FOR RICHER OR POORER:
ANALYZING SIERRAN REDUCTION ASSEMBLAGES

William W. Bloomer
Placerville Ranger District
Eldorado National Forest
4260 Eight Mile Road
Camino, CA 95709

ABSTRACT

As Sierran archaeologists our research areas are comprised of hundreds of lithic reduction assemblages. Whether data rich or data poor, each assemblage is a piece of our prehistoric puzzle and should be afforded appropriate attention. A technological approach to the analysis of all lithic assemblages elucidates the variable reduction modes that reflect local and regional settlement, subsistence, and economic behaviors. Results of current investigations on the Eldorado National Forest exemplify various sample and data collection methods, assemblage variability, and research advancements.

INTRODUCTION

The topic of this paper is lithic analysis. Its focus is the application of technological analysis to initial site recordation and National Register Criteria evaluations. Two case studies illustrate technological methods being used in both of these contexts on the Eldorado National Forest (Figure 1). Both are exemplary of preliminary efforts to develop useful and do-able methods for recording and analyzing Sierran lithic assemblages. This methodological expansion is directed towards assessing and advancing the theoretical contribution of lithic assemblage data to local and regional research.

Academic concerns are increasingly becoming management concerns within research areas administered by government agencies such as the Eldorado National Forest. Some lithic assemblages on those lands are "data rich" and some are "data poor", but they all hold some amount of information and must be managed from a knowledgeable perspective. In the high Sierra, reduction assemblages and the organization of lithic technologies are our most accessible and tangible connection to the behavior of prehistoric populations (see Kelly 1988:717).

The use of technological analysis in the Cultural Resource Management of lithic assemblages blends appropriate academic research within the context of administrative needs.

Lithics are often the predominant artifact of prehistoric sites in the high Sierra, and lithic debitage are often most frequent. Traditionally, chipped stone tools have been afforded the most attention, though they are usually less frequent, and within the structure of many Sierran assemblages their associations are not spatially distinct. Unless associated with an on-site food processing assemblage, the spatial distribution of a few chipped stone tools doesn't necessarily represent the spatial distribution of the activities associated with their use. In contrast, debitage assemblages are characteristic of particular reduction techniques used in tool production and maintenance at their immediate location.

The lithic assemblage of most high Sierran prehistoric sites is essentially a reduction assemblage, often a composite of several reduction events employing different techniques to knap various toolstone materials towards a desired product. Technological analysis of debitage and manufacture

Proceedings of the Society for California Archaeology, 1993, Vol. 6, pp. 49-65.

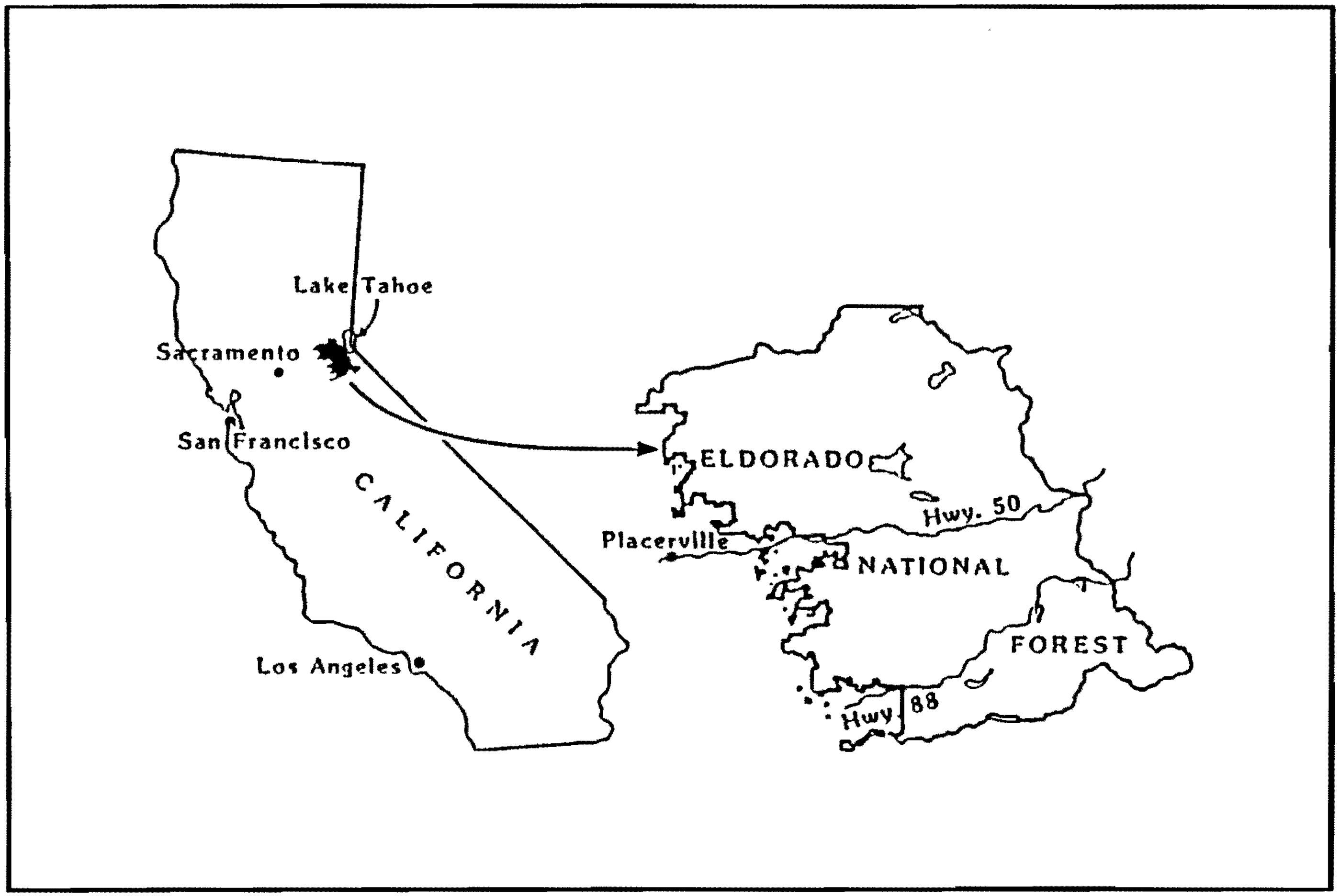

Figure 1. Location map, Eldorado National Forest.

failures, as well as finished tools, suggests the kind and frequency of reduction activities which occurred to create a site's lithic artifact assemblage.

The field of technological analysis has enjoyed an energetic history of development (Johnson 1978), which continues as its application becomes common and more diversified (Bloomer and Ingbar 1991). Various approaches and applications are not without controversy (Thomas 1985); but controversy serves as a theoretical stimulant. Technologists don't all agree on analytical methods, but whether you measure a dozen attributes (Mauldin and Amick 1989; Ingbar et al. 1989) or chunk each specimen into a typological "shoebox" (Bonnichsen 1977; Flenniken 1978, 1981, 1987; Flenniken and Ozbun 1988; Young and Bonnichsen 1984) the interpretive premise is similar. That is, that debitage retain as attributes the evidence of reduction processes. Hence, flakes or more appropriately flake assemblages are diagnostic of reduction techniques and the various stages or steps along what is often a continuum of flake removals (Crabtree 1972).

Recent investigations at 2 site locations point up the often overlooked spatial integrity of variable reduction assemblages and the untapped interpretive potential of technological analysis. Both of the investigated sites are set in the upper Red Fir zone, at approximately 7600 ft, and within 2 miles of each other.

