KEYWORDS: ***Site complex – Rock art – Arnhem Land – Jawoyn – Australia***

THE COMPLEXITY OF ARNHEM LAND ROCK ART COMPLEXES

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Abstract. No comprehensive archaeological descriptions of individual rock art site complexes from western Arnhem Land have been published to date. Here the spatial patterns of seven small rock art site complexes in the Jawoyn Lands of the Arnhem Land Plateau, Northern Territory (Australia) are examined; these all contained a main rock art shelter with a disproportionately high number of motifs, surrounded by a suite of smaller satellite shelters, each with lower motif numbers than the main shelter. The number of motifs in a shelter was found to be unrelated to its interior volume and the notable rock art styles described by previous researchers for the region were found to account for a very small proportion of the overall repertoire. In contrast to the apparent situation in adjacent rock art provinces of Arnhem Land, yellow pigment constitutes a significant proportion of the older 'Mimi' rock art in the Jawoyn Lands (c. 16%). The more recent white-based images account for around 25% of the rock art recorded, and occur in notably fewer shelters (41%) than do the earlier rock art styles.

Introduction

The landscape of rock art sites is fundamental to understanding how communities related to a natural environment that they both inhabited and structured (Wilson and David 2002). Indeed, 'place markings are not found randomly across the landscape, but rather are an ordered component of socially constructed space' (Wilson and David 2002: 7; see also David and Wilson 1999 for a social interpretation of changes in regional shelter use over time). Taçon (2002) looked at rock art and landscape in western Arnhem Land at the generalised scale, finding differences in the location of recent x-ray images (at the base of the escarpment) and earlier rock art (more widely distributed across all areas of the plateau). To date, however, no comprehensive archaeological plans and descriptions of individual rock art site complexes from western Arnhem Land have been published. This paper explores the spatial distribution of specific aspects of the rock art in the Jawoyn Lands of the Arnhem Land Plateau.

The numerous studies of Arnhem Land rock art to date have largely concentrated on properties of the more readily identifiable styles and their proposed chronologies, or identifying depicted artefacts, fauna or flora (e.g. Brandl 1972, 1973, 1977, 1980; Chaloupka 1984, 1993; Murray and Chaloupka 1984; Lewis 1986, 1988; Chippindale and Taçon 1998; May et al. 2013; Wesley 2013; Hammond 2016; Jones et al. 2017). Few studies have looked at the overall corpus of Arnhem Land rