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Changing Perspectives in Australian Archaeology, Part VI

Point Production at Jimede 2, Western Arnhem Land

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ABSTRACT. Inferred production patterns and morphological variation in bifacial points have been central to models of prehistoric settlement, territoriality, and economy. In this paper a re-analysis of the Jimede 2 assemblage excavated by Carmel Schrire in Kakadu provides the basis for re-describing the nature of point production in Western Arnhem Land.

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For more than a decade the reanalysis of artefact assemblages has been a key strategy in efforts to recast our understanding of Australian prehistory. Such reanalyses have repeatedly shown that earlier typological studies of lithic artefacts provided few technological insights while simultaneously allowing new and sophisticated models of artefact manufacture and land use to be tested. Well known examples of the redescription of assemblages from famous sites include Burkes Cave (Shiner *et al*., 2007), Ingaladdi and nearby sites (Cundy, 1990; Clarkson, 2002a, 2006, 2007), Puritjarra (Law, 2005, 2009), Puntutjarpa (Hiscock & Veth, 1991), Lake Mungo (Hiscock & Allen, 2000; Allen & Holdaway, 2009), Mussel Shelter (Hiscock & Attenbrow, 1998), and Capertee 3 (Hiscock & Attenbrow, 2002, 2003, 2004, 2005). Because the original interpretations of these assemblages were important in developing explanatory models of the variability and nature of prehistoric technologies in this continent, the technological re-examinations of them have been fundamental in improving our comprehension of ancient tool manufacture.

A series of assemblages from Western Arnhem Land excavated in the 1960s and 1970s formed the basis for extensive debates about the nature, timing and causes of technological change in the region, and the formulation of influential models of spatial and chronological technological change in Australia (Hiscock, 1999, 2009). One of the key sites in the production of archaeological interpretations about human occupation of Western Arnhem Land was Jimede 2 (also written as Jimeri II and Tymede II), a cave excavated by Schrire in 1964–1965 (Fig. 1). The deposit spanned much of the Holocene, with occupation beginning before 7,000 BP. Schrire (1982: 245) characterized the later assemblage as point dominated, and her typological classifications identified 38% of the flaked implement as points and a further 34% as fragments, some of which potentially came from broken points (N = 502). Schrire (1982: 246) argued that there were two different types of points, each with a different manufacturing process, and that the abundance of points in any particular landscape setting indicated either a distinctive seasonal site function or a distinctive identity for the occupants (White, 1967a, 1967b, 1971; White & Peterson, 1969; Schrire, 1972).

A number of possible explanations for variations in point abundance has been offered. Initially White (1967b) hypothesized that assemblage differences between lowlands and the escarpment/uplands were a consequence of the long-term co-existence of two cultural groups, each occupying a different part of the landscape. She subsequently offered the alternative interpretation that a single group of people moved seasonally between lowlands and uplands and employed points more frequently in their wet season occupation of the uplands, creating sites like Jimede 2.