CASE STUDIES

Case 1

Case 1 concerns the Buck Pasture Site, situated in a low saddle on a ridge system that divides the upper reach tributaries of the Silver Fork and the South Fork of the American River (Figure 2). The site is a complex of 4 loci with artifact concentrations and bedrock mortars, connected by a widely dispersed scatter of flakes (Figure 3). All loci border the east margin of a wet meadow known as Buck Pasture.

The site was originally recorded during the reconnaissance of a proposed recreational trail reconstruction. The trail is to be rerouted around this meadow and straight through site locus D on the far side. Increased recreational use, including camping, will impact the entire area. Therefore, the site is being evaluated for National Register significance.

Various sampling methods were employed during testing. Initial subsurface excavations at most loci were limited, testing for depth and general artifact density. Subsequent investigations have used intensive surface recordation to recover technological reduction data, and have expanded testing to incorporate a representative sample of surface scrape units and subsurface excavation units. Technological analysis of recovered artifacts and surface data indicate spatially distinct and variable reduction events occurred at each locus.

Reduction variability can be graphically represented using ogives (Figures 4, 5, 8 and 10), which are line graphs of cumulative percentages (Thomas 1986); in this case percentages of flake types. Ogives indicate the contribution of each flake type to the analyzed reduction assemblage. Relative proportions of flake types indicate reduction technologies (Intermountain Research 1992:241-242).

Figure 4 represents 2 separate reduction assemblages within locus A. The upper line illustrates the analytical results for unit 1 and suggests core reduction activities. Basalt core reduction is indicated by a predominance of basalt interior flakes (at 80%) with cortical flakes comprising the remaining 20% of the sample. The definitions for flake terminology used here are in accordance with other lithic analysts (Crabtree 1972; Flenniken 1987; Flenniken and Ozbun 1988), and the analytical approach is straightforward in that flake types, such as biface thinning flakes, are diagnostic of reduction technique. Interior flakes are the exception.

Interior flakes have no dorsal cortex and lack the characteristics for confident assignment to any of the other more definitive flake categories. Interior flakes are essentially a wildcard in analysis. Their frequency relative to other flake types and a consid-

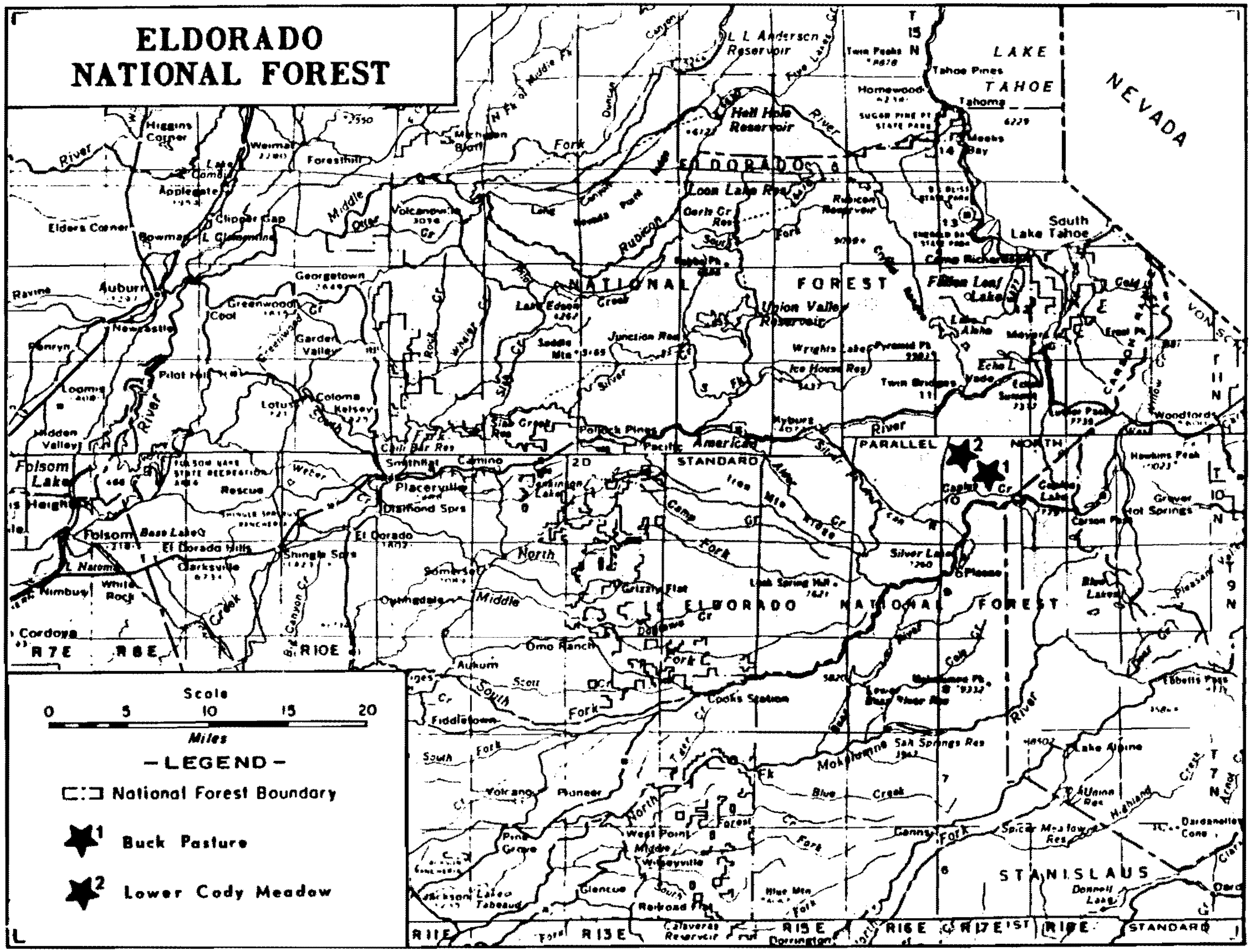

Figure 2. Project location map: 1 = Buck Pasture Site, 2 = Lower Cody Meadow Site.

