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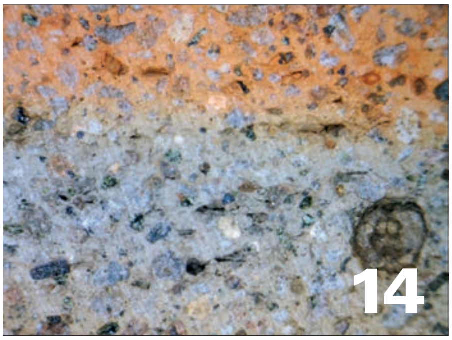
Table of Contents




116


131


156


167


203

PUTTING WA ARCHAEOLOGY ON THE MAP:

THE INESTIMABLE CONTRIBUTION OF CHARLIE DORTCH

THEMED SECTION

GUEST EDITORS: SANDRA BOWDLER, JANE BALME AND JOE DORTCH

Image: Charlie Dortch at Devils Lair, southwest Australia.

Backed points in the Kimberley:

Revisiting the north-south division for backed artefact production in Australia

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THEMED SECTION

Abstract

Dortch (1977:117) first identified the 'Kimberley backed point' from the east Kimberley as an asymmetrical point form with steep-angled backing retouch along one dorsal margin. O'Connor (1999) subsequently recorded backed points as a component of the mid- to late Holocene assemblages in sites from the coastal west Kimberley. However, the distribution and morphology of backed point technology, and the relationship of backed points to other forms of point technology, has not been assessed for the broader Kimberley region. Here we use morphological analysis and measures of retouch intensity to examine the differences between backed points and other forms of point technology. We use three assemblages from the south Kimberley and reassess two assemblages from the west Kimberley, and argue that backed points are a discrete and specialised reduction trajectory of point technology which were produced throughout the Kimberley region. Although produced from the same pool of flake blanks as other point forms, the backed variant focused on the production of a maintainable blunted margin with a steep-angled retouched edge of between 75 and 90°.

Introduction

Backed artefacts have been central to academic discussions of Australian artefact assemblages for close to a century (see Hiscock 2014). These kinds of artefacts occur widely across the central and southern portions of the continent and include a variety of symmetrical and asymmetrical forms. These have been variously described as backed microliths, backed blades, geometric microliths, Bondi points and eloueras, and, although morphologically variable, they share a common feature: backing retouch.

Although backed artefacts were reported from the Kimberley as early as 1977 (Dortch 1977), little attention has been given to these artefacts as part of the broader spectrum of point forms in the Kimberley, or to the relationships between the Kimberley backed artefacts and those from elsewhere in Australia. For example, a backed flake/blade variant, the elouera, has been reported from the Oenpelli region of the Northern Territory (NT) (Kamminga 1977:208–211; Schrire 1982:40). Schrire (1982:40) suggested that these artefacts, which she termed 'Oenpelli polished flakes', were a functional group resembling the Currarong elouera identified by Lampert (1977:48) from the Illawarra region of eastern Australia. Like the Kimberley backed points, many of the NT backed artefacts have steep-angled retouched margins and irregular morphology, and are argued to have been hafted adzes employed in the working of plant material (Kamminga 1977:208–211; see also Akerman 1998).

Despite the early recognition of backed artefact forms in the Kimberley and NT there has long been debate about whether there was a northern boundary beyond which backing technology was absent from the lithic repertoire and, if so, where this boundary lay (e.g. Flood 1995:222, Figure 15.1; Hiscock 2001:56–58, 2014; Hiscock and Hughes 1980; Mulvaney 1969:123, 1985; Pearce 1974:301–302; Smith and Cundy 1985). A better understanding of Kimberley backed tools is essential for understanding the spatial variation in lithic technologies across Australia and for assessing the reality of a north-south division for backing technology. Here we assess 11 complete and four partial backed points from five assemblages in the south and west Kimberley on technological and morphological grounds to determine if they can be classed as backed artefacts.

Kimberley Backed Points: The Historical Context

The Kimberley backed point was originally identified by Dortch (1977:117) following the salvage excavation of sites in the Ord River catchment prior to their flooding for the Ord Dam. The excavation of Miriwun and Monsmont rockshelters (Figure 1) established a temporal framework for the appearance of point technology in the east Kimberley. At the time, these sites also provided the first records of new technologies in the Holocene archaeological record of the region. Dortch (1977) argued that the appearance of points represented a major technological change which occurred around the mid-Holocene, and related this to the mid- to late Holocene appearance of the 'Australian Small Tool Tradition' in southern Australia. The Ord assemblages contained a range of point forms (Dortch 1977), and the backed points were a distinctive but proportionally small component of the overall assemblages. Backed points were noted as respectively representing 2.3% and 3.7% of the formal tool types identified from the surface and sub-surface contexts at Miriwun (Dortch 1977:121, Table 4). No quantitative data was presented for the other Ord sites.