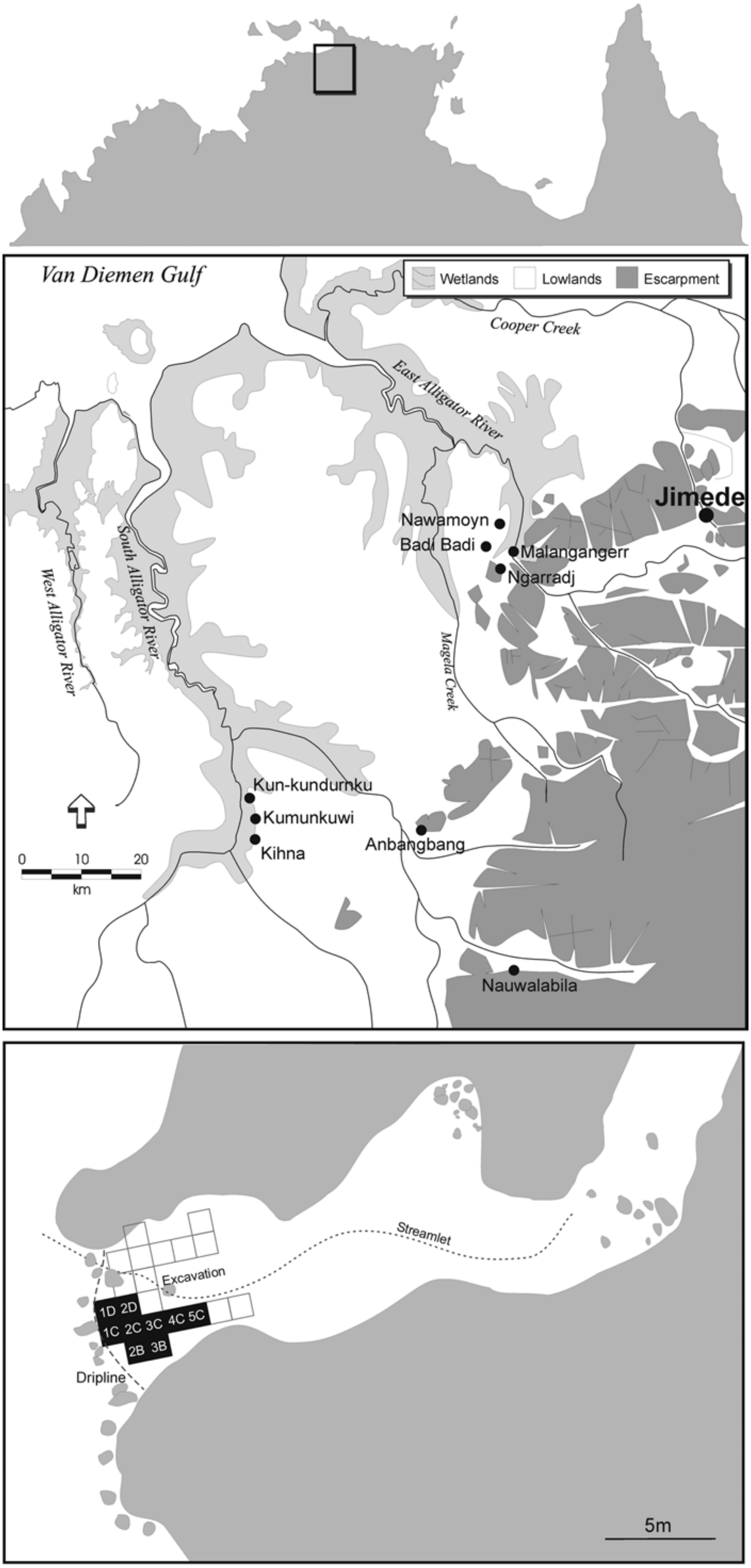


Figure 1. Location of Jimede 2 and plan of site with squares highlighted that were included in this study.

These models were rejected in later work as the magnitude and continuous nature of spatial variation in assemblages was recognized: Allen and Barton (n.d.) found a point-rich lowland site, while Brockwell (1989, 1996) documented marked differences within lowland assemblages. Seasonal models were still proposed in the 1980s, but they no longer offered plausible explanations for the extreme range of differences in lithic assemblages.

To re-invigorate explanations of lithic variability in the region, I recently offered an economic model of the production of tools in western Arnhem Land (Hiscock, 2009). In this model assemblage differences can be explained in terms of changed technological practices at each landscape position as a response to material cost, and a major process creating variation was differential use of lithic materials and extending the use-life of tools made on flakes by maintaining their edges through additional retouching. The effect of procurement economics on point abundance and form in Western Arnhem Land was identified from a number of observations and inferences.

- The abundance of quartzite and points generally co-varied across the landscape in a way that is consistent with transportation of quartzite points from sources in the uplands.
- The ratio of bifacial to unifacial points varies around the landscape in a way that is consistent with more intensive reduction of points away from the uplands, as foragers maintained points to reduce the cost and inconvenience of obtaining replacements.
- As tool maintenance was extended, bifacial points were often transformed into other tool forms, perhaps with different functions, such as the "bifacial ovals" that Schrire had reported (Hiscock, 2009).

Given these observations, the model hypothesized that assemblage composition across the landscape was explicable in terms of procurement economics: the patterns of lithic variation emerged as knappers rationed, recycled, and substituted artifacts in response to the varying cost of obtaining replacement stone in each location.

The benefit of this approach is that, by understanding that technological behaviours were sensitive to the economic contexts of artifact manufacture and use, it is possible to explain much of the geographical variation in assemblages, and to explain both the persistence of those geographical patterns through time and the existence of temporal changes in the extent of implement reduction (Hiscock, 1999, 2009). Over time, foragers adjusted their technology to changed conditions of tool-use as landscape and climate evolved, but the geographical differences in the costs of tool production and maintenance persisted because these largely reflected unchanged distances to lithic raw material sources.

Assemblage differences presented in the recent model of the economics of reduction, recycling, and raw material procurement (Hiscock, 2009) were based largely on the characterization of assemblages offered by earlier researchers, and including the description of point production that had been published for Jimede 2. Technological re-examination of the Jimede 2 therefore offers the potential to enhance our understandings of point variation and reduction.

In this paper I present a reanalysis of the points from Jimede 2 which tests and refines existing models of the manufacturing process of points at Jimede 2, with implications for the way economic and land-use models can be framed for western Arnhem Land. The results again illustrate how reanalysis of old assemblages can yield significant new information.

Previous analyses of Jimede 2

Schrire's analysis of Jimede 2 points continued a long debate about the interpretation of stone implements from northern Australia. As explored elsewhere (Hiscock, 1994), the relationship between unifacially and bifacially flaked points in assemblages has been disputed for more than 70 years. One model depicted the two point forms as having been manufactured in different ways, and hence represented the end products of two distinct manufacturing sequences. This "divergence model" was argued by Schrire (1982) to be the best description of the diversity of points at Jimede 2. The alternative model depicted the diversity of points as a continuum from unifacial specimens with limited retouch to extensively retouched bifacial points, thereby presenting different point forms as merely different manufacturing stages. I have previously argued that this "sequence" model was the best description of points at Jimede 2, based on records of the scar superimposition on 48 specimens which indicated that most bifacial points from the site displayed the same order of retouching as unifacial points, with initial retouching onto the dorsal face and ventral retouch occurring subsequently (Hiscock, 1994). While there was a range of retouching patterns visible on the points from Jimede 2, I concluded that in northern Australia bifacial points were generally more extensively reduced than, and transformed from, unifacial points. Subsequently, I employed this conclusion in testing models of land use in the region, by using the ratio of bifacial to unifacial points as one measure of the extent of point reduction and, hence, as an expression of the geographical variation in the cost of accessing replacement material and the extent of point maintenance.

Although a range of point manufacturing and recycling procedures was acknowledged, my interpretation of assemblage variability was largely based on the proposition that the majority of points had similar manufacturing histories that could be represented as a linear sequence, as illustrated in Figure 2. In this image bifacial points are presented as being more reduced than unifacial points and "bifacial ovals" as more reduced than bifacial points, in a diverse but directional series. Although the notion that bifacial points were initially unifacial points has been demonstrated empirically for Jimede 2 (Hiscock, 1994), the other elements of this scenario resulting from interpretations of Schrire's classification and descriptions, particularly the proposition that all bifacial points were more reduced than all unifacial points, had not been determined through examinations of the assemblage. Consequently, the next step in developing a detailed understanding of point production at Jimede 2, and evaluating the economic model of assemblage variation, is to reanalyse the assemblage technologically. Such a reanalysis is presented below.

