THE WHIPPLE SITE AND PALEOINDIAN TOOL ASSEMBLAGE VARIATION: A COMPARISON OF INTRASITE STRUCTURING

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Abstract

Belonging to the "Bull Brook Phase," the Whipple site is noteworthy for its radiocarbon dates and faunal remains (caribou, cervid). The tool assemblages from Whipple and other northeastern North American Palaeo-Indian sites are discussed in terms of varying subsistence strategies and ancient environments.

Introduction

The discovery of the Whipple site in 1975 by Arthur Whipple, an amateur archaeologist, provided an opportunity to reevaluate current models of Northeastern Paleoindian subsistence and settlement systems, while developing a research program for the Whipple site area. Emphasis was placed on improving knowledge of Paleoindian internal site "dynamics," as well as expanding the geological and vegetational history of the study area, the Ashuelot River Valley, New Hampshire. A second stage of analysis considered the variation in activity loci within the Whipple site, for comparison with distributions of five other Northeastern Paleoindian sites: Templeton (6LF21), Connecticut; Wapanucket and Bull Brook, Massachusetts; Vail, Maine; and Debert, Nova Scotia (Figure 1, site locations). Distributional differences in tool assemblages permit an assessment of the processes that may be responsible for the structure of the Paleoindian archaeological record.

Nature of the Assemblage and Research Potential

The primary research area is in the Ashuelot River Valley, New Hampshire, a tributary of the Connecticut River, intermediate to the uplands of southwestern New Hampshire (Keene quadrant, 42° 53′N; 72° 18′W, elevation 148.5 m (483′). On-site survey began in 1976. Fieldwork continued in 1977 under a National Science Foundation doctoral dissertation research grant. Further work has taken place as point-counterpoint to continued site looting in 1978, 1982, and 1983.

The first findspot locale (Locus B), in an area adjacent to a hillslope pathway, had been minimally disturbed at time of site discovery. Unfortunately, before funding could be obtained for site excavation, Locus B was looted. In subsequent years the area was searched for further activity clusters. Locus A was excavated in 1977 and unlooted portions of Locus C were recovered in 1978, 1982, and 1983 (Curran 1980a, c, Figure 2).

This lithic assemblage from the Whipple site consists of 136 recognizable tools and tool fragments, including fragments from 32 different bifaces (including fluted and unfluted preforms), 1 fluted drill, 38 endscrapers, 12 sidescrapers, 1 flake shaver *(limace),* 2 wedges *(pièces esquillées)* and numerous flake tools, gravers, scrapers, and knives. There were numerous hammerstones, anvil fragments, a chopper, and over 38,000 chert, silicified siltstone, and quartzite flakes, many utilized.

The faunal assemblage consists of some 350 calcined bone fragments. Analysis by Dr. Arthur Spiess (Maine Historic Preservation Commission) has resulted in the identification of 83 mammal bones, of which 15 bones are attributable to family *Cervidae,* 36 are from large or medium mammal, and 3 have been identified as caribou.

Typologically, and for the most part lithologically, the materials from the Whipple site are identical to materials from the Bull Brook site (Grimes 1979). As a result, the Whipple site has considerable potential for expanding our knowledge of early Paleoindian subsistence and settlement systems in central New England.

Aims of Research

Several ecological and social organization concepts have been selected for development of a subsistence model from which test implications for Paleoindian behaviors may be generated. The need for parameter specification, essential in order to avoid the tendency to homogenize behaviors and environments, requires paleoenvironmental reconstruction.

Environmental Parameters

In previous papers the early deglacial period (Late Pleistocene) in New England has been characterized as a period of significant climatic instability (Curran and Dincauze 1977; Curran 1979). The process of deglaciation and continued climatic amelioration produced an environmental system that was undergoing drastic transformations. These changes were evident in extinctions as well as the redistribution of flora and fauna across the continent (Graham 1979; Guilday 1967, 1982).

Within the Northeast a variety of habitats was supporting a diverse plant and animal population from about 13,000 to 10,000 years ago. For the period 11,000 to 10,000 B.P., a reasonable estimate for Paleoindian occupation based on currently dated sites (Gramly 1982; MacDonald 1968; Moeller 1980), tundra persisted only in the northernmost reaches (portions of Nova Scotia, Cape Breton, and eastern Prince Edward Island) and northern high elevation sites (Ammann *et al.* n.d.; T. Anderson 1980; R. Davis 1981; R. Davis *et al.* 1975; Mott 1975, 1977).

Southward, spruce associations varied in intensity and expression, reflecting altitudinal and latitudinal controls on association development, as well as changes associated with repopulation of deglaciated terrain during a period of climatic instability. Spruce dominated the vegetational assemblages for some 2,000 years in the south, decreasing by 11,000 years ago, to be replaced by a transitional conifer-hardwood forest. Associations represented by the pine-dominated pollen assemblages supplanted the spruce woodland throughout the Northeast within 500 years of 10,000 B.P. (Ammann *et al.* n.d.; R. Anderson 1979; T. Anderson 1980; M. Davis *et al.* 1980; R. Davis *et al.* 1975; Mott 1975) (Figure 1).

New England's spatial heterogeneity, including small resource patch sizes and rapid changes over short distances, played a considerable part in determining the distribution of flora and fauna across the early landscape. Northward, the decrease in available energy should have resulted in more pronounced differences in resource availability over a yearly cycle, increasing the severity of temporal resource distribution incongruities. Modern frost-free day estimates approximate this variation for the six sites considered in this study. Estimates must be modified to account for the specific floral associations in each site region, since vegetational composition, especially species density and diversity, will influence the densities, distributions, and behavior of faunal populations dependent upon such resources (Figure 10).

It is generally accepted that in northern climates faunal, rather than floral, resources provide the main source of energy for human groups inhabiting the region (Binford 1980; Lee and DeVore 1968). Given previous studies in which caribou exploitation has been linked to Paleoindian occupations in the Northeast (Fitting 1968; Funk 1972; MacDonald 1968), it also is critical to consider the probable variation in herbivore population structure in the Northeast. Numerous studies indicate that herbivore populations disperse within wooded environments, in small bands (woodland caribou) or as more solitary grazers (moose, deer) (Knight 1965; Winterhalder 1981a).

The extent of spruce woodland or forested environments between 11,000 and 10,000 years ago indicates that game dispersal would have been typical of all locations except those at the northern tundra-woodland borders. Such a structure would have prohibited intensive herd herbivore harvesting in New England and most of the Northeast (Dincauze and Curran 1983). Given the Late Pleistocene climatic perturbations, even at the tundra borders large faunal clusters, specifically caribou, should have been limited in duration and frequency of occurrence, rarely sufficient to encourage exploitation by large cooperative work groups (Burch 1972, caribou; Reher 1977, western bison).

Late Pleistocene Human Behaviors and Settlement Implications

Optimal foraging theory concepts, used as early as 1973 by Edwin Wilmsen to generate implications for western Paleoindian demographics and spatial organization, have not been applied to Paleoindian studies in the Northeast until recently (Curran 1980; Dincauze and Curran 1983). In this paper some aspects of optimal foraging theory have been incorporated into a framework that generates test implications for human subsistence strategies in late Pleistocene New England and parts of the adjacent Northeast. Winterhalder, in a study of the boreal forest Cree, for example, indicates that where resources are dispersed and unpredictably located (as in the case of mobile game in forested environments), search time is costly (1981 a,b). As search time increases, the optimal forager should adjust strategies to take whatever becomes available, rather than being highly selective and increasing both search and pursuit time (Charnov 1976; MacArthur and Pianka 1966; Winterhalder 1981b; Dincauze and Curran 1983: 4-5). One must be cautious, however, in the use of animal foraging model concepts to explain human behaviors.

The environmental structure sets the bounds within which certain strategies can work effectively (Weissner 1982). As much more behaviorally flexible beings, humans may counter the variability in the resource system through a series of risk-reducing strategies unavailable to animals (Weissner 1982; Jochim 1976; 1980). Increased diet breadth may be the optimal solution for animal populations in unstable environments. Humans may *alternate* their resource search behaviors, balancing the risk incurred in diet selectivity (generally a rank-ordering of large to small animals, Keene 1981; Perlman 1976), by careful selection of resource extraction locations. The search territories selected would provide alternative resource choices in the event of unsuccessful capture of the preferred resource (Campbell 1968; J. Smith 1977).

Maximizing flexibility is the most obvious means of minimizing the risk caused by energy perturbations that probably typified late Pleistocene environments. The strategies employed should have consisted of easily evoked, reversible, or resilient mechanisms, capable of adjustment to short-term fluctuations (Colwell 1974; Holling 1973). In the long run they could be characterized as stabilizing or "conservative" behaviors (Holling 1973).

Information exchange or resource sharing, additional mechanisms for reducing risk, would increase the relative predictability of the resource base. The sharing need not imply large group cooperative collective activities or similarly formalized organization. Instead, a fluid social organization, in which there is an egalitarian and flexible approach to the use of territory (a broad, open territoriality), is more advantageous where the rates of resource fluctuation are high (J. Smith 1977; Hunn 1982). Residential flexibility, for example, permits the redistribution of people, information, and resources (Keene 1981: 174).

Variation in group size is a flexible, easily reversible response to stress. Given the environmental reconstruction for New England, one would expect dispersal of groups into small units much more often than aggregation, producing many more small sites than large ones, although varying by region, season, and year. Larger group aggregations, at least of limited duration, may have been possible in a few relatively stable and productive locations: temperature-moderated coastal plains and possibly large edge environments within woodland or forested regions, especially where edges were relatively stable (lake or pond margins). The length of such aggregations may have been expanded through fluidity of group composition. Such fluidity may have been encouraged by the advantage gained through the sharing of information about resource availability and locations (Moore 1981; E. Smith 1981).

The degree to which groups would use risk-minimizing strategies should vary, producing settlement distributional differences in site location choices, site densities and sizes, as well as varying internal site dynamics (occupation duration, activity intensity, diversity, and tool assemblage composition). Table 1 summarizes the settlement implications of such strategies for Northeastern Paleoindian sites.

Paleoindian Lithic Assemblages

The Paleoindian toolkit long has been recognized as distinctive in its structure. Often that distinctiveness has been related to the practice of specialized harvesting of big game herds. Yet Wilmsen, as early as 1970, cautioned that Paleoindian cultural organization was more diverse than the traditional emphasis on projectile point typology and hunting of extinct megafauna would imply (1970: 81). Dincauze and Curran (1983) more recently have argued that, under conditions of resource instability, which forces scheduling and resource processing flexibility, the importance of maintaining a similarly flexible toolkit may contribute considerably to its form.

Goodyear, however, was the first to elaborate on the extent to which that need for flexibility might shape Paleoindian tool assemblages (1979), while simultaneously relaxing constraints on Paleoindian behaviors. The typical hunter-gatherer toolkit contains a limited number of easily portable, curated, and easily shaped forms from which a variety of tools may be formed (Binford 1979). However, in the Paleoindian toolkit there also is a careful selection for high quality materials. When coupled with techniques such as hafting, which prolongs the use life of tools, the tool assemblage form reduces the need to maintain exploitation territories tightly linked to quarry sources (A. Goodyear 1979, n.d.; *cf.* Gardner 1983). The Paleoindian toolkit's standardized forms, rather than implying specialization of function, serve as a means "to maximize the ends of efficiency and flexibility of application" (A. Goodyear n.d.; Dincauze and Curran 1983: 6).

Consequently, the use of diverse resources by Paleoindians throughout the Northeast, as inferred on Table 1, should be represented by differences in the numbers of tools used and discarded, rather than by different tool forms (the latter an expectation associated with resource specialization) (Dincauze 1981). Once beyond the basic tool assemblage structure, occupation length, group size, and site purpose will be major determinants in the number of tools made, used, and discarded. For example, a tool assemblage will be more completely represented at a given site, the longer the occupation (Schiffer 1975). However, there are limits on assemblage diversity, dependent on site emphasis. In a short-duration resource procurement or processing site, a very limited range of tools may be used. At a habitation site, which incorporates maintenance and planning activities, as well as organization around resources, a wider range of tool forms will be present. The more successful the acquisition of a specific resource, the more focused an assemblage will become. One then must discriminate among diversity related to basic tool assemblage requirements, occupation length, and the specific resource acquisition focus.

Archaeological Correlates

Translation of assemblage composition implications into appropriate archaeological correlates is a complex process (Schiffer 1976). Site structuring not only is a product of "the consequence of direct organization around resources" (Weissner 1982: 1972), but also there are aspects of the archeological assemblage that reflect social organization strategies. Analysis of materials from the Whipple site provides a basis for beginning estimation of the extent of some of these influences: activity intensity, diversity, and occupation duration. Following description of the Whipple site materials, tool assemblage variation within and between sites will be compared, providing a baseline against which future observations of variation may be measured and by which the current propositions concerning Paleoindian strategies may be judged.

The Whipple Site

Site Setting and Stratigraphy

The Whipple site lies on a gently sloping terrace or deltaic deposit 180 meters from the modern Ashuelot River course. A small spring-fed brook, now four meters (13') below the terrace surface borders the site, emptying into a nearby bog and lowlying marsh area (Figure 2).