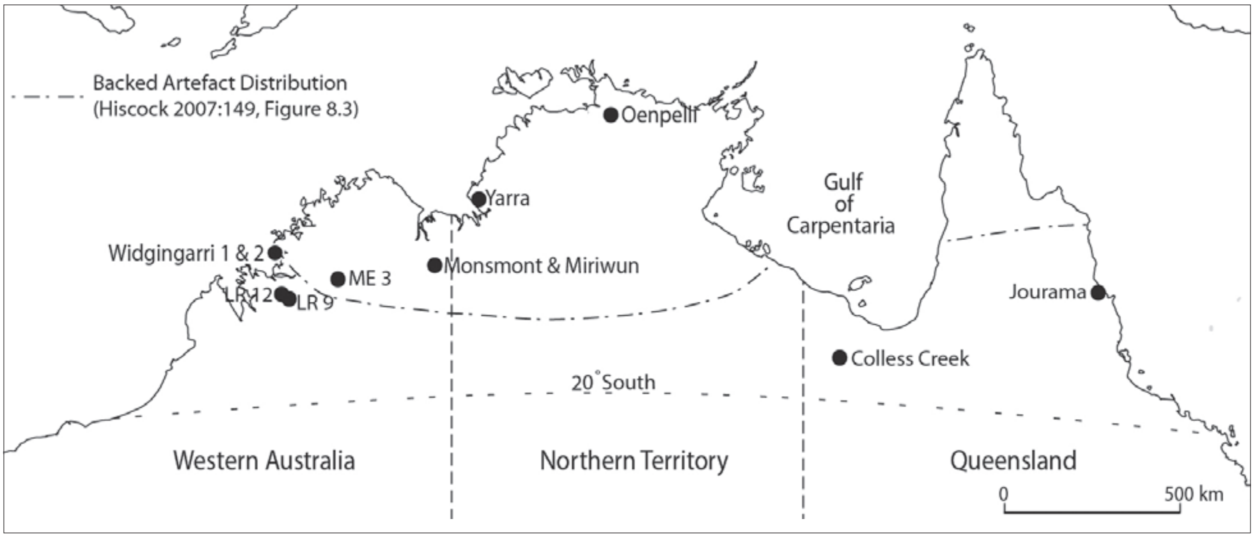

Figure 1 Northern Australia showing sites mentioned in text and backed artefact distribution line (after Hiscock 2007:148, Figure 8.3).

Dortch (1977:117) described the morphology of the east Kimberley backed points as larger, thicker and broader than those known from eastern and southern Australia. Their retouched margins were produced with direct percussion, with no observation of bipolar anvil-rested retouch. Furthermore, the backing retouch was described as 'generally semi-abrupt instead of abrupt' and, unlike many eastern Australian backed artefacts, did not appear to expand around proximal margins and remove or truncate the platform or 'butt' (Dortch 1977:117). Despite these contrasts, several illustrated specimens were noted as being morphologically similar to geometric microliths and Bondi points (Dortch 1977:116, Figures 5.6, 5.12 and 5.13). A single specimen was described with the platform surface truncated by backing retouch (Dortch 1977:116, Figure 5.13). Additional technological observations made by Dortch (1977:117) included crushing along the proximal edge of backed surfaces, which led him to suggest that the Kimberley backed points were likely used in adzing activities.

O'Connor (1999) subsequently identified a range of point forms, including marginally retouched, bifacial and unifacial points, as well as four complete and three fragments of backed points at Widgingarri Shelters 1 and 2 in the coastal west Kimberley. Backing retouch on these artefacts was argued to have been produced with bipolar anvil-rested percussion (O'Connor 1999:72, 73, Figure 5.13[3]) on the four complete specimens, described by O'Connor (1999:72) as 'double backing'. The retouched margins were otherwise primarily unidirectional, with scars initiated from the ventral surface. The retouch edge angle was abrupt; between 80–90°, with the maximum retouch scar height approaching the maximum flake thickness (see O'Connor 1999:69, Table 5.13); this is evidenced by the illustrated cross-sections (O'Connor 1999:73, Figure 5.13 and 74, Figure 5.14). On one specimen, retouch expanded around the perimeter and truncated the platform surface (O'Connor 1999:74, Figure 5.14[3]). No evidence suggested that these backed points were made on relatively thicker flakes than the other point technologies in the assemblages (O'Connor 1999:72). Importantly, O'Connor argued that the backed points were not the discard stage of other point technologies but rather a discrete form of point produced for a distinct purpose. Although O'Connor (1999) did not comment specifically on the function of these artefacts, residue analysis on the Widgingarri points indicated that the majority were used for processing plant materials (Wallis and O'Connor 1998). The four backed points were no exception and were all found to contain visual residues of starch, whilst three were observed with cellulose residues and one with ochre (Wallis and O'Connor 1998:160, Table 2).

Both Dortch's (1977:117) and O'Connor's (1999:72) observations of backed points suggested they occurred in low frequencies, could generally be described as morphologically larger than the asymmetrical and symmetrical forms in central, eastern and southern Australia, and were consistently associated with a range of other unifacial and bifacial point technologies. Neither researcher discussed the relationship of the Kimberley forms with NT elouera s.

Hiscock and Hughes (1980:93) included Dortch's (1977:177) observation of the Kimberley backed points in their reassessment of the spatial distribution of backed artefacts in Australia. They noted that 'on morphological criteria we have little doubt that a number of the artefacts illustrated by Dortch (1977:116, Figures 5.6–5.13) are technically 'backed blades'' (Hiscock and Hughes 1980:93). They also drew on evidence for steep-angled retouch observed on points recovered from Flood's excavation of Yarra shelter in the NT (see Flood 1970:47, Figures 6B and 6C), and a single point from the excavation of the Jourama site in northeast Queensland (Qld) (Brayshaw 1977:281). They concluded that if all these artefacts, as well as the backed artefacts from Colless Creek in northern Qld (Hiscock and Hughes 1980), were accepted as 'backed blades', it would 'drastically alter the concept of an abrupt northern boundary in the distribution of backed blades' (Hiscock and Hughes 1980:93).

Smith and Cundy (1985:35) argued that a northern limit could be applied to the distribution of backing in Australia, with Kimberley backed points interpreted as remote from the other forms of backing technology. Owing to the lack of 'blunting' retouch and the high morphological variability of the backed points in the east Kimberley in Dortch's (1977) data, Smith and Cundy suggested that backed points were best described as a 'variety of asymmetrical point with steep retouch' (1985:35). A similar view had been expressed by White and O'Connell (1982:113), who suggested that backed points were 'probably varieties of abruptly trimmed points'.

THEMED SECTION

Subsequently, Hiscock (2001) pointed out that the distribution model for backed artefacts proposed by Smith and Cundy (1985) was flawed, as it was based on small sample sizes. The sample to the north of the line demarcating the boundary of backing technology included a mere 92 artefacts, and was thus unlikely to include rare artefact forms such as backed artefacts (Hiscock 2001:57). There can now be little doubt that the backed points illustrated by O'Connor (1999) do have blunting retouch produced with bipolar anvil-rested percussion. Three complete backed points from the Widgingarri excavations are illustrated in Figure 2, where the cross-sectional shape is shown at multiple points and the backed margin is shown with bidirectional retouch scars and marginal step terminations.