The value and nature of further analyses of the Jimede 2 points can be clarified in light of the detailed descriptions of point production that have been provided by Clarkson (2006, 2007) for a region to the south. His analysis was based on a retouching index that enabled him to evaluate the amount of reduction on individual specimens, independent of the kinds of retouching that were employed. With this approach Clarkson (2007: 102–112) inferred several trends in the process of point production.

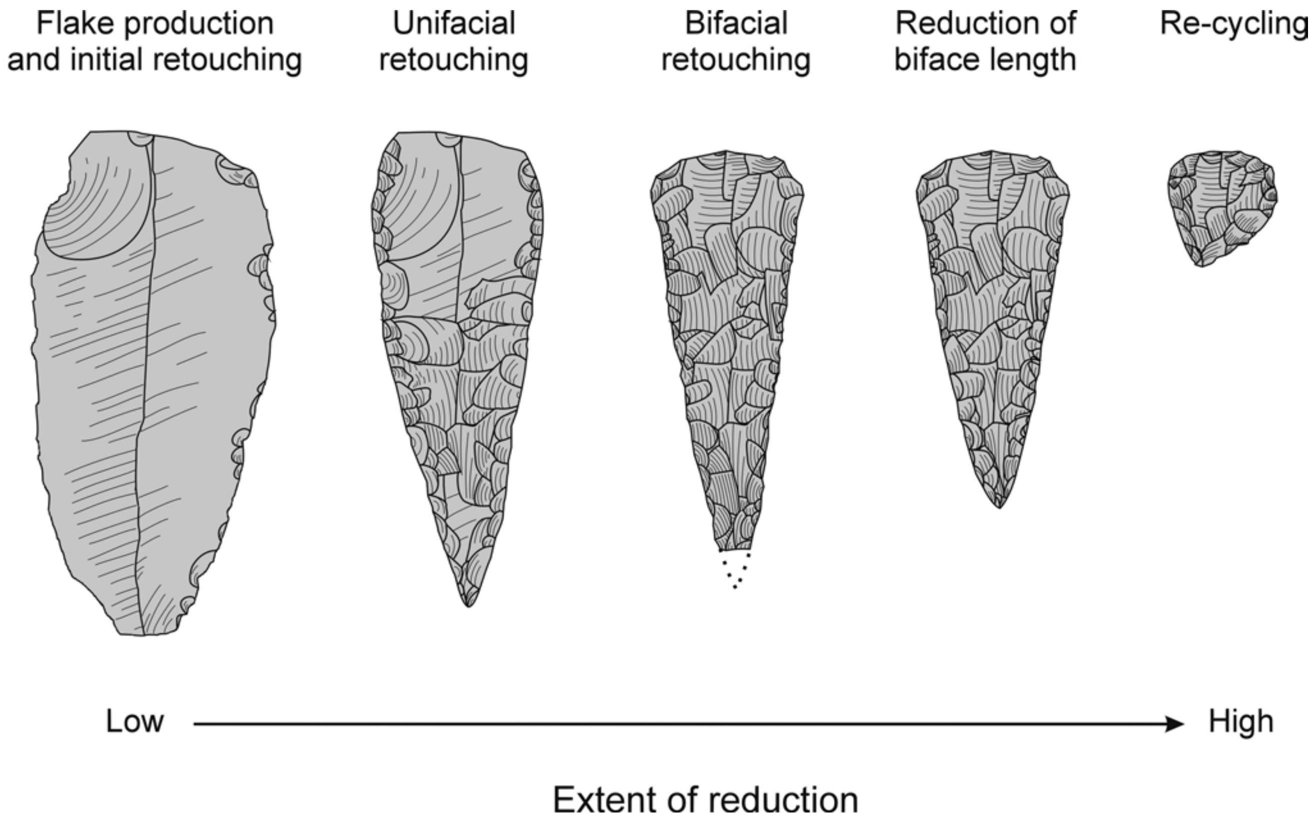


Figure 2. Image depicting Hiscock's (2009) model of morphological changes associated with increasing levels of retouching. All specimens illustrated with their platform at the top.

- Points became progressively smaller as reduction proceeded, with bifacial varieties often being discarded when they were smaller than unifacial ones.
- Retouch expanded around the perimeter as retouch proceeded.
- Cross-sectional shape changed as reduction proceeded, from wide and relatively thin to narrow and relatively thicker and finally to lenticular and relatively thin in the later stages of bifacial reduction.
- Butt trimming/thinning (retouch to the base of the point) became more frequent and pronounced as reduction proceeded, leading to more curved bases.
- In the majority of specimens points began being retouched on the dorsal face only and retouch to the ventral face was added as reduction continued.
- Only larger points continued to be reduced to form bifacial points. Smaller points sometimes continued to be retouched unifacially, but the extent of their reduction was often less than that of bifacial points.

Since there are currently no comparable interpretations of the Arnhem Land points, it is valuable to redescribe the points from Jimede 2 in ways that allows the presence or absence of these trends to be established, thereby testing my economic models concerning technology and land use.

Methodology employed in the re-analysis

The sample analysed below comes from 11 squares excavated by Schrire on the southern side of the streamlet running through the cave: 1D, 1C, 2F, 2E, 2D, 2C, 2B, 3C, 3B, 4C and 5C (Fig. 1). From these squares 102 points and point fragments were identified out of a total of 221 retouched flakes. Most of these specimens were made from quartzite (73%), the others from chert (17%), tuff (7%), and quartz (4%). In the following analysis differences between raw materials in the reduction of specimens is not examined, but it is relevant to the analyses below that there is no statistical association between raw material and extent of reduction, using quartile classes of the invasiveness index ($F = 0.089$, d.f. = 2, $p = 0.223$; $t = 7.623$, d.f. = 6, $p = 0.267$). Only 21% of these points are complete, 41% are butt fragments and the rest are tip and shaft fragments. Measurements were made on any specimen that preserved the trait of interest. For example, while weight could only be made on complete specimens, basal width and relative thickness (width/thickness) could be measured on not only complete specimens but also most butts.

