ASSESSING THE VARIABLE ROLE OF BIFACES IN HUNTER-GATHERER TOOLKITS OF EASTERN CALIFORNIA

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The manner in which hunter-gatherers used tools likely varied through time and according to the situation at hand. For example, biface use is often seen to differ between roles as transportable cores, versus long use-life tools. Moving beyond theoretical speculation, one should be able to test assumptions by identifying variable artifact morphology. The current undertaking examines over 1,100 bifaces from 53 sites in the Owens Valley of eastern California. Attributes analyzed include biface stage, metrics, and use-wear. Results based on empirical data demonstrate changing patterns of biface use throughout prehistory.

The role that bifaces may have had in the toolkits of prehistoric North American hunter-gatherers has been discussed in many contexts. Such tools are found across the landscape in different stages of their use-life. Often, based on raw material profiles and stages of tool reduction, archaeologists speculate about the areal extent of mobility patterns and the nature of toolstone acquisition. While bifaces may be seen to have had various roles in the past, few studies have large enough samples to warrant in depth discussion of the tool forms directly. More often, debitage analysis is used to infer the types of activities that occurred at a site, and from these data, researchers speculate about the manner of biface use.

The present study takes a somewhat different approach toward understanding the past organization of biface technology. Rather than focusing interpretation of tool-use on debitage samples, the analysis investigates the nature of morphological variability of over 1,100 bifaces recovered from dated contexts at 53 sites in the Owens Valley of eastern California. These attributes are used to understand the changing role that this artifact class may have had within the toolkit over time. The roles are presented as a dichotomy between use mainly as a transportable core or a long use-life tool. Initial discussion will focus on theoretical aspects of developing interpretations using a technological organizational approach, followed by a brief overview of pertinent aspects of Owens Valley prehistory, continuing with analysis and interpretation of the data under scrutiny.

THEORETICAL BACKGROUND

The presence or absence of various tool classes in a given archaeological assemblage has been used to infer the activities that occurred at a site. It has also helped researchers to develop hypotheses relating the nature of mobility to tool manufacture and design (cf. Kelly 1988; Nelson 1991; Parry and Kelly 1987). Based on surveys of ethnographic literature, archaeologists have argued that hunter-gatherers organize their technology by designing it in ways that would optimize such features as maintainability versus reliability (Bleed 1986), or versatility versus flexibility of a given tool class (Shott 1986). The decisions that past foragers made in regard to such factors are seen as conditioned by the degree and nature of mobility undertaken by a given population. For example, greater logistical mobility has often been equated with increased use of curated rather than expedient tools (Binford 1979). These strategies are seen to reduce risk of tool failure at critical times, or to overcome periods of raw material scarcity or uncertainty (Torrence 1989).

The availability of raw material and its mode of acquisition is a factor affecting the nature of tool manufacture, use, and discard (Nelson 1991). It has been demonstrated in diverse localities that when low quality local toolstone is available to mobile groups, it will generally be used expediently (Andrefsky 1994; Bamforth 1986). At the same time, higher quality exotic materials will often be employed for more formal tools. Local availability and quality of raw material has a role in the nature of tool manufacture and should be evident in the archaeological record.

A rough estimate of the importance of a particular artifact class can be inferred through a ratio of its abundance relative to other tool forms. This may be achieved by comparing relative quantities of different tool classes, such as handstones and projectile points, or flake tools and bifaces. A complicating factor is the differential use-life of a given tool class. For example, a handstone arguably has greater use-life potential than a flake tool. As a result, the latter will often be more

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abundant than the former; however, changes in the ratios of these tools may indicate more large scale changes in the make-up of a hunter-gatherer toolkit. A less straightforward example is seen when comparing projectile points and bifaces. These were almost certainly retained in toolkits for longer periods than flake tools, but for how long? Likewise, the difference in use-life between these two artifact classes may be more difficult to ascertain.

