254.07895	3630.34211	146.78947
TOTAL	3.95506	205.12360	6275.51685	187.08989

LOC	GRA	OTH	ML	MB
1	42.90196	79.74510	228.27451	46.03922
2	13.78947	538.94737	88.18421	28.94737
TOTAL	30.47191	275.80899	168.46067	38.74157

LOC	PK
1	1.13725
2	25.39474
TOTAL	11.49438

GROUP STANDARD DEVIATIONS

LOC	AXE	CORE	BLFL	SCR
1	12.67011	351.59510	28399.23964	747.76872
2	4.60626	402.74003	3849.22730	234.95717
TOTAL	10.12749	374.48855	21673.72906	584.92604

LOC	GRA	OTH	ML	MB
1	140.98401	204.17609	595.68448	94.39957
2	24.29788	1360.58006	102.63656	74.07591
TOTAL	108.40393	924.22981	459.23744	86.27079

LOC	PK
1	3.20012
2	117.20219
TOTAL	76.98659

Table 30: DFA Coeffiecients and Functions Calculated (Direct Method)

CANONICAL CORR	AFTER FCN	WILKS' LAMBDA	CHISQUARE	DF	SIG
0.5070	0	0.7430	24.507	9	0.0036

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1
AXE	1.14615
CORE	-0.65920
BLFL	0.79576
SCR	0.38393
GRA	0.35269
OTH	-1.39678
ML	-1.62450
MB	1.20289
PK	0.29734

STRUCTURE MATRIX:
POOLED WITHIN-GROUPS CORRELATIONS BETWEEN DISCRIMINATING VARIABLES AND CANONICAL DISCRIMINANT FUNCTIONS

OTH	-0.43369
PK	-0.26984
AXE	0.26509
ML	0.26103
GRA	0.22920
CORE	-0.19421
BLFL	0.18116
MB	0.16839
SCR	0.10188

CANONICAL DISCRIMINANT FUNCTIONS EVALUATED AT GROUP MEANS (GROUP CENTROIDS)

GROUP	FUNC 1
1	0.50193
2	-0.67364

Table 31: Predicted Group Membership Probabilities

CASE SEQNUM	ACTUAL GROUP		HIGHEST PROBABILITY GROUP	P(D/G)	P(G/D)	2ND HIGHEST GROUP	P(G/D)	DISCRIM SCORES
1	1	**	2	0.6413	0.5358	1	0.4642	-0.2078
2	1		1	0.1846	0.9047	2	0.0953	1.8286
3	1		1	0.7221	0.5678	2	0.4322	0.1463
4	1		1	0.0888	0.9365	2	0.0635	2.2039
5	1		1	0.5865	0.5129	2	0.4871	-0.0420
6	1		1	0.7375	0.5737	2	0.4263	0.1667
7	1		1	0.0207	0.9680	2	0.0320	2.8154
8	1		1	0.7100	0.5631	2	0.4369	0.1300
9	1		1	0.7107	0.5634	2	0.4366	0.1310
10	1		1	0.8945	0.6307	2	0.3693	0.3694
11	1	**	2	0.6618	0.5441	1	0.4559	-0.2362
12	1		1	0.8416	0.6121	2	0.3879	0.3021
13	1		1	0.0236	0.9662	2	0.0338	2.7657
14	1		1	0.1003	0.9323	2	0.0677	2.1455
15	1		1	0.1710	0.9089	2	0.0911	1.8710
16	1		1	0.7585	0.5817	2	0.4183	0.1945
17	1		1	0.5751	0.5080	2	0.4920	-0.0586
18	1	**	2	0.6288	0.5307	1	0.4693	-0.1903
19	1		1	0.6609	0.5437	2	0.4563	0.0633
20	1		1	0.7163	0.5655	2	0.4345	0.1385
21	1		1	0.8108	0.6010	2	0.3990	0.2625
22	1		1	0.6313	0.7782	2	0.2218	0.9818
23	1		1	0.6293	0.5308	2	0.4692	0.0192
24	1	**	2	0.8219	0.6050	1	0.3950	-0.4485
25	1		1	0.5744	0.5077	2	0.4923	-0.0597
26	1	**	2	0.6008	0.5189	1	0.4811	-0.1503
27	1	**	2	0.6839	0.5529	1	0.4471	-0.2666
28	1		1	0.6578	0.5425	2	0.4575	0.0590
29	1		1	0.6488	0.5388	2	0.4612	0.0465
30	1	**	2	0.6025	0.5197	1	0.4803	-0.1528
31	1		1	0.6907	0.7611	2	0.2389	0.8998
32	1		1	0.9861	0.6616	2	0.3384	0.4845
33	1	**	2	0.5704	0.5060	1	0.4940	-0.1061
34	1	**	2	0.7096	0.5630	1	0.4370	-0.3012
35	1		1	0.8937	0.6304	2	0.3696	0.3683
36	1	**	2	0.7106	0.5634	1	0.4366	-0.3026
37	1	**	2	0.5619	0.5023	1	0.4977	-0.0936
38	1	**	2	0.8559	0.6172	1	0.3828	-0.4920
39	1		1	0.8889	0.6287	2	0.3713	0.3622
40	1		1	0.4194	0.8376	2	0.1624	1.3094
41	1		1	0.3577	0.8547	2	0.1453	1.4217
42	1		1	0.6371	0.7765	2	0.2235	0.9736
43	1		1	0.6846	0.5532	2	0.4468	0.0957
44	1		1	0.7020	0.5600	2	0.4400	0.1194

