

The Depiction of Species in Macropod Track Engravings at an Aboriginal Art Site in Western New South Wales

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ABSTRACT. The research reported in this paper investigates variability in a motif type. The material used consisted of engraved macropod tracks from a Panaramitee style Aboriginal engraving site in western New South Wales. The analysis consisted of two experiments – one on zoological specimens and the other on an archaeological assemblage. The zoological experiment investigated macropodid taxonomy on the basis of pes morphology, while the archaeological experiment searched for patterning within the engraved macropod track assemblage. Principal Component Analysis and Cluster Analysis were the statistical methods employed. A major proportion of the variability observed within the track engravings was explained in terms of macropod species differentiation.

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This paper is a summary of research (McDonald, 1982) undertaken at an extensive Panaramitee style site with well over 20,000 individual engraved motifs (Clegg, 1981, 1987). The main aim of this research was to identify variability within a motif class (the macropod track) and to investigate possible causes for that variability.

In Australia it has long been held that prehistoric art is beyond the explanatory capabilities of archaeologists. Aboriginal art has been considered culturally conventionalised and 'unfettered in respect to detail' (Davidson, 1936:13). It has been recognised as having a highly symbolic content, whereby the communication of ideas depends on a complicated structure of symbols (Morphy, 1977; Munn, 1973). It has also been considered intrinsically bound to the 'religious' component of

Aboriginal culture (Spencer & Gillen, 1904; Mulvaney, 1969), containing an ideological element which no archaeologist would attempt to interpret. These considerations have resulted in art contributing little to the more commonly pursued questions in Australian prehistory, even though art can be viewed as an artefact assemblage like any other studied enthusiastically by prehistorians.

All aspects of the archaeological record can be seen as manifestations of the mental constructs or ideologies of their respective cultures. Regardless of this, in all other areas of prehistory the research continues, seeking structure in artefact types and patterns in their structure and distribution within archaeological assemblages. For art studies to achieve their potential for cultural interpretation, similar analytical goals (i.e., description

of patterns and structure, and interpretation of the archaeological record) are necessary.

Maynard (1976:92) defined the Panaramitee style as those engravings which:

appear to have been made by pecking (indirect percussion); they are composed of bands and solid forms...there is a narrow range of motifs, dominated by macropod and bird tracks and circles, with a smaller number of crescents, groups of dots, human footprints, radiating lines, 'tectiforms' or line mazes, and a tiny fraction of other non-figurative designs...Figurative motifs apart from tracks are also extremely rare and consist mainly of lizards...the relative proportions of different motifs (is) very consistent. Tracks average 62%, circles and other Simple-Non-Figuratives 32%, with the remaining motifs comprising the balance of 6%.

The predominance of track motifs and the recognition of these as 'figurative' suggested that an analysis of the variability in a macropod track assemblage at a Panaramitee site would be useful in terms of ultimate interpretation of these motifs. The aim of the project was to discover whether macropod species differentiation accounted for any of the variability in the engraved macropod track assemblage at Sturt's Meadows; that is, whether the tracks of different species of kangaroos can be recognised in this art. As Aboriginal hunters learn from childhood how to recognise animal tracks and to decipher them accurately, it was felt that such a cause of variability in the macropod track engravings was highly probable. Further, this line of investigation could eventually result in a credible, cultural classification of this part of the art assemblage.

Davidson (1936:13-14) expressed overt scepticism about any attempt at animal identification, expressing the opinion that:

the Australian artist has not caught the living spirit of his animals, nor has he ventured to portray them with (a) fidelity to life.

... it is obvious that any lack of ability could not be responsible for the total disregard for detail so characteristic in Australian art, for regardless of the shortcomings resulting from a lack of knowledge of technical principles of portrayal, it would be an easy matter to indicate the proper number of toes or fingers, or legs and other anatomical features, details which the Australians have consistently disregarded.

Animal identification in Australian Aboriginal art, however, has been a long standing quest. One objective of such identification has often been to establish the antiquity of Aboriginal art (Basedow, 1914; Hale & Tindale, 1929). At Yunta Springs in South Australia, Basedow (1914) interpreted certain engravings as depicting *Diprotodon* tracks. Davidson (1936), however, felt that these depictions could equally represent the 'poorly engraved feet of a Dreamtime anthropomorph'. Tindale (1941:381-382) interpreted very large bird tracks as depictions of *Genyornis* (extinct mega-emu). This has been refuted by McCarthy (1967:31), whose major criticism was based on such an antiquity not fitting into his style sequence for an Australian art

chronology. Often, these early attempts to identify 'extinct species' were based purely on size (not shape), and for this reason they have been validly criticised.

More recently, Clegg (1978) analysed 'striped mammal' motifs identified as Thylacines by Wright (1972) in the Pilbara and in Arnhem Land by Brandl (1973) and Lewis (1977). The purpose of this analysis was to investigate which of these depictions could objectively be interpreted on the basis of their overall shape as representing this (now extinct) mammal.

Rosenfeld (1982:204-205) has also investigated species identification through examination of 'the degree of explicitness or ambiguity in paintings of furred animals'. Identification was based on the recognition of anatomical traits, with particular diagnostic value being attributed to feet rather than overall shape:

in view of the importance attached to feet, or tracks which seem widespread in Aboriginal art, feet have been taken as the primary and most reliable trait for species identification.

The Project

It was decided to concentrate the present study on the engravings of kangaroo tracks at a Panaramitee style site in western New South Wales. Sturt's Meadows is a prehistoric rock engraving site some 100 km north of Broken Hill. The site stretches for approximately 2 km by 1 km, straddling Eight Mile Creek. The rocks on which the engravings are found are a pre-Cambrian mudstone. The engravings are spread along a north-south ridge which is divided by the creek and a clay pan into three low undulating hills, with peaks roughly 100 m above the creek bed.

As with other Panaramitee style sites, this one is located close to a water source and there is other evidence of occupation in the form of scattered surface artefactual material and scarred trees (*cf.* Maynard, 1976; Morwood, 1979). Clegg has identified six sub-sites, each representing concentrations of artistic activity within the larger site area (Clegg, 1987).

The site was first described by Black (1943) with subsequent descriptions by McCarthy & Macintosh (1962), Edwards (1966) and Maynard (1976). This research described here was conducted within a broader project being undertaken by Clegg in 1981 and 1982 (Clegg, 1987). Clegg's work aims to describe in detail a large proportion of the site, to facilitate 'comparisons between [Panaramitee] sites, to ascertain whether they have similar distribution patterns' (Clegg, 1981:3). The question of a pan-continental homogeneity for this art style was central to this aim. The identification of distinct motif categories (e.g., various macropod tracks) is, therefore, pertinent to the broader aims of that study.

The over-riding assumption for this research was that attribute analysis of animal depictions will reveal patterns which can be interpreted culturally. A more

specific assumption was that those engravings which look like animal tracks were intended to be representations of animal tracks. In other words, the engraved motifs were assumed to be naturalistic, possessing explicit visual resemblance. While these assumptions are generally accepted by art researchers (*cf.* Maynard, 1976; Morwood, 1979; Rosenfeld, 1982), there had been no detailed description of engraved animal tracks which allowed for zoological comparison. The research described here sought to pursue that goal. Two experimental designs were formulated to investigate the zoological aspect of variability and that seen in the archaeological assemblage.

Interpretation of the archaeological sample was couched in terms of the zoological differentiation of species. Differences in pes morphology between the species were sought in the variability observable in the engravings. The cultural information to be gained by this comparison would result from the types of questions which could then be asked of the engraved assemblage. Such questions include, for example, was any particular species of macropod depicted more often than another? What is the economic or cultural significance of such an artistic favouritism? This represents a level of cultural interpretation which, following a quantified approach, had not previously been attempted in Australian prehistory. More fundamentally, it also enabled a distinction to be made between categories of motif and different stylistic depictions of the same.

The Zoological Experiment

The zoological experiment was undertaken to discover whether it was possible to distinguish the species of macropods known to have been in the Sturt's Meadows area in the last 4-10,000 years through an analysis of their pes morphology. Marsupials typically have five digits on manus and pes, though in many species these are reduced in either or both regions (Wood Jones, 1968:8). The pes of a macropod has four digits – the 2nd, 3rd, 4th and 5th. The first digit is missing in all species with the exception of *Hypsiprymnodon*. Digits 2 and 3 are syndactylous, enclosed in one skin with both claws protruding. Their function is primarily grooming. The 4th digit is the largest and main supporting digit, with the 5th being the second biggest and used primarily for balance (Fig.1).

External characteristics which differ markedly between different environmental zones include length of 4th toe claw (short on rock dwellers, long on grass/sand dwellers) and the extent and configuration of the tubercles. All of the *Petrogale* species have a variegated tubercle pattern (similar to finger prints), while species which do not have the same need to grip rocky surfaces have an even (and not always fully extending), small and circular tubercle pattern.

The species of importance in this analysis are the Eastern and Western Greys (*Macropus giganteus*, *M.*

fuliginosus), the red kangaroo (*Osphranter rufus*), the euro (*Osphranter robustus*) and the yellow-footed rock wallaby (*Petrogale xanthropus*). This nomenclature follows that of T. Flannery (1980, and personal communication). Mounted specimens from the Australian and Macleay Museum mammal collections were used for the analysis. Sixteen variables were recorded, 11 metrical and five assorted variables on ordinal scales (Table 1 [Appendix]). These were considered adequate to describe the variation observable in terms of the research hypothesis and included such measurements as length and breadth of various foot parts as well as degrees of hairiness and separateness of the pads.

Only a very small sample was used for this analysis, with one only representative of each macropodid species being measured. Where a genus contains more than one species, all that could be located were used. Only for the red kangaroo, which exhibits marked sexual dimorphism (Dawson, 1977) were a male and female included in the sample. The majority of the museum specimens were not sexed or aged, and my identification of them relied on museum labelling. The possible biases introduced by sexual dimorphism, size/shape changes resulting from age and non-representative or unreliably identified specimens are acknowledged problems. Each could have adversely affected the results. These sample problems, however, were unavoidable

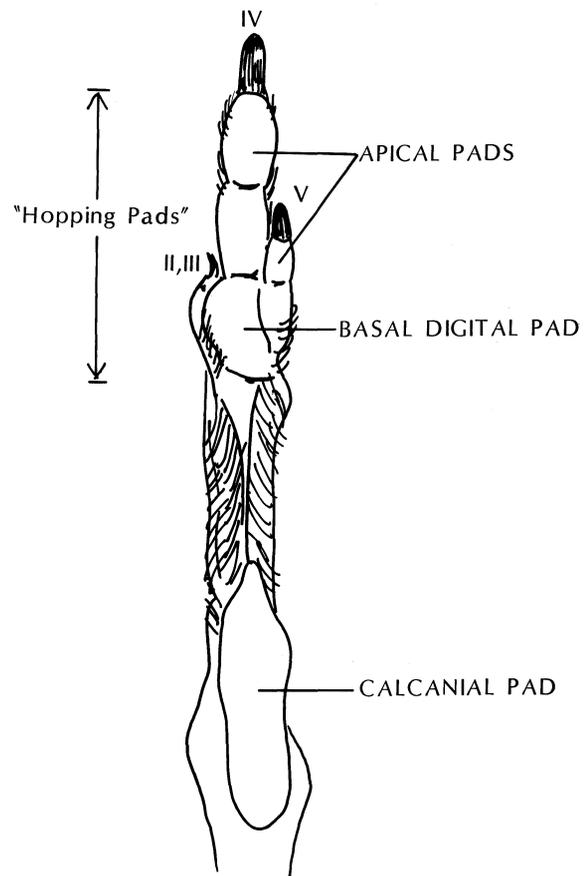


Fig.1. Posterior view of padded macropod pes.

given the scope of the project.

It was hoped that the pes-based taxonomy would reveal certain points relevant to the overall research project by indicating either i) that foot shape would prove to be at least genus specific, if not species specific; or ii) that environmental conditions are more influential on the structure of the foot than genetic ties (i.e., analogous traits are stronger than homologous traits). It was hoped,

also, that those aspects of foot shape which are significant in discriminating either homology or analogy would be identifiable.