Identifying a change in the relative abundance of one class over another is often used to argue for a change in technological organization (cf. Basgall and McGuire 1988; Delacorte et al. 1995; Zeanah and Leigh 2002). Furthermore, even if a tool such as a biface is not present at a site, archaeologists may be able to infer its presence if debitage used to produce that tool class is present (Carr 1994; Kelly 1988). This can be used to study the type of reduction practiced at a site, or to determine the extent that debitage was used for flake tools; however, without recovering the formed artifact, direct discussion of the tool is not possible.

Studying morphological change through time of a single artifact class can provide insight to the artifact's role within the greater toolkit. Change in morphology and type of use-wear may provide evidence for the varying roles that an artifact may have had. This could be supported by changes in form and frequency of other artifact classes associated with a given time period.

Owens Valley Prehistory

Owens Valley prehistory has commonly been segregated into four periods based on perceived changes in the archaeological record. These are the pre-Newberry (pre-3500 B.P.), Newberry (3500-1350 B.P.), Haiwee (1350-650 B.P.), and Marana (650-100 B.P.) periods. These latest two periods are considered to represent a similar cultural adaptation, understood through patterns associated with resource intensification (Bettinger 1999; Delacorte 1999; Delacorte et al. 1995). Following earlier studies, Haiwee and Marana components will be combined to a single late prehistoric analytical unit. In the past 20 years, the Owens Valley has seen a considerable amount of excavation conducted in the context of multi-site projects. The result has been an increase in our understanding of the past, yet it has also brought forth a number of new research questions. Those most pertinent to the current discussion will be outlined.

In Owens Valley, the nature of prehistoric mobility has been a subject of concerted discussion. Based on the diversity of toolstone material profiles, including sourced obsidian samples, pre-Newberry mobility is understood to be wide ranging with a generalized toolkit of flaked stone and very little associated ground stone. There is also a prevalence of what are apparently unifacial cores or scraper planes, as well as flake tools (Delacorte 1999; Delacorte et al. 1995). However, some projects have recovered more bifaces and bifacial flaking debris than other flaked stone material in components dating to this period (Basgall and McGuire 1988; Zeanah and Leigh 2002).

Although there have been arguments to the contrary (King et al. 2001), Newberry mobility patterns are understood by many to have become regularized, with an annual north-to-south population movement (Basgall 1989; Basgall and McGuire 1988; Basgall et al. 2003; Delacorte 1999; Delacorte et al. 1995; Zeanah and Leigh 2002). Obsidian source variability during this time is more standardized and less diverse than during previous times. While the unifacial cores are no longer present, bifaces are believed to have become a more important part of the toolkit due to their larger size, fine craftsmanship, and abundance relative to other tool classes (Basgall and McGuire 1988; Bettinger 1999). When compared with earlier and later times, the Newberry period has an increased amount of more formalized groundstone, and artifact diversity increases at a greater rate than sample size in dated components. This, along with the presence of specialized, task-specific sites, argues for greater logistical mobility (Delacorte 1999).

The Haiwee/Marana period coincides with the introduction of the bow and arrow and the onset of a pattern of resource intensification, which continues until protohistoric times. Mobility is believed to be more highly constrained, with obsidian profiles being either less diverse than in earlier periods, or mirroring the diversity of nearby sites (Delacorte 1999; Delacorte et al. 1995). This, in conjunction with the paucity of early-stage biface forms, supports propositions of toolstone acquisition through scavenging earlier archaeological deposits. There is a decreased use of bifaces in conjunction with an increased use of simple flake tools. Flaked and ground stone tools are generally expedient with shorter use-lives, and site assemblages become more generalized again.

Owens Valley Bifaces

Bifaces in the present sample come from seven projects (Figure 1) conducted between the northernmost reaches of the Owens Valley at Sherwin Grade to the southern part of the valley near the town of Lone Pine (Basgall and Delacorte 2003; Basgall et al.

2003; Delacorte and Basgall 2003; Delacorte et al. 1995; Eerkens and King 2002; King et al. 2001; Zeanah and Leigh 2002). Only bifaces from dated components were included in the sample. One thousand four hundred and eighty-nine bifaces recovered from 53 excavated prehistoric sites were included in the initial investigation. However, the bulk of the analysis focuses on a subset of 93 discrete temporal components comprising a total of 1,137 bifaces (Table 1).