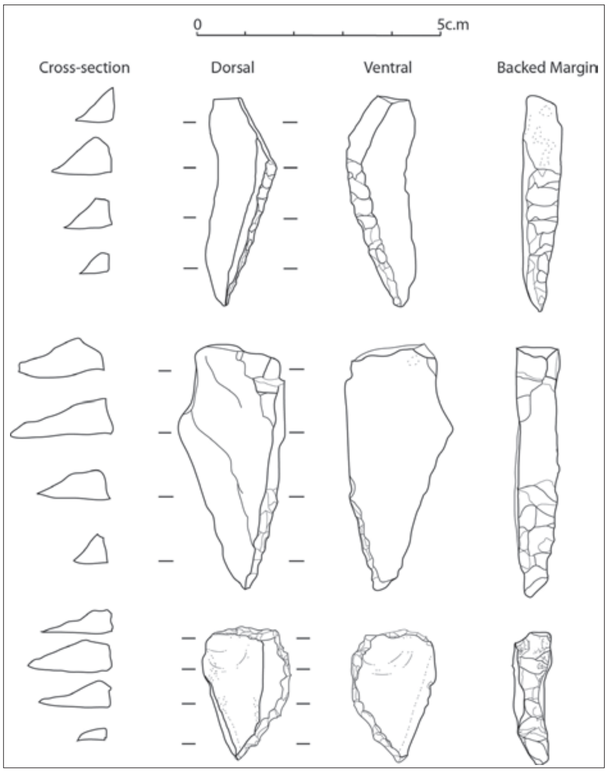

Figure 2 Three complete backed points from Widgingarri Shelters 1 and 2 (modified from O'Connor 1999).

The South and West Kimberley Samples

To assess the divergence of the northern backed point technology, two assemblages from the Napier Ranges in the south Kimberley, and one from the Mount Elizabeth region in the southeast Kimberley, were analysed, and the point assemblages from the Widgingarri 1 and 2 excavations in the west Kimberley were re-analysed. The locations of these sites are shown in Figure 1. Three of the assemblages, Lennard River 12 (LR12), Lennard River 9 (LR9) and Mount Elizabeth 3 (ME3), were collected and excavated by Blundell (1975:218–221, 232–236). Blundell collected the total surface assemblage from all three rockshelters and excavated in the two Lennard River rockshelters. Although she noted that both excavated and surface collections were 'screened', she did not elaborate on this methodology nor the screen size (Blundell 1975:227). The Widgingarri Shelter 1 and 2 assemblages were derived solely from excavation. O'Connor (1999:53–54) excavated five adjoining 1 x 1 m squares in Shelter 1 and a 2 x 1 m pit in Shelter 2; all excavated material was screened through nested 6 and 3 mm sieves.

The Blundell collections were subsampled for this analysis. Our sample from LR12 included all artefacts from the 1 x 1 m excavation, as well as all retouched flakes from the floor of the cave (an area of approximately 110 square metres). A single backed point was identified in this sample, representing <1% of the assemblage. Our LR9 sample included all of the material from a single 1 x 1 m test pit (of the three Blundell excavated). From her LR9 surface assemblage we analysed all artefacts from a 2 x 2 m area, as well as all retouched artefacts from the remaining surface assemblage (approximately 72 square metres in total area) (Blundell 1975:218–221). Four backed points were recovered from this sample, representing <1% of the assemblage. The ME3 assemblage is a surface collection from a small sandstone rockshelter to the north of the Napier Range sites on Mt Elizabeth Station (Blundell 1975:198). No excavations were conducted at this shelter. Our sample from ME3 comprised the entire surface collection assemblage. Blundell provides no information about the size of the area collected at this shelter. Two complete and one broken backed point were recovered from this collection. Point technology dominates the formal tools represented in these assemblages and includes a range of marginally retouched and invasively flaked direct percussion points, as well as pressure flaked points, such as Kimberley points and dentate Kimberley points (after Akerman and Bindon 1995). The backed points in each sample represent <2% of all the retouched flakes. Other lithic artefacts found include flakes, cores, burren retouched flakes, edge ground adzes and axes, portable grindstones and large blades (leilira). Amorphous retouched flakes are found in every sample and lack backing retouch. The technological classes observed in the analysed assemblages are listed in Table 1. A total of 11 complete and four broken backed points were identified in the assemblages from the five sites.

Methodology

Here we test the proposition that Kimberly backed points were a discrete and specialised reduction trajectory of point technology. We argue that if Kimberley backed points were a real technological divergence from other point reduction trajectories, representing a deliberate attempt to create and maintain a steep retouched edge angle, then several phenomena can be predicted and empirically tested.

Firstly, if backed points are made on different flake or blank morphologies than other points, then it would suggest technological divergence in the earliest stages of artefact use life. Hiscock (2006:79) argued that backing technology in Australia may have been assisted by the production of standardised blanks; however, it did not depend on this strategy. He suggested they 'were made on any flake with an appropriate cross-section and one straight or gently undulating margin of sufficient length' (Hiscock 2006:78).

Secondly, backed points could equally diverge from other point technologies during their manufacture and use life. For example, if backed points were simply a discard stage in a reduction continuum of laterally retouched or bifacial points and the 'backed margin' was a result of a gradual build up of unwanted steep angle scars, the backed margin would logically occur in the later or discard stage of point reduction and the backed point would display retouch on the dorsal or ventral face of the margin opposed to the backed margin.