Palynologic and geologic studies of the bog and surrounding areas confirm a spruce woodland-forest environment during Paleoindian times (a transition from tundra may have occurred as early as 12,900 years ago) (Gaudreau 1982; Patterson 1980). Geologic observations also suggest a small pond, rather than large proglacial lake or bog environment, for the period of Paleoindian occupation (McIlvride 1980). Pond basin stability assured a successional environment at the decreasing pond margins over a considerable timespan, probably producing reasonable year-to-year local resource predictability.

All archaeological materials occur within the uppermost stratum (stratum I, Figure 3) of the complex sequence of sedimentary deposits. This sedimentary unit includes both structured and unstructured fine to medium sands.

The soils in the Whipple site area (Loci A and B) are Carver loamy sands, a Typic Udipsamment (mixed, mesic), developed in thick deposits of sand and gravel (Rosenberg pers. comm. 1979.) Patches of less gravelly Windsor loamy sands have been identified within the main site area as well (Locus C). An organic layer (Ao) is underlain by a 10 to 15 cm dark humic plowzone, gleyed and leached, beneath which are fine unstructured sands characterized by a B and then C soil development horizon.

Nearly all Paleoindian artifacts, as well as charcoal and bone clusters, occur within the B horizon in both loci A and C. Only occasional items were found in root casts or rodent burrows extending into the C horizon.

Soil Horizon Disruptions

While forestation processes in New England are capable of reversal of sedimentary units (Lutz and Griswold 1939), recent disruptions at the Whipple site have only loosened, rather than reversed, soil units and interrupted the developing spodosol.

Early vegetation clearing activities are evident mainly as burnings, resulting in charcoal and remnants of burned root systems concentrating at the base of the shallow plowzone and extending into the B horizon. On-site observations by Lyford suggest that ants probably were the most active microfauna (pers. comm. 1976), although grubs, a rodent burrow, and even a toad were uncovered at depths of over 50 cm. Microfaunal activity has been responsible for rapid incorporation of artifacts into the soil matrix. Recent archaeological observations indicate that once artifacts are buried, their continued lowering in the profile occurs much less rapidly (Thomas and Robinson 1980).

Microincremental Data Collection and Analysis

Lithics, bones, and charcoal, once located in troweling, were plotted *in situ,* the remaining sand was screened through 1/8" mesh, recorded by 2 cm levels and 25 by 25 cm blocks, with controlled samples also processed through 1/16" mesh. Feature soils and additional control units were water-screened. In the laboratory each level was analyzed in terms of its cultural content and physical characteristics. Artifacts from each section were plotted against their corresponding profiles and the grid map, to determine if there were any horizontal or vertical clusterings of materials suggestive of features unrecognized in the field. The close interval controls indicate that recurrent biogenic and physical disruptions of varying ages throughout the site appear to be surprisingly uniform, resulting in relatively minor translocations of archaeological materials.

In 1976, testing established one intact Paleoindian artifact assemblage (Locus A), while several other clusters were identified whose perimeters were poorly defined (Loci B and C). In the 1977 field season intensive areal survey was continued and Locus A was excavated (Curran 1979).

Locus A Description

Some 55 recognizable tools and tool fragments, including fragments from 12 different fluted bifaces, 11 preforms, a fluted "drill," 4 endscrapers, 5 sidescrapers, numerous flake tools (knives, gravers, and scrapers), a chopper, and several hammer stones, as well as nearly 30,000 quartzite and chert flakes, were recovered from Locus A (Figure 4). Approximately one-third of the debitage sample was under .5 cm (1/4") in size. The remaining material produced a tool/flake ratio of one tool to 361 flakes.

The dominant raw material was a fine-grained chert, ranging from grey to brown in color. A red-brown, coarser silicified siltstone and a fine-grained bluish quartzite formed a smaller portion of the materials discarded. The chert and siltstone samples are identical, visually, to materials from the Bull Brook site, Ipswich, Massachusetts (Grimes 1979).

Although some lithics were recovered in the plowzone, much debitage concentrated at 2 to 6 cm beneath the plowzone (*ca.* 16 to 20 cm below ground surface). Larger tool fragments, which occur with some repetition at this same depth, appear intermittently below this level, and again occur with some repetition within a second more minor debitage peak 12 to 14 cm lower in the soil profile. Horizontal plots indicate that the second clustering is more localized in a given unit than the earlier peak. Lithics below this lower level decrease rapidly.

Features

The only cultural feature defined in the field consisted of a 1 by 1½ m concentration of burned bone, debitage, and charcoal (Figure 5).

Bone fragments first appeared as early as 10 cm below the plowzone. There was initial concern that the first find represented an intrusive activity indiscernible to the naked eye. However, its position closely matched the depth of the first debitage and tool peak described. The recovery depth coincides with observations made in Locus C and at other sites which suggest that in the first 20 to 25 cm below surface biogenic and soil chemistry processes are responsible for considerable destruction of organic matter in New England's acidic soils (Curran and Thomas 1979; Thomas and Robinson 1980). A significant increase in bone fragments occurred at 45 cm below ground surface, close to the more basic C horizon, and continued in a deepening associated with an ancient root cast. Coupled with a debitage peak in a locally restricted area, this distribution provided the best areal definition of the feature. An increase in the size and quantity of charcoal fragments was noted in the same general area as the bone clustering. No other well-defined feature area was defined in laboratory analyses.

North of this hearth area there is a dramatic decrease in both tool fragments and debitage. It coincides with a relatively high phosphate increase, suggesting perhaps a lean-to or partially enclosed shelter or the location of a pile of organics that preceded the subsequent site activities that resulted in tool and debitage discard. Beyond the immediate hearth-centered activity area (3 by 3m) peripheral activities resulted in other phosphate peaks, as well as additional low density tool and debitage discards.

Wood Identification and Radiocarbon Dating

Only a diffuse scatter of charcoal fragments was observed in the feature area of Locus A at the Whipple site. While the fragments were distinctive in their distribution from the surrounding areas, problems of vertical profile mixing required caution in collection, identification, and dating of samples as well as in interpretation of their significance.

Karen Saunders, Forestry Department, UMASS, Amherst, provided wood identifications for the charcoal collected. Both soft and hardwood fragments were identified in the feature area—some 55 cm below ground surface. The softwoods, either spruce or pine, could not be discriminated. A hardwood sample was identified as *Prunus,* spp. cherry or another *Rosaceae* species. There was insufficient charcoal for standard radiocarbon dating from Locus A from any one level excavated. Since tandem accelerator dating was unavailable, one combined sample, from six levels (12 cm) within the feature area, was dated, producing a date of 8180±360 radiocarbon years (GX-7496). Problems with the use of diffuse scatters of charcoal from unsealed deposits for radiocarbon dating will be discussed more fully in relation to locus C excavations.

Soil Chemical Analyses and Feature Identification

A variety of physical and chemical changes occurs in natural soils as a result of human occupations. The differential distribution of chemical alterations can be used to determine site boundaries, clarify stratigraphic relationships, as well as define intrasite activity areas and features, aiding in their functional interpretation (Woods 1983).

The most widely used technique, qualitative phosphorus analysis, was the main chemical analysis conducted on the Whipple site soils (Woods 1977). Testing identified anomalies in phosphate distributions that were then confirmed through site excavation distributional analyses of archaeological materials and quantitative phosphate testing (Figure 5, based on laboratory work by Marie Bourassa, University of Massachusetts, Amherst).

While one would expect a general rise in phosphate levels over the whole site area, the increase in phosphate response, relative to non-habitation solid phosphate readings, expanded activity area definition beyond the lithic activity area distributions by at least two meters. Expansion of site area definition has important implications for improving the discovery of low density sites and activity areas elsewhere.

Faunal Remains

The 42 bone fragments recovered from locus A undoubtedly represent a fraction of the material originally deposited, since low soil pHs have serious effects on bone preservation (F. Goodyear 1971). The bone recovered from the hearth area was too fragmentary for faunal identification, despite the presence of a basal cranial fragment much larger than any other bone fragment in the site area (Spiess, Curran, and Grimes 1984). The close proximity of tool fragments representing cutting and scraping activities suggests a strong association with the fauna represented by the burned bone.

Locus A Activity Area Summary

Neither length of occupation nor postdepositional processes since occupation have obliterated the pattern created by the original discard actions in Locus A, although artifacts have been separated by soil, and features have been blurred significantly, especially in terms of organic remains. Lithic material distributions do not appear to have been interrupted sufficiently to hinder interpretation of the spatial distribution of activities, including specific tool manufacturing and use events. This fact has important implications both for the interpretation of cultural behavioral processes represented by site materials, as well as identification of postdepositional processes. More complete definition will be provided in future computer plots of material distributions (Curran 1984a).

The dominant activity in locus A involved projectile point manufacture. However, there were numerous additional processing activities. The use and discard of large sidescrapers are notable, when compared with Locus C. Horizontal plots of tool fragments and debitage expand nicely upon the original feature definition. In fact, the debitage distributions have been critical for determining minimal spatial translocation of cultural materials. The distributions also make a strong case for only primary refuse deposition during site occupation (Schiffer 1976) (Figure 4 and 5).

Activity Area Characteristics - Locus A

The central feature area, the focus of greatest activity variety and intensity, measured approximately 3m x 3m. Phosphate responses define an area much more in line with total areal distribution of debitage and tool counts (11m by 6m).

The discreteness of specific lithic events as well as the remarkable definition of the use of space in Locus A suggests that activity duration was relatively short and intensity of activity relatively low. Later these observations will be compared with other sites, using measures of tool assemblage diversity.

The 11m by 6m activity area was compared with numerous ethnographically observed activity areas and known archaeological site sizes (Curran 1980c). Recently, Peter Thomas (1984) has presented a more detailed literature search for appropriate analogues for small, short-term, low-density sites. The perimeters and internal distributions are most similar to activity areas associated with sleep shelters at Kung base camps (Yellen 1977) and an open-air hearth-centered activity area at an Eskimo hunting stand (Binford 1978).

Locus B Description

The first artifact discoveries at the Whipple site occurred in Locus B. Unfortunately, between the time the site was reported by Arthur Whipple and when funds were obtained for field work, the area was almost completely destroyed by looting. The collection of Paleoindian materials from this Locus was available temporarily, permitting a rapid descriptive summary. Since Paleoindian materials were mixed with materials from an Archaic site downstream, only clearly Paleoindian tool forms or distinctively Paleoindian raw materials were counted.

A total of some 34 tools and fragments were identified in the collection from Locus B, including 3 different fluted points and fragments, 1 preform, as least 1 sidescraper, 9 flake scrapers, a few graver scrapers, and 17 endscrapers. Debitage sorting of some 2,000 flakes also revealed a high quantity of utilized flakes. In combination with the number of endscrapers recovered, the assemblage suggests a decidedly different activity focus than in Locus A.

No reliable debitage counts were obtained, given the uncontrolled method of collecting. Of the tools recorded, the dominant material in the assemblage was a chert that grades from brown through gray to black, as in Locus A. Fewer tools were similar to the red-brown silicified siltstone used in Locus A. Locus B contained the largest piece of chert recovered from any activity area; it is the only piece that has not been modified to a blank stage or further. In addition, this locus contains the only sizeable pieces of black chert, used for the two projectile points in the locus, one of which was the most complete chert specimen recovered from the site.

Testpitting around the central findspot area produced only a low density lithic distribution in undisturbed context, but did expand knowledge of postdepositional disturbances. B horizon soils terminate abruptly along the slope edge in this area. Erosion, in the past probably related to downcutting by the adjacent stream, undoubtedly resulted in artifact loss and some downslope movement of artifacts.

A few small fragments of burned bone were collected from areas along the pathway, but context was not confirmed by any additional finds in the Locus B feature area. The possibility of Paleoindian association was considered only subsequent to the recovery of burned bone in the two other activity areas excavated.

Activity Area Characteristics - Locus B

Although poorly defined by testpit distributions, the activity area was a minimum of 6m x 6 m. No phosphate grid was done, given the extent of recent disturbance. It is not possible to assess accurately the activity duration or intensity from spatial distributions of materials; quantitative comparisons were more successful. In contrast to the emphasis on projectile manufacturing in Locus A; scraping activities are presumed to have been dominant in Locus B.

Locus C Description

In 1978 the New Hampshire State Historic Preservation Office provided emergency funds for a two-week site salvage of this area (Curran 1980a). Volunteer work continued for an additional week. Burned bone in looters' backdirt piles, identified as cervid, provided the impetus for the salvage effort.

Locus C, containing at least 47 tools and fragments and over 6000 pieces of debitage, distinguishes itself from Locus A in the high proporation of endscrapers retrieved (19). The rest of the assemblage included fragments from 3 different fluted projectile points, 2 preforms, and 2 wedges plus several wedge spalls. Six small sidescrapers, the only flake shaver from the site, and numerous flake tools, including flake scrapers, 3 gravers, as well as unmodified flakes used as knives and scrapers, completed the toolkit. Several hammerstones and anvil fragments also were recovered (Figure 6).

Materials in Locus C appear to be of variable quality, but are predominantly of brown-grey chert. The quality undoubtedly has been obscured in many cases by extreme "weathering," related to heat spalling. Quartzite, red-brown silicified siltstone, and a small amount of red jasper also were recovered.

There have been numerous disruptions of the A horizon in Locus C. Some buried A horizons downslope appear modern in origin. No artifacts were recovered in these soils in the testpits sampled. Elsewhere, downslope, artifacts were recovered from undisturbed B horizon soils, suggesting that artifact movement occurred over a considerable timespan prehistorically (Thomas and Robinson 1980). Within the *unvandalized* areas, A horizon, and occasionally B horizon, soils have been disrupted severely. In some cases soils were loose and dry.

Cultural Features

Early Woodland occupation (a Meadowood component) on the same terrace as Locus C was represented by fireshattered rock, a stone-lined hearth and a Meadowood preform. Fortunately, the activity center was peripheral to the main Paleoindian activities. Most materials were found at the base of the A horizon, incorporated only minimally into B horizon soils, with the exception of the stone-filled hearth.

Study in 1978 was directed toward untangling the confusion created by several looting episodes, in order to confirm the origin of burned bone and probably hearth remnants. Figures 6 and 7 illustrate the horizontal dispersal of tools, bone and debitage recovered from this area.

In one of the most badly disturbed units (N17E01) a sizeable quantity of debitage and a few tool fragments were recovered *in situ* with 18 bone fragments, including cervid foot bone fragments (Spiess *et al* 1984). In an adjacent unit, N18E02, also disturbed by looting, over 500 pieces of debitage and 21 burned bone fragments, including a calcined cervid sesamoid fragment, were recovered. Most bone fragments occurred from 31 to 50 cm below surface, with a small concentration of debitage. Near the surface was a small amount of firecracked rock.

In N17E02 over 80 calcined bones were uncovered. At 50 cm below surface a fluted point fragment was surrounded by burned bone. A nearby rodent burrow had left the Paleoindian artifacts undisturbed. Charcoal was collected carefully from this unit. Bone and debitage in this unit provided the best definition for a central hearth area, although bone, tools and debitage were scattered for a considerable distance over other units (Figures 6 and 7).

Charcoal Identification and Radiocarbon Dating

As in Locus A, charcoal samples were carefully separated and sorted for wood identification and dating purposes. Dosia Laeyendecker (Smithsonian Institution) provided the wood identifications. Because of the difficulties with small samples, she distinguished fragments only in terms of hardwood or softwood (coniferous) categories. The exception was one hardwood fragment of willow or poplar.

Charcoal occurred in greater concentration at greater depth in this area than in Locus A. One sample (1.08g.) collected from the N17E2 bone and debitage concentration was dated by Geochron Laboratories. It combined fragments over considerable vertical depth (23 cm) and produced a date of 8240± 380 radiocarbon years (GX-7497). It was within range of the date from Locus A (8180± 360, GX-6003), but similarly represented considerable vertical depth. At least one-third of the sample was from the upper half of the profile sampled, placing it 6 to 11 cm above the nearby fluted point fragment.

The charcoal pieces with best association with Paleoindian materials and burned bone at the deepest feature levels, were reserved for tandem accelerator mass spectometry dating (direct carbon isotope counting) by the University of Arizona (Haynes *et al.* 1983; see also this volume).

The first sample dated included two charcoal lumps, identified as coniferous specimens (targets C-344 and C-453). They yielded dates of 9,820 ± 450 and 11,430 ± 395 years B.P., suggesting that the fragments were not from the same population of charcoal. The second sample (two measurements on one target (C-345) of 10,150 ± 815 and 10,670 ± 570 years B.P. agree very well with a second target (C-454) which dated at 10,885 ± 665 years B.P.) produced a weighted mean of 10,680 ± 400 years B.P. In this case they represented four pieces of hardwood charcoal.

It is very likely that at the level sampled ((0 cm datum) 50 cm below surface) in the feature area, there have been processes which have introduced or mixed materials over a considerable timespan within a small area. However, when compared to standard dating methods, the amount of error potentially introduced by combining samples vertically does appear to be reduced.

Even though a conservative approach to feature dating was taken, resulting in no inordinately young dates from the features selected, there still remain serious limitations with diffuse charcoal features, in spite of advances such as direct ion counting. There are several possible resolutions to reducing the considerable variation noted. One may need to consider only "sealed" or "protected" deposits. Alternatively, if one could run a large number of samples for each of many microincremental levels, one might be able to sort out the mixing processes, producing more replicable results. The latter option, of course, is financially unrealistic. A less expensive, although time-consuming alternative, wood identifications, might be able to identify obvious deposition patterns or disruptions.

Faunal Identifications

Of some 300 bone fragments recovered from Locus C, Dr. Arthur Spiess (Maine Historic Preservation Commission) has provided a mammalian identification for over twenty percent of the sample. A detailed description of the faunal remains is being prepared (Spiess *et al.* 1984). The identification of three bone fragments as probable caribou has important implications for interpretations of Paleoindian subsistence strategies in central New England.

Activity Area Characteristics - Locus C

The unevenness of data collection, due to limited funding and excavation time, and the extent of serious disturbances inhibit detailed assessment of the use of space in Locus C. Nevertheless, based on excavation of intact areas, it is evident that a hearth area, including burned bone and some 6,000 pieces of debitage, served as a central focus for activities, as in Locus A. While the highest bone and debitage concentrations overlap in both Loci A and C, to the near exclusion of tool fragments, in Locus C there is a broader scattering and higher quantity of burned bone. In part, it may be a product of better preservation in Locus C, related to sediment, soil chemistry, and soil development processes.

Tools, tool fragments, and debitage were scattered over an eight by six m area, although activities probably concentrated in a four by three meter area. No large tools and only a few "complete" ones were found. Many pieces were heat spalled, indicating that fire may have exacerbated the fragmentary nature of the artifactual materials. The close association of burned bone fragments and scraping tools suggests that tool use was related to processing the fauna represented by those bones. The locus was distinctive in containing the only flake shaver *(limace)* at the site and wedges.

Light scraping activities dominated the central activity area of Locus C. Early Woodland activities related to the fire-cracked rock scatter and the stone-lined pit were relatively well-separated vertically and horizontally from Paleoindian materials. Post-depositional disruptive processes had most serious impact on vertical distributions of material but not so great as to prohibit separation of Woodland from Paleoindian materials. The use of different raw materials for tool production was an important aid in sorting, as well. While discrimination of specific events has been limited (due both to intervals used and the incomplete stage of data recording), the available material distributions are able to provide a general description of the activity area.

Despite an incomplete tool count, the numbers of tools are comparable to Locus A and somewhat larger than the known sample from Locus B. The amount of debitage recovered in Locus C, however, is significantly less than that from locus A, matching expectations that more debitage is produced in tool manufacturing areas. The heat shattering noted so frequently in Locus C probably means that an unheated assemblage would have had an even lower flake/tool ratio than observed (1 tool/176 flakes). Final sorting and cataloguing has not been completed, but there should be no dramatic change in these observations, since rapid counts were taken in the field during excavations.

The Whipple Site Summary

Site Size, Duration, Intensity of Activities

There should be little internal site variation where site emphasis is on short-term intensive material processing. It is evident that the processing activities observed at the Whipple site do not fit this pattern. In addition, the Whipple site clusters clearly do *not* represent material processing at the scale that would produce an extensive accumulation of materials from repeated exploitation of large resource clusters. Instead, when coupled with the diversity of activities focused about a hearth, the patterning, although of low density, suggests a habitation occupation for Locus C. The similar spatial distributions in Locus A, although over a somewhat larger area, also suggest a habitation location.

Despite the lack of detailed locational information, comparison of Locus C with the other two loci suggests similar activity intensity and duration, although somewhat more intense or of longer duration than Locus B, *if* most of the Locus B collection has been seen. The difference in tool counts between Loci A and C are *not* comparable, since they represent differences in activity focus. At issue then is an appropriate scale against which to measure activity intensity and differentiation. For intersite comparative purposes, a statistical measure for assemblage diversity provides a scaling of similarities and differences.

Table 2 includes a summary of the activity area sizes at Whipple, as well as assemblage composition. The concentration of activity around a hearth area suggests one focal point per activity area, the dimensions of which are three meters by three meters in Locus A. Since the dominant activity in this case is tool manufacturing, it would tend to confirm an open-air rather than enclosed space, although a windbreak may have been present. The concentration in Locus C could well have taken place in more enclosed space, but lack of detailed distributional information inhibits such interpretation.

All three activity areas fall within the size range of !Kung residential sites occupied between two and ten days by two to four families (Yellen 1977) and a Nunamiut Eskimo hunting stand (Binford 1978). However, the identification of only single hearths suggests that the Whipple clusters represent single nuclear units (a family or small work group) involved in maintenance as well as more focused processing activities. Another measure of occupation duration has been suggested by Spiess (1982; see also this volume), estimating the number of man-days represented by the total tool sample, citing Middle Dorset Eskimo data. Since Eskimo assemblages include bone tools, unaccounted for in the current Paleoindian record, more information on lithic material procurement strategies will be needed to evaluate the constraints on obtaining lithic raw materials and thus the potential loss of tool assemblage information in the Paleoindian archaeological record.

The small areal size and internal discreteness of activities within loci at the Whipple site support an argument for single, short-term occupations by a small group. Unresolved, however, is the question of whether the three excavated activity areas represent simultaneous occupations or not. The inability to prove activity area contemporaneity hampers site size definition significantly.

There are several lines of evidence that suggest that the Whipple areas represent at least two different periods of occupations—although the timespan between them could be short or long. Tool assemblage diversity among the loci is similar, and yet the dominant activities are strikingly different. See Figure 8 histogams. There is a fairly dramatic difference in the size of lithic materials discarded as well. At an initial glance it does not appear that activities of Locus A indicate extreme concern for recycling of tools. A significant amount of discarded raw material is beneath a size needed for projectile point production, but adequate for other tool recyling. In contrast, in Locus C, virtually no material discarded could be recycled into anything other than small, very simple, expedient tools. The small sizes in Locus C in part may be related to extreme heat spalling, but it also is likely that the sizes represent more complete use of lithics before discard. With the exception of one large chunk of chert (the only non-blank stage chert item collected at Whipple), the situation is similar in Locus B.

Most of the larger, potentially recyclable, materials in Locus A are of quartzite and red-brown silicified siltstone. Their presence does not indicate rejection of poorer quality materials, however. While a fine quality chert dominates the toolkit, both quartzite and the coarser grained silicified siltstone have been used in all categories of tools, suggesting a fluid approach to raw material resupply. This indicates that the occupants at Whipple were not bound to a single raw material source (*cf.* Gardner 1983) and skillfully incorporated less than optimum materials when needed.

The condition and diversity of lithic materials between loci suggest differences related to both on-site tool use as well as the temporal or spatial relationship to lithic material procurement from periods of site occupation, rather than contemporaneity of all three loci. However, a more thorough lithic life cycle model is essential for specifying the effects of various manufacturing, maintenance, and use activities on tool assemblage composition (Grimes and Curran in prep.) Activity area composition suggests either redundant occupation by a nuclear family unit or small extended family (small band).

The Whipple Site in Context

Stylistic similarities with other dated Paleoindian sites in New England and the time-of-occupation estimate obtained from direct ion counting suggest that the Whipple site occupation falls broadly within the time range of other Paleoindian sites in New England. This observation places site occupation within a spruce woodland-forest environment, which extended well into Maine by 10,500 years ago.

The Paleoindian analogues which have associated humans with caribou must be viewed in this light. Caribou, represented by at least three bones at the Whipple site (Spiess *et al.* 1984), would be expected to behave decidedly differently within the woodlands of the Ashuelot River valley and its adjacent uplands, than caribou operating between the broad open northern tundra and tundra/woodland borders. Both caribou and humans would need to be dispersed in small groups for most, if not all, of the year. In fact, the relatively low energy budget in the Whipple site area argues strongly for only limited seasonal use of the region. Even when clustered seasonally, the total caribou populations would have been low and subject to rapid locational shifts.

The small activity area sizes, the spatial discreteness, and low material densities observed in the Whipple Site activity areas match the expectations of small group, short-term occupations during the late Pleistocene. Paleoindian occupations may have been dependent on the use of such stable microenvironments as found in the Whipple site vicinity, to counter problems of overall low resource productivity and instability.

To gain a better understanding of the use of space by groups during the late Pleistocene and to determine the extent of which the Whipple site is representative of New England Paleoindian behaviors, it is essential to compare the Whipple site materials with other sites. As mentioned previously, I have selected five Paleoindian sites along a northeast-southwest trending axis for comparison (see Figure 1 and Table 1 for site distributions and anticipated site characteristics).

Intersite Comparison

Intersite analyses will be restricted to evaluation of tool assemblage variation as a product of subsistence-related activities and varying social organization. Future studies must consider the impact of sampling problems, lithic life cycles, as well as the functional flexibility of a given assemblage on archaeological distributions (A. Goodyear n.d.; Grimes and Curran in prep.).

Artifact assemblages produced by single component, short-term occupations provide the best starting point against which to estimate changes that occur with increased site complexity. The Whipple site assemblage serves as a basically intuitive common denominator against which to measure the other Paleoindian artifact assemblages selected for study. However, with increased assemblage size, comparisons become increasingly difficult. Descriptive statistics will be used as an aid in identifying significant variation (diversity) among activity loci and site assemblages. Combined with field observations of site characteristics, the information will be used to assess the extent to which such variation in tool assemblages is a product of group size, activity duration and intensity, or a focus on specific resource planning or processing activities.

The Shannon-Weaver information theory equation will be employed as a measure of tool assemblage diversity (entropy) (Wilson and Bossert 1971). Figure 9 presents the formula, as well as a plot of the indices obtained for the sites in this study. Histograms of site assemblage composition provide a visual representation of this diversity.

As mentioned earlier, a specific aim in this analysis is to distinguish among three possible activity forms that reflect the degree to which site assemblages are products of organization around resources. The forms include limited activity locations (Wilmsen 1968) of varying intensity (short-term resource procurement or processing areas—designated as Type I here), multiple activity locations (Wilmsen 1968—campsite—habitation areas) where a variety of daily maintenance activities take place (Type II), and multiple activity locations with a focus (Type III), where preparation or processing activities may influence strongly the site structure. Type II locations may occur as a response to social needs or desires (information sharing or visiting locations) or because they function as central places (locations to which a variety of materials may be brought for processing and possibly sharing) (E. Smith 1981; Weissner 1982). Central places may be occupied by small or large groups, depending on the distribution and productivity of resources in the local region.

An archaeological site may be composed of only one or a combination of the above activity types, depending upon group size, the nature and duration of the activities performed, as well as the extent to which the site may have been reoccupied. It must be remembered that the site assemblage diversity sum is an amalgam that may represent an averaging of noncontemporaneous activities. Therefore, the smaller the sample size, the more likely assemblages may appear skewed (or focused).

The histograms in Figure 8 depict the "ideal" tool assemblage composition that might be expected with each activity form, its diversity measure, as well as selected examples from actual Paleoindian sites.

Tool Assemblage Comparability

Tool categories have been redefined in some cases to permit comparability in counts between sites. Nevertheless, differences occurred in category recognition and counting, depending upon analyst, as well as tool assemblage size. The counts must be taken at face value, despite one's suspicions of non-comparability. In the future a more standardized approach to tool classificiation must be implemented. Such standardization will be incorporated in the development of a lithic life cycle model for the Bull Brook and Whipple site materials (Grimes and Curran in prep.). The embedded error in the present sample must be kept in mind when assessing variability, prohibiting fine-scale distinctions.

Site characteristics (known site and activity sizes) are in Table 2. Site reports provided the information from which activity area sizes and tool assemblage data were derived. Only tools identified with specific loci were included. Site size estimates vary in reliability, given differing conditions that have led to site discovery (bulldozing at Debert and Bull Brook; lake lowering and erosion at Vail).

Figure 10 depicts the assemblage size differences for the six Paleoindian sites selected for study, and illustrates the possible relationships to Late Pleistocene vegetational distributions, as well as annual energy budget variation.

Comparison of Tool Assemblages and Subsistence Strategy Expectations

As postulated by Dincauze (1981), in the sample analyzed the same tool forms and tool types occur repeatedly in sites of all sizes across the Northeastern landscape (Dincauze and Curran 1983). What differs is assemblage size and proportional frequencies of tools among and within Paleoindian sites in widely varying environmental contexts.

Site and Activity Area (Loci) Sizes

The Bull Brook site is the largest site in terms of the number of activity loci excavated: 42 at Bull Brook I and 6 at Bull Brook II (Grimes 1979; 1983; see also this volume). The Debert assemblage (11 loci), however, may have been as large as Bull Brook in total number of activity areas, if MacDonald's estimate of total site occupation area is correct (MacDonald 1968: 1). The site with the next largest number of activity loci (8) is Vail (Gramly 1982). The remaining sites contain from one to six activity areas.

Proving contemporaneity among activity clusters is important for refining impressions of the group sizes that may have occupied each site. This cannot be achieved for most sites at this time, although lithic life cycle modeling may improve such evaluations, as indicated in the analysis of Whipple site materials. At present the strongest case for a contemporaneous large group aggregation is based on the regularity of spacing and tool refitting between loci at Bull Brook I (Byers 1956; Grimes 1979, 1983). Since band aggregates are not considered stable social units (E. Smith 1981; Weissner 1983), one might expect a fluid group composition at Bull Brook (a local resident group joined for shorter periods by smaller groups of extended-family members). Grimes is addressing the possible relationship between Bull Brook I and II in ongoing research (Grimes 1983).

Refitting of tool fragments between activity areas has been achieved at Debert, Vail and the Bull Brook sites. At Vail there is a strong case for three instances of contemporaneity between the kill site and habitation locations and two cases for habitation loci contemporaneity (of three areas in one case; two areas in the second) (Gramly 1982: 48). At Debert there were crossmends between Section D and other areas, but the number of matches was not reported (MacDonald 1968: 133).

The final means for estimating group sizes has been suggested in the Whipple site analysis, and in MacDonald's report on Debert (1968). The spatial distributions of materials and features within activity areas indicate occupation by one nuclear family or small work group in each of the Whipple site loci and an average of two such groups within each area at Debert (based on multiple hearths). MacDonald argues forcefully for contemporaneous use of those features, rather than recurrent occupation of the same location (1968: 133). At Bull Brook one or more diffuse charcoal lenses or pits were noted in each locus, but distributional information is unavailable (Grimes 1979). With the exception of locus E at Vail, no other reports mention multiple features (hearths or artifact distributions) suggestive of larger group activity areas.

If all loci were considered contemporaneous at each site, the known site distributions at Templeton, Whipple, and Vail would represent occupation by nuclear families or extended family groups (bands) of limited size. The recurrence of this group size is not unexpected, since ethnographic band size estimates average 25 people, a size large enough to serve as an effective cooperative social unit, yet small enough not to overexploit local food resources (Wobst 1974). It is this same social unit size that periodically fissions in response to resource fluctuations (E. Smith 1981).

The Wapanucket site distributions are of such low density that occupation was almost ephemeral. In fact, at least three loci may represent only randomly dropped items.

Site and Activity Diversity - Duration - Intensity

Templeton represents a very short-term habitation site, with the most focused site assemblage (Type III) (Figure 9). In comparison with the Whipple site, where activity counts are similar, it is clear that the identification of only one activity area is responsible, to a great extent, for such low assemblage diversity. Low tool diversity also may be a product of short occupation length, since sample size has been increased significantly by the presence of gravers, which are expedient tool forms, subject to rapid use, discard, as well as production.

Wapanucket counts and low assemblage diversity, if representative of the original clusters, suggest extremely short-term procurement or processing activities (Type I activity areas) and even randomly dropped items. Such distributions suggest the possibility that a larger site may have been in the site vicinity, from which occupants had been searching the area for subsistence items.

At the Whipple site low tool counts and distributions suggest short-term habitation locations, with a moderately diverse tool assemblage (Type II). Activity areas, however, vary considerably in focus, with manufacturing emphasis in Locus A and processing emphasis in Loci B and C. The detailed activity area descriptions provided earlier illustrate the possible problems in assuming all activity loci per site area are contemporaneous. Information on lithic material variation, as well as activity focus between clusters, will be important for improving contemporaneity or non-contemporaneity interpretations. In the Whipple site instance the suspected non-contemporaneity may reflect reoccupation of a favorable location at varying subsistence acquisition stages. It is likely the loci represent a similar seasonal span, given the local low annual energy budget, although they may have been produced in alternate years. Elsewhere, especially in more seasonally moderated locations (Bull Brook, Wapanucket), interpretations of assemblage variation would be more complex.

The Bull Brook sites I and II provide an interesting comparison of activity intensity and diversity in two spatially close locations. At Bull Brook II at least three activity areas are very similar to Wapanucket in terms of low tool diversity. However, the high numbers of endscrapers in these clusters clearly represent short-term processing activities (Type I clusters), rather than randomly aggregated tools. At least two of the remaining areas probably represent short-term habitation locations (Type II).

In the Bull Brook I sample, assemblage diversity is significantly higher, supporting an argument for categorizing the loci there as habitation locations (Type II). The varying quantities of artifacts, as well as features, per locus suggest a fluid group composition (band aggregate) in which lengths of stay differed among family groups.

The Debert assemblage contains the largest average number of tools per activity area. The site with the next largest inventory per cluster is Vail. There is an intriging correspondence between the identification of multiple hearths at Debert and close to a 2:1 ratio of tools found per locus there, in contrast to Vail. It strongly suggests the presence of a group size twice that at Vail activity areas, rather than recurrent occupations.

An alternative explanation might be related to an emphasis on intensive processing activities that increased sample size significantly. Site assemblage diversity estimates tend to support this latter interpretation. However, in the absence of a good lithic life cycle model, it is impossible to determine the extent to which samples are reflecting this process or are the result of longer occupation duration. A final problem may have been created by the amount of pre-excavation damage to many of the Debert activity areas. The activity loci, regardless of sampling and analytic difficulties, represent habitation locations, most of which contain relatively focused assemblages (Type III areas), and considerable processing intensity or duration.

The Vail assemblage is the most diverse in this study, and thus is the best candidate for a Type II location designation. The loci represented in this analysis are all habitation locations, although Gramly has defined a special purpose area in the site vicinity (his killsite). High assemblage diversity may be a reflection of the fact that site location was as much a product of intentions to acquire raw materials for toolkit refurbishment from a nearby quarry source, as it was the result of subsistence acquisitions. That is to say, site location selection incorporated more than positioning for acquisition of a specific, productive food resource.

The histogram patterns for individual loci, however, force one to consider the probability that tool identification and counting methods played a large part in producing the high diversity measure at Vail. An attempt was made to estimate the number of gravers that had been combined to produce the "cutter" category in the Vail assemblage (Gramly pers. comm. 1983). Combined with the extreme care taken in counting, the identification rates for the graver-cutter category undoubtedly were well above average. Comparison of counts with other site assemblages tends to confirm this suspicion.

The histograms also indicate that even the least focused assemblage is still a product of a relatively limited number of resource extraction and processing behaviors. The pronounced differences in resource availability over a yearly cycle in New England, and especially at the tundra-woodland border during the Late Pleistocene, would result in such site emphasis. Focused assemblages need not imply focused Paleoindian resource procurement behaviors, however. At issue is the extent of Paleoindian residential mobility. If confined to a limited exploitation territory, under conditions of resource stress, the Paleoindian groups would need to increase the diversity of resource acquisition strategies, within the available resource mix. The alternative would be to "outrun" this variability, through fluid group sizes and considerable movement over an open, broad annual exploitation territory. The nature of the Paleoindian assemblages indicates that the latter solution was a primary one.

Model Assessment

As anticipated, the majority of the sites in this study represent short-term occupations, if interpretation of activity area structuring at Debert and Whipple are correct. However, there are significant differences in the sizes of occupying groups, not all of which fit model expectations. At Debert multiple features suggest larger nuclear unit sizes; possibly extended family work groups, organized for some intensive resource processing. A possible site size similar to Bull Brook indicates considerable predictability of resources, at least on a seasonal basis. Late Pleistocene instability did not appear to limit at least short-term, relatively intense resource processing activities.

The tool assemblage proportional frequency similarity between Vail and Debert, in tundra-woodland border relationships, suggests exploitation emphasis on similar resources. However, tool assemblage sizes and distributions indicate that there was a more productive and/or more predictable resource base in the Debert site area, permitting larger minimal group sizes than at Vail, and possibly repeated occupations over a considerable timespan. Unfortunately, one cannot establish firmly the contemporaneous group sizes at Debert.

Within the Late Pleistocene spruce woodland and transitional forest environments site distributions probably represented small, dispersed families or bands, as predicted. The exception is Bull Brook, where band aggregation may have taken place.

The Use of Resource Space

The site occupation at Bull Brook I, based on the current sample, resulted in lower numbers of tool discards per locus than at either Vail or Debert, despite the probable contemporaneity of a band aggregate. The lower numbers may be a product of a different assemblage composition, perhaps indicative of seasonal, environmental as well as social organization differences. A winter aggregation would explain many of the current observations, including the relatively high assemblage diversity at Bull Brook I, and the proximity of Bull Brook II. Population clustering would most likely occur during the period of greatest resource stress. That stress would force incorporation of a relatively diverse series of resource acquisition strategies. The same conditions would make a fluid group size particularly advantageous. Aggregation would permit the sharing of resources and information as needed. The identification of beaver bone, in addition to caribou, at Bull Brook I continues support for this argument (Grimes pers. comm.).

The use of caribou by Paleoindians is undeniable, since calcined bones have been identified at both Bull Brook and Whipple. However, in the Whipple site area associated woodland-forest habitats would have restricted caribou group sizes significantly. The case is less clear for Bull Brook, since rapid sea level lowering may have expanded open and semi-open habitats considerably in the site vicinity (Oldale 1983). While marine resources may have been very unpredictable, as Oldale suggests, terrestrial resources undoubtedly were more productive than in interior New England environments, due to expanded edge environments. Contrary to the expectations of Oldale, which are based on a marine resource exploitation emphasis, the coastal plain environments, in locations in the wake of retreating sea levels, may have been particularly productive ones for terrestrial resources, and thus Paleoindian occupations. A shallow sea covering the continental shelf also would have had ameliorating effects on local climate.

The possible similarity in total site sizes at Debert and Bull Brook deserve special consideration. Although there is no geologic reconstruction of sufficient detail in the Debert region, a similar situation may have existed there. More detailed descriptions of local habitat characteristics and Paleoindian site locational site strategies is planned (Curran 1984b).