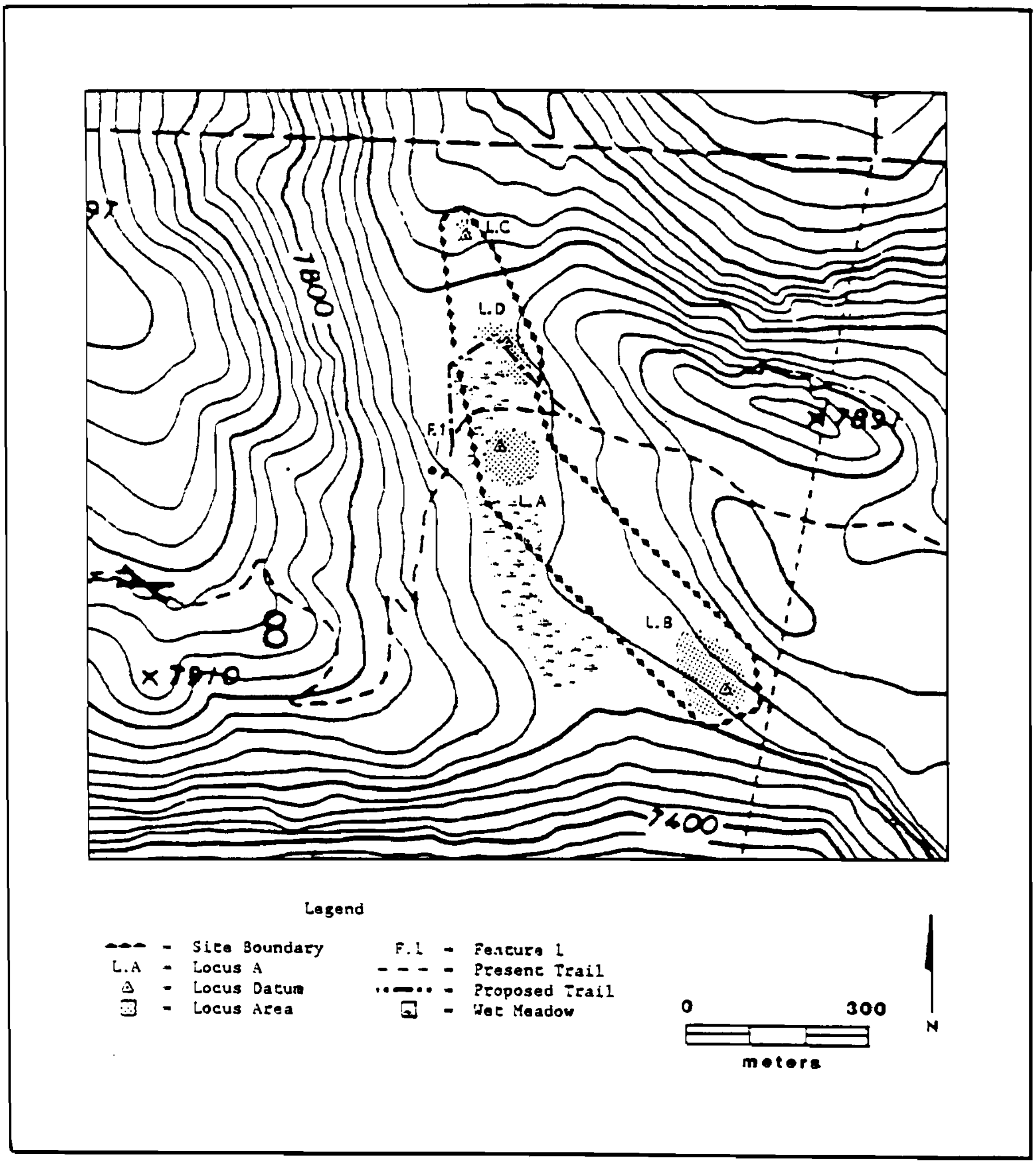

Figure 3. Buck Pasture Site map.

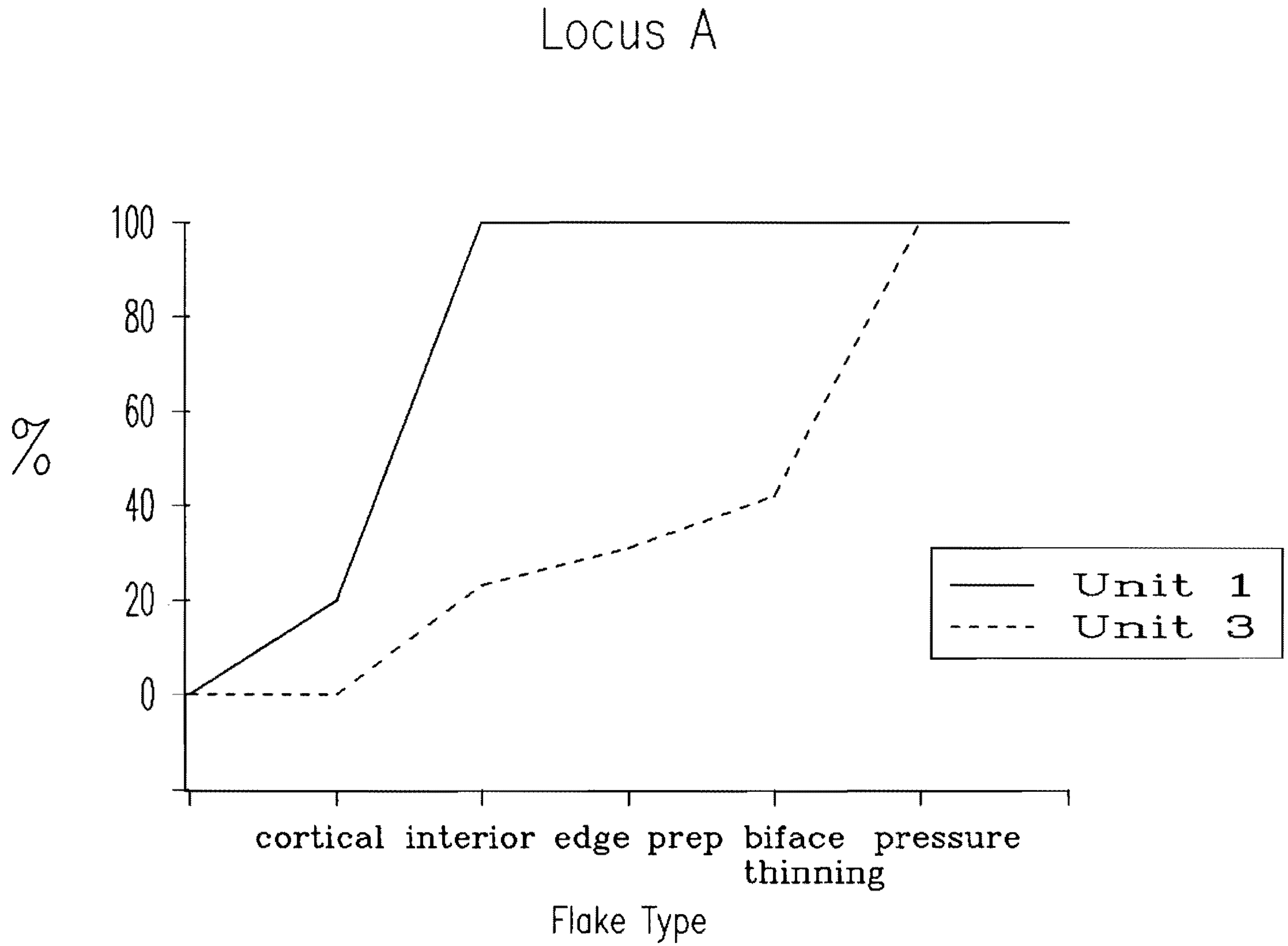

Figure 4. Cumulative proportions of flake types; Locus A, Units 1 & 3.