45	1		1	0.1809	0.9058	2	0.0942	1.8399
46	1		1	0.6420	0.5361	2	0.4639	0.0371
47	1		1	0.0790	0.9402	2	0.0598	2.2585
48	1		1	0.7236	0.5684	2	0.4316	0.1483
49	1		1	0.2438	0.8871	2	0.1129	1.6676
50	1		1	0.6224	0.5280	2	0.4720	0.0095
51	1		1	0.6659	0.5457	2	0.4543	0.0702
52	2		2	0.5828	0.5113	1	0.4887	-0.1243
53	2	**	1	0.6071	0.5216	2	0.4784	-0.0123
54	2		2	0.6661	0.5458	1	0.4542	-0.2422
55	2		2	0.5647	0.5035	1	0.4965	-0.0977
56	2		2	0.6040	0.5203	1	0.4797	-0.1549
57	2		2	0.6056	0.5210	1	0.4790	-0.1573
58	2		2	0.6210	0.7811	1	0.2189	-1.1681
59	2		2	0.6774	0.5503	1	0.4497	-0.2576
60	2		2	0.7021	0.5600	1	0.4400	-0.2912
61	2		2	0.4264	0.8356	1	0.1644	-1.4690
62	2		2	0.0045	0.9826	1	0.0174	-3.5170
63	2		2	0.0309	0.9619	1	0.0381	-2.8322
64	2		2	0.0413	0.9564	1	0.0436	-2.7137
65	2		2	0.8456	0.6135	1	0.3865	-0.4789
66	2	**	1	0.5778	0.5092	2	0.4908	-0.0547
67	2		2	0.8396	0.6114	1	0.3886	-0.4713
68	2		2	0.6209	0.5274	1	0.4726	-0.1791
69	2		2	0.7960	0.5956	1	0.4044	-0.4152
70	2		2	0.7604	0.5824	1	0.4176	-0.3686
71	2		2	0.9140	0.6374	1	0.3626	-0.5657
72	2	**	1	0.6739	0.5489	2	0.4511	0.0811
73	2		2	0.6122	0.5237	1	0.4763	-0.1667
74	2		2	0.9596	0.6793	1	0.3207	-0.7244
75	2		2	0.6380	0.5344	1	0.4656	-0.2031
76	2		2	0.0000	0.9961	1	0.0039	-4.8017
77	2		2	0.9275	0.6420	1	0.3580	-0.5827
78	2	**	1	0.7323	0.5717	2	0.4283	0.1599
79	2		2	0.8288	0.7201	1	0.2799	-0.8898
80	2		2	0.1629	0.9114	1	0.0886	-2.0689
81	2		2	0.5405	0.8039	1	0.1961	-1.2858
82	2		2	0.9815	0.6601	1	0.3399	-0.6504
83	2	**	1	0.5714	0.5064	2	0.4936	-0.0641
84	2	**	1	0.8129	0.6018	2	0.3982	0.2653
85	2	**	1	0.6709	0.7668	2	0.2332	0.9268
86	2		2	0.8916	0.6297	1	0.3703	-0.5373
87	2	**	1	0.8399	0.7168	2	0.2832	0.7040
88	2		2	0.5609	0.5018	1	0.4982	-0.0921
89	2		2	0.5646	0.5034	1	0.4966	-0.0976

Table 32: Group Means and Standard Deviations (Stepwise Method)

GROUP MEANS

LOC	AXE	CORE	BLFL	SCR
1	5.29412	168.64706	8246.43137	217.11765
2	2.15789	254.07895	3630.34211	146.78947
TOTAL	3.95506	205.12360	6275.51685	187.08989

LOC	GRA	ML	MB	PK
1	42.90196	228.27451	46.03922	1.13725
2	13.78947	88.18421	28.94737	25.39474
TOTAL	30.47191	168.46067	38.74157	11.49438

GROUP STANDARD DEVIATIONS

LOC	AXE	CORE	BLFL	SCR
1	12.67011	351.59510	28399.23964	747.76872
2	4.60626	402.74003	3849.22730	234.95717
TOTAL	10.12749	374.48855	21673.72906	584.92604

LOC	GRA	ML	MB	PK
1	140.98401	595.68448	94.39957	3.20012
2	24.29788	102.63656	74.07591	117.20219
TOTAL	108.40393	459.23744	86.27079	76.98659

Table 33: Discriminant Analysis Data: Stepwise Method

STEPWISE VARIABLE SELECTION

SELECTION RULE: MINIMIZE WILKS' LAMBDA	
MAXIMUM NUMBER OF STEPS..................	16
MINIMUM TOLERANCE LEVEL..................	0.00100
MINIMUM F TO ENTER.......................	1.0000
MAXIMUM F TO REMOVE......................	1.0000
CANONICAL DISCRIMINANT FUNCTIONS	
MAXIMUM NUMBER OF FUNCTIONS..............	1
MINIMUM CUMULATIVE PERCENT OF VARIANCE...	100.00
MAXIMUM SIGNIFICANCE OF WILKS' LAMBDA....	1.0000

PRIOR PROBABILITY FOR EACH GROUP IS 0.50000

----- VARIABLES NOT IN THE ANALYSIS AFTER STEP 0 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA
AXE	1.0000000	1.0000000	2.1147	0.97627
CORE	1.0000000	1.0000000	1.1350	0.98712
BLFL	1.0000000	1.0000000	0.98761	0.98878
SCR	1.0000000	1.0000000	0.31233	0.99642
GRA	1.0000000	1.0000000	1.5808	0.98215
ML	1.0000000	1.0000000	2.0505	0.97697
MB	1.0000000	1.0000000	0.85328	0.99029
PK	1.0000000	1.0000000	2.1911	0.97543

AT STEP 1, PK WAS INCLUDED IN THE ANALYSIS.

		DEGREES OF FREEDOM			SIGNIF.
WILKS' LAMBDA	0.97543	1	1	87.0	
EQUIVALENT F	2.19111		1	87.0	0.1424

------ VARIABLES IN THE ANALYSIS AFTER STEP 1 ------

VARIABLE	TOLERANCE	F TO REMOVE	WILKS' LAMBDA
PK	1.0000000	2.1911	

-----VARIABLES NOT IN THE ANALYSIS AFTER STEP 1 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA
AXE	0.9383499	0.9383499	3.4102	0.93823

CORE	0.9766503	0.9766503	0.69524	0.96761
BLFL	0.9925269	0.9925269	1.2224	0.96176
SCR	0.9927092	0.9927092	0.45610	0.97029
GRA	0.9899618	0.9899618	1.9244	0.95408
ML	0.9983711	0.9983711	2.1490	0.95165
MB	0.9417724	0.9417724	1.6799	0.95675

AT STEP 2, AXE WAS INCLUDED IN THE ANALYSIS.