The statistical approach employed was Principal Components Analysis, as this is a useful technique for discovering key (species) attributes. Cluster analysis was also used, since a hierarchical ordering of the species into a taxonomy was also required (see McDonald, 1983

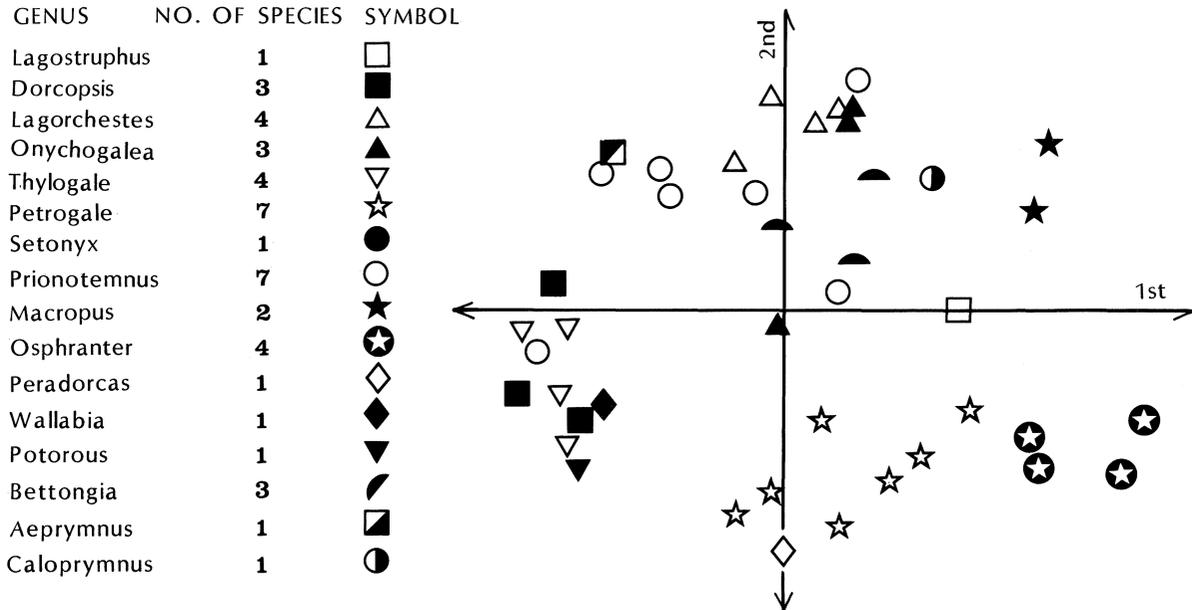


Fig.2. Bivariate graph for component scores (PCA): zoological data.

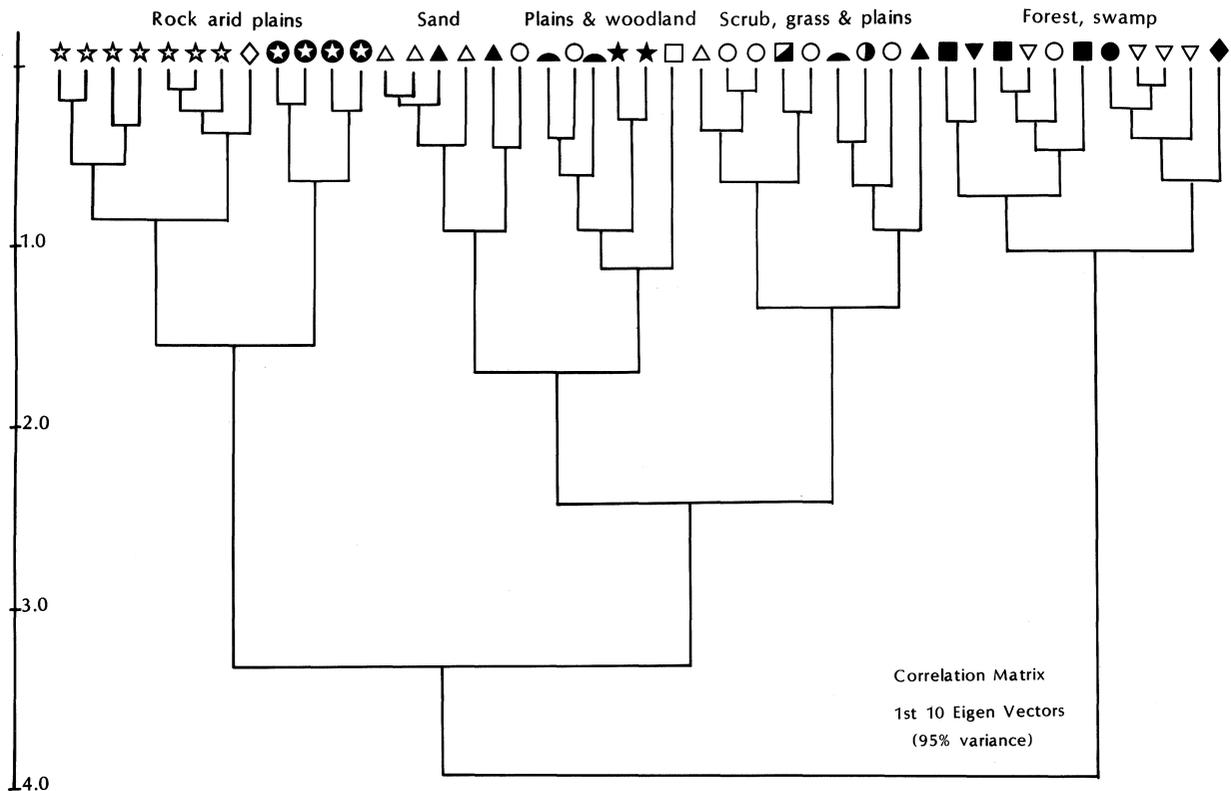


Fig.3. Results of Cluster Analysis: zoological data.

for a detailed description of these techniques and the results).

The Results

Principal Components Analysis, with its ability for data reduction, is designed to reveal information concerning the effect – in this case species discriminating effect – of particular variables used in the analysis. The results of the PCA revealed that almost all of the variables counted contributed equally to the variability within the sample. That is, they were equally good at discriminating between different species and genera. While this is an unusual result, statistically speaking, it is not surprising from the zoological point of view. Given the complexity of macropod taxonomy, the separation of the entire family on one or a few simple variables could not have been expected. The results indicate, however, a separation of the key species (Fig.2).