This study employed a technological rather than typological approach, classifying as points only those specimens that were retouched flakes with converging retouched margins, following the general analytical procedures set out elsewhere (Hiscock, 2007). Predictably the items that were included as points in this study did not entirely match the specimens Schrire had classified as points. Approximately 80% of points included in this study was also classified as points by Schrire, but the other points had been previously classified as bifacial or unifacial retouch, and in one case a scraper. Some specimens that had originally been included as points, but which were not retouched flakes, were excluded from this analysis. The difference in the sample

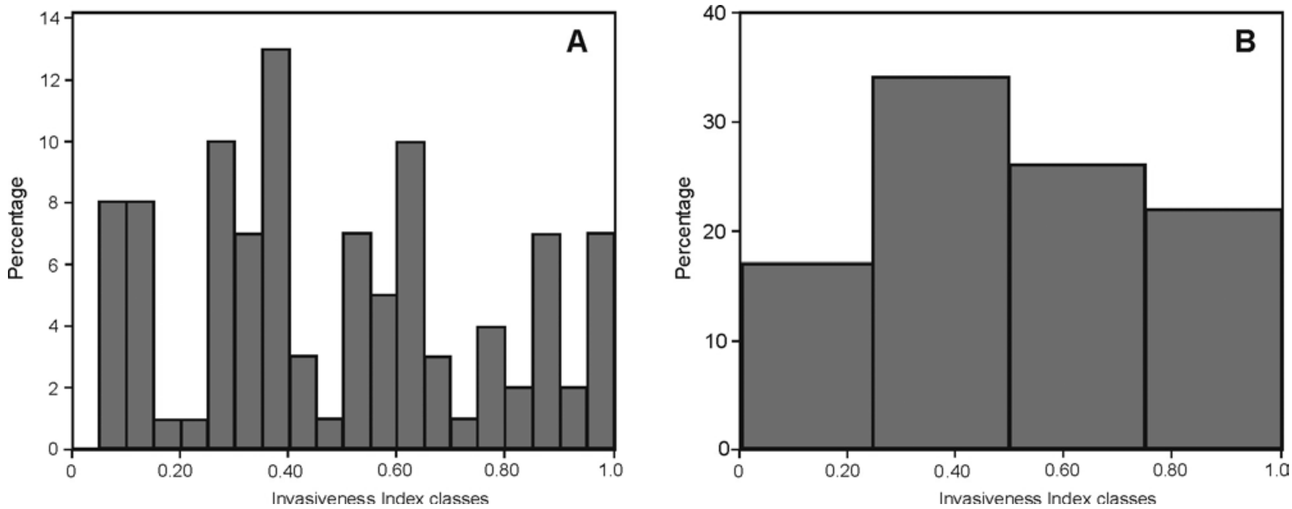


Figure 3. Histograms showing the percentage of specimens in each reduction class: *A,* using index classes of 0.05; *B,* using index classes of 0.25.

that was constructed clearly alters some interpretations. For example, in her analysis Schrire (1982:246) observed that quartzite points were usually bifacial, whereas quartz points were usually unifacial. This pattern is absent from the Jimede 2 sample used here, with no statistically significant association between bifacialness and raw material ($\chi^2 \geq 3.78$, d.f. = 3, p = 0.286).

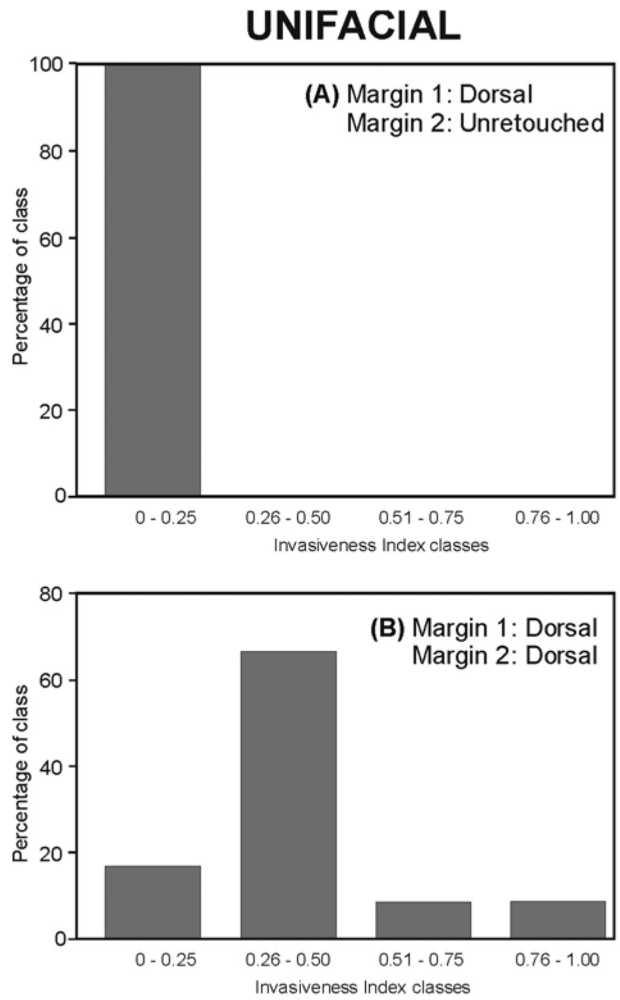
The state of being bifacial cannot be employed as a measure of reduction without predetermining the retouching stage that it represents. An independent measure of the extent of reduction is required if the association between retouching pattern and retouching quantity is to be examined. For this reason the principle measure of reduction employed in analysing the Jimede 2 points is Clarkson's (2002b) invasiveness index, a robust calculation of the amount of mass removed through retouching. The index operates by recording the surface area that has been covered by retouched scars, notionally dividing a specimen into 32 sectors, counting the number containing retouch and dividing by 32 to give an index between 0 and 1. Experimental evaluations by Clarkson have shown that the higher the index, the more material has been removed through retouching. As Clarkson (2007: 102) has pointed out, the division of specimens into a number of categories representing different levels of the invasiveness index provides analytical power in studying changes through the reduction process. Figure 3A shows that when divided into classes of 0.05 values of the index, there are multiple modes in the abundance of specimens that coincide with quartiles in the index, and hence it is appropriate to create four classes of 0.25 each, as shown in Figure 3B. For unifacially flaked points a secondary reduction index is the GIUR, which is also known to be a robust indicator of amount of mass removed through retouching (Hiscock & Clarkson, 2005).