To test these propositions, quantitative and qualitative variables were recorded for retouched artefacts in each

Assemblage	LR12		LR9		ME3		Widgingarri 1 and 2 (Formal Tools)	
Technological Class	n	% of Sample	n	% of Sample	n	% of Sample	n	% of Sample
Flakes	285	40.42	529	34.15	33	23.50	0	0
Retouched Flakes	39	5.53	43	2.80	3	2.12	0	0
Blades	29	4.10	39	2.51	17	12.10	0	0
Unifacial Points	26	3.68	42	2.71	13	9.21	27	64.28
Backed Points	1	0.15	4	0.25	2	1.41	4	9.72
Broken Backed Points	0	0	0	0	1	0.70	3	7.14
Bifacial Points	28	3.97	25	1.62	10	7.10	7	16.66
Pressure Flaked Points	1	0.15	1	0.06	3	2.12	0	0
Bifacial Preforms	10	1.41	1	0.06	14	9.92	0	0
Tulas	0	0	0	0	0	0	1	2.38
Cores	5	0.70	19	1.25	14	9.92	0	0
Bipolar Flakes	5	0.70	3	0.18	1	0.70	0	0
Edge Ground Flakes	7	0.99	11	0.71	0	0	0	0
Burrens	1	0.15	3	0.18	0	0	0	0
Hammerstones	7	0.99	2	0.14	0	0	0	0
Broken Flakes	95	13.47	291	18.80	6	4.25	0	0
Broken Retouched Flakes	12	1.70	26	1.68	9	6.39	0	0
Pot Lid / Heat Shatter	1	0.15	3	0.18	0	0	0	0
Broken Points	35	4.96	40	2.60	7	4.97	0	0
Broken Pressure Flaked Points	2	0.28	1	0.06	1	0.70	0	0
Flaked Pieces	115	16.35	465	30.00	7	4.97	0	0
Grindstone Fragments	1	0.15	1	0.06	0	0	0	0
Total	**705**	**100**	**1549**	**100**	**141**	**100**	**42**	**100**

Table 1 Technological classes observed in the analysed assemblages.

assemblage. Blank selection, edge angles, cross-section shape, retouch intensity and retouch characteristics, as well as morphological variation, were assessed, because they directly relate to different aspects of the reduction sequence and allow the identification of any technological divergence present within the assemblages.

Two types of statistical tests were calculated using SPSS. The first, analysis of variance (ANOVA), provided regression analysis and one way analysis of variance for one dependent variable by one or more factors or variables (Hiscock and Attenbrow 2005a:37). This test was used for comparisons of retouch intensity, edge angles and other metric measurements of artefact morphologies. The data analysed were deemed to be appropriate for ANOVA tests due to the normality or symmetry in each sample as gauged by graphical representation and normal quantile-quantile plots. The second test, linear regression analysis, is an evaluation of the strength of covariation between two variables. Linear regression was used for comparison of retouch intensity and edge angle, which have been shown to be in positive correlation (Hiscock and Attenbrow 2005b:51); however, we were interested in testing the strength of this correlation in the early stages of point use life.

Blank Selection

Determining the blank flakes selected for retouching reveals both the level and importance of standardisation. We were interested primarily in determining the blank morphology of backed points and determining whether a unique morphology was being selected or whether backed points were made from the same pool of flakes as other types of points in the assemblage.

The remaining platform surface presents a viable link to the unmodified size of all discarded retouched artefacts. Provided the platform is intact and not truncated by retouch, this surface area measurement can be used to obtain a proxy for the size of the original blank. The recent application of 3D laser scanning has improved the accuracy of platform surface area measurements (Clarkson and Hiscock 2011). Platform area was here measured with a Next Engine 3D laser scanner and converted to mm^2 (see Shott and Trail 2012 for a methodological description of 3D laser scanning for lithic artefacts).

Additionally, to identify the early stages of use life prior to extensive modification, only the platform area of points with Index of Invasiveness values less than 0.3 were selected in each assemblage. Clarkson (2007:109) used this methodology in an analysis of blank selection on point assemblages from the NT. Clarkson (2007:38, 108, Figure 6.17) further used graphical techniques to illustrate the early stages of point reduction against the larger sample of variation in all other flakes.

Edge Angles and Cross-Section Shape

Two edge angle calculations were made for each complete retouched artefact. Edge angles were measured using a goniometer in degrees (see Dibble and Bennard 1980:858–859). This device cannot realistically measure the nonlinear retouched margins of artefacts to any greater precision than 5°, hence, mean values were calculated for both retouched edges and non-retouched edges. The average edge angle was taken at six points along the margins of complete artefacts, regardless of retouch. The average retouched edge angle was taken at multiple points along only the retouched margins.

The cross-section shape was quantified by width to thickness ratios that were calculated at three points on each complete artefact's percussion length. Caliper measurements of width at the midpoint, proximal quartile and distal quartile of percussion length, were divided by the thickness at these points. Additionally, 3D laser scanned images were able to be manipulated to provide more precise cross-section shapes at four points along the percussion axis of backed points. Each 3D image was edited to retain only the cross-section shape at these points, which was then converted to line drawings. An example of this is given in Figure 3, where the cross-section shape was taken at four points along the percussion axis of a backed point from ME3. Qualitative observations were also recorded for each artefact as generally representing either plano-triangular, convex triangular, convex trapezoid or plano-trapezoidal cross-sections.

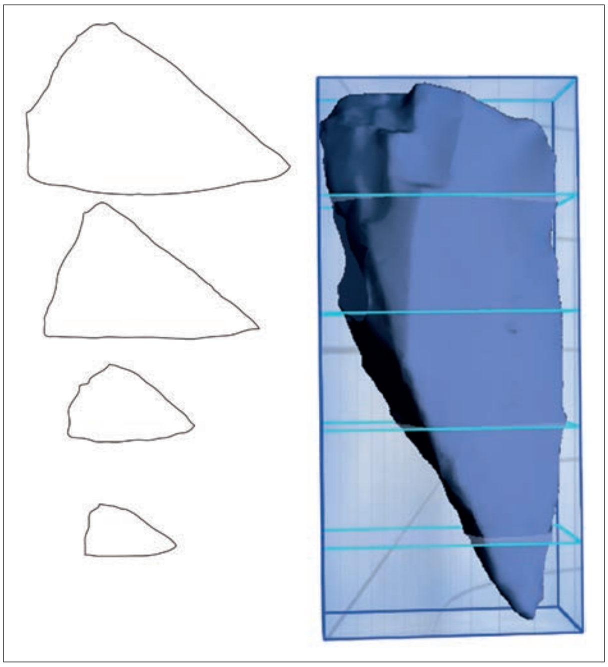

Figure 3 3D laser scanned image of backed point from ME3, illustrating multiple points along percussion axis where cross-section shapes were calculated.

Retouch Characteristics and Intensity

A range of definitions for backing are available. Andrefsky (2005:169) described backing simply as an intentionally dulled edge produced by retouch, abrasion or grinding, in preparation for hafting. Holdaway and Stern (2004:159, 259) stated that backing is 'abrupt unidirectional or bidirectional retouch, normally found on one lateral margin', most often initiated from the ventral surface. Hiscock stated that backed artefacts are 'flakes with near ninety degree retouch retouched along one or more margins that was often accomplished with the use of bipolar techniques on an anvil' (2006:78). Here, we follow Hiscock (2006:78) in defining backing as steep angled retouch approaching 90°, which forms a blunted retouched margin which was likely produced by anvil-resting of the flake. Bipolar anvil-rested retouch was recognised by bidirectional scars with evidence of crushing, such as multiple small step terminating scars (see Cotterell and Kamminga 1987:689). We emphasise, however, that the observation of anvil-rested retouch is complicated by variability in flake morphology. Cross-section shape may prevent anvil contact. For example, Flenniken and White (1985:143–144) pointed out that there are three modes of anvil-rested retouch. The first occurs when the anvil is used to immobilise small flakes and prevents anvil contact on the surface opposite the fracture initiation. This form of backing results in steep angled unifacial scars only. The second mode of backing occurs when dorsal ridges or arises prevent the opposite surface from making anvil contact and results in one edge being backed and the opposite edge being rounded. In this instance, crushing on the dorsal ridges may provide some confirmation of anvil-resting (Hiscock and Attenbrow 2005:39). In the third mode (Flenniken and White 1985:143–144), anvil contact does occur and force is produced on the backed margin from both the mobile percussor and the stationary anvil (see also Cotterell and Kamminga 1987:689). Flenniken and White (1985:144) referred to the resultant margin as 'squared off'.

The order of retouch was recorded as ventrally initiated, with retouch scars propagating onto the dorsal surface, or, dorsally initiated, with retouch scars propagating onto the ventral surface. When retouch scars initiated from one surface impact existing scars initiated from the opposite surface, the latter surface was the last to be retouched. Using this premise, retouch order was recorded as either dorsal only, dorsal last, ventral only or ventral last.

As many of the points in the analysed assemblages have retouch on only one face, the Average Geometric Index of Unifacial Reduction (AGIUR) (Kuhn 1990; see Hiscock and Clarkson 2005a, 2005b, 2009) was employed to assess the retouch intensity of unifacially retouched points. The AGIUR calculates the relative difference between retouch scar height and retouched flake thickness using caliper measurements and averages these values across six zones.

The Index of Invasiveness (Clarkson 2002) calculates the intensity of retouch by estimating the frequency of retouch scars initiated from lateral margins and the extent that scars 'invade' or spread across the retouched flake surface. A retouched flake is conceptually divided into 16 segments, with eight on each of the dorsal and ventral surfaces. Each segment can receive a value of 0 (no retouch), 0.5 (marginal retouch scar/s are present but do not extend beyond a quarter of flake width at that point) or 1 (invasive retouch scar/s extend more than a quarter of flake width). These values are then tallied and divided by the total number of segments to give a value between 0 and 1.

Morphology

A range of quantitative measures was recorded with calipers to characterise the general shape of complete points, including percussion length, and multiple width and thickness calculations. These measurements were then used to calculate other indices, such as marginal angle (Clarkson 2007:38, 39, Figure 3.7), and length to thickness and width to thickness ratios.

Results

Blank Selection

Backed points were made on the same pool of blank flakes as the other direct percussion points. No specialised blank form was selected for backed point manufacture. The 3D laser scanned platform surface areas for the backed points are not significantly different to those for unifacial and bifacial points with intact platforms (Table 2). The fact that the morphology of early stage points and backed points is drawn from the same pool of flakes, with similar size and shape characteristics, is further evidence to support this. Figure 4 illustrates these phenomena, where the backed points from the LR9, LR12 and ME3 assemblage are shown to overlap with the other point morphologies from the assemblage. The blank flake morphology for backed points, and indeed all point morphologies, are typically those flakes with either parallel or contracting margins, with length to thickness ratios between 2 and 12.

Assemblage - ANOVA	df	f	p
LR9 (n = 71)	1	0.005	0.945
LR12 (n = 55)	1	0.245	0.630
ME3 (n = 25)	1	0.110	0.744
Widgingarri 1 and 2 (n = 16)	1	0.067	0.800

Table 2 ANOVA results: 3D scanned platform area measurements for points with Index of Invasiveness values below 0.3 against point type. Note: backed point platform surface area is not significantly different to other point morphologies.

Edge Angle and Cross-Sectional Shape

The retouched edge angle of backed points varied from 75–90°. Figures 5 and 6 contrast the average retouched edge angle of backed points with other point morphologies from the LR9 and Widgingarri assemblages, where backed point sample sizes allowed for meaningful graphical representation of these data. The retouched edge angle of backed points was found to be significantly different to other point morphologies in three of the analysed assemblages. ANOVA results are given in Table 3, though we caution that these results may be affected by the small sample size, despite determining that ANOVA tests were appropriate based on quantile-quantile plots. The average edge angle, which included the non-retouched margin, was not found to be significantly different in each sample. This indicates that margins of backed points were altered to such an extent that the high retouch angles were significantly different to the retouched margins of other points and were likely very similar in edge angle prior to this modification.