Cluster Analysis indicated that the key species in this study were distinguishable, falling into two groups (Fig.3). The red kangaroos and the euros cluster cohesively, while the yellow-footed rock wallaby is the closest of the other key species (this species clusters most closely with the six other rock wallaby species in its genus). There

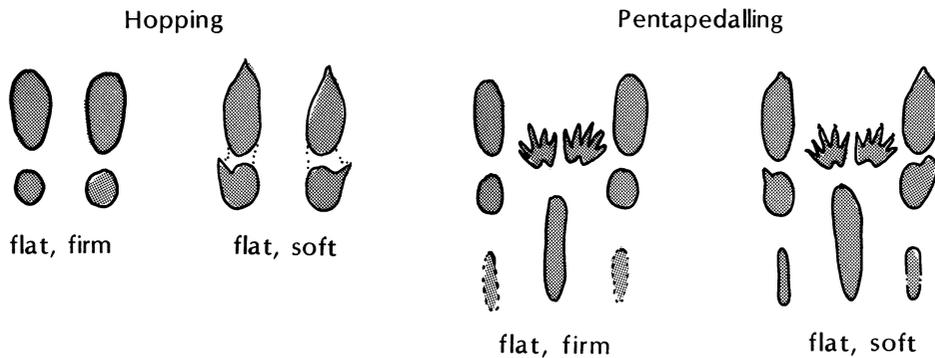
is internal species cohesion within the euro/red cluster. It had been thought the male red may be more similar to the robust euros than its more gracile female counterpart. This analysis indicates, however, that the sexual dimorphism does not create shape differences within species.

The grey kangaroos, while showing marked correlation to each other, are distanced from the other Sturt's Meadows species. The greys' closest statistical neighbours are an amorphous group of two bettongs, *Prionotemnus rufogriseus* and *Lagostruphus fasciatus*. These species are not present in western NSW.

Having determined on the basis of pes morphology that the macropod species from the Sturt's Meadows region fall into two broad groups, it was necessary to discover whether two distinct and comparable groups could be observed in the rock engravings. Before doing this, however, the normal range of variation in tracks as a result of different locomotive factors should be described.

While a comprehensive analysis of this facet of macropedal behaviour would have been desirable, this was not possible in the short time allocated to practical research. Track analysis would have been highly desirable, however, because tracks may reveal species' specific locomotory traits, and these would have been a source of data directly comparable to the

Osphranter Rufus



Macropus fuliginosus

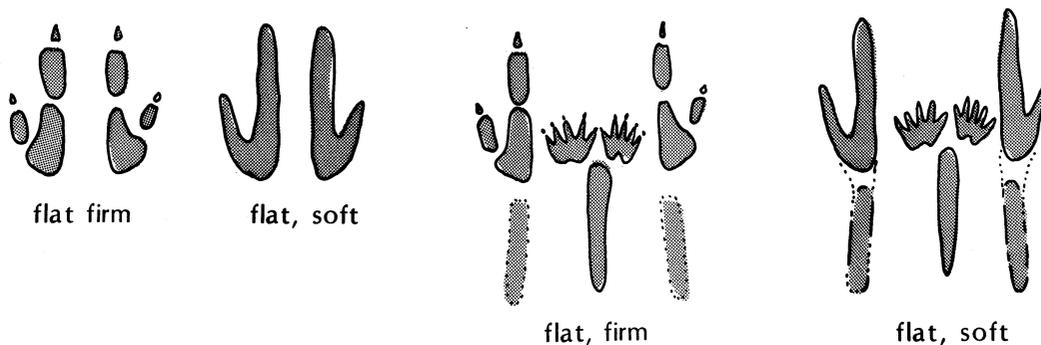


Fig.4. Macropod track imprint varieties for two species in differing conditions.

engravings.

Any one species will produce vastly different track imprints under different conditions. The information that can be gleaned at even a cursory level is invaluable, and includes information that a tracker might expect to obtain from a set of tracks. The best published authority for this information is Triggs (1985), who states that when tracking an animal, the following seven categories of information can be obtained: species, approximate size (age), gait, speed, surface, terrain, and (sometimes) sex.

Species. Triggs assumes that species can be differentiated by their tracks. Around Mallacoota Inlet, Victoria where she has done the majority of her work, the tracks of the three most common macropod species

– *Macropus giganteus* (Eastern grey), *Wallabia bicolor* (swamp wallaby) and *Prionotemnus rufogriseus* (red-necked wallaby) – are easily distinguishable.

Size. Triggs has done little quantitative recording of the size variation in any species, but contends, however, that it is possible to estimate whether a track has been made by an adult or a juvenile. This of course may be confused in species where sexual dimorphism plays a considerable part, although only at the species level, not across genera.

Gait. By definition, gait is a particular mode of locomotion: any species can move by any number of gaits. The most popularly recognised gait of the kangaroo is bipedal hopping ('leaping', 'bounding',