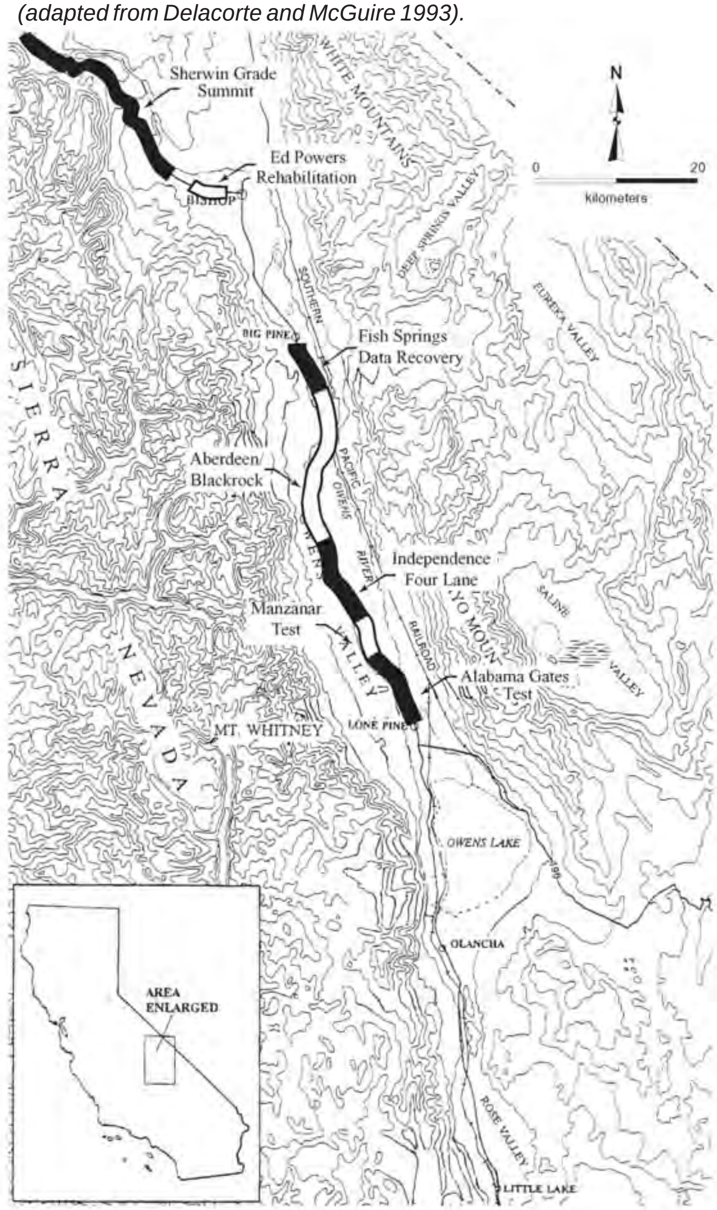
There is much discussion about how hunter-gatherers organize their toolkits depending on manner of mobility, kinds of resources exploited, and the availability of raw material. The present research is interested in determining whether bifaces in the Owens Valley were manufactured and used differently through time. One should expect this to be true, considering the previous discussion of regularized scheduling and reduction of annual mobility in conjunction with late prehistoric resource intensification. With this in mind, the present paper seeks to test a hypothesis about the use of the tool form, namely, does the role of bifaces in the Owens Valley change from that of a core to one of a long use-life tool (Figure 2)? If they were used predominantly as cores, one would expect bifaces to be not only wider, but also thicker relative to their width. By this the core would have greater mass, lending the implement greater utility and allowing for a longer use-life in flake production. Conversely, if it were being used more as a tool in its own right, one would anticipate there to be evidence of this in the form of use-wear on the margin. To more properly represent tools used in daily activities, whole width and thickness measurements are used to estimate biface form rather than using only complete artifacts.