The cross-section shapes of backed points were either plano-triangular or slightly convex-triangular. Figure 7 shows the cross-section shape at four positions along the percussion axis of a backed point from ME3. Retouch edge angles are shown to be from 80–90° and retouch scar height approaches the maximum thickness of the flake. The backed retouch margin shows retouch scars initiated from the ventral surface and along the left dorsal margin, as well as several scars initiated from the opposite dorsal surface on the distal margin. The inset image of Figure 7 highlights these bidirectional scars on the left distal margin, with evidence of multiple smaller step terminating scars

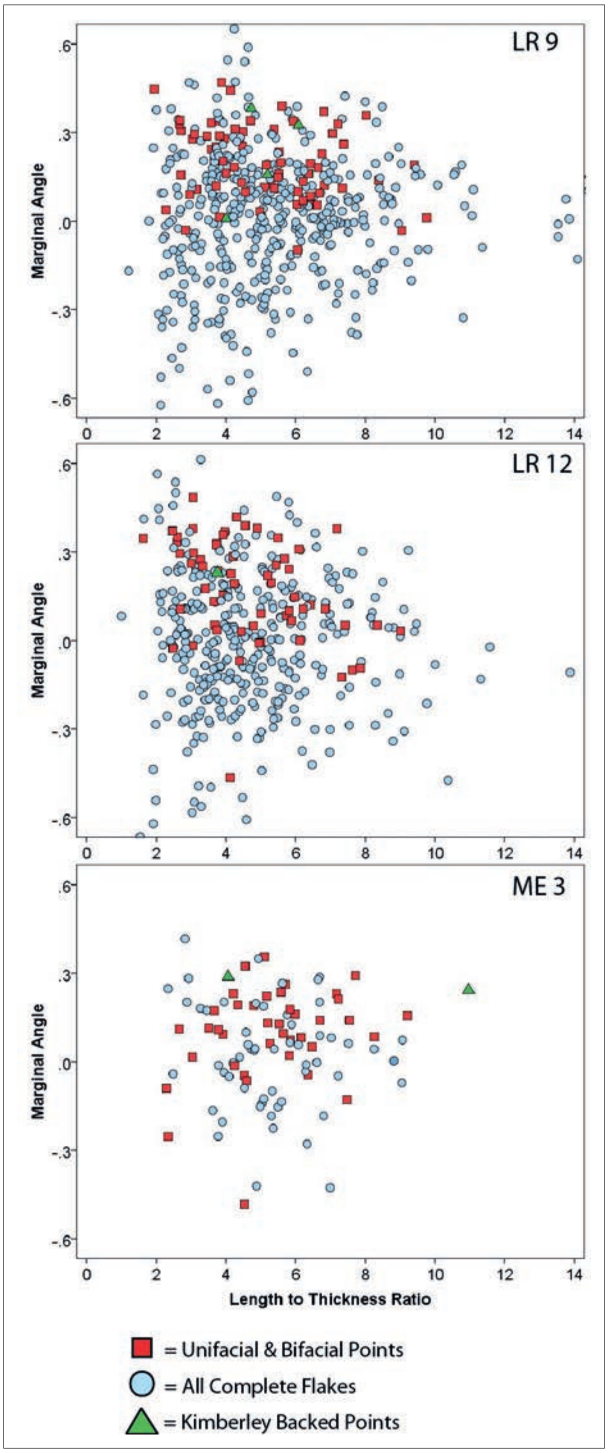

Figure 4 Scatter plots showing marginal angle against length to thickness ratio for LR9, LR12 and ME3 samples. Backed points were selected from the same pool of flakes, with similar size and shape characteristics. The blank flake morphology for backed points, and indeed all point morphologies, are typically those flakes with either parallel or contracting margins and with length to thickness ratios between 2 and 12.

or crushing. The superimposition of multiple scars on this anvil-rested margin suggests the morphology was likely maintained along the length of the retouched margin, rather than modified.

Width to thickness ratios also indicate that backing was highly unlikely to be a result of the gradual buildup of steep-angled retouch scars. As the width to thickness ratios were reduced with increasing unifacial retouch, the

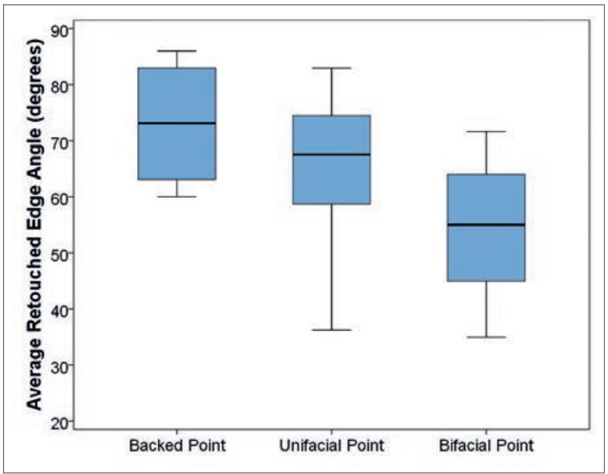

Figure 5 Average retouched edge angle for the Widgingarri points.

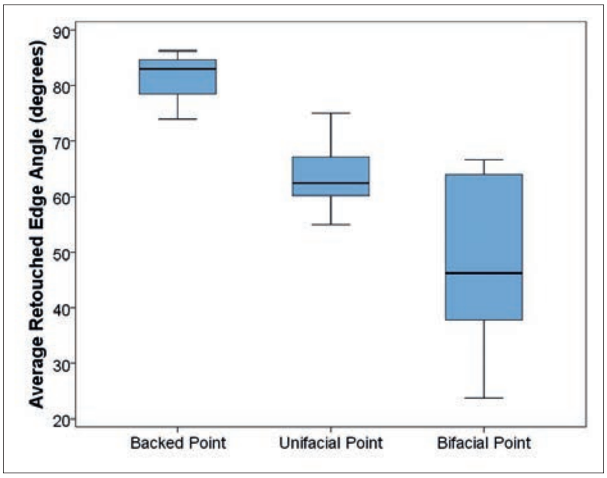

Figure 6 Average retouched edge angle for the LR9 points.