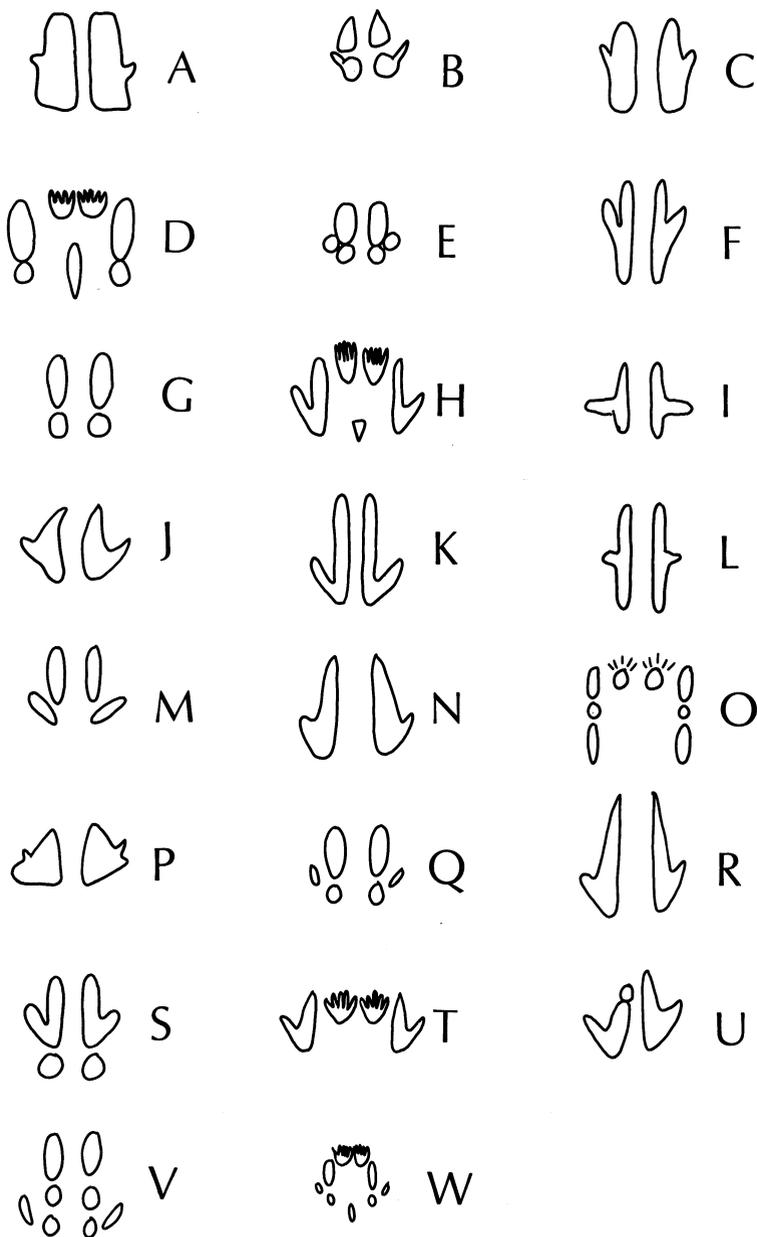


Fig.5. The artefact types identified in one subsite at Sturt's Meadows.

'ricocheting', etc.). This gait involves only the distal pesal pads; the heel (calcanial pad) does not touch the ground, nor does the tail which is used here only for balance. When browsing ('punting') kangaroos move either quadrapedally or pentapedally. In the former both manus and pes are involved. Pentapedally, the tail also is employed, resulting in five imprints per track. Depending on the speed, both gaits can include either the entire pes (from calcaneum to distal end of the digital metatarsal) or only the 'hopping pads' (Figs 1,4). The final variation of imprint is sitting, and here the entire length of the pes is involved along with the tail, but excluding the manus.

Speed. Little definition is required for this concept though the effect speed has on track imprints should be described. Basically, the faster the animal moves, the less clear the prints, since less of the foot touches the ground.

Every type of gait is affected by speed with numerous configurations possible in each. At high speed, the imprint is usually deepest around the distal fourth toe area, with the fifth toe not being visible. A deep imprint may also result from a wet or soft soil matrix, though here the fifth toe, and possibly the entire foot, will be imprinted. The distance between imprints becomes greater as an animal speeds up. At full speed, the distance between tracks varies insignificantly.

Surface. The hardness and consistency of the surface directly affects the shape of the track imprint. The softer the matrix, the more of the foot is incorporated into the track. A loosely-packed matrix such as beach sand is not at all conducive to clear print outlines, but then neither is rock or any other extremely hard surface.

Terrain. Here the factor of slope is introduced. Hopping up, down or around a hill on one stable conducive dirt matrix will produce four different tracks.

When hopping down a hill the prints will not only become further apart, but the whole foot (i.e., 'hopping pads') tends to move forward, creating the impression of a longer foot. The fourth toe claw imprint will be deeply embedded. Uphill, often only the imprint of the tip of the fourth toe and claw will be visible. Hopping around and down a slope, the pair of imprints will not be parallel. The downhill foot will be forward, and its impression deeper than its uphill partner (similar to skiing where the weight is on the downhill leg/ski).

Sex. The usual method of determining the sex of the animal in question is size, although there are recognised complications here (see above). There is no feature of macropodid feet which is a purely male or female trait (such as the male spur on some species of birds). One possible way of determining sex is when there is a joey-at-foot. In this case it can be assumed that the larger of the two will be female.

The Archaeological Experiment

Fieldwork for this research was undertaken in May and August 1982. Due to the vastness of the site, the most obvious strategy was to select one of the sub-sites and to do a comprehensive analysis of that area. 'South Saddle' was chosen for this. The sub-site consists of nine rock platforms. The engravings are dense and there is a suggestion of great antiquity. As well as much superimpositioning, there are, on the peripheries of these great slabs, the remains of earlier surfaces – badly eroded and fragmented away from the fresher surfaces. The surfaces of these fragments contain older engravings – intensively superimposed, deeply patinated and heavily eroded.