Table 2 shows the average complete width measurement and standard deviation for bifaces by stage and component. Although there are a few sources of variation, width generally decreases with reduction stage. In general, Newberry bifaces are wider than those from other periods of similar stage. However, the large variance in all samples demonstrates the inconsistent nature of their relationships.

The thickness-to-width ratios of all bifaces with complete measurements in the sample provides a context to see how bifaces are reduced by stage, regardless of time (Table 3). Stages 1 and 2 are thicker, while stages 3 to 5 are relatively thinner but not much different from one another. Also, when noting the percentage of those with use-wear, the first two stages have a relatively low level of use. Presence of this attribute peaks with stage 3 forms, and decreases thereafter. From this overall sample, it is apparent that stage 1 and 2 bifaces are thicker and have less use-wear than stages 3 to 5, which are comparable to each other. Use-wear is more prevalent at stage 3, and is about 8 percent higher than use-wear among the complete sample of bifaces.

Separating out bifaces by component to look for variation in the thickness-to-width ratio and use-wear profiles shows similar patterns across reduction stages (Table 4). Stages 1 and 2 are thicker, while stages 3 to 5 are thinner relative to their width (Figure 3). While there is variability in the ratios of middle and later stage

Figure 1: Distribution of projects contributing to sample (adapted from Delacorte and McGuire 1993).



Project	Pre-Newberry	Newberry	Haiwee/Marana	Total
Sherwin Grade	1	23	5	29
Ed Powers	9	171	55	235
Fish Springs	118	39	-	157
Aberdeen-Blackrock	18	51	91	160
Independence	-	9	105	114
Manzanar	-	24	61	85
Alabama Gates	278	15	64	357
Total	424	332	381	1137

Table 1: Number of bifaces by component and project.*
**Only includes bifaces attributed to one of the three named components; i.e., Pre-Newberry/Newberry, Newberry/Haiwee are excluded.*

Table 2: Complete width (mm) and standard deviation of Owens Valley bifaces by stage and component. Mtrl. = material; all = all materials; obs. = obsidian.

Stage	Mtrl.	Pre-Newberry	Newberry	Haiwee/Marana
1	all	29.00 ± 9.40	33.50	-
		n = 20	n = 1	-
	obs.	25.36 ± 4.75	33.50	-
		n = 8	n = 1	
2	all	24.12 ± 7.83	27.31 ± 6.07	22.86 ± 6.91
		n = 21	n = 9	n = 7
	obs.	23.89 ± 5.75	27.31 ± 6.07	21.57 ± 6.58
		n = 18	n = 9	n = 6
3	all	24.06 ± 9.42	28.95 ± 5.96	28.40 ± 9.29
		n = 21	n = 10	n = 7
	obs.	22.69 ± 5.94	28.95 ± 5.96	29.53 ± 9.63
		n = 18	n = 10	n = 6
4	all	20.92 ± 7.46	17.08 ± 5.08	19.78 ± 4.65
		n = 30	n = 8	n = 17
	obs.	20.65 ± 5.94	17.14 ± 5.48	19.78 ± 4.65
		n = 28	n = 7	n = 17
5	all	17.47 ± 5.12	23.64 ± 8.81	14.40 ± 8.50
		n = 31	n = 9	n = 29
	obs.	17.04 ± 4.90	23.64 ± 8.81	12.10 ± 5.84
		n = 29	n =9	n =25

*Table 3. Thickness-to-width ratio and use-wear of complete sample (n = 1,489).**

Stage	Mtrl.	N	Thickness/Width	% with use
1	all	55	.44	9.1%
	obs.	41	.45	4.9%
2	all	147	.39	21.8%
	obs.	122	.37	19.7%
3	all	322	.32	33.5%
	obs.	294	.29	34.7%
4	all	455	.26	27.9%
	obs.	421	.27	28.5%
5	all	348	.29	27.0%
	obs.	308	.30	25.0%
Complete Sample	all	1,489	–	25.9%
	obs.	1,325	–	26.0%

**Includes all components from the data set (i.e., Pre-Newberry/Newberry, Newberry/Haiwee). Mtrl. = material; all = all materials; obs. = obsidian.*

Table 4. Thickness to width ratio and use-wear by component and stage. Mtrl. = material; all = all materials; obs. = obsidian.