Assemblage	LR12 (n = 55)			LR9 (n = 71)			ME3 (n = 25)			Widgingarri 1 and 2 (n = 50)		
ANOVA	df	f	p	df	f	p	df	f	p	df	f	p
Retouched Edge Angle	1	9.028	0.003	1	0.027	0.869	1	6.232	0.016	1	8.836	0.007

Table 3 ANOVA results for comparison of retouched edge angle and edge angle of backed points with other point morphologies.

average retouched edge angle did not always significantly increase. To explore this relationship, Index of Invasiveness values below 0.3 were selected in each assemblage as an additional proxy for blank flake morphologies. As the width of points is reduced relative to thickness at each position on the percussion axis, the average edge angle showed three statistically significantly increases from the three calculations from each assemblage. Table 4 lists ANOVA results for width to thickness ratios taken at three points along the percussion axis against the average morphologies' retouched edge angle. The majority of cases show no significant relationship between average edge angle and cross-section shape.

Unifacial retouch was also found to have little effect on the average retouched edge angle. As unifacial retouch intensity increased, the average retouched edge angle did not. These data contrast with results presented by Hiscock and Attenbrow (2005b:51) and provide further support for the backed margin being the end product of a deliberate technological strategy, as opposed to a consequence of increasing retouch frequency and a corresponding increase in retouched edge angle. Linear regression results for this trend are given for each assemblage in Table 5.

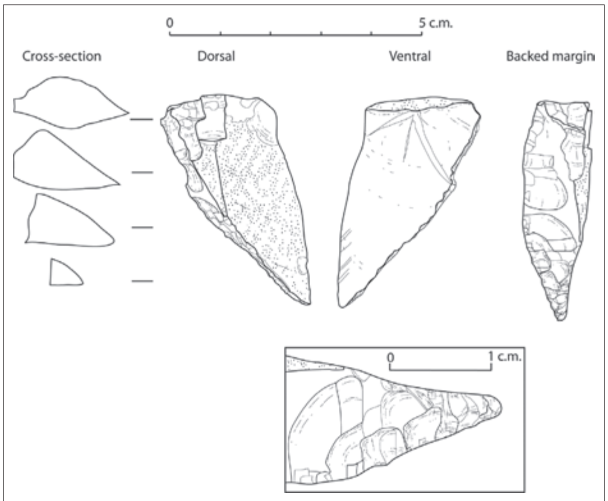

Figure 7 Backed point from ME3 showing cross-section shapes at multiple points obtained from 3D laser scanned images. The backed retouch margin shows that retouch scars initiated from the ventral surface extend along the left dorsal margin. The medial to distal left margin shows bidirectional scars with small step terminating scars indicative of anvil-rested percussion. The inset image highlights the retouched section, with observation of bipolar anvil-rested percussion.

The backed margin therefore cannot be explained as a by-product of increasing unifacial reduction reducing the width to thickness ratios as retouch scar heights approach the maximum flake thickness. Backing retouched edge angles from 75–90° were produced earlier in artefacts' use lives.

Retouch Characteristics and Intensity

The backed margin was formed in the early stages of reduction. Bipolar anvil-rested retouch was identified on four of the 15 backed points (see Table 6). Scar superimposition shows multiple steep-angled scars on the backed margin, with 'cascades' of small step scars (Cotterell and Kamminga 1987:689). The other backed points are likely to have been retouched with anvil-rested percussion, as evidenced by minor crushing and the steep-angled scars; however, dorsal ridges prevented anvil contact from forming bidirectional scars. Bipolar retouch was not observed in any other retouched flake morphology in the analysed assemblages, which strongly suggests a divergent technological strategy was being used to produce the backed points. Bipolar flakes and cores were also observed in the LR9 and LR12, as well as ME3, assemblages.

The order of retouch for backed points was dominated by ventrally initiated retouch, with no observation of bifacial or invasive retouch truncating a backed margin. The only instances to the contrary were the observations of bipolar retouch from a bidirectional platform, where additional scars follow the same steep angle as previous scars. Backed points are the result of a unique retouch strategy. It is therefore reasonable to suggest that backed margins were likely to be maintained.

Assemblage	LR12 (n = 27)			LR9 (n = 45)			ME3 (n = 15)			Widgingarri 1 and 2 (n = 13)		
ANOVA	df	f	p	df	f	p	df	f	p	df	f	p
Proximal Width: Thickness	32	2.371	0.019	34	3.207	0.002	15	50.379	0.110	-	-	-
Mid-Width: Thickness	32	0.591	0.914	34	3.887	<0.001	15	1.968	0.513	12	5.572	0.162
Distal Width: Thickness	32	2.217	0.636	34	0.680	0.852	15	0.774	0.726	-	-	-

Table 4 Analysis of variance results for the Average Geometric Index of Unifacial Reduction against the average retouched edge angle.

Linear Regression Average Retouched Edge Angle vs AGIUR	r	r^2	df	f	p
LR12 (n = 27)	0.031	0.001	1	0.034	0.856
LR9 (n = 45)	0.116	0.014	1	0.700	0.407
ME3 (n = 15)	0.337	0.113	1	1.534	0.239
Widgingarri 1 and 2 (n =13)	0.166	0.028	1	0.226	0.647

Table 5 Linear regression results for Average Retouched Edge Angle against the Average Geometric Index of Unifacial Reduction.

The frequency of retouch order and placement for backed points in the analysed assemblage is given in Table 6. Backing only occurs in the lower retouch intensity values for all point technologies, with no remnant backed margins observed on later stage point morphologies. These data demonstrate that backed points were not the discard stage in point reduction continuums.