		DEGREES OF FREEDOM			SIGNIF.
WILKS' LAMBDA	0.93823	2	1	87.0	
EQUIVALENT F	2.83099		2	86.0	0.0645

------ VARIABLES IN THE ANALYSIS AFTER STEP 2 -----

VARIABLE	TOLERANCE	F TO REMOVE	WILKS' LAMBDA
AXE	0.9383499	3.4102	0.97543
PK	0.9383499	3.4869	0.97627

------ VARIABLES NOT IN THE ANALYSIS AFTER STEP 2 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA
CORE	0.7345918	0.7057840	3.8848	0.89722
BLFL	0.9919947	0.9326283	1.0746	0.92652
SCR	0.9827013	0.9288900	0.23052	0.93569
GRA	0.9622498	0.9120826	1.1371	0.92584
ML	0.8506215	0.7994829	0.63698	0.93125
MB	0.9353597	0.8946048	1.2521	0.92461

AT STEP 3, CORE WAS INCLUDED IN THE ANALYSIS.

		DEGREES OF FREEDOM			SIGNIF.
WILKS' LAMBDA	0.89722	3	1	87.0	
EQUIVALENT F	3.24556		3	85.0	0.0259

------ VARIABLES IN THE ANALYSIS AFTER STEP 3 ------

VARIABLE	TOLERANCE	F TO REMOVE	WILKS' LAMBDA
AXE	0.7057840	6.6683	0.96761
CORE	0.7345918	3.8848	0.93823
PK	0.9374964	3.0678	0.92961

----- VARIABLES NOT IN THE ANALYSIS AFTER STEP 3 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA

BLFL	0.7439422	0.5509040	5.1532	0.84536
SCR	0.8036509	0.6007475	2.0179	0.87618
GRA	0.9072655	0.6926162	2.3694	0.87261
ML	0.6172690	0.5330699	4.3634	0.85292
MB	0.8389160	0.6588490	3.2338	0.86396

AT STEP 4, BLFL WAS INCLUDED IN THE ANALYSIS.

		DEGREES OF FREEDOM			SIGNIF
WILKS' LAMBDA	0.84536	4	1	87.0	
EQUIVALENT F	3.84140		4	84.0	0.0065

------ VARIABLES IN THE ANALYSIS AFTER STEP 4 -----

VARIABLE	TOLERANCE	F TO REMOVE	WILKS' LAMBDA
AXE	0.6597096	9.2229	0.93818
CORE	0.5509040	8.0639	0.92652
BLFL	0.7439422	5.1532	0.89722
PK	0.9325283	3.4343	0.87993

----- VARIABLES NOT IN THE ANALYSIS AFTER STEP 4 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA
SCR	0.2181350	0.2019283	0.91713	0.83612
GRA	0.6303042	0.5168387	0.10889	0.84426
ML	0.1695590	0.1695590	0.82047E-01	0.84453
MB	0.7368619	0.5421321	1.0738	0.83457

AT STEP 5, MB WAS INCLUDED IN THE ANALYSIS.

		DEGREES OF FREEDOM			SIGNIF.
WILKS' LAMBDA	0.83457	5	1	87.0	
EQUIVALENT F	3.29057		5	83.0	0.0092

------ VARIABLES IN THE ANALYSIS AFTER STEP 5 ------

VARIABLE	TOLERANCE	F TO REMOVE	WILKS' LAMBDA
AXE	0.6597092	8.9900	0.92496
CORE	0.5421321	8.5729	0.92077
BLFL	0.6534417	2.9236	0.86396
MB	0.7368619	1.0738	0.84536
PK	0.8929994	4.0607	0.87540

------ VARIABLES NOT IN THE ANALYSIS AFTER STEP 5 -----

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	WILKS' LAMBDA

SCR	0.2098554	0.1779339	0.57911	0.82871
GRA	0.6296485	0.4665853	0.12894	0.83326
ML	0.0834051	0.0834051	0.40546	0.83046

F LEVEL OR TOLERANCE OR VIN INSUFFICIENT FOR FURTHER COMPUTATION.

SUMMARY TABLE

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.	LABEL
1	PK		1	.97543	.1424	
2	AXE		2	.93823	.0645	
3	CORE		3	.89722	.0259	
4	BLFL		4	.84536	.0065	
5	MB		5	.83457	.0092	

CANONICAL DISCRIMINANT FUNCTIONS

CANONICAL CORR	AFTER FCN	WILKS' LAMBDA	CHISQUARE	DF	SIG
0.4067	0	0.8346	15.281	5	0.0092

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1
AXE	0.94629
CORE	-1.02168
BLFL	0.56103
MB	0.32368
PK	-0.56189

STRUCTURE MATRIX:
POOLED WITHIN-GROUPS CORRELATIONS BETWEEN DISCRIMINATING VARIABLES AND CANONICAL DISCRIMINANT FUNCTIONS

ML	0.39475
PK	-0.35644
AXE	0.35017
CORE	-0.25654
BLFL	0.23930
SCR	0.22923
GRA	0.22540
MB	0.22244

CANONICAL DISCRIMINANT FUNCTIONS EVALUATED AT GROUP MEANS (GROUP CENTROIDS)

GROUP	FUNC 1
1	0.37997

2	-0.50996

Table 34: Predicted Group Membership Probabilities (Stepwise Method)

CASE SEQNUM	ACTUAL GROUP		HIGHEST PROBABILITY GROUP	P(D/G)	P(G/D)	2ND HIGHEST GROUP	P(G/D)	DISCRIM SCORES
1	1	**	2	0.7106	0.5164	1	0.4836	-0.1389
2	1		1	0.3507	0.7732	2	0.2268	1.3132
3	1		1	0.7454	0.5267	2	0.4733	0.0553
4	1		1	0.2477	0.8061	2	0.1939	1.5360
5	1		1	0.7099	0.5162	2	0.4838	0.0080
6	1		1	0.7948	0.5410	2	0.4590	0.1199
7	1		1	0.1905	0.8265	2	0.1735	1.6892
8	1		1	0.7694	0.5337	2	0.4663	0.0869
9	1		1	0.7663	0.5328	2	0.4672	0.0828
10	1		1	0.9485	0.5838	2	0.4162	0.3154
11	1	**	2	0.8278	0.5504	1	0.4496	-0.2925
12	1	**	2	0.6471	0.6907	1	0.3093	-0.9677
13	1		1	0.0832	0.8741	2	0.1259	2.1122
14	1		1	0.0006	0.9695	2	0.0305	3.8230
15	1		1	0.0382	0.9039	2	0.0961	2.4530
16	1		1	0.8711	0.5626	2	0.4374	0.2177
17	1		1	0.7553	0.5296	2	0.4704	0.0683
18	1		1	0.6795	0.5071	2	0.4929	-0.0331
19	1		1	0.7744	0.5352	2	0.4648	0.0934
20	1		1	0.8105	0.5455	2	0.4545	0.1402
21	1		1	0.7769	0.5359	2	0.4641	0.0967
22	1		1	0.8083	0.6484	2	0.3516	0.6227
23	1		1	0.7084	0.5158	2	0.4842	0.0060
24	1		1	0.7682	0.5334	2	0.4666	0.0853
25	1		1	0.7148	0.5177	2	0.4823	0.0145
26	1		1	0.6620	0.5017	2	0.4983	-0.0572
27	1	**	2	0.9458	0.6122	1	0.3878	-0.5780
28	1		1	0.6986	0.5128	2	0.4872	-0.0072
29	1		1	0.6946	0.5116	2	0.4884	-0.0127
30	1	**	2	0.7188	0.5189	1	0.4811	-0.1499
31	1		1	0.4140	0.7546	2	0.2454	1.1969
32	1		1	0.8397	0.5538	2	0.4462	0.1777
33	1	**	2	0.9292	0.5786	1	0.4214	-0.4211
34	1	**	2	0.8011	0.5428	1	0.4572	-0.2580
35	1		1	0.8184	0.5478	2	0.4522	0.1503
36	1	**	2	0.6602	0.5012	1	0.4988	-0.0703
37	1		1	0.6982	0.5127	2	0.4873	-0.0078
38	1	**	2	0.6718	0.5047	1	0.4953	-0.0863
39	1		1	0.9887	0.6007	2	0.3993	0.3941
40	1		1	0.4576	0.7421	2	0.2579	1.1228
41	1		1	0.8227	0.6446	2	0.3554	0.6041
42	1		1	0.6368	0.6934	2	0.3066	0.8521
43	1		1	0.8214	0.5486	2	0.4514	0.1542