		Pre-Newberry		Newberry		Haiwee/Marana	
Stage	Mtrl.	Ratio	% Use	Ratio	% Use	Ratio	% Use
1	all	.44	2.6%	.33	0%	-	0%
			n = 1 of 38		n = 0 of 3		n = 0 of 4
	obs.	.47	0 %	.33	0%	-	0%
			n = 0 of 27		n = 0 of 3		n = 0 of 3
2	all	.41	19.5%	.36	28.6%	.39	23.8%
			n = 16 of 82		n = 6 of 21		n = 5 of 21
	obs.	.38	12.5%	.36	28.6%	.44	35.7%
			n = 8 of 64		n = 6 of 21		n = 5 of 14
3	all	.29	11.2%	.29	54.5%	.34	40.0%
			n = 9 of 80		n = 42 of 77		n = 30 of 75
	obs.	.29	8.8%	.29	54.5%	.33	46.2%
			n = 6 of 68		n = 42 of 77		n = 30 of 65
4	all	.23	18.1%	.31	35.6%	.27	21.3%
			n = 15 of 83		n = 42 of 118		n = 23 of 108
	obs.	.29	19.1%	.31	36.2%	.27	21.2%
			n = 14 of 79		n = 42 of 116		n = 18 of 85
5	all	.32	43.8%	.23	23.2%	.28	21.1%
			n = 39 of 89		n = 16 of 69		n = 31 of 147
	obs.	.33	53.4%	.24	25%	.32	18.9%
			n = 39 of 73		n = 16 of 64		n = 24 of 127

forms, gross similarities in the ratios imply that these tools were likely reduced in the same fashion through time. If bifaces functioned more as transportable cores during a particular time period, the current model would expect to find a higher thickness-to-width ratio throughout the reduction sequence, signifying relatively thicker implements. No such pattern is apparent and, in fact, the two aberrant cases trend toward being thinner.

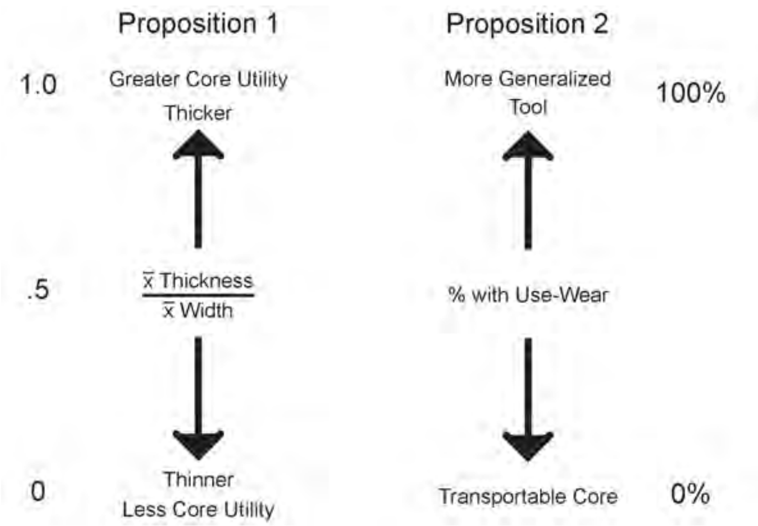


Figure 2: Two hypotheses pertaining to biface manufacture and use.