Evaluation and Future Research Needs

Paleoindian occupants of New England and the Maritime Provinces left behind evidence of a diverse set of flexible resource extractive and social organization strategies, which may have included considerable territorial mobility. Such behavioral flexibility, incorporated fully within a cultural system, would assure long-term persistence of social units. If thoroughly incorporated, such techniques may appear conservative in nature. Contrary to being equatable with rigidity, however, a well-selected suite of practices could be very effective stablizing mechanisms for dealing with environmental perturbations. As a result, what may appear to be "slavishly repetitive" behaviors (Gramly 1982: 51)—carefully selected resource locations that allow maximum access to a diverse resource base keeping group sizes well below biomass limits; and a standardized toolkit—would be extremely effective means for countering resource stress. Such practices would be optimal solutions to Late Pleistocene conditions in New England.

One must recognize that this framework represents only the beginning stages of an attempt to explain Paleoindian materials and behaviors. Future research must incorporate thorough modelling of processes affecting the archaeological record, including a standardized approach to tool inventory. It is especially important to determine the degree to which tool assemblage diversity is a product of lithic life cycles variables (raw material access, manufacturing processes, use, discard, and recycling rates), the functional flexibility of the assemblage, or organizational strategies related to subsistence and social needs.

Grimes presents a model of the potential social relationships among the Whipple, Bull Brook, and Wapanucket sites, and other Paleoindian groups (1983). Detailed comparison of the materials from the Bull Brook and Whipple sites will help refine those intersite relationships, while lithic material typing and sourcing holds great promise for improving understanding of territorial ranges and accompanying social structures.

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I accept full responsibility for abusing other people's data in an attempt to make tool assemblages more comparable.

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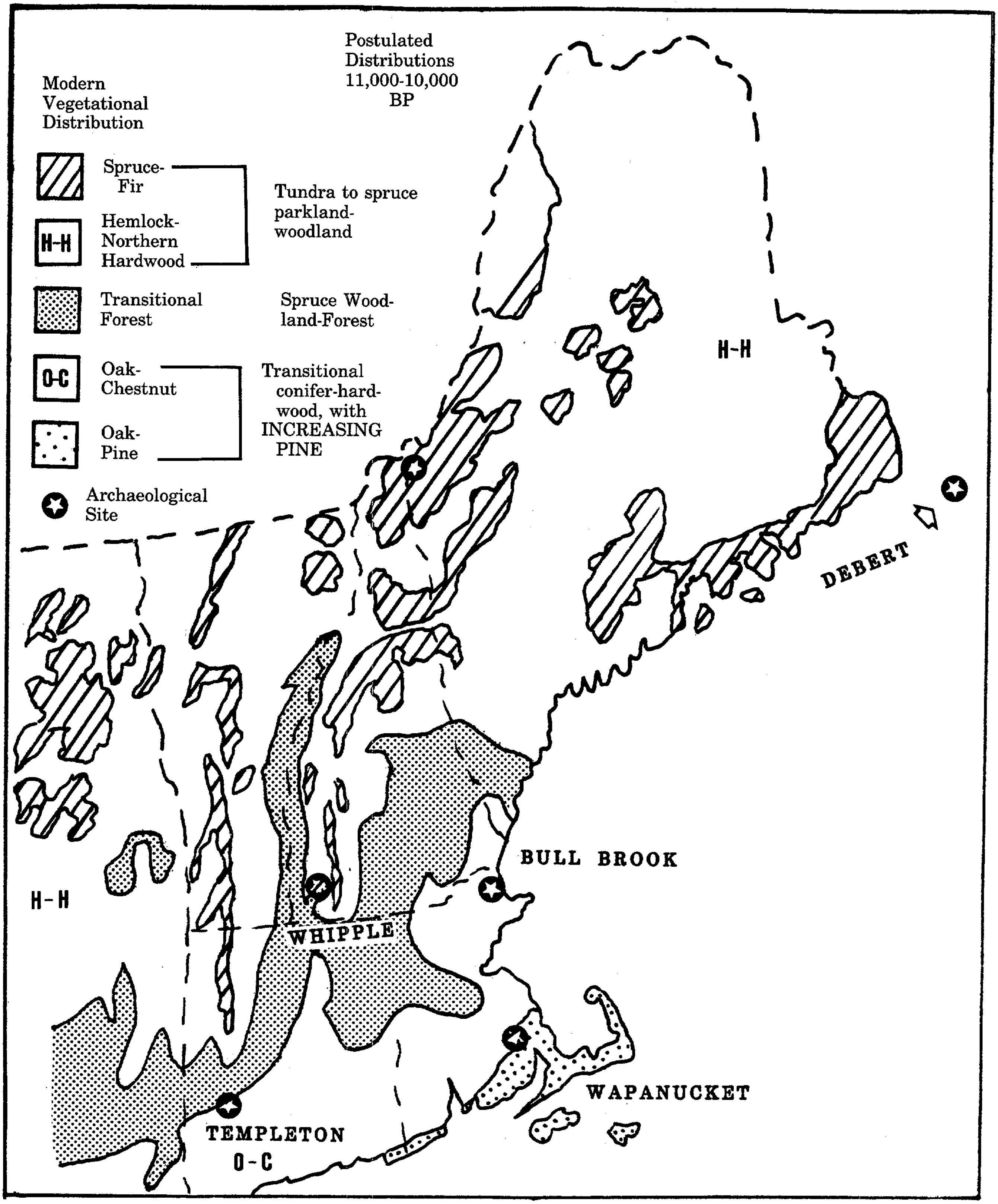

FIGURE 1. Potential natural vegetation of New England, past and present. Based on Livingston (Kuchler) 1968; M. Davis *et al.* 1980; R. Davis 1981; D. Gaudreau 1982; R. Mott 1975, 1977; M. Winkler 1982.

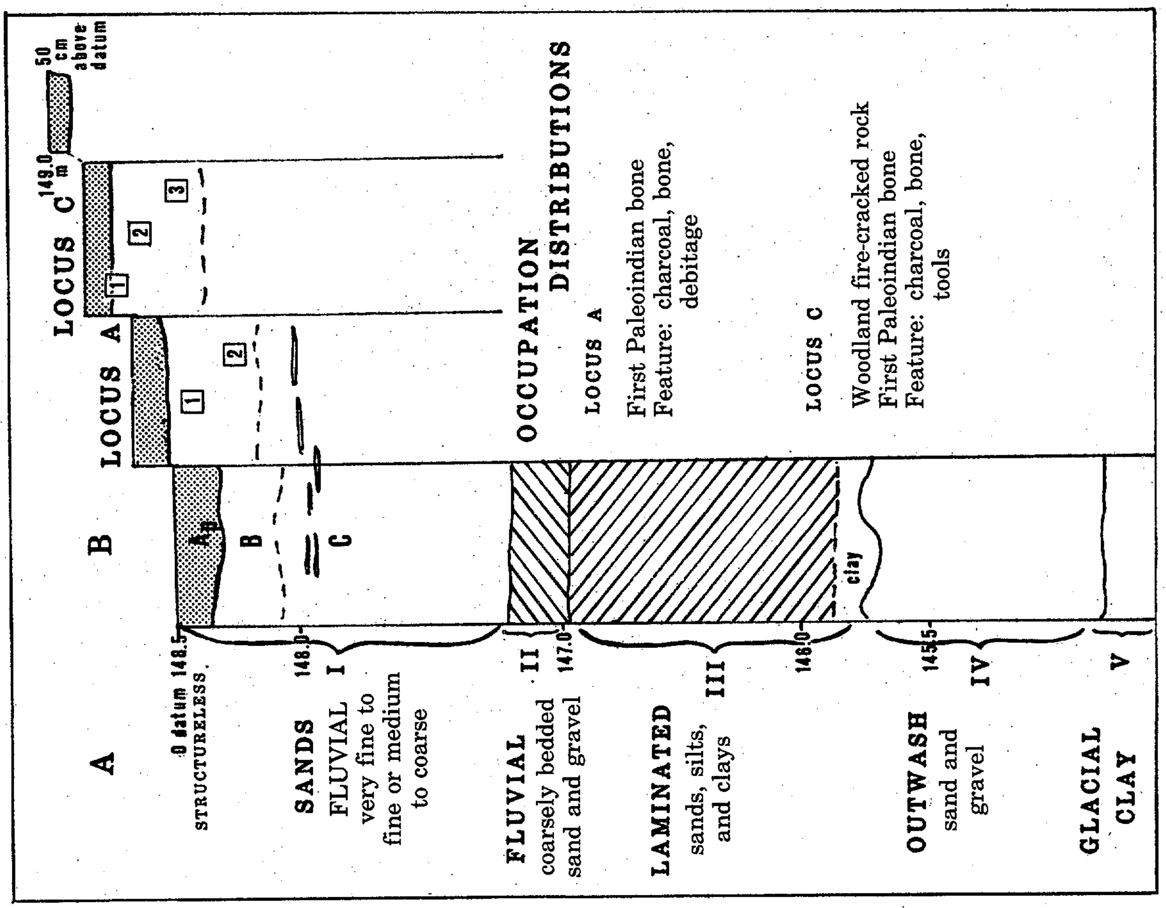

FIGURE 3. Schematic section of Whipple deposits:
A. Structural horizons
B. Soil horizons

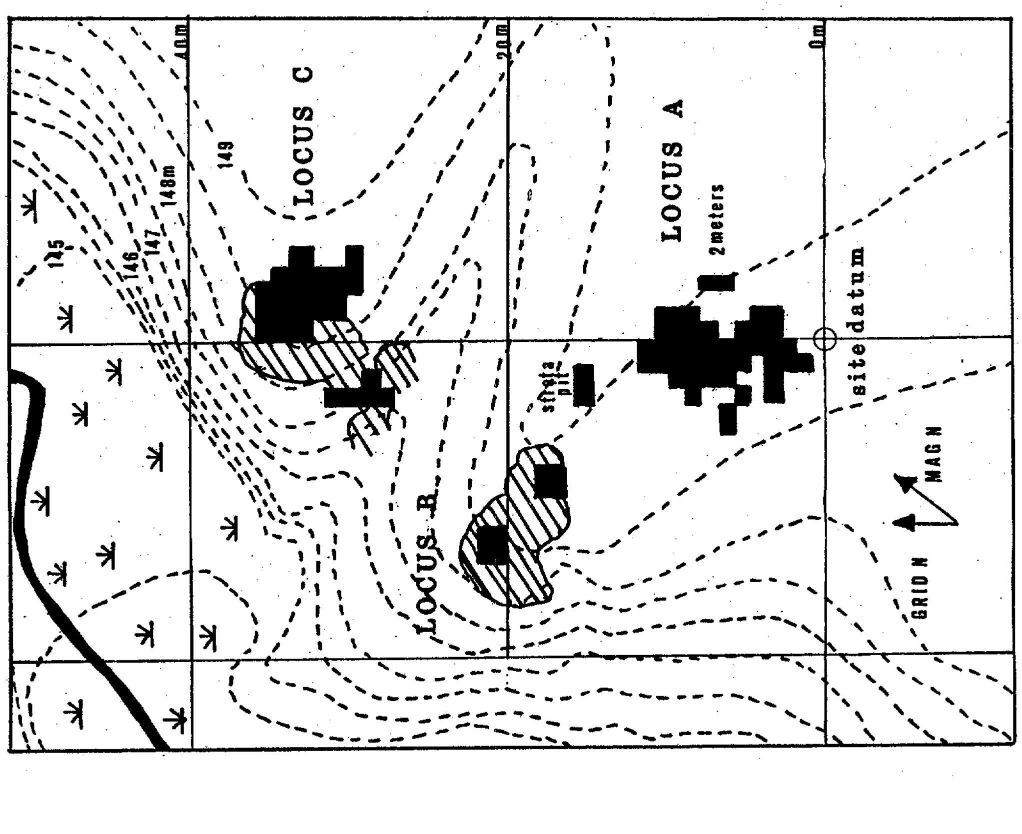

FIGURE 2. The Whipple site activity area distributions—Loci A, B, and C. Topographic mapping by Brian Robinson.