44	1		1	0.7523	0.5287	2	0.4713	0.0643
45	1		1	0.5403	0.7193	2	0.2807	0.9923
46	1		1	0.8285	0.5506	2	0.4494	0.1634
47	1		1	0.7555	0.6622	2	0.3378	0.6913
48	1		1	0.7835	0.5378	2	0.4622	0.1052
49	1		1	0.7136	0.6732	2	0.3268	0.7470
50	1		1	0.6966	0.5123	2	0.4877	-0.0099
51	1		1	0.7902	0.5397	2	0.4603	0.1140
52	2		2	0.6572	0.5003	1	0.4997	-0.0661
53	2	**	1	0.7031	0.5142	2	0.4858	-0.0012
54	2		2	0.6881	0.5097	1	0.4903	-0.1085
55	2		2	0.6882	0.5097	1	0.4903	-0.1086
56	2		2	0.7786	0.5364	1	0.4636	-0.2288
57	2		2	0.7358	0.5239	1	0.4761	-0.1726
58	2		2	0.3036	0.7878	1	0.2122	-1.5386
59	2		2	0.7950	0.5411	1	0.4589	-0.2501
60	2		2	0.8391	0.5536	1	0.4464	-0.3070
61	2		2	0.1818	0.8298	1	0.1702	-1.8451
62	2		2	0.0000	0.9935	1	0.0065	-5.7116
63	2		2	0.6119	0.7000	1	0.3000	-1.0173
64	2		2	0.0008	0.9666	1	0.0334	-3.8467
65	2	**	1	0.7473	0.6644	2	0.3356	0.7022
66	2	**	1	0.7699	0.5339	2	0.4661	0.0875
67	2		2	0.7489	0.5278	1	0.4722	-0.1899
68	2		2	0.6753	0.5058	1	0.4942	-0.0911
69	2		2	0.7928	0.5405	1	0.4595	-0.2473
70	2	**	1	0.6568	0.5001	2	0.4999	-0.0643
71	2		2	0.9568	0.5861	1	0.4139	-0.4558
72	2	**	1	0.7336	0.5232	2	0.4768	0.0396
73	2	**	1	0.6641	0.5024	2	0.4976	-0.0542
74	2		2	0.9810	0.6028	1	0.3972	-0.5338
75	2		2	0.6567	0.5001	1	0.4999	-0.0655
76	2		2	0.9189	0.6193	1	0.3807	-0.6118
77	2		2	0.8126	0.5461	1	0.4539	-0.2729
78	2	**	1	0.7974	0.5418	2	0.4582	0.1233
79	2		2	0.8872	0.6277	1	0.3723	-0.6519
80	2		2	0.1020	0.8643	1	0.1357	-2.1451
81	2		2	0.8623	0.6342	1	0.3658	-0.6835
82	2		2	0.8791	0.6298	1	0.3702	-0.6621
83	2	**	1	0.7196	0.5191	2	0.4809	0.0210
84	2	**	1	0.6789	0.5069	2	0.4931	-0.0340
85	2	**	1	0.8836	0.5660	2	0.4340	0.2335
86	2	**	1	0.8192	0.5480	2	0.4520	0.1515
87	2	**	1	0.3436	0.7754	2	0.2246	1.3270
88	2	**	1	0.6765	0.5062	2	0.4938	-0.0373
89	2	**	1	0.6591	0.5008	2	0.4992	-0.0612

APPENDIX C: KEY TO COUNTY CODES

Key to County Codes (England)