To argue for similarities in the manner of biface reduction through time, cases that deviate from the overall pattern must be explained. The low ratio (.23) for pre-Newberry stage 4 bifaces (all materials) appears to be skewed by the four non-obsidian bifaces. Without these, the obsidian biface ratio (.29) is within the range of .27-.33 where most of the other middle and late stage averages fall. Variation in the thickness-to-width ratio implies that raw material may be a factor determining how a particular biface is used. The second point of deviation appears in the Newberry stage 5 bifaces where there is no great distinction between ratios of the raw material classes. Unlike the pre-Newberry stage 4 bifaces, both the obsidian and non-obsidian samples are considerably thinner than similarly staged bifaces from other periods. This irregularity is likely due to other factors than use as a core. Possibly these artifacts were being thinned to make Elko projectile points, which are most often made from bifacial preforms. Support for this proposition is found in a sample of Elko projectile points from the same region where the corner-notched sub-types have a thickness-to-width ratio of .23, while a more general category that subsumes the Elko variants has a ratio of .24 (Brady 2004).

The general comparability in trends of relative thickness across reduction stages and through time does not support the first proposition that if bifaces were used more as cores they would exhibit greater utility with a higher thickness to width ratio. In fact the two aberrant cases identified were relatively more thin than the overall sample, contrary to expectations.

When studying patterns of use-wear by stage and component, there is variability across time (Table 4). Newberry and later bifaces peak in evidence of secondary use with stage 3 forms, decreasing thereafter. In contrast, pre-Newberry bifaces have a gradual increase in use-wear throughout the reduction process, peaking at stage 5 (Figure 4). Newberry stage 3 forms have the most use-wear of the sample, but pre-Newberry use is at its highest when later periods are practically at their lowest.

Patterns of use-wear suggest that bifaces served different functions through time. The dramatic increase in secondary use among stage 5 pre-Newberry bifaces supports the notion that these tools may have been used predominantly as transportable cores until late in their use-life. At this time, their role shifted to that of a more generalized tool used for cutting and scraping functions. Prevalence of use on stage 3 forms in Newberry and Haiwee/Marana times is likely a function of these tools being used for more general purposes earlier in their use-lives.

CONCLUSIONS

The present analysis suggests two main points about the manner of biface manufacture and the role of these tools within the toolkit in eastern California. First, based on the thickness-to-width ratios, it is apparent that Owens Valley bifaces were reduced in roughly the same manner throughout prehistory. No period demonstrates that the tools were manufactured dramatically different to improve their utility as a core. Second, pre-Newberry bifaces were not as often used as generalized tools until late in their use-life, whereas later period bifaces see their greatest amount of use-wear in middle stage forms.

Reasons for temporal change in biface use may be better understood within the context of mobility patterns and toolkit composition. Pre-Newberry mobility patterns are wide-ranging, and a lack of available toolstone could have drastic consequences, hence the need for easily transportable cores. Additionally, during this time there are unifacial tools, which were likely cores or scrapers. It is possible that the unifacial tools served both purposes, while bifaces