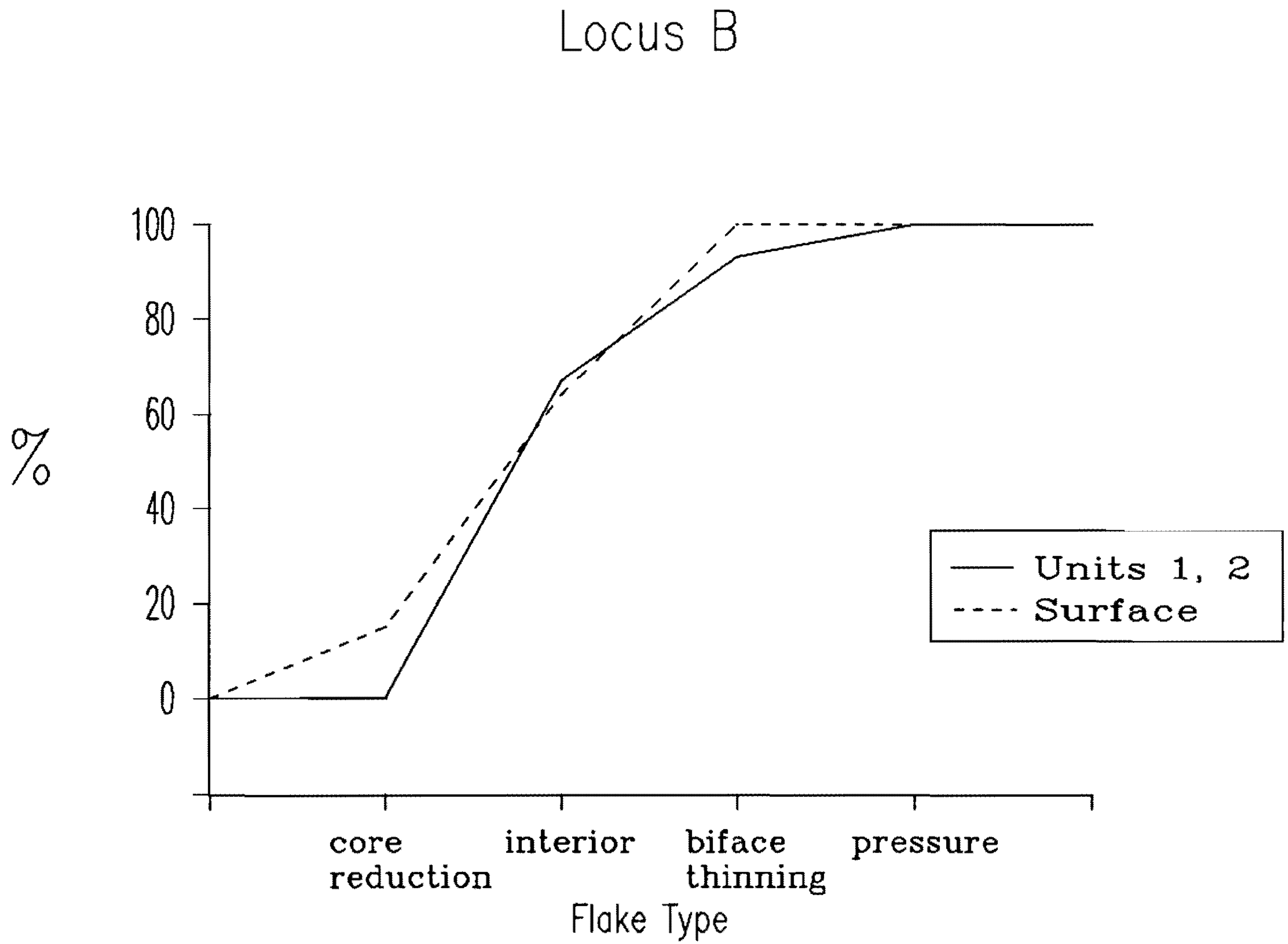

Figure 5. Cumulative proportions of flake types; Locus B, Units 1, 2 and surface.

eration of their platform characteristics can be decisive factors in an analytical conclusion.

Contrast the upper line in Figure 4 with the lower line, which represents the analytical results from locus A, unit 3. In unit 3 a small percentage of interior flakes, edge preparation flakes, and biface thinning flakes indicates some occurrence of percussion biface reduction. However, a 54% majority of the assemblage are pressure flakes. They indicate the production and/or maintenance of small bifacial tools. Attributes on some of the pressure flakes indicate pressure reduction during the early stages of tool production, probably initiated on small flake blanks. Obsidian accounts for 73% of the recovered artifacts. Clearly, the artifacts recovered from each of the 2 excavation units at locus A represent distinctly different and separate reduction assemblages.

At locus B a relatively dense reduction concentration is located within an open sandy flat. The lithic assemblage here is different from either reduction assemblage at locus A. In sampling, prior subsurface excavations were supplemented with intensive technological recording of all visible surface artifacts, mostly debitage.

A comparison of the ogives for surface and subsurface debitage (Figure 5) shows virtually no difference for an almost equal number of specimens. Analysis suggests that most debitage in the assemblage resulted from the reduction of chert flake blanks to produce bifacial tools. Early stages of biface reduction are indicated by the high frequencies of interior flakes relative to less frequent early stage biface thinning flakes. The presence of core reduction flakes along with some of the larger and less complex interior flakes indicates that the production of flake blanks by core reduction contributed to the assemblage. Comparing the results of technological analysis at loci A and B demonstrates that interpretable reduction assemblages exist within the greater realm of the site assemblage.

At locus D, because of poor visibility, the dispersed nature of a small number of artifacts, and the impending trail construction we opted for a more intensive sampling strategy (Figure 6). Within a 5400 sq. meter grid, 23 1x1 m units were randomly selected, surface scraped to approximately 2 cm deep, and the matrix was screened through 1/8" mesh. This expanded our surface exposure and helped to better define the distribution of artifacts.

Six of the 20 surface units yielded artifacts. Five of those units and 5 yielding no artifacts were chosen for subsurface testing with 50 cm x 50 cm excavation units. All surface scrape units with artifacts yielded subsurface artifacts. With one exception, surface scrape units with no artifacts yielded no subsurface artifacts. At locus D surface scrapes appear to be an appropriate method for investigating the distribution of near-surface and subsurface artifacts.

The majority of the surface artifacts and all of the subsurface artifacts were located in the west half of the sample area (Figure 7). The artifact deposit ranged from 20 cm to 80 cm deep, and the artifact frequency ranged from 1 to 44 in a single level.

Technological analysis of the recovered debitage indicates concentrations of pressure reduction within a general background scatter of percussion biface and core reduction (Figure 7). The pressure assemblages were recovered in the 2 northern units. Combining their data best illustrates the differences between the localized pressure assemblages and the background assemblage.

In figure 8, the bottom ogive illustrates flake type percentages from units 11 and 29. The top ogive illustrates flake percentages from all the other surface and subsurface units. The variability between the 2 is primarily in the greater frequency of pressure debitage recovered in units 11 and 29. Also in these 2 units the absence of obvious core reduction debitage and relatively few biface reduction flakes indicates a minimal contribution of percussion core and biface reduction to the assemblage.

The importance of the locus D test results is that a fairly extensive excavation sample in an area of a very sparse surface lithic scatter has demonstrated the presence of a