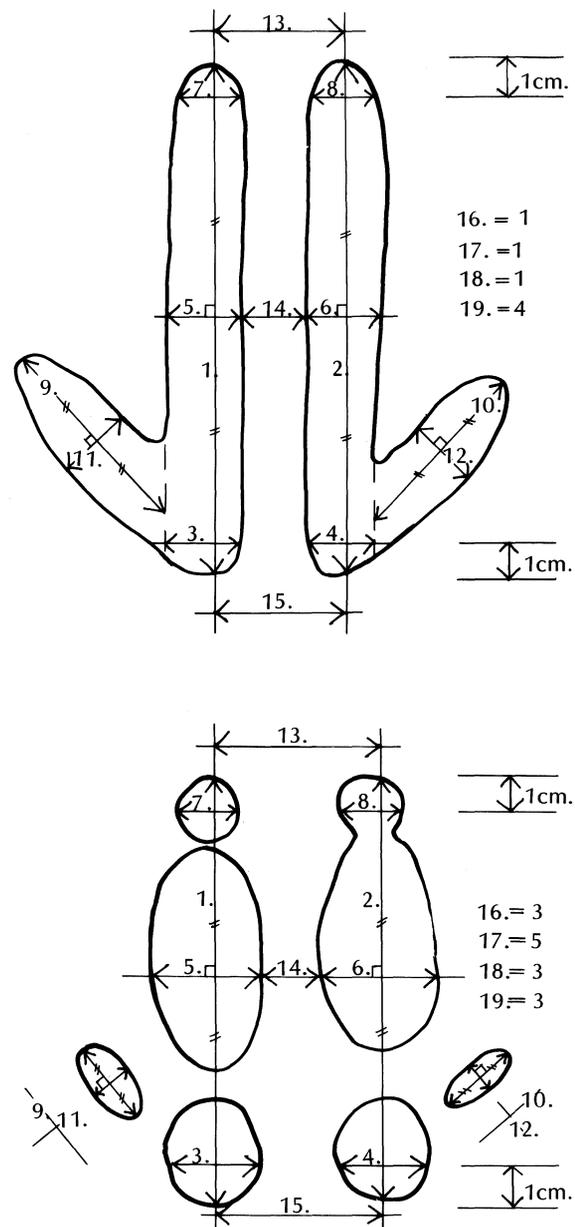


Fig.6. Variables measured on the engravings.

All the surfaces have a thick layer of desert varnish. Subsequent calcium carbonate analysis has tentatively dated the site to a minimum of 10,000 years bp (Dragovich, 1986). It is likely that artistic activities took place here over several thousands of years.

There are 233 macropod tracks of discriminating shape on the nine rocks in South Saddle. A roughly symmetrical pair of imprints is counted as a single track. Single imprints, pairs of 'bars' (simple stylised versions) as well as incomplete representations were excluded from the analysis. Of the 233 allomorphs present, 18 were excluded on the basis that they were damaged, incomplete or indecipherable. This was justified since such representations were not useful for quantitative analysis. A further reduction to the sample was made by deleting those tracks which indicated variable gaits. Eleven penta- and quadrupedal track combinations were excluded, and the analysis was made on the remaining 204 'hopping' track allomorphs only.

All 233 track allomorphs were traced onto polythene sheets in the field, and later subjected to description and quantitative analysis in the laboratory. The 204 fully 'diagnostic' motifs were classified into 23 'varieties' or types on morphological criteria (Fig.5). This classification was based purely on shape characteristics; size was not considered a distinguishing attribute.

Quantitative analysis involved the measurement of 19 variables (Fig.6). The sample was subjected to PCA on the University of Sydney's mainframe computer. A

detailed description of the data treatment, methods and results can be found elsewhere (McDonald, 1982, 1983). Each track allomorph was treated individually, the computer not being informed of the classification which had been assigned to each track. The aims of the analysis were twofold, to determine whether: i) the analysis would reveal clusters of morphologically similar tracks which could be interpreted in terms of the two species groups which were distinguished in the zoological experiment; and ii) the track allomorphs outside the modern range of variation would also cluster distinctively. Possible megafaunal depictions would fall into this third group.

While three definite groups were predicted for the majority of the allomorphs, several of the visually classified varieties were considered anomalous. It was of interest, then, to note where these more stylised varieties were distributed by the analysis. More shall be said of these in relation to the residual variability observable in the assemblage once the species factor has been eliminated.

Before plotting the results, the 23 varieties were placed into their expected species (and non-species) groups (Fig.7). Visually, the species specific trait which discriminates between the varieties is the separation between the 4th toe and the basal digital pad, and the length of the 5th toe. It was contended that engravings consisting of two or more parts represent the euro/red species, while single entity engravings represent the greys.

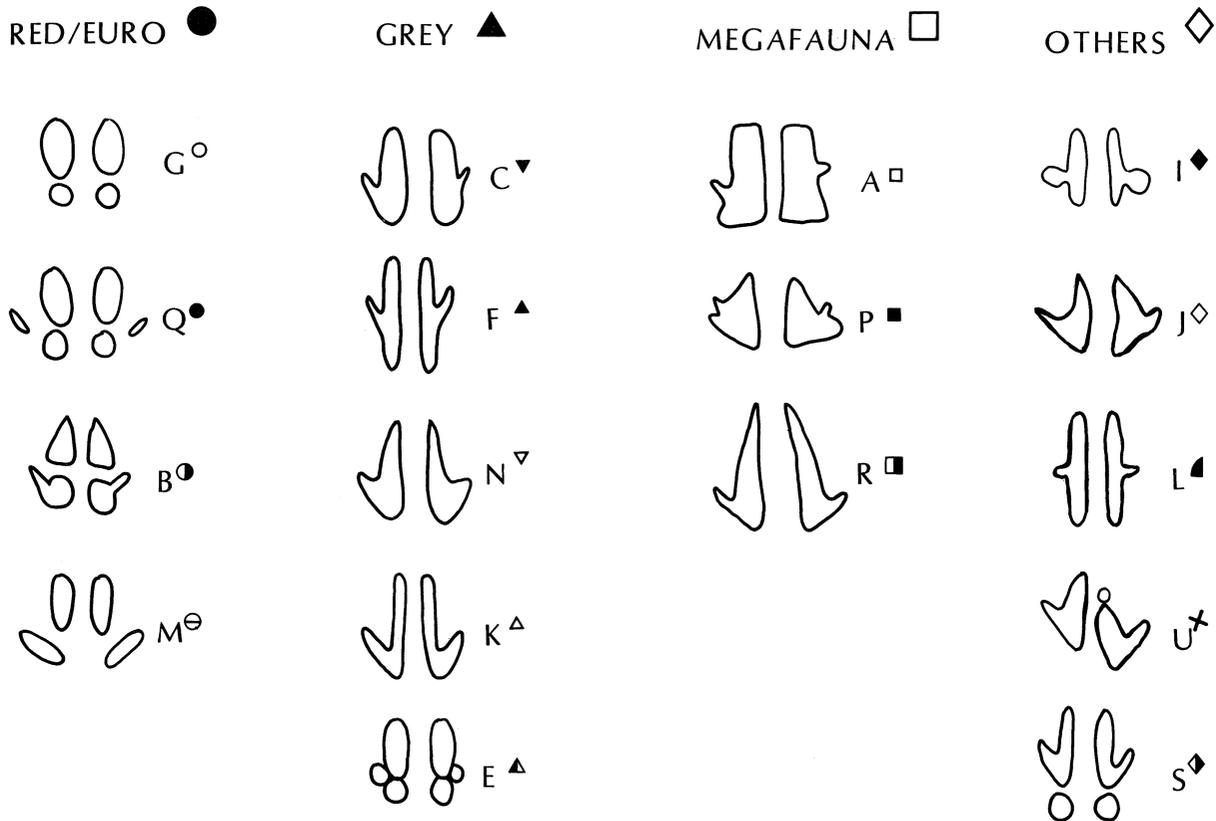


Fig.7. Proposed engraving groups, based on observed differences in macropod tracks. Artefact types and groups keyed for Figures 8 and 9.