Code	County	Code	County
Beds	Bedforshire	Berk	Berkshire
Buck	Buckinghamshire	Camb	Cambridgeshire
Ches	Cheshire	Corn	Cornwall
Cumb	Cumberland	Derb	Derbyshire
Devo	Devon	Dors	Dorset
Durh	Durham	Esse	Essex
Glou	Gloucestershire	Hamp	Hampshire
Here	Hereford	Hert	Hertfordshire
Hunt	Huntingdonshire	IoMa	Isle of Man
IoWi	Isle of Wight	Kent	Kent
Lanc	Lancashire	Leic	Leicestershire
Linc	Lincolnshire	Lond	London
Norf	Norfolk	Norp	Northamptonshire
Norl	Northumberland	Nott	Nottinghamshire
Oxfo	Oxfordshire	Rutl	Rutland
Shro	Shropshire	Some	Somerset
Staf	Staffordshire	Suff	Suffolk
Surr	Surrey	Suss	Sussex
Warw	Warwickshire	West	Westmoreland
Wilt	Wiltshire	Worc	Worcestershire
YoER	Yorkshire, East Riding		
YoNR	Yorkshire, North Riding		
YoWR	Yorkshire, West Riding		

Key to County Codes (Wales)

Code	County	Code	County
Angl	Anglesey	Brec	Breconshire
Caer	Caernarvonshire	Card	Cardinganshire
Carm	Carmarthen	Denb	Denbighshire
Flin	Flintshire	Glam	Glamorgan
Meri	Merioneth	Monm	Monmouth

Mont	Montgomeryshire	Pemb	Pembrokeshire
Radn	Radnorshire		

APPENDIX D: LIST OF SITES FOR DISCRIMINANT FUNCTION ANALYSIS

This list may be used in conjunction with the tables in Appendix B. A map of the sites is provided in Figure 37.

1	Anglesey	2	Braywick I
3	Wawcott I	4	Grrenham Dairy Farm
5	Thatcham	6	Wawcott XV
7	Braywick II	8	Wawcott III
9	Welford	10	Bowyer's Pit
11	Oakend	12	Aberystwth
13	Pednamanere	14	Booby Bay
15	Monk Moors N	16	Monk Moors S
17	Williamsnon's Moss	18	Netherton N
19	Netherton S	20	St. Bees
21	Melbourne	22	Westward Ho
23	Iwerne Minster	24	Culver Well
25	Portland I	26	Whitcomb Hill
27	Poole	28	Chesil Beach
29	W Monkton A	30	W Monkton B
31	Penbury Knoll	32	Beacon I
33	Crimdon Dene	34	Loughton Camp
35	Woodham Ferrers	36	Hylas Lane E
37	Hylas Lane W	38	Hengistbury Head
39	Broom Hill	40	The Warren
41	Sandy Lane	42	Dobbs Weir 105
43	Moor Park	44	Sandy Lodge
45	Tolpitts Lane	46	Dobbs Weir 103
47	Shorwell	48	Cheshunt
49	Selling	50	Parkwood farm
51	Knowle Hill	52	Worsthorne Moor
53	Sheffields Hill	54	Kelling
55	Allendale	56	Lynne Hill
57	Misterton	58	Brawdy
59	Caldey Is.	60	Eye
61	King's Site	62	Wangford
63	Sproughton Knoll	64	Farnham
65	Hersham	66	Wootton
67	Guildford	68	Kettlebury
69	Frant	70	Parrock

71 Horsham
72 Roffey Halt
73 Foxhill
74 Warham Lodge
75 Clayton
76 Hadlen Down
77 Hastings
78 Iping Common
79 Selmeston
80 Cherhill
81 Downton
82 Bridlington
83 Flixton
84 Goathland
85 Star Carr
86 Warcock Hill
87 Deepcar
88 Ling House
89 Pike Low