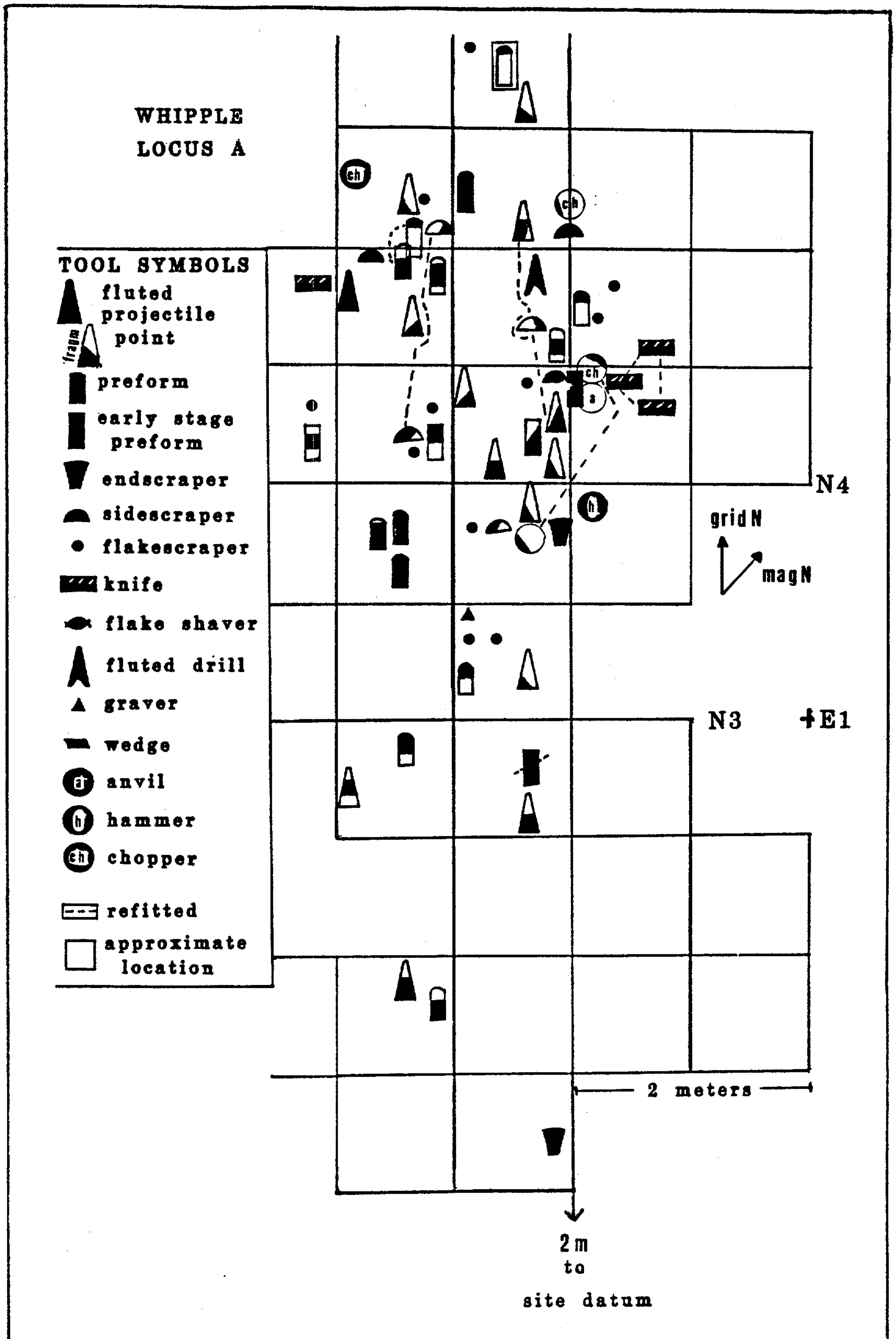

FIGURE 4. Tool and tool fragment distribution, Locus A

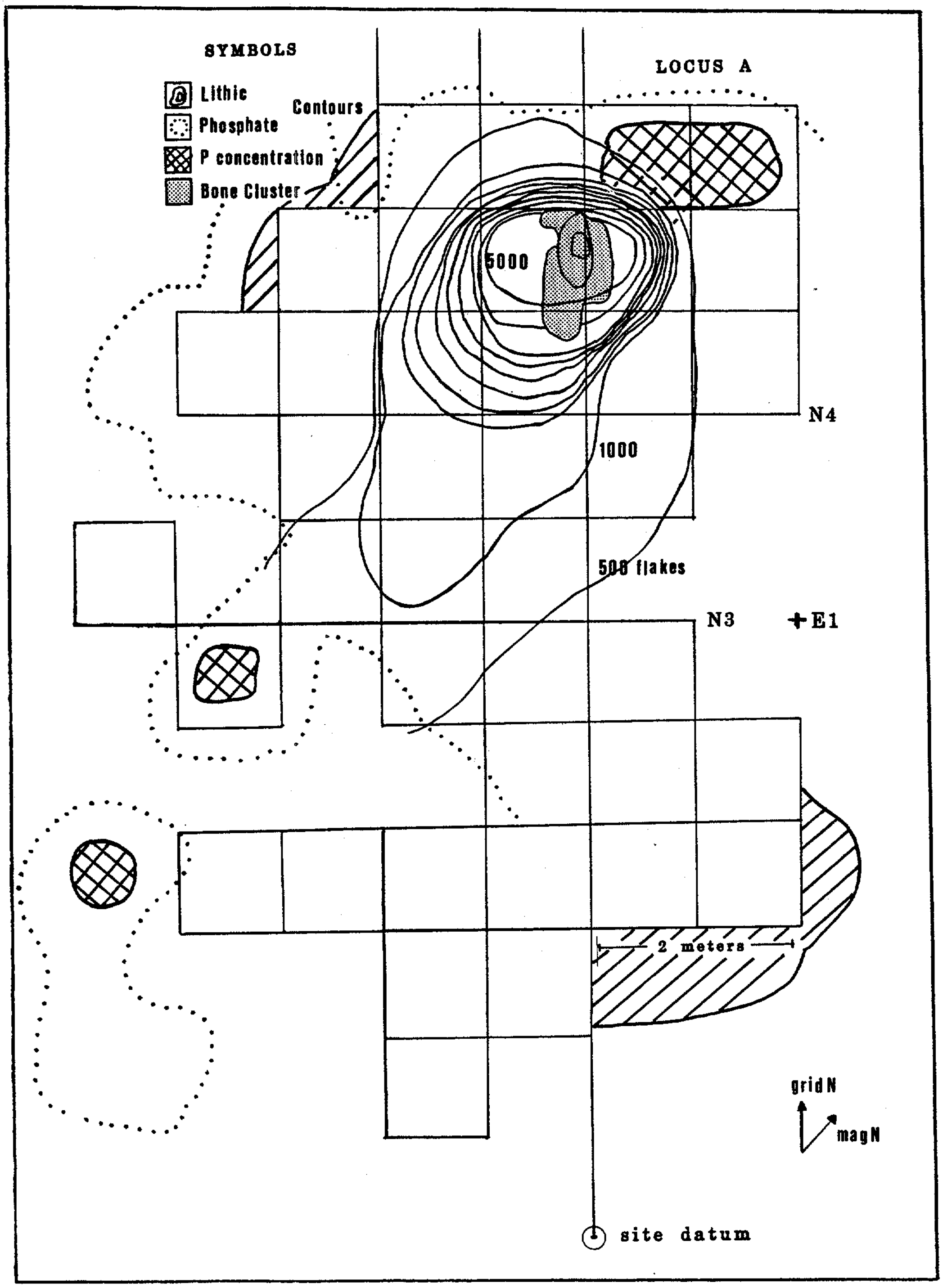

FIGURE 5. Debitage, bone, and phosphate distributions, Locus A

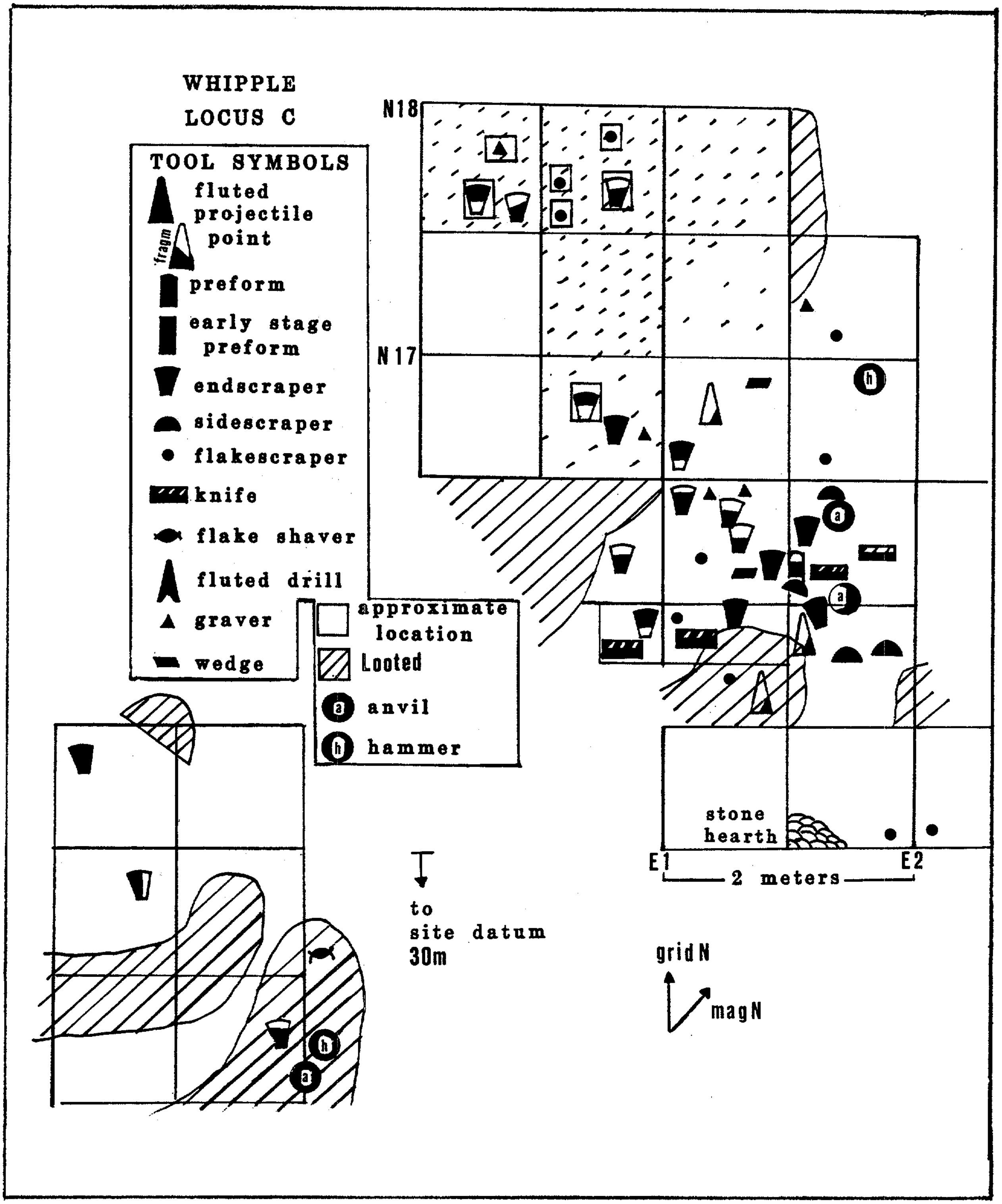

FIGURE 6. Tool and tool fragment distribution, Locus C

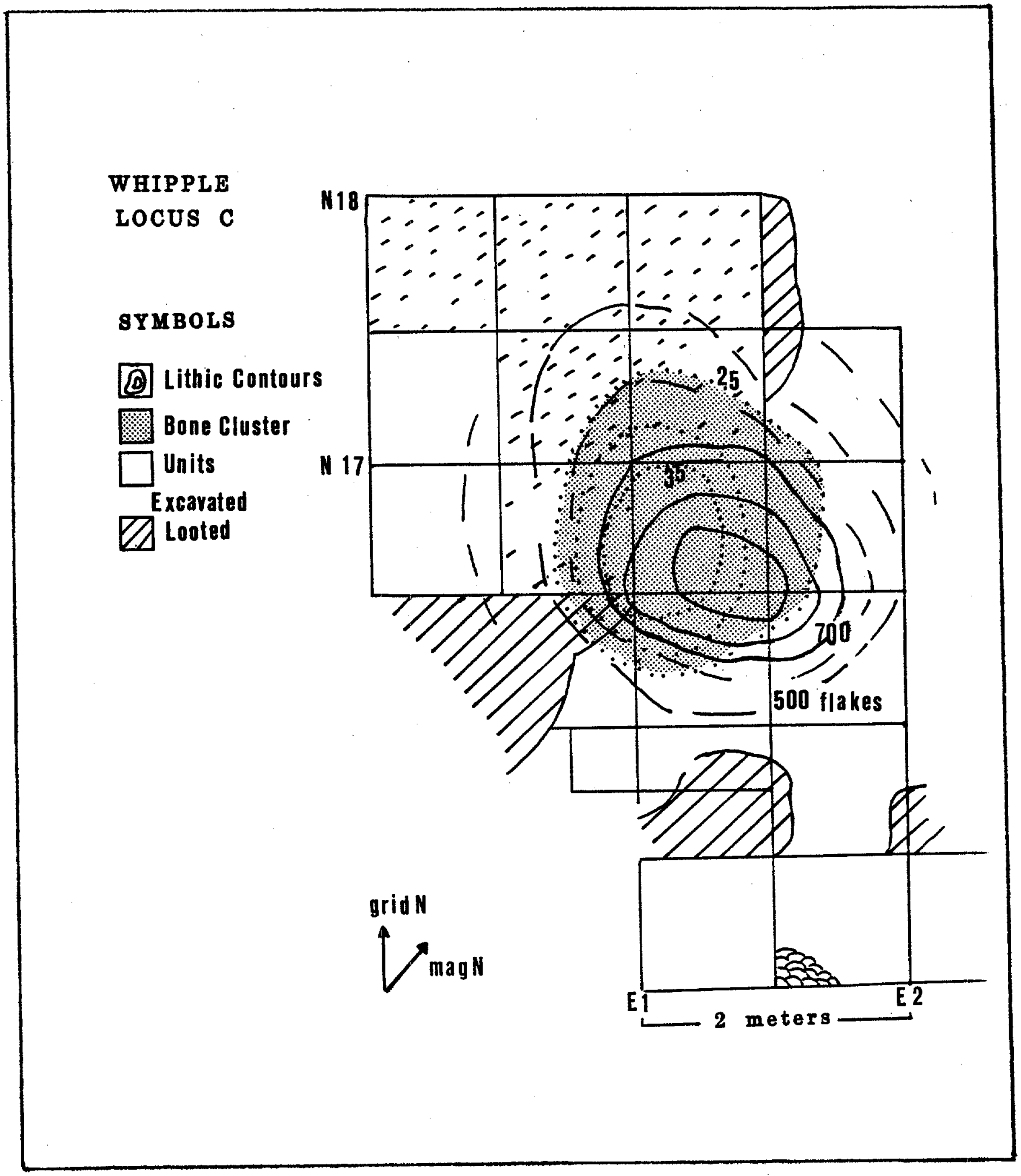

FIGURE 7. Debitage and bone distributions, Locus C

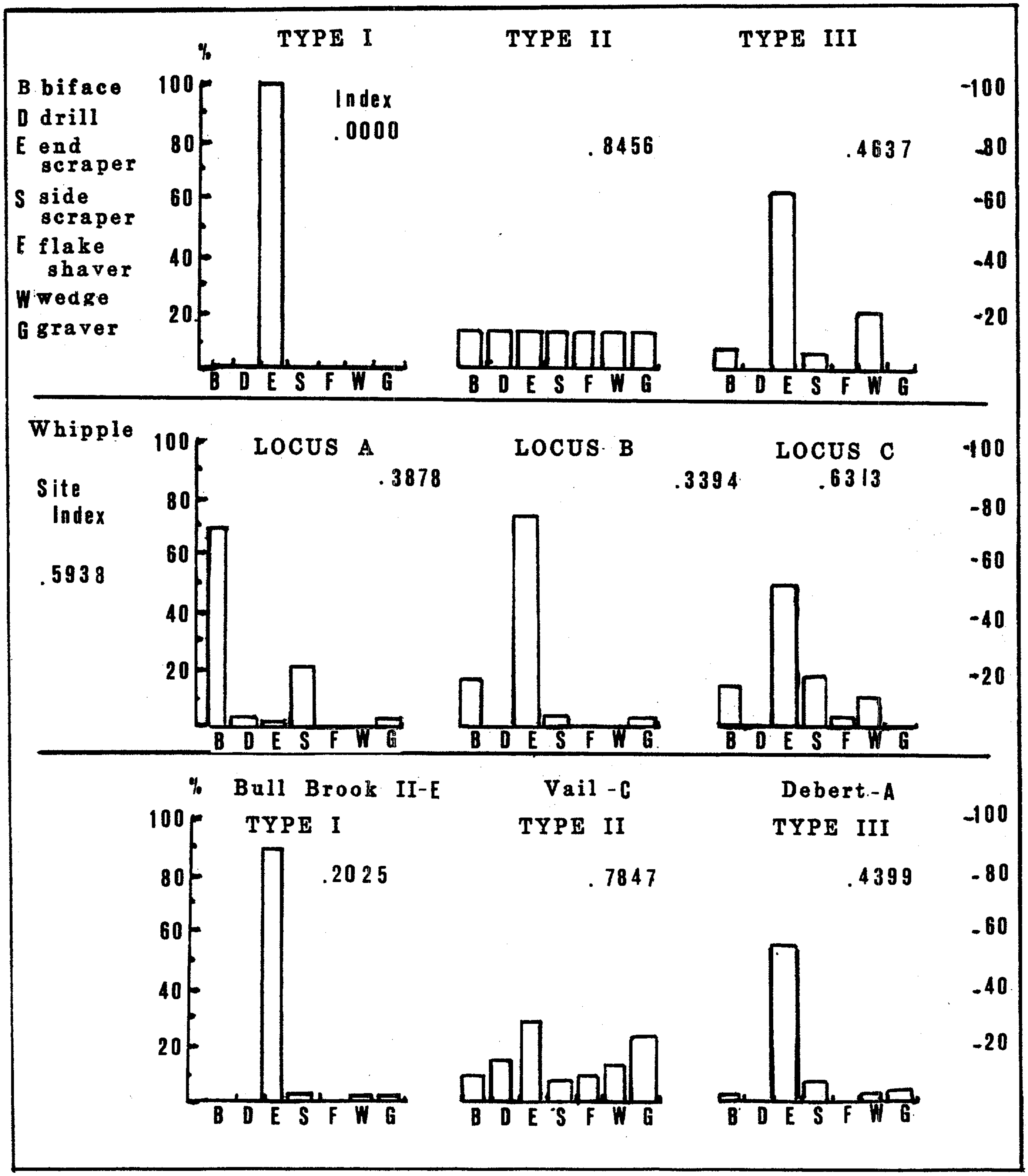