Clear differences exist between the engravings of single form compared with the multiple ones. It is not simple, however, to measure comparable variables for the single and multiple forms, especially without biasing the analysis. Therefore, all variables which distinguished features in the multiple forms not present in the single form were deleted. It was felt that this editing removed any species bias from the analysis. As a result of this stringent use of variables, the results of the PCA were inconclusive. However, there are several interesting results (Fig.8): i) while there is no definite distinction between the single and multiple engravings (on the basis of the non-biased variables used), the majority of the varieties classified visually demonstrate high, though not distinctive, clustering tendencies; ii) variety A, considered most likely to be a megafaunal depiction, does cluster distinctively, both cohesively and separately; and iii) the attributes which contribute most to this patterning are width of heel, width of mid-point, and the distances between the pair of imprints in each track.

These results were not expected, and it is considered that the clustering is due to the 19 variables measured not being specifically attributable to species differentiation.

They may indicate more about the acceptable range of variation for this motif type in terms of the artists' 'mental template' (Deetz, 1967). The key species attributes, then, are swamped by attributes that are diagnostic of other causes of (stylistic) variability, such as 'Personality' or 'Culture' (Clegg, 1977).

This interpretation suggested an exciting prospect. This form of statistical analysis may eventually provide a technique which allows for the different types of variability within an assemblage to be identified and categorised according to certain formulated causes of variability. That is, interpretations can be made based on the resultant distribution of artefact types, in terms of the different attributes which have strongly affected that distribution. By using different attributes, and different combinations of attributes, it should be possible to account for different aspects of variability within an artefact assemblage (McDonald, 1983).

To complete the investigation of species as a source of variability within this assemblage, the track allomorphs were compared with the zoological specimens. In this final analysis six measurements (variables) that had been made both on the engravings and the museum examples

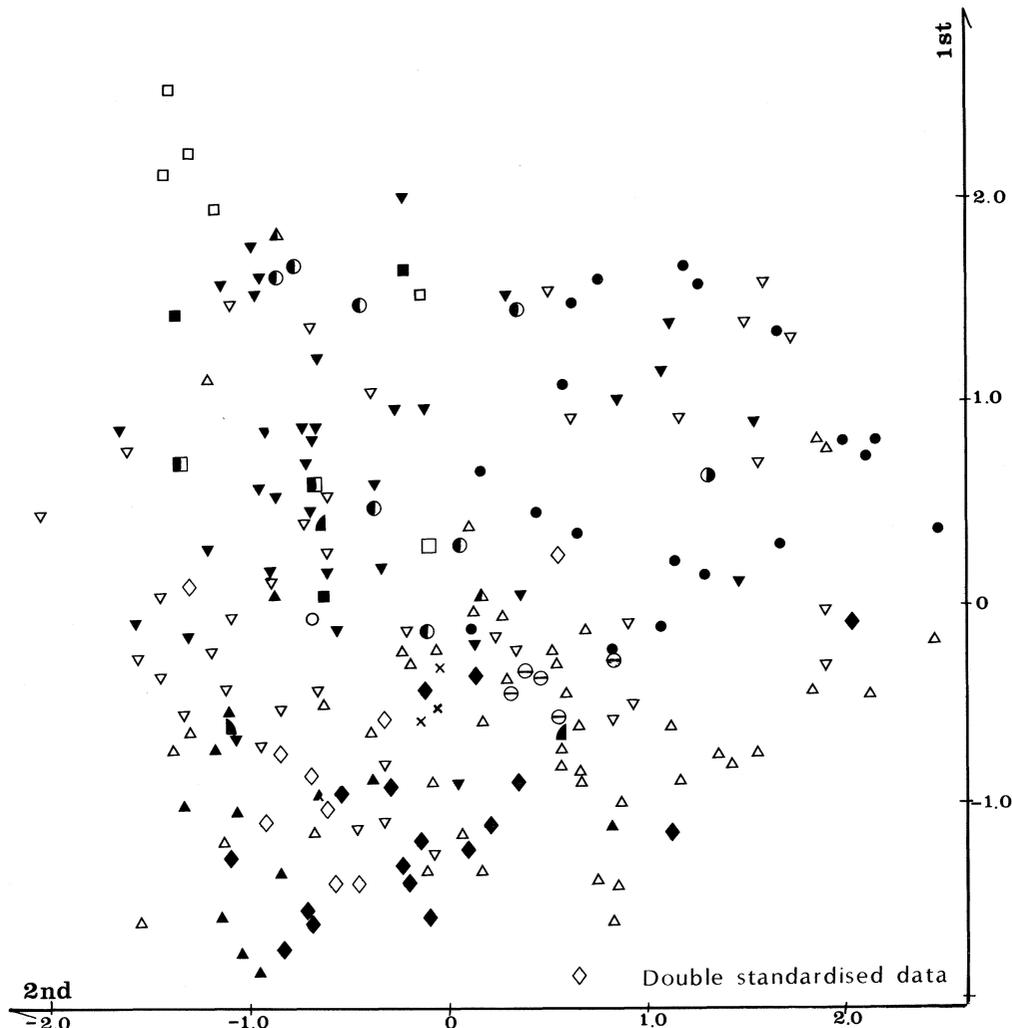


Fig.8. Bivariate graph for component scores (PCA): engraving assemblage.

were used. Since the zoological experiment indicated that all of the zoological variables were equally good at discriminating between the macropods, it was hoped that this analysis would be more conclusive.

The results were exciting (Fig.9). The five macropod species from around Sturt's Meadows were separated by this analysis, and the predicted engraving distribution was also achieved. Those engravings which had been predicted as red kangaroo/euro depictions cluster with their zoological counterparts, while those engravings predicted to be depictions of the grey kangaroos cluster separately and specifically with their respective zoological specimens.