Point reduction at Jimede 2

All points were made on flakes, not reduced from cores. Except in a few specimens that were entirely covered in retouch scars, remnants of the ventral surface were always visible. The changes that accompanied progressive retouching of points are consistent with those that Clarkson observed further south in the Northern Territory. The amount of retouch around the margin varies greatly between specimens, from as little as 12.5% to 100%, and this variation is associated with higher invasiveness index values (F = 5.07, d.f. = 26, p<0.001), supporting the proposition that retouch expanded around the perimeter as retouch proceeded. All points have retouch onto the dorsal surface, and those that have retouch on only the dorsal surface have significantly lower invasiveness index values than points with bifacial retouch (t = 2.649, d.f. = 97, p = 0.009). This is consistent with my previous inference that point retouching at Jimede 2 began with the removal of flakes from the dorsal surface and then proceeded to bifacial flaking (Hiscock, 1994).

Assessing the nature of morphological changes related to the incremental addition of retouch is difficult because the majority (79%) of points are transversely broken, and consequently accurate measurements of weight and length are available infrequently. However in estimating point length from some broken fragments (large butts with the tip missing), an analysis revealed a statistically significant trend to shorter points on specimens with higher invasiveness index values (r = –0.333, N = 53, p = 0.015). Furthermore, width and thickness is able to be measured on most specimens, and relative thickness (thickness/width) is significantly inversely correlated/covarying with the invasiveness index (F = 2.044, d.f. = 22, p = 0.031; r = –0.598, N = 20, p = 0.005), indicating that as retouch continues to reduce point width, the result was relatively thicker forms. These trends towards somewhat different sizes and shapes in minimally and heavily reduced points are similar to those that Clarkson (2007) observed elsewhere, but at Jimede 2 the association of greater butt trimming and reduction that he observed is not found. There is no difference in the extent of reduction between points with basal retouch and those without (t = 0.316, d.f. = 16, p = 0.756), or between points with curved and square butts (t = –0.738, d.f. = 7, p = 0.485). It is likely that such treatments of the point base are assemblage or regionally specific rather than universal as is the case with size decreases as reduction continued.

Point reduction processes can be explored in more detail by examining relationships between the invasiveness index, which broadly measures the level of reduction of each point, and the retouch scar location, which reflects the retouching strategy applied to each point. There is a complex but statistically significant association between the four invasiveness index categories and the different retouching patterns (F = 6.207, d.f. = 3, p = 0.001). This information is summarized in Figure 4, which graphs the



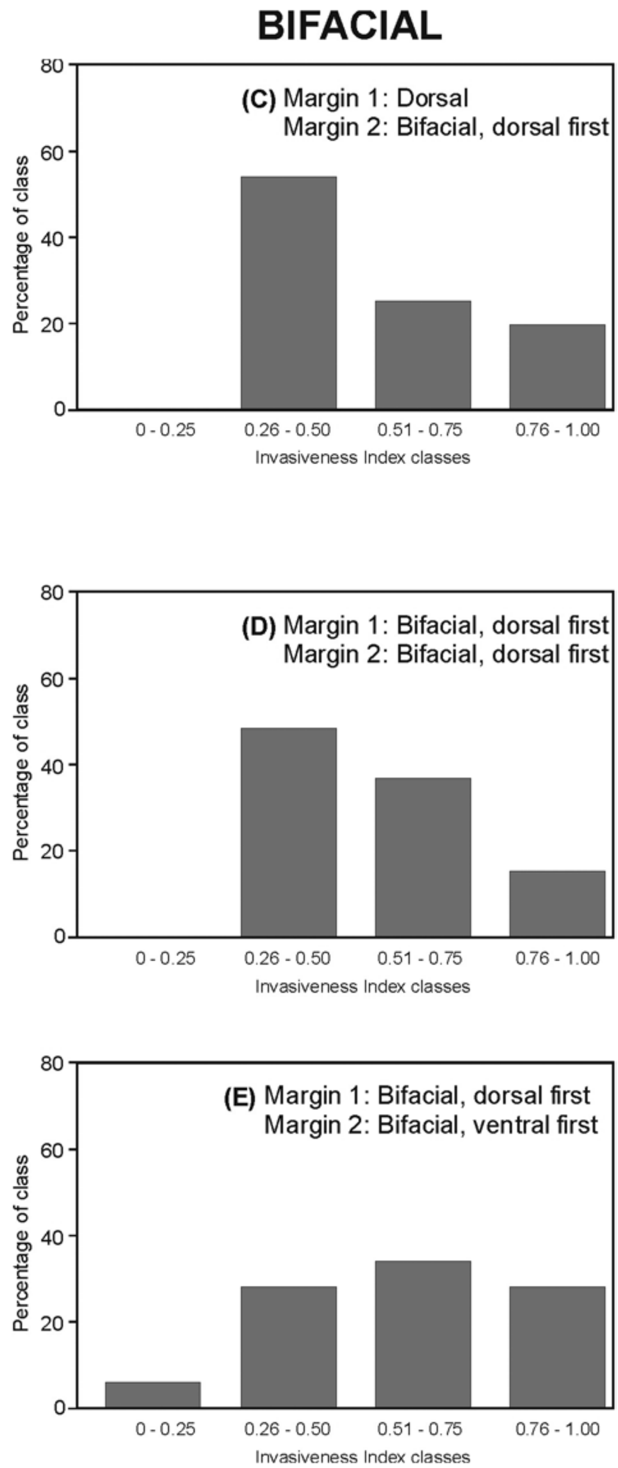


Figure 4. Histograms showing, for each retouching strategy, the percentage of specimens in the four levels of reduction.