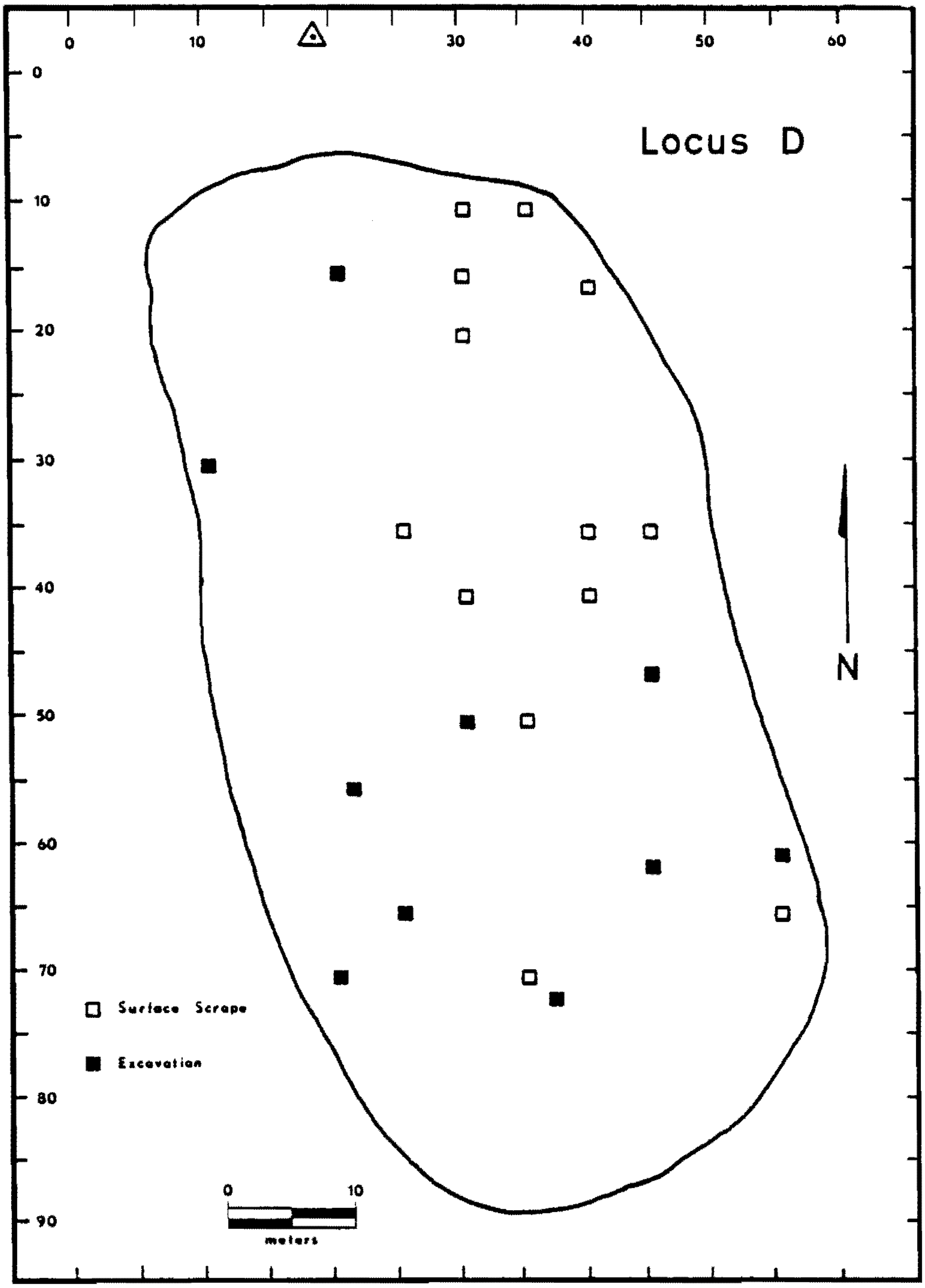

Figure 6. Buck Pasture Site, Locus D sample area.

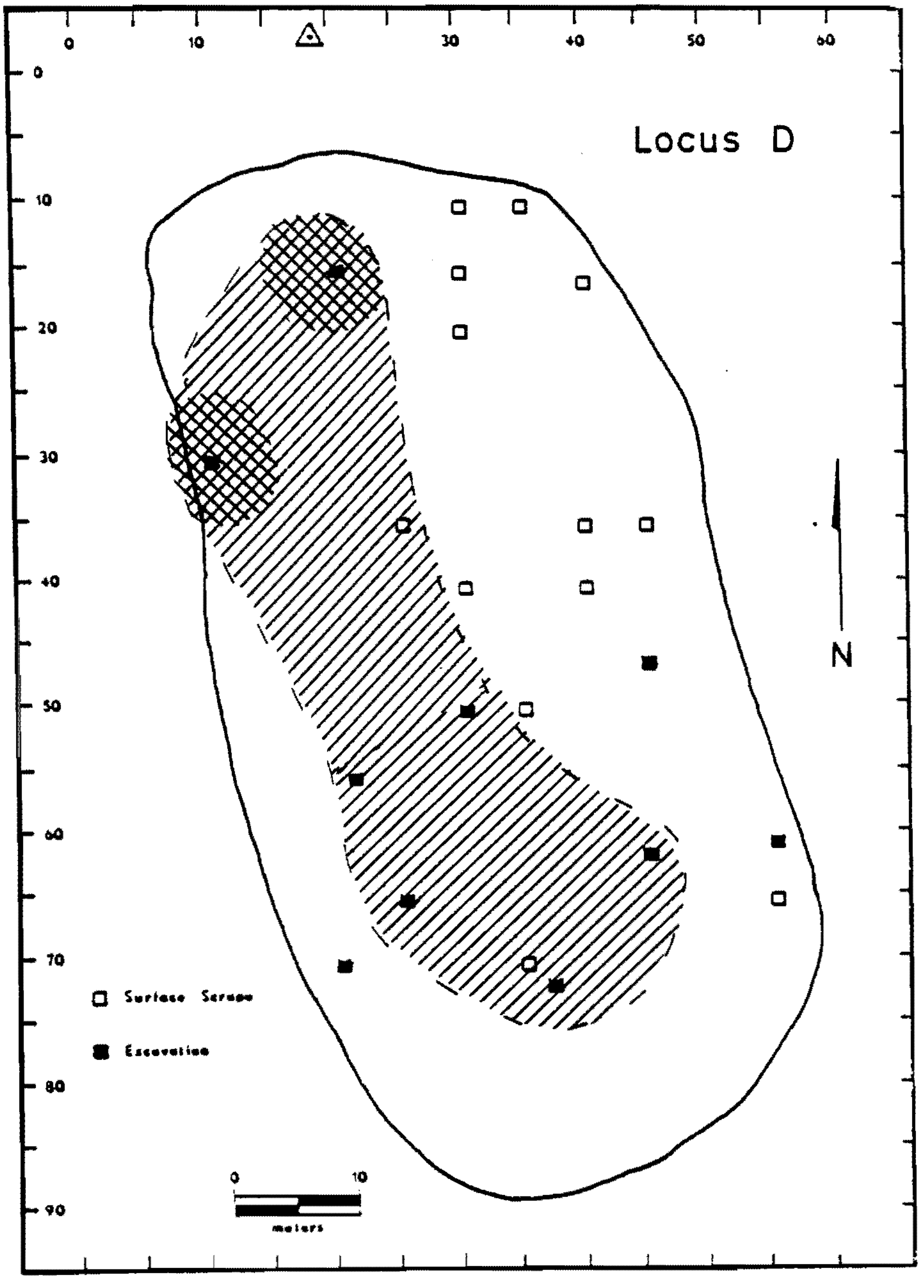

Figure 7. Buck Pasture Site, Locus D sample area showing locations of the pressure reduction concentrations (cross-hatching) within the background assemblage (diagonal hatching).