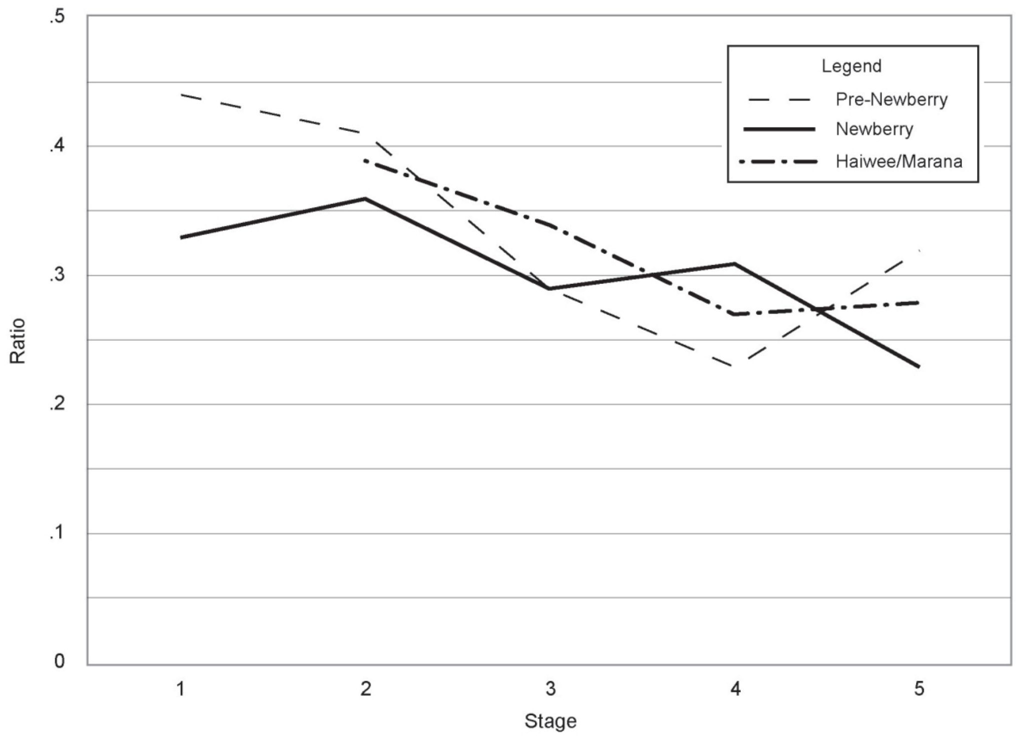
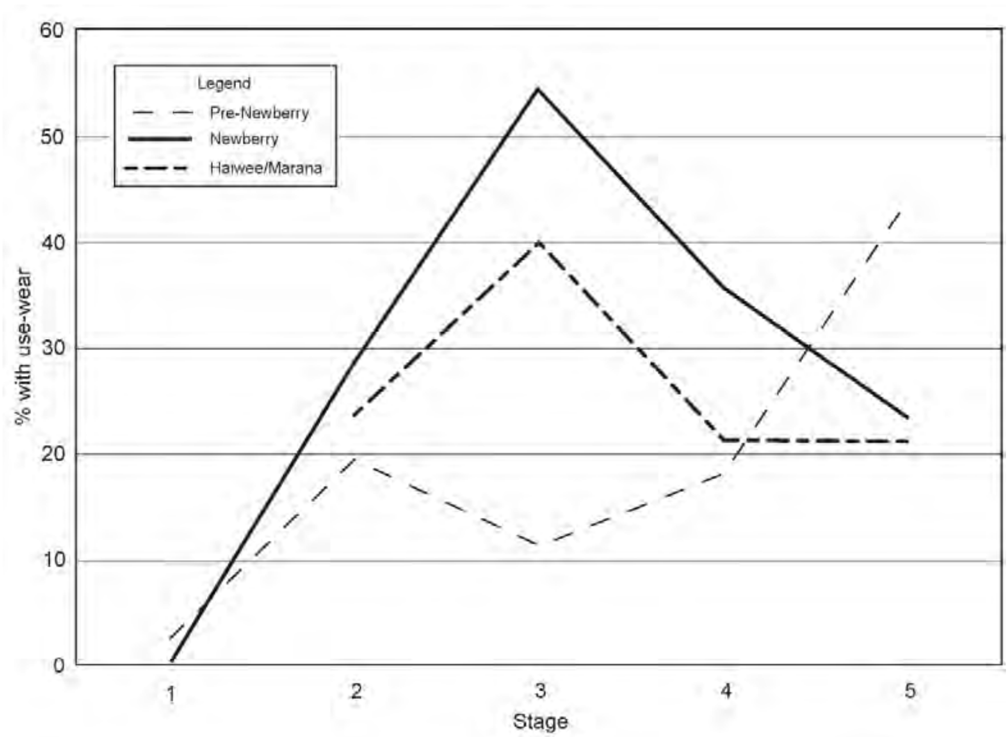


Figure 3: Biface thickness-to-width ratio (all materials).

Figure 4: Biface use-wear by stage and component (all materials).



were predominantly used as cores for flake production. This role may have changed in Newberry and later times when mobility is reduced and toolstone is acquired on a regularized basis from familiar localities, lessening the need for transportable, efficient cores. Furthermore, the unifacial cores or scrapers are no longer in the toolkit. It is likely that bifaces were needed to cover the role of both tools, leading to a predominance of use-wear on earlier stage, more robust tool forms.

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