relative abundance of each retouching strategy for each of the four levels of reduction, thereby characterizing the phase(s) of the reduction process in which that strategy was most frequently employed. Dorsal retouch on only one margin is undoubtedly the first phase of point production: all specimens displaying this pattern have only small marginal retouch scars and low invasiveness index values (Fig. 4A). Addition of dorsal retouch to the second margin often occurred while the points were still minimally retouched (from invasiveness indices as low as 0.16) and often produced points that were only moderately reduced before being discarded (most being in the 0.26–0.50 invasiveness class). However, some points with dorsal retouch on both margins became extensively reduced. This is shown not only by high, corrected Invasiveness Indices, but also by GIUR values above 0.8 (Fig. 4B). Specimens which already had dorsal retouch and which then received bifacial working on one margin are somewhat more reduced. They have invasiveness index values above 0.26, with more than 50% of specimens in the 0.26–0.50 invasiveness class and the remaining specimens having invasiveness indices above 0.50 (Fig. 4C). Specimens with bifacial working on both margins, i.e., with retouch removing scars from the ventral surface subsequent to dorsal retouching, have moderate or high scar coverage invasiveness, beginning from invasiveness indices above 0.35 and with more than half the specimens above 0.5 (Fig. 4D). Finally, bifacial points that have ventral retouch prior to the last episode of dorsal retouching, or have one margin with ventral retouching later than dorsal and the other margin with dorsal scars produced after ventral retouching are discarded at all levels of reduction, but are predominantly extensively retouched, with more than 60% of specimens greater than 0.5 (Fig. 4E). Given the absence of any specimens with only ventral retouch, it is inferred that for all bifacial points in which the retouch shows ventral scars under dorsal scars, there has been an earlier stage of dorsal retouching, which has been obscured. Consequently, at Jimede 2 points with only dorsal retouch show diversity in scar patterns because they were discarded at different phases of reduction: (1) bifacially worked with the dorsal surface as the last one flaked and (2) bifacially worked with the ventral surface being the last one flaked.

This conclusion implies that point production is indeed one ramified process, not a separate process for unifacial and bifacial points. All points begin with the same treatment, but the subsequent patterns of retouching vary, thereby diversifying the outcomes. Consequently, any detailed description of the reduction process cannot be normative or unilinear; it must represent the diversity of retouching strategies found within the single reduction process. One depiction of this elaborate, diversified reduction process is presented in Figure 5.

In this depiction of point production the vertical length of each line (y axis) denotes the range of invasiveness index values observed for each point retouching pattern. The position of these lines on the vertical axis describes the timing within the reduction sequence of the initiation of each retouching pattern as well as the maximum reduction observable on points with that pattern. Note that the invasiveness index value at a branching location is not the only time that the manufacture of a point shifted from one retouching pattern to another. It merely represents the earliest time in the production process that the shift can be documented in this assemblage. Furthermore, an individual specimen might shift to and fro between different retouch patterns, such as from bifacial (dorsal first) to bifacial (ventral first) and back again, without preserving evidence of the different retouching directions. Consequently, although the branching lines in Figure 5 do not reintegrate, this should not be construed as indicating that retouching of every specimen proceeded in a directional manner; no doubt cycles of these knapping patterns occurred but are not often preserved in the scar patterns on the Jimede points and are not represented in the diagram.

What Figure 5 shows is the evidence for the staggered, sequential onset of the diverse knapping approaches applied to the points. As extended reduction adds a second margin and/or a second face of retouched scars, the potential diversity of retouching patterns increased. Even though a common origin in dorsal marginal retouch for all points means we can talk about them as part of a single reduction process, individual specimens were treated differently. A second retouch edge was added by working either the dorsal or ventral face, and on bifacial points the order in which flakes were removed from either face varied. An example of the different options for bifacial working is presented in Figure 6, which contrasts (1) a pattern of retouching on both margins of one face before rotating the specimen in the hand to flake the other face with (2) a pattern of retouching one margin, then rotating the piece around the long axis to retouch the other margin, thereby flaking different faces of each margin. The first approach produces bifacial points that alternate between dorsal scars first on both margins and ventral scars first on both margins, whereas the second approach produces bifacial points that have a scar pattern of dorsal first on one margin and ventral first on the other. The diversity of scar patterns/sequences visible on the Jimede 2 points patterns may therefore be partly a consequence of decisions about retouch location early in the reduction process.

The patterns of retouching at Jimede 2 are linked to aspects of point morphology and reduction history. For instance, the potential maximum length of the reduction process is conditioned by the size of the flake blank, such that larger specimens are able to be reduced more extensively than smaller one. This is seen in the larger weights of more reduced specimens, revealing that they had originally been substantially larger and hence remained larger even after greater retouching. Hence, the weight of complete bifacial points is significantly greater for specimens with higher invasiveness index values, above 0.7, than for less reduced specimens ($t = 2.726$, d.f. = 9, $p = 0.023$). It is hypothesized that large flakes are more frequently worked into bifacial points than smaller flakes, which are more likely to be discarded as unifacial points.