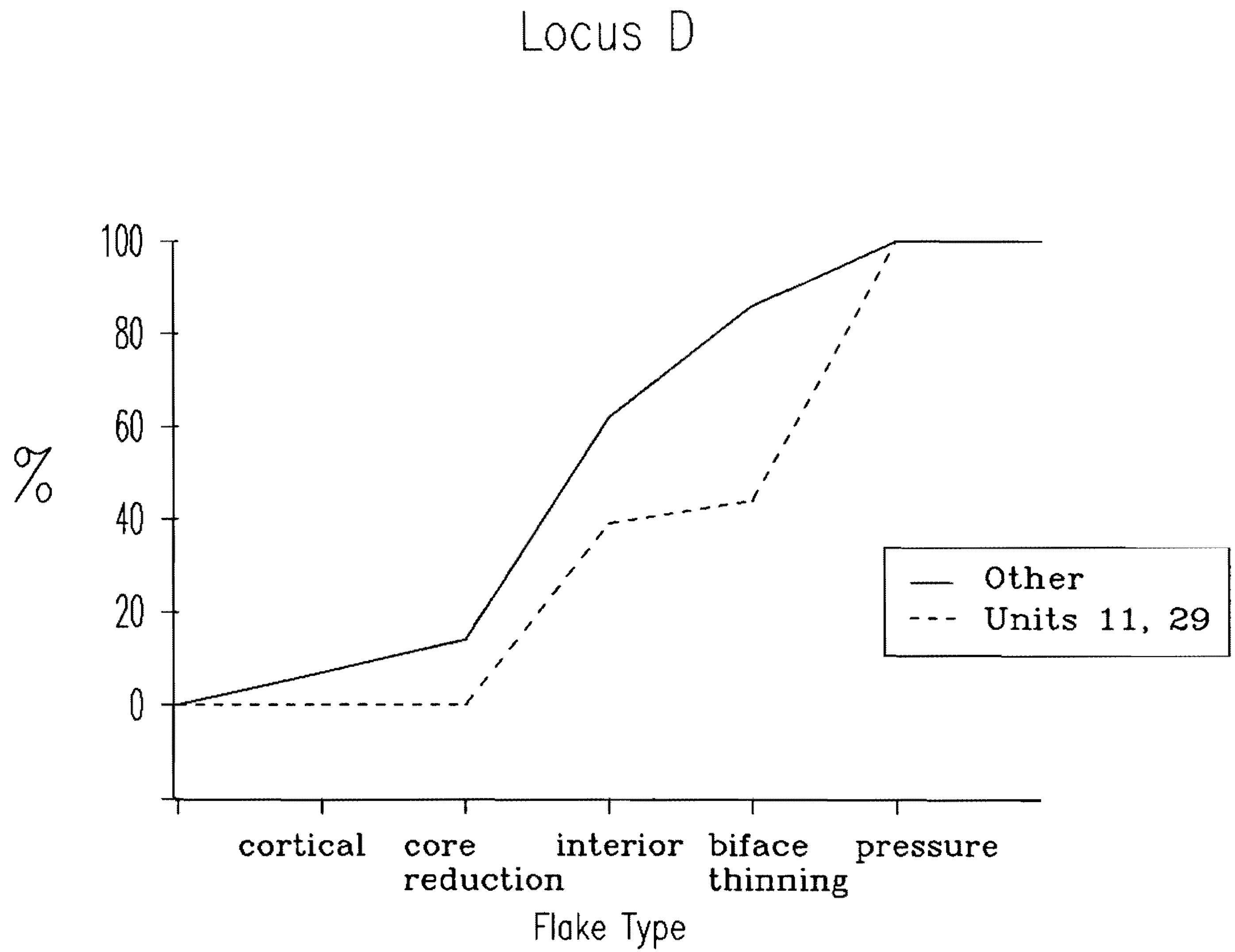

Figure 8. Cumulative proportions of flake types; Locus D, Units 11, 29 and all others.

substantial subsurface deposit, and that the artifact distribution reflects a spatially distinct organization of lithic reduction activities.

Case 2

Case 2 briefly discusses an intensive surface recordation at the Lower Cody Meadow Site and illustrates the use of technological analysis to investigate a possible single mode reduction assemblage. The site is located at the north end of Cody Meadow, on a small bench overlooking Cody creek (Figure 2).

Analysis of reduction concentrations indicates both single discrete and multiple overlapping reduction events. Concentrations A, B, and C (Figure 9) evince the most intense reduction activity and the greatest frequency of all artifact classes. The numbered dots represent locations of cores, failed preforms, and projectile points discarded either as failures or at the end of their use-lives.

Figure 10 shows that the debitage profiles for each concentration are slightly different, varying mainly in the occurrence of bifacial reduction and the later stages of the reduction trajectory. The top 2 lines represent concentrations on the periphery of the site where core reduction to produce flake blanks was the only activity. The lower 3 lines represent an entire reduction trajectory in concentrations A, B and C (Figure 9). Interior flakes with multifaceted platforms comprise much of the sample, followed less frequently by biface thinning flakes. Pressure flakes are not well represented because there was no attempt to screen the site matrix. The few pressure flakes that were observed and the evidence of pressure reduction on finished tools indicate future excavation will increase their frequency.

Technological analysis suggests most reduction followed a single trajectory (Figure 11). First, core reduction produced relatively small flake blanks. The flake blanks were then bifacially reduced using percussion to produce preforms. Preforms were pressure thinned and shaped to make small contracting stem projectile points morphologically classifiable within the Gunther Series (Zeier and Elston 1986).

The recovered artifacts evince the details of the reduction trajectory and spark insights into assemblage characteristics which might have been problematic. For example, interior flakes predominate in the analyzed assemblage, but many of those had multifaceted platforms which indicated their production during initial stages of biface reduction. Flake scar analysis of the preforms indicates that initial percussion reduction probably thinned and shaped many of the flake blanks to a preform stage without creating complex patterns of facial scars or a lenticular cross-section. Therefore, percussion flakes retained attributes that classified them as interior flakes, not biface thinning flakes. This complete biface reduction assemblage contains relatively few classic biface thinning flakes.

DISCUSSION

Overall the test results in each case indicate a high potential for identifying characteristically distinct reduction assemblages through technological analysis. Two general, but related, propositions guide the application of technological analysis to future research:

1. Spatial and temporal distribution of reduction assemblages and their variable attributes will reflect technological adaptations to settlement and subsistence.

2. Technological adaptations were influenced by the resource landscape as well as by cultural context.

Future research includes the investigation of technological adaptations in light of paleoenvironmental models and fluctuating cultural influences.

Of course, without a temporal dimension the full potential of technological analysis cannot be realized. In the Sierra, the 2 most common temporal indicators are obsidian hydration data and projectile point types. Problems are recognized in the application of both (Jones and Beck 1990:84-87, on hydration rates of surface materials; Flenniken 1984; Flenniken and Raymond 1986; Flenniken and Wilke 1989, on the use of projec-

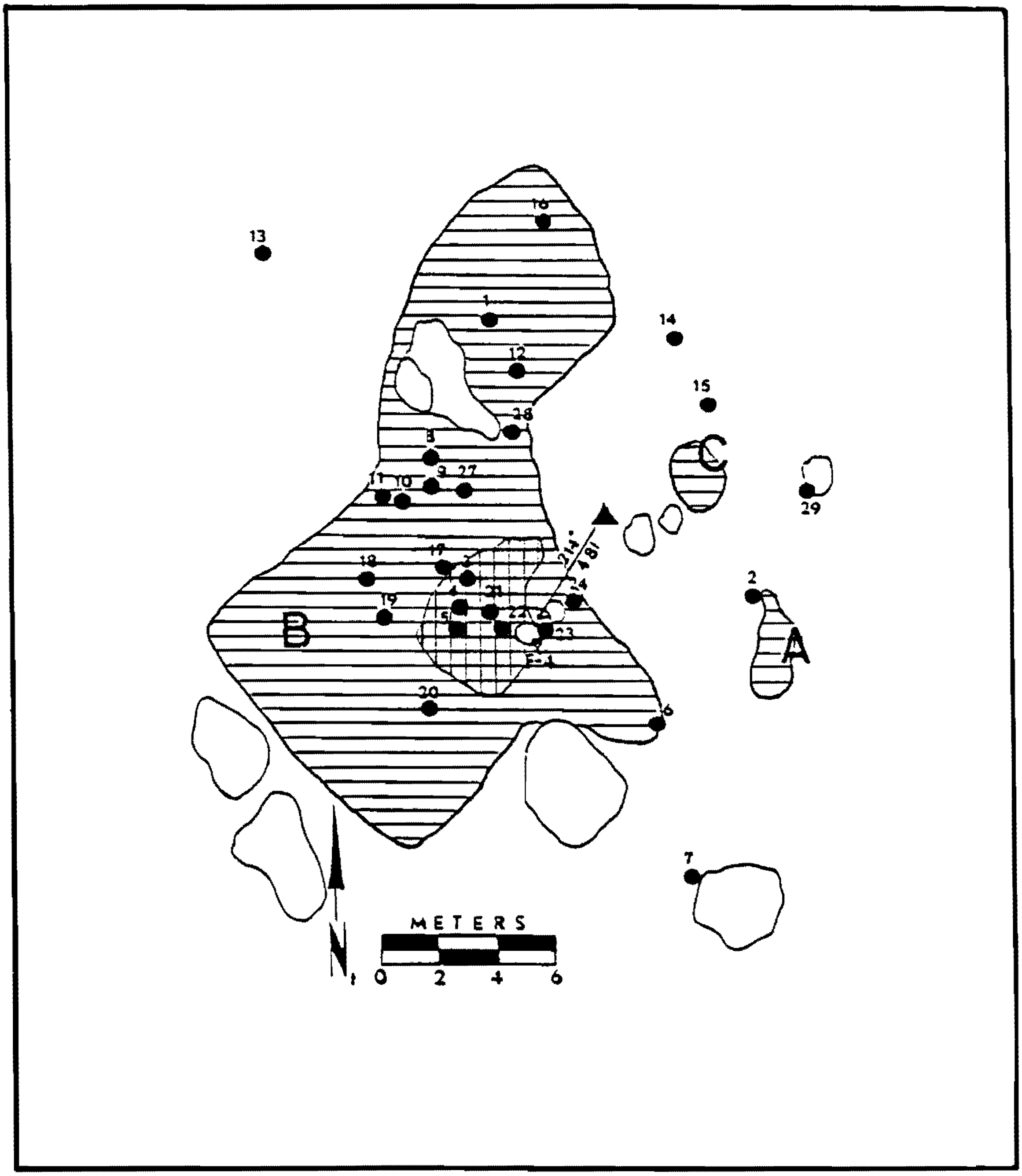

Figure 9. Lower Cody Meadow Site map, focusing on concentrations A, B, and C (horizontal shading). Cross-hatching indicates the area of greatest flake density. Numbered dots indicate locations of artifacts.