Discussion

There is no evidence that backed points in the Kimberley were produced from small blades and flakes that were similar in size to backed artefacts produced elsewhere in Australia. On the contrary, Kimberley backed points were made from the same pool of flakes as other point technologies. The greatest divide between backing technologies in the Kimberley and those from the central and southern portions of the Australian continent is the relative frequency of backed artefacts within the total retouched artefacts in the assemblages. The Kimberley backed points occur in low frequencies relative to other point forms, and it is thus reasonable to argue that backing retouch was not a high priority for stone tool makers in the Kimberley.

In contrast to the observations by Hiscock (2009:85)—that bipolar reduction was associated with the end of reduction sequences—bipolar, anvil-rested retouch was not a strategy to extend the use life of individual artefacts in the Kimberley samples. We suggest that the bipolar anvil-rested retouch observed on the Kimberley backed sample is likely to be a technological strategy to increase the predictability of steep flake removals, rather than to extend an individual artefact's use life.

Because backed points are a unique retouching strategy within the broader range of point reduction in the Kimberley, it is possible that backing represents a technological response to a specialised functional requirement. In answer to the form and function question posed by Hiscock and Attenbrow (2005b:46), 'how can implements be designed for, and be efficient in, a specific use if their morphology is continuously changing?', we argue that the backed margin was deliberately produced. The backed morphology does not continuously change and therefore is likely to be related to an efficient and specific use. Just what this use was will remain elusive until further residue analysis is conducted, particularly as the only residue analysis undertaken to date (Wallis and O'Connor 2003) revealed no difference in observed residues between backed and other points from the Widgingarri 1 and 2 assemblages.

Hiscock (2006:80–83) contrasted backed artefacts with northern Australian point technologies using a framework that compared the abundance of production versus the extendibility of those products. Backed artefacts were identified as part of an abundance strategy, with high production rates and low reduction potential. Therefore, backed artefacts represent an extreme form of raw material conservation per unit. These artefacts were contrasted with edge ground axes, which had comparatively low frequencies of production but greater reduction potential. Point technologies typical in northern Australia were modelled as the median of these two theoretical references. The Kimberley backed points do not, however, fit in the abundance strategy described by Hiscock (2006), as they were produced in low frequencies.

Australian archaeologists have suggested that ENSO-forced climate changes in the mid-Holocene may have underpinned changes in technology at this time, as people adapted their tool-kits to offset the severity of subsistence risks associated with both increased aridity and the periodicity of environmental change. Hiscock (1994, 2002, 2006, 2009:90) has argued that, after the mid-Holocene, people invested more time and energy in producing maintainable and portable tool-kits in order to reduce both the severity and probability of risks associated with subsistence failure. Highly reduced

Assemblage	Dorsal Only	Ventral Last	Bipolar Retouch	Plano-Triangular	Convex-Triangular
LR12 (n = 1)	1			1	
LR9 (n = 4)	3	1	1	2	2
ME3 (n = 3)	2		1		2
Widgingarri 1 and 2 (n =4)	1	3	4	3	1
Total (n = 12)	7	5	4	6	5

Table 6 The placement and order of retouch for complete backed points in the analysed assemblages.

forms of flaked lithic artefacts were also detected by Clarkson (2006:104) in the mid-Holocene archaeological record of northwest Australia, which he argued were a response to higher subsistence risks associated with environmental fluctuations. McGowan et al. (2013) recently presented data from Black Springs which indicate that the Kimberley region underwent rapid environmental change beginning about 6000 years ago, when it transitioned from a tropical humid climate with an intense and predictable summer monsoon to a much drier climate with a summer monsoon either absent or intermittent. Evidence for slight climatic amelioration and a switch back to a more active monsoon was detected in the Black Springs record for a brief period between 4600 and 4200 cal. BP, but was followed by another period of extreme aridity peaking between ca 2400 and 1300 years ago. In this scenario the backed point may represent one component of a suite of technologies that developed in the Kimberley in the mid-Holocene to offset subsistence risk in the face of unpredictable rainfall and resources. The backed form may have been selectively used for tasks requiring an abrupt margin, as well as a stout point capable of penetration that reduced the risk of breaking or altering other point forms in the technological suite and simultaneously provided a transportable source of small sharp flakes. However, until a larger sample of backed points is examined and further residue studies are carried out, this will remain a testable hypothesis.

Conclusion

Backing technology has now been documented in assemblages from the east (Dortch 1977:117), west (O'Connor 1999:72) and south Kimberley regions. Data presented here demonstrate that backing retouch was highly unlikely to be either the discarded manufacturing stages in unifacial and bifacial point reduction continuums or the result of unwanted or unintentional build-ups of steep-angled retouch. Rather, backed points were made from the same pool of blank flakes as other point technologies and received specialised retouching, such as bipolar anvil-rested percussion, in order to create and maintain the backed margin. Backed point technology in the Kimberley region, therefore, appears to constitute a unique reduction trajectory within the broader range of point reduction continuums.

The only observations of retouch truncating backed margins were additional bipolar, anvil-rested retouch, with no observation of remnant backed margins on more intensely reduced point forms. This suggests that, whilst Dortch (1977:117) did not observe this form of point reduction, it was practiced in the west and south Kimberley. We suggest that some points received additional bipolar retouch during their use life to rejuvenate or maintain the backed margin.

The proposed northern boundary for backed artefact manufacture has gradually been broken down, with increasing sample sizes and studies of lithic artefact technology identifying backed artefacts in northern Qld (Davidson 1983:34; Hiscock and Hughes 1980) and the Kimberley (Dortch 1977:117; O'Connor 1999:72). Backing technology has been observed throughout the Kimberley region and potentially represents a regional response to a particular technological requirement rather than an extension of the range of any of the backed industries found elsewhere in Australia. Although backed artefacts were a small component of overall retouched assemblages in the Kimberley, our data and review of the literature clearly demonstrate that they are widely distributed north of the 20° south latitude (contra Smith and Cundy 1985). Further analysis of museum collections could bolster the sample size of Kimberley backed points, enabling more robust technological comparison with backed industries elsewhere and better information about their use life. Future attempts at mapping the distribution of backing as a technological strategy within Australia should include Kimberley backed points.

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