There is also a relationship between the treatment of points during retouching and their cross- sectional shape. One metrical expression of shape differences is the index of relative thickness (width/thickness), in which higher values are relatively thin. For example, complete unifacial points have significantly higher relative thickness values than bifacial points ($t = -3.137$, d.f. = 13, $p = 0.008$); bifacial points with retouch on the dorsal face on both margins preceding ventral retouch (bifacial—dorsal first) have significantly higher relative thickness values than those with retouch on one margin being dorsal first and on the other ventral first (bifacial—dorsal first and ventral first) ($t = -2.118$, d.f. = 22, $p = 0.046$). The tendency for points with dissimilar retouch patterns to have different relative thickness values is expressed in Figure 5, which plots this measure of cross-sectional shape on the x-axis. Bifacial points with retouch on the dorsal side first, and points with dorsal, unifacial retouch on one or both margins tend to have flatter cross-sections than points with ventral unifacial retouch or bifacial retouch with the ventral surface flaked first. These differences certainly relate to the history of retouching in each category, but may additionally reveal dissimilar blank characteristics. The relationship of point retouch history to blank form is not pursued here.

Conclusion

These data document a complex interaction between flake blank size, extent of retouching and the order in which retouch was applied to different surfaces. Many of the trends that Clarkson (2007) observed in Wardaman country have also been established for Jimede 2, including the diminution of point dimensions as reduction continued, the greater reduction of larger blanks, change to cross-section shape, and the progression from unifacial dorsal retouch to bifacial retouch. However the most significant finding is that the diversity of scar superimposition patterns that has been observed in the Jimede 2 assemblage (Hiscock, 1994) is explicable within a single ramified reduction process, which began with the same pattern of retouching on all specimens but subsequently diversified as different decisions about the location of retouch were made. At moderate levels of reduction there were multiple ways of working a point, including unifacial, bifacial or a mixture of both on different margins; a finding that demonstrates that a simple sequential model of unifacial succeeded by bifacial flaking cannot account for the diversity of knapping options present within the reduction sequence.

One consequence of this ramified production process is that when looking at assemblages the extent of point maintenance, and therefore the general level of reduction represented by the assemblage, need not be adequately assessed merely by the ratio of bifacial to unifacial points. Although the economic model recently formulated (Hiscock, 2009), and its implication that seasonal mobility was not a factor in shaping lithic variability, is based on several measures of the extent of reduction the results of this analysis reveals that bifacial to unifacial point ratios may provide inaccurate and simplistic images of the geographical variation in the intensity of point reduction. For this reason economic models will be better tested following detailed

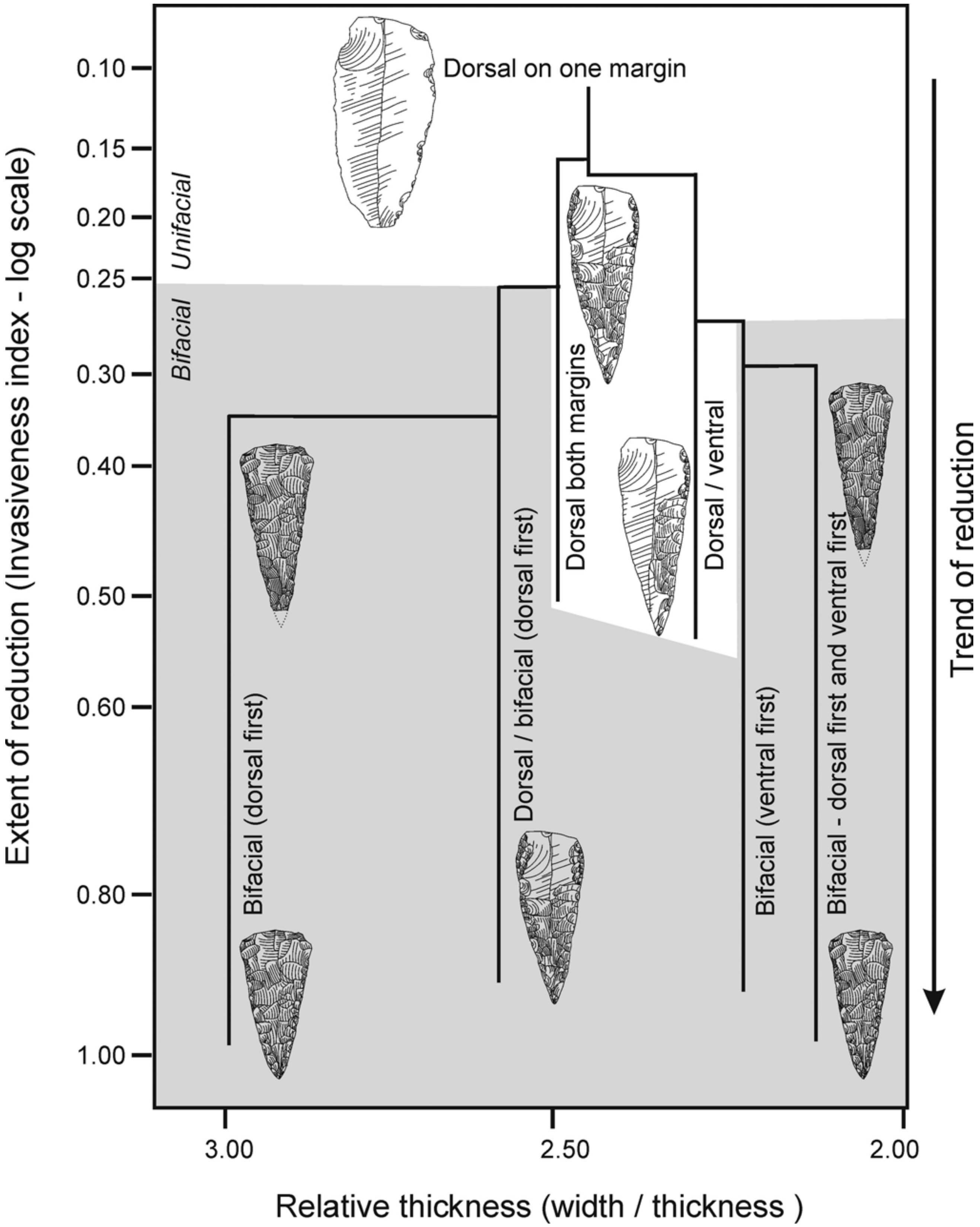


Figure 5. Reduction model for points at Jimede 2.

technological descriptions of the western Arnhem Land assemblages, enabling studies to move beyond typological classifications and directly measure the geographic differences in reduction and recycling that reflect prehistoric economics in the region.