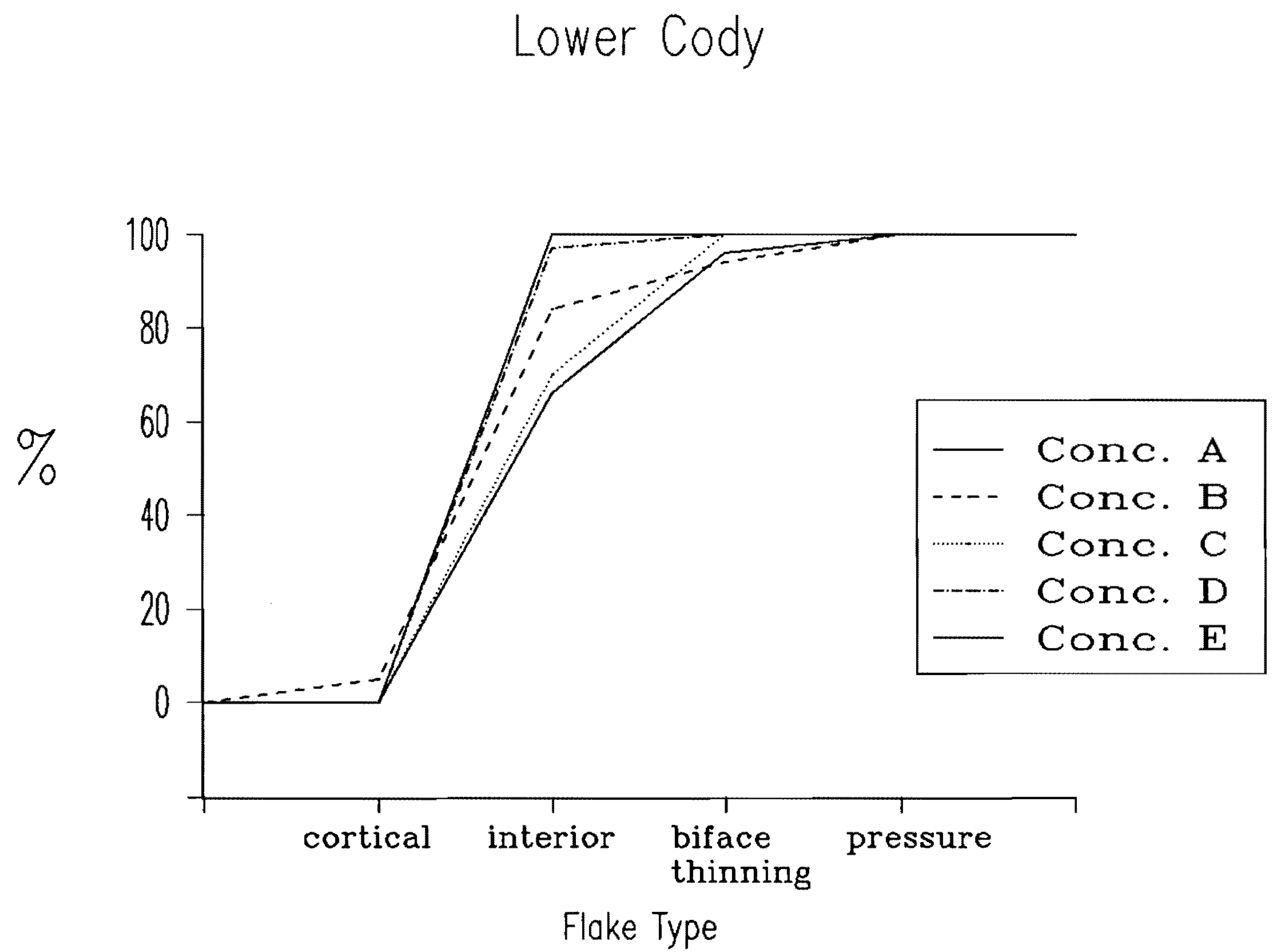

Figure 10. Cumulative proportions of flake types; Lower Cody site, Concentrations A–E.