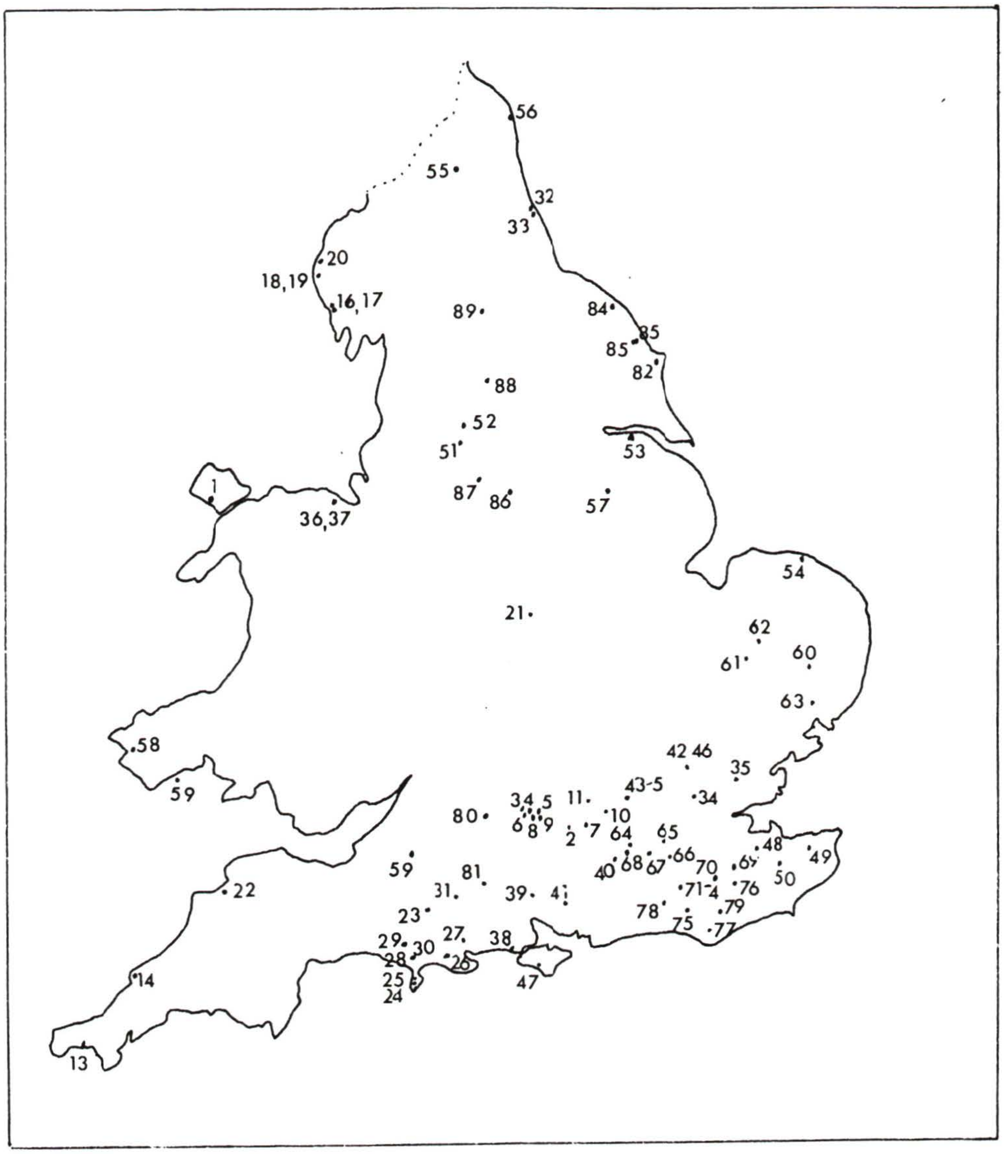

Figure 37: Map of Sites providing Technological Data

Curriculum Vita

John Anton Castleford

Date of Birth: 7 June 1950

Place of Birth: England

Educational Institutions Attended:

City of Birmingham College of Education, Birmingham, England	1971 to 1975
City of Birmingham Polytechnic, Birmingham, England	1979 to 1981
University of Victoria, B. C., Canada	1984 to 1987

Academic Awards:

Certificate in Education	(1975)	University of Birmingham
Bachelor of Education	(1981)	Council for National Academic Awards
Bachelor of Arts (Honours)	(1985)	University of Victoria

Publications:

Coastal Archaeology: a look at the database.
(1986) The Midden XVIII (5):3-5.

Away from a definition of the Mesolithic.
(1986) Mesolithic Miscellany 7 (2): 1-3.

Figure 2: Mesolithic Sites in England and Wales