Conclusions

This research demonstrates that a proportion of variability in the engraving assemblage at Sturt's Meadows can be explained in terms of macropod species

differentiation. As well as addressing this specific question of variability, the project has formulated a method for interpreting general variability within an assemblage. While subsequent investigation of this technique and data is yet to be made, the potential of quantitative methods for investigating artistic artefact variability is clear.

The discovery that the classification of macropods based on pes morphology divides the family into two groups is extremely useful on a broader archaeological scale. This separation, not previously recognised in the literature, can be observed both zoologically and archaeologically. Support is given by these results to the underlying assumption of this research, that engraved Panaramitee depictions of macropod tracks are naturalistic. Such a strong correlation between nature and the archaeology indicates profitable areas of research, such as the investigation of both the presence and distribution of particular species and their importance to the artisans who produced the engravings. At other Panaramitee sites across Australia it should be possible to make a similar

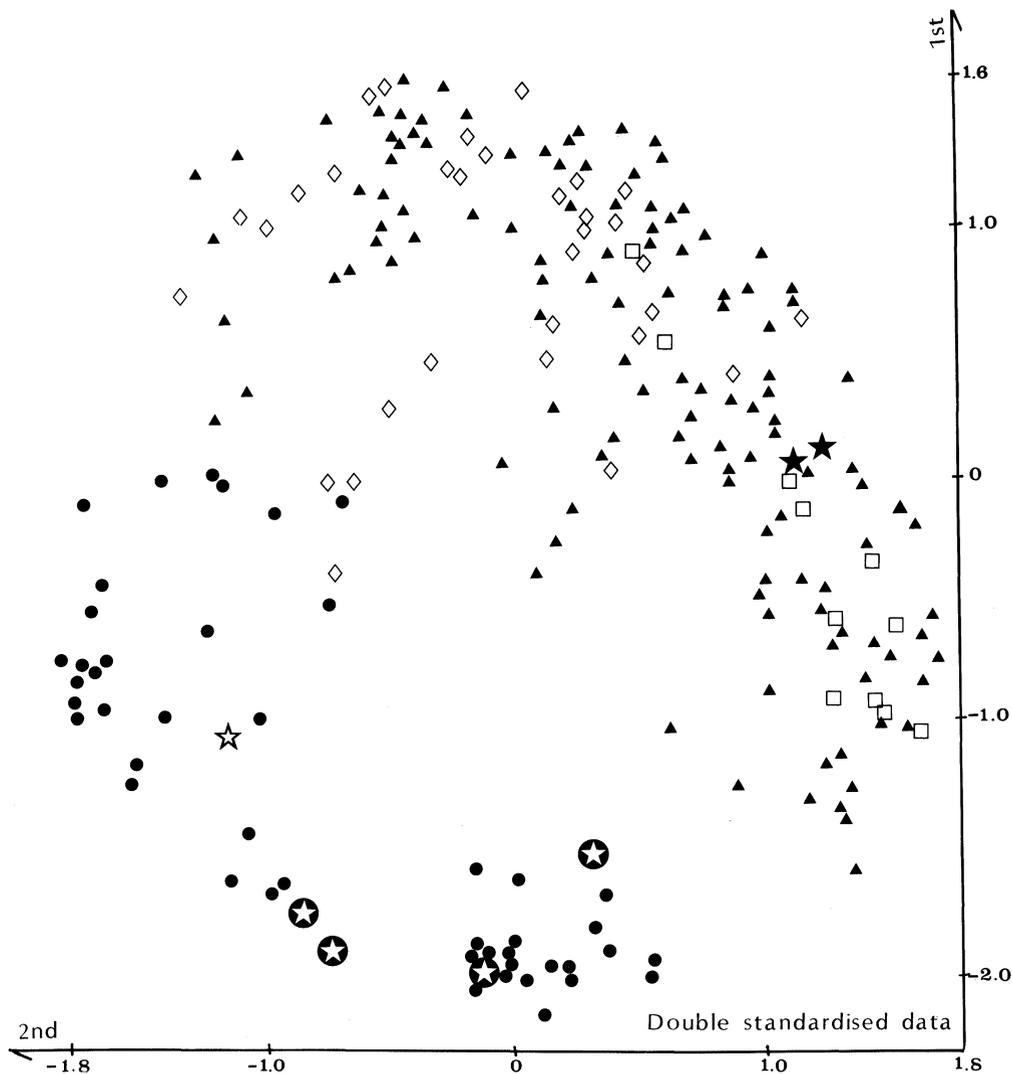


Fig.9. Bivariate graph for component scores (PCA): engraving and macropod pes comparison. Zoological species key as for Figures 2 and 3.

division involving the local species of macropods.

The value in identifying species and in investigating the presence, preferential use and distribution thereof, is exemplified by Vinnecombe's work with Bushman art. She comments (1976:347) that:

One of the most striking facts that emerges from an objective and quantitative study of the rock paintings is that they are not a realistic reflection of the daily pursuits or environment of the Bushmen. Specific subjects or activities selected for preferential treatment recur again and again at different sites over a wide area.

As well as interpretations relating to economic or cultural significance, the recognition of mega-faunal depictions also seems possible. Engravings outside the acceptable modern range of variation within the macropod track assemblage may well be interpreted as such following appropriate analysis.

The question of naturalism – explicit visual information – within Australian art is one which has still been only briefly examined (e.g., Rosenfeld, 1982). It is an area of much potential, which future art/archaeological investigation in Australia should develop and pursue.

The results of this research indicate that the analysis of prehistoric art can produce more than formal description. The use of appropriate research questions and assumptions, systematic and quantified analysis, and then applied interpretation means that rock art research in Australia can contribute increasingly to our understanding of Australian prehistory.

ACKNOWLEDGMENTS. The fieldwork for this project was partially funded by an Australian Museum Grant-in-Aid. John Clegg provided logistic and moral support, including access to (then) unpublished data from Sturt's Meadows. Tim Flannery assisted in the identification and photography of the specimens from the Macleay Museum. A draft version of this paper was read by John Clegg, Ron Lampert, Isabel McBryde, Kelvin Officer, and Andree Rosenfeld. This version is much improved in light of their comments. My thanks to all of the above.

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