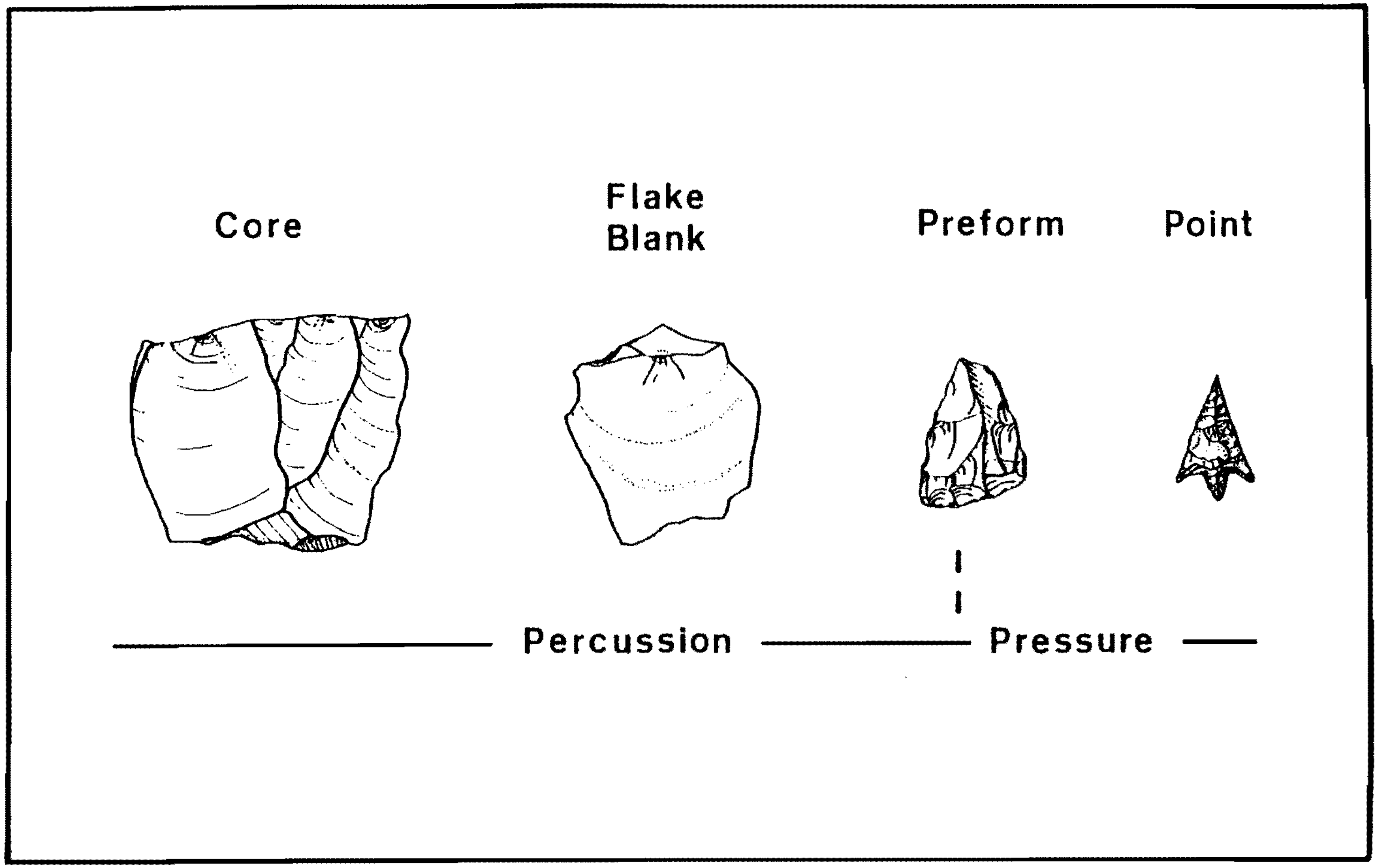

Figure 11. Lower Cody Meadow Site, reduction trajectory.

tile points as temporal markers), but in using them as tools we can continue to explore their validity.

Within the Eldorado Research Area, we are routinely collecting obsidian and submitting samples for hydration and sourcing. We are also comparing point types to hydration data and analyzing morphological variability to shed light on projectile point use-life. In combination, hydration data and time diagnostic artifacts must provide the vehicle for exploring the temporal dimension.

Temporal indicators and reduction data sets, especially within the structure of other activities represented by groundstone features, hearths, storage facilities, and shelters, are basic variables for attempts to distinguish distinct prehistoric components (Sullivan 1992). The identification of temporally and spatially distinct components is necessary for a progressive step towards investigating Sierran settlement and subsistence adaptations and developing culture chronologies.

CONCLUSIONS

In conclusion, Cultural Resource Management is, and must be, a blending of administrative needs with the academic goals and research designs put forth by a cadre of past, present, and future archaeologists. Hence, we as managers are recognizing the need to expand our collective research efforts. Technological analysis produces data sets for interpreting a region-wide organization of prehistoric activities and should be a standard methodological approach to recording and evaluating prehistoric sites. Even the smallest lithic assemblage holds some information. Each assemblage is a piece of our larger "prehistoric puzzle".

It has been said that "our research sites are chosen for us, not by us" (Markley 1982). I believe that in the Sierras that situation can be reversed by recognizing the variability and research potential of technological data sets at almost every prehistoric site with a lithic assemblage.

ACKNOWLEDGEMENTS

Many people contributed inspired energy to the Buck Pasture and Lower Cody projects. Foremost, I am grateful for the insights and support of Gwen Walter, Placerville District Archaeologist. Paul Willard's survey crew was responsible for the initial discovery of the Lower Cody site. Paul, Tad Allred, Steve Moore, and Eric Wulf each contributed intent energy to the detailed surface recording of the Lower Cody lithic assemblage. I appreciate the efforts of the numerous surface recordation and excavation crew members responsible for accurate and detailed data collection at each of the Buck Pasture loci. I am especially grateful to Pam Higgins for her enthusiasm and constructive editing of the final draft of this paper.

REFERENCES CITED

Bloomer, William W., and Eric E. Ingbar
1991 Debitage Studies of Opalite Procurement at the Tosawihi Quarries: Economics, Mobility, and Reduction. Paper presented at the 56th Annual Meeting for the Society for American Archaeology, New Orleans.

Bonnichsen, Robson
1977 Models for Deriving Cultural Information from Stone Tools. National Museum of Man Mercury Series, Archaeological Survey of Canada, Paper No. 6. Ottawa.

Crabtree, Don E.
1972 An Introduction to Flintworking. Occasional Papers of the Idaho State Museum No. 28. Pocatello.

Flenniken, J. Jeffrey
1978 Reevaluation of the Lindenmeier Folsom: A Replication Experiment in Lithic Technology. American Antiquity 43:473-480.

1981 Replicative Systems Analysis: A Model Applied to the Vein Quartz Artifacts from the Hoko River Site. Reports of Investigations, Laboratory of Anthropology, Washington State University, No. 59. Pullman.

1984 The Past, Present, and Future of Flintknapping: An Anthropological Perspective. *Annual Review of Anthropology* 13:187-203.

1987 *The Lithic Technology of the East Lake Site, Newberry Crater, Oregon.* Lithic Analysts Research Report No. 1. Pullman, WA.

Flenniken, J. Jeffrey, and Terry L. Ozbun
1988 *Archaeological Investigations in Newberry Crater, Deschutes National Forest, Central Oregon.* Lithic Analysts Research Report, No. 4. Pullman, WA.

Flenniken, J. Jeffrey, and Anan W. Raymond
1986 Morphological Projectile Point Typology: Replication Experimentation and Technological Analysis. *American Antiquity* 51:603-614.

Flenniken, J. Jeffrey, and Philip J. Wilke
1989 Typology, Technology, and Chronology of Great Basin Dart Points. *American Anthropologist* 91(1):149-158.

Ingbar, Eric E., Marylou L. Larson, and Bruce A. Bradley
1989 A Nontypological Approach to Debitage Analysis. In *Experiments in Lithic Technology*, edited by Daniel Amick and Raymond Mauldin, pp. 117-136. British Anthropological Reports, International Series No. 528. Oxford.

Intermountain Research
1992 The Periphery. vols. 1-2. In *Archaeological Investigations at Tosawihi, a Great Basin Quarry*, Part 1. Intermountain Research, Silver City, Nevada. Submitted to Galactic Services, Inc., Reno. Ms. on file, Bureau of Land Management, Elko, NV.

Johnson, L. Lewis
1978 A History of Flint-Knapping Experimentation, 1838-1976. *Current Anthropology* 19(2):337-372.

Jones, George T., and Charlotte Beck
1990 An Obsidian Hydration Chronology of Late Pleistocene-Early Holocene Surface Assemblages from Butte Valley, Nevada. *Journal of California and Great Basin Anthropology* 12(1):84-100.

Kelly, Robert L.
1988 Three Sides of a Biface. *American Antiquity* 53:717-734.

Markley, Richard E.
1982 Northern Sierra Prehistory: The View from the Forest. Paper presented at the 18th Annual Great Basin Anthropological Conference, Reno.

Mauldin, Raymond, and Daniel Amick
1989 Investigating Patterning in Debitage from Experimental Biface Core Reduction. In *Experiments in Lithic Technology*, edited by Daniel Amick and Raymond Mauldin, pp. 67-88. British Anthropological Reports, International Series No. 528. Oxford.

Sullivan, Alan P.
1992 Investigating the Archaeological Consequences of Short-Duration Occupations. *American Antiquity* 57:99-115.

Thomas, David H.
1985 Contemporary Hunter-Gatherer Archaeology in America. In *American Archaeology Past and Future: A Celebration of the Society of American Archaeology 1935-1985*. Smithsonian Institution Press, Washington, D.C.

1986 *Refiguring Anthropology: First Principles of Probability and Statistics*. Waveland Press, Prospect Heights, IL.

Young, David, and Robson Bonnichsen
1984 *Understanding Stone Tools: A Cognitive Approach*. Peopling of the Americas Process Series No. 1. Center for the Study of Early Man, University of Maine, Orono.

Zeier, Charles D., and Robert G. Elston
1986 *The Archaeology of the Vista Site 26Wa3017*. Intermountain Research, Silver City, NV. Submitted to Cultural Resources Section, Environmental Services Division, Nevada Department of Transportation, Carson City.