FIGURE 8. Tool assemblage proportional frequency histograms.
A. Ideal histograms for Type I, II, III activity locations, with diversity indices.
B. Whipple Loci A, B, C
C. Bull Brook II, Type I; Vail, Type II; Debert, Type III

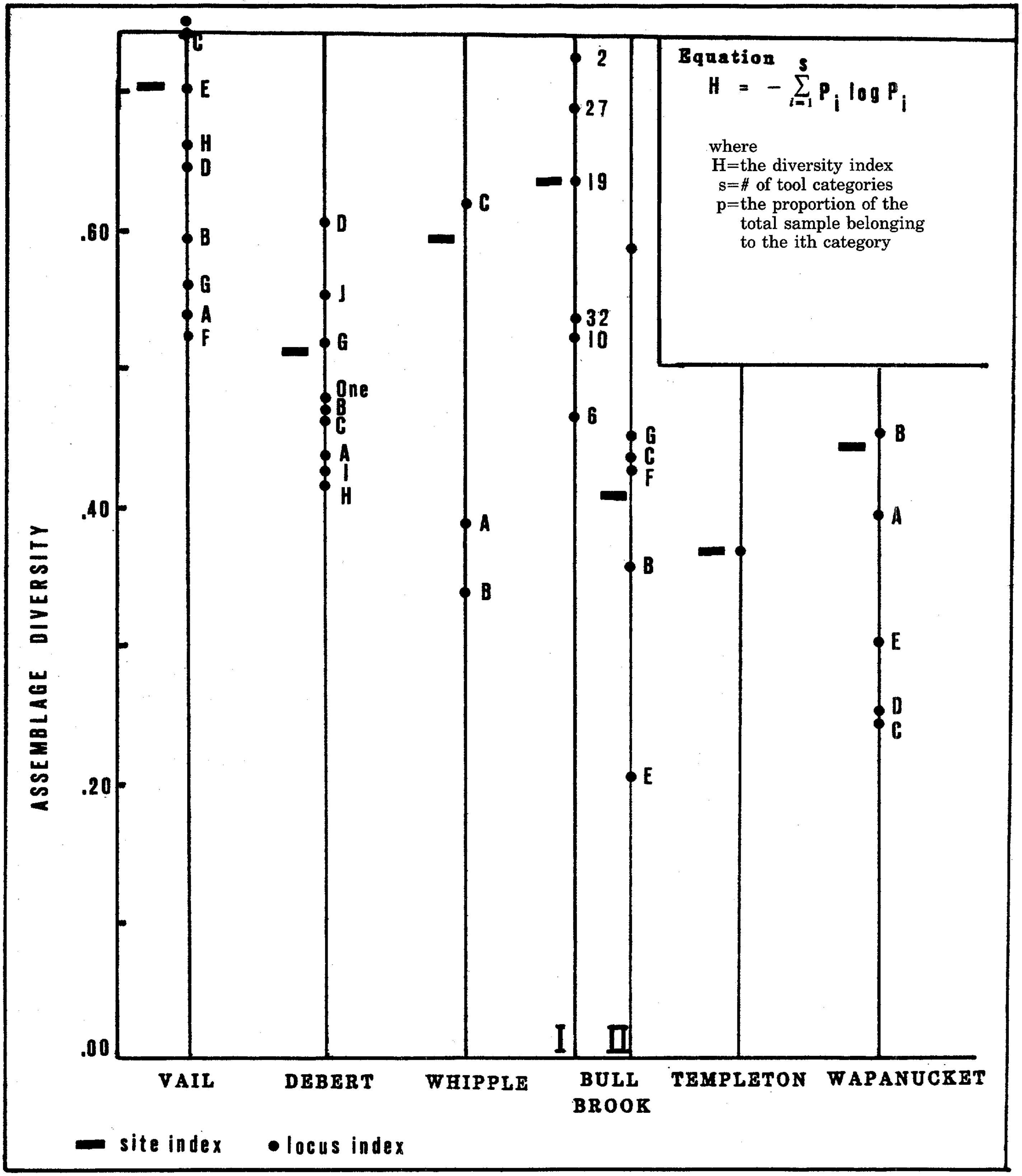

FIGURE 9. Site and loci diversity indices and Shannon-Weaver information theory equation.

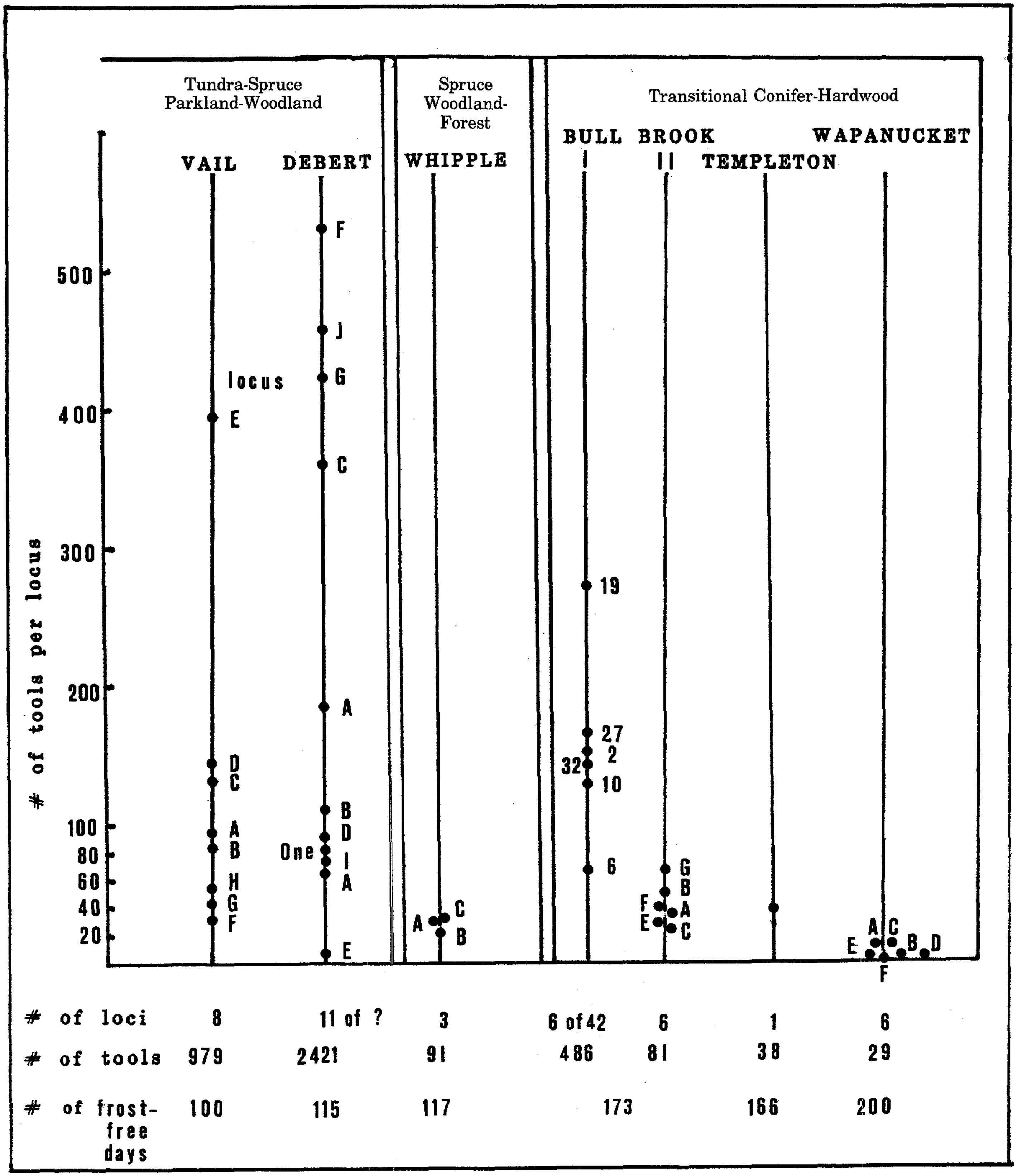

FIGURE 10. Tool assemblage sizes and associated environments. Based on seven tool types.