The recognition of the single ramified point production system also raises further questions about whether the different retouching patterns are random or idiosyncratic or are a direct consequence of blank characteristics, whether they reflect the preparation or maintenance of tools with different functions or hafting procedures, and whether they display geographic variation that reflects economic factors. Additionally similarities between the factors creating variation in points and those underlying variation in other tool forms remains to be explored. Further technological examination of Jimede 2 and other assemblages will help resolve these questions, and revise our understanding of lithic variation in western Arnhem Land.

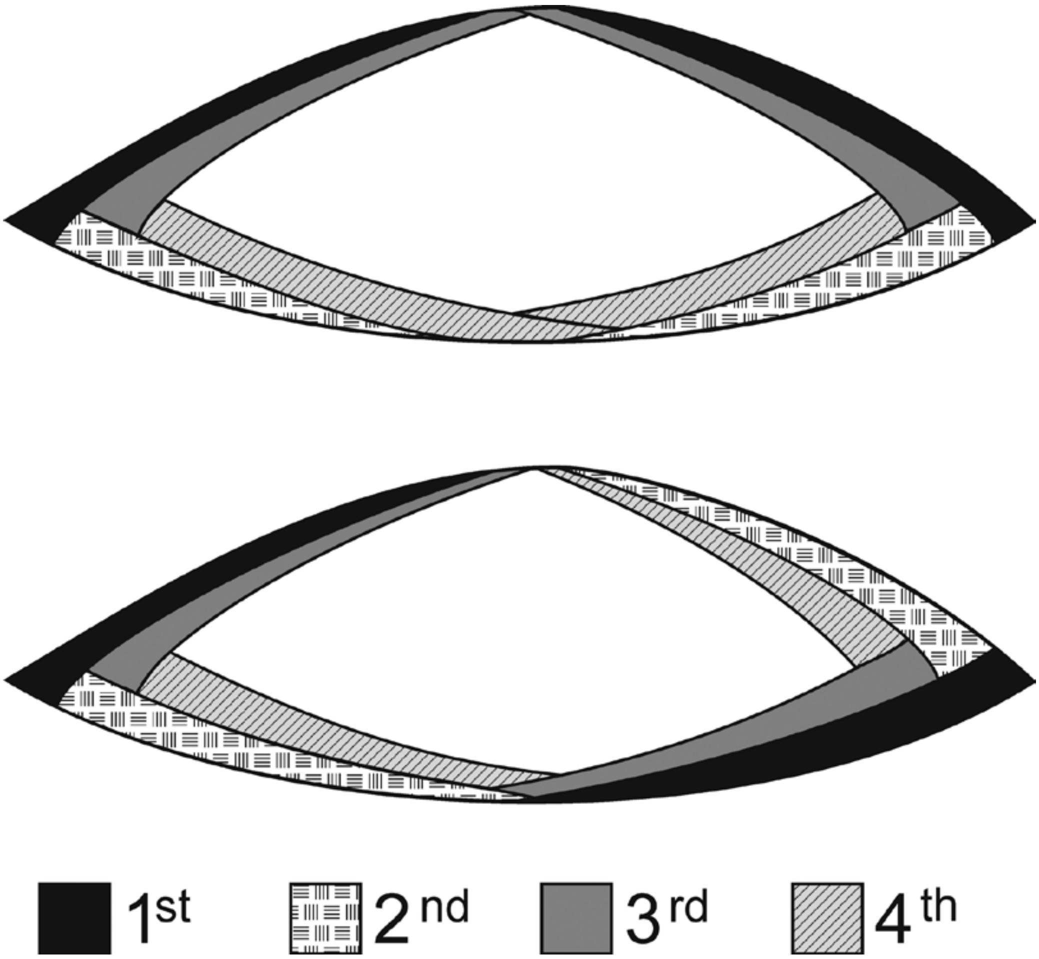


Figure 6. Idealized cross-sections of bifacially retouched points, illustrating two retouching patterns seen on the Jimede 2 assemblage: Top = retouching one face then rotating the piece to retouch the other face, Bottom = retouching one margin then rotating the piece to retouch the other margin. Four colour-coded pairs of flakes removed from the biface indicate the pattern of retouch.

An appreciation of Val Attenbrow

I am pleased to acknowledge that an important stimulus for this kind of assemblage reanalysis in Arnhem Land is the work that Val Attenbrow and I have carried out in the Sydney Basin. There we have begun a process of re-examining multiple archaeological sequences, to build a novel picture of technological change in that region. Of course, lithic analysis is only one of the many skills that Val has displayed in her remarkable and productive career in archaeology. Her extensive program of detailed excavations, the meticulous Mangrove Creek investigation, her syntheses of Sydney prehistory, and her critique of demographic models in Australian archaeology have all been major contributions to the field. In view of those diverse research activities, it is all the more remarkable that Val has had the energy to also pursue the reinterpretation of lithic assemblages across the Sydney region. It has been a pleasure to work closely with Val on that project, and to have such a remarkable person as friend and colleague. Thanks Val!

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