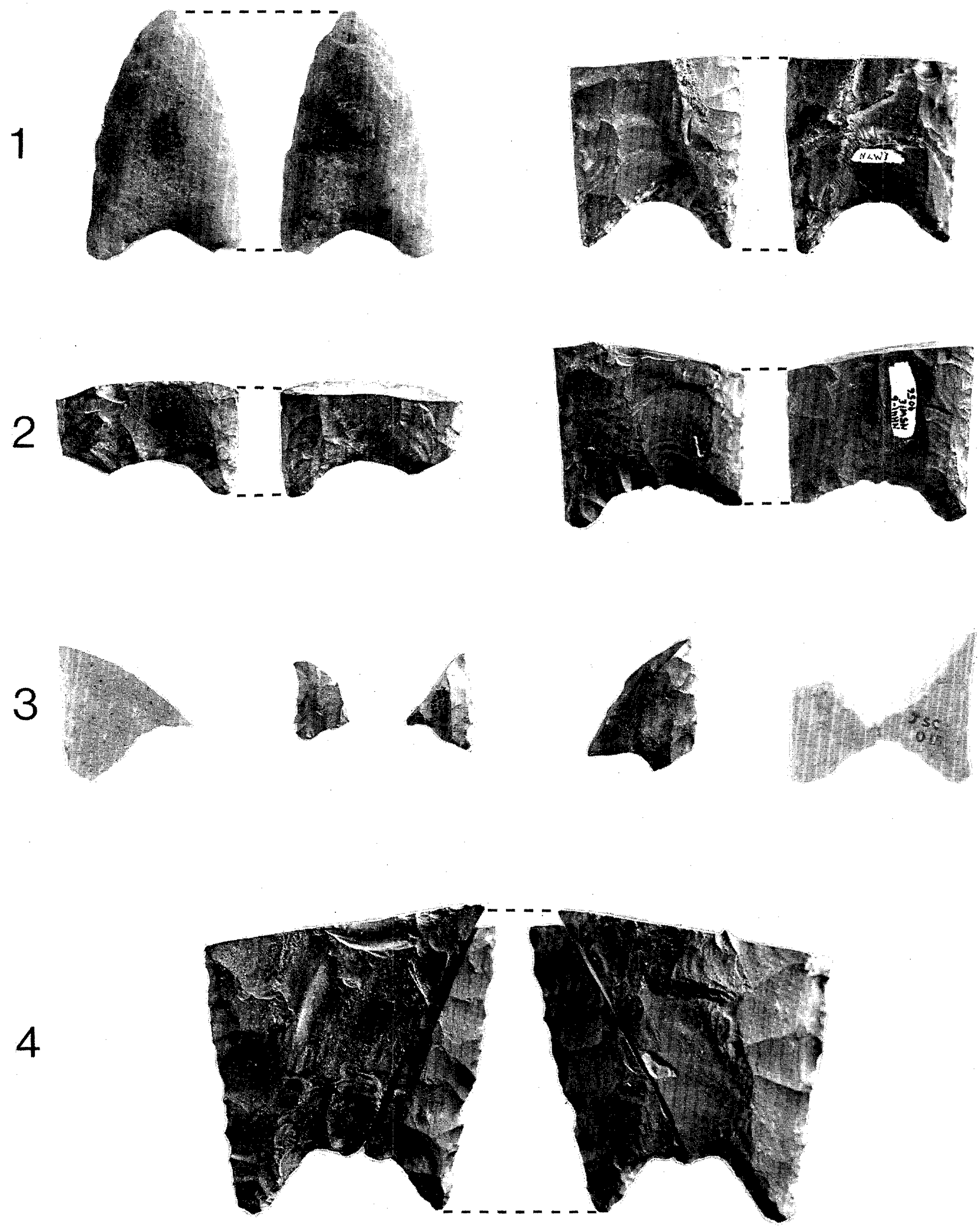

PLATE 1. Fluted projectile point (row 1, left), fluted projectile point basal fragments (row 1, right; rows 2 and 3) and large late-stage projectile point preform base (row 4). Whipple Site. (Actual size)

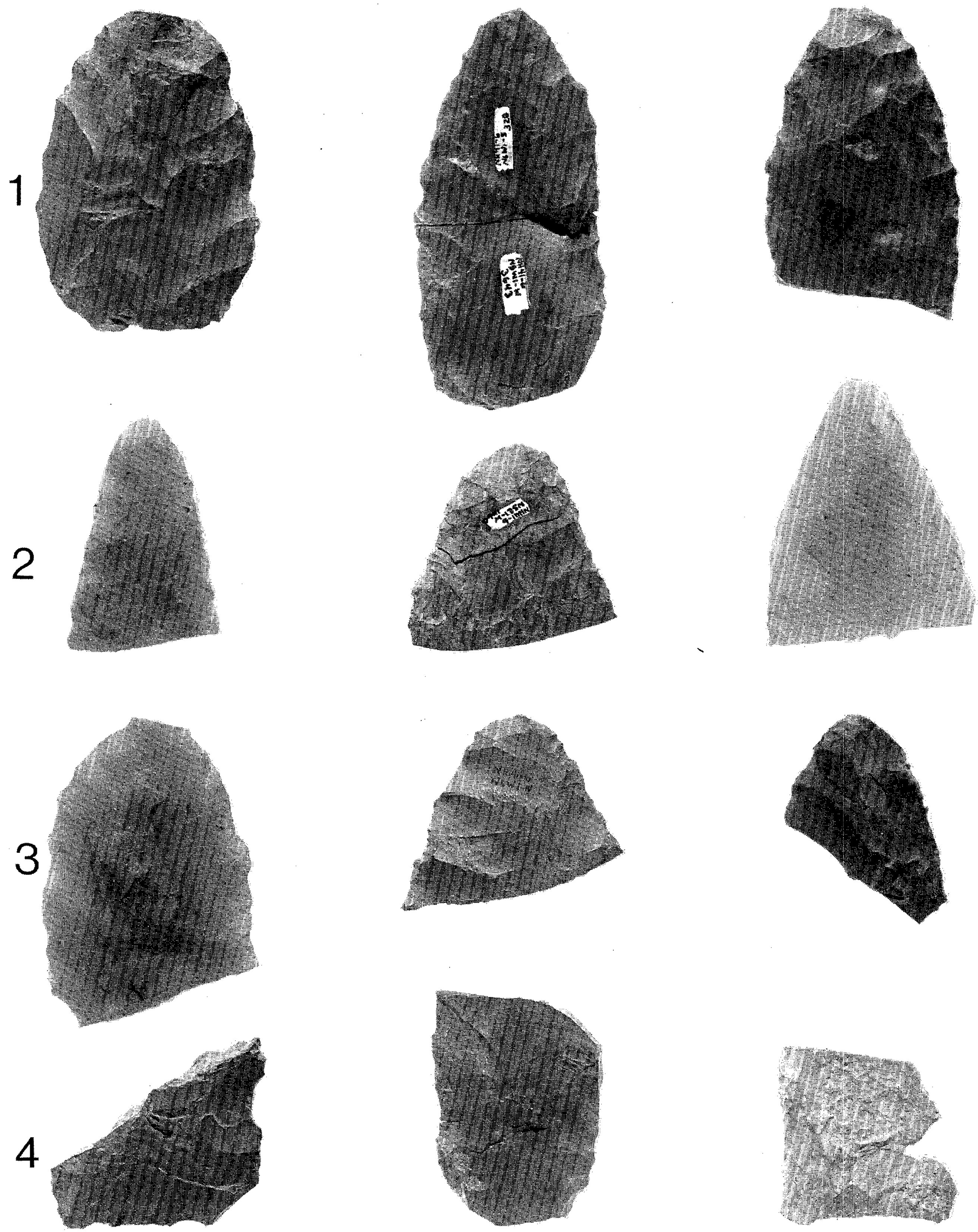

PLATE 2. Projectile point preforms (row 1, left and center) and fragments (row 1, right; rows 2-4). Whipple Site. (Actual size)

PLATE 3. Side scrapers. Whipple Site. (Actual size)

PLATE 4. End scrapers and fragments. Whipple Site. (Actual size)

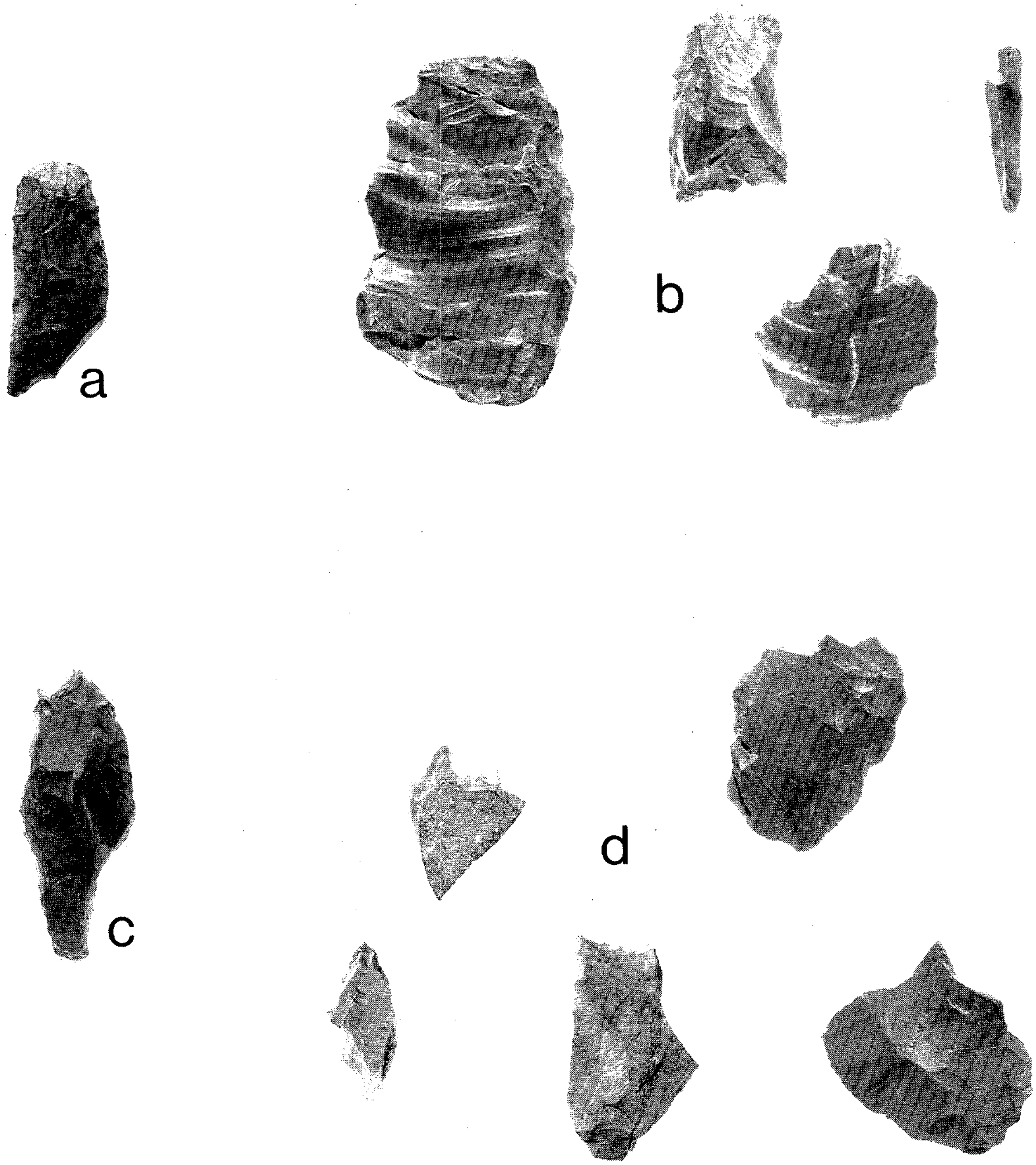

PLATE 5. Fluted bifacial drill (incomplete; a), wedges *(pièces esquillées)* and fragments (b), flake shaver (c) and gravers (d). Whipple Site. (Actual size)

PLATE 6. View of the Whipple Paleoindian site under excavation. Loci A, B, and C are shown by arrows. In the foreground is the Ashuelot River.

Table 1. Settlement and Site Implications of Risk-Reducing Strategies in Late Pleistocene New England

I. Environment and Resources

Frost-Free Days	Habitats		Resource Variability and Availability	Tundra-Parkland	Spruce Woodland	Transitional Conifer and Hardwoods
	Northern	*Interior*				
100	Vail		Limited; food-getting strategy is focused	Vail		
115	Debert			Debert		
117		Whipple			Whipple	
	Southern	*Coastal*				
173		Bull Brook	More diverse; food-getting strategy less focused			Bull Brook
166	Templeton					Templeton
200	Wapanucket					Wapanucket

II. Settlement Implications

Population Density		Occupation Duration		Group Size		Tundra Parkland	Spruce Woodland	Transitional Conifer & Hardwoods
Low	*Higher*	*Short*	*Moderate-length*	*Small*	*Moderate*			
Northern Interior		Northern Interior		Northern Interior		Short occupation and larger group size	Moderate-length and small group size	Moderate-length occupation and larger group size
	Southern Coastal		Southern Coastal		Southern Coastal			

III. Settlement Implications Under Conditions of Resource Instability*

Population Density	Occupation Duration	Group Size	Tundra Parkland	Spruce Woodland	Transitional Conifer & Hardwood
Decreasing everywhere; limited number of sites	Decreasing everywhere; small sites are predominant	Decreasing everywhere	smaller site size and short occupation	smaller site size and short occupation	smaller site size; moderate-length occupation

*Increased mobility and use of many environments result; locations of sites (settlements) are selected carefully for maximum diversity of resources.

Table 2. Site and Tool Assemblage Characteristics

Site Name	Site Size (in square meters)	Total # of Artifacts	Total # of Loci	Number of Tools per Locus	Loci Sizes (in square meters)
Vail	1500	979	8	122	50
Debert	8464 (28329 including scattered loci)	2421	11 of ?	220	90
Whipple	875	91	3	30	57
Bull Brook I	7854	486 of 3,500+	6 of 42	81	49
Bull Brook II	525	81	6	14	25
Templeton	54+	38	1	38	54+
Wapanucket	2700	29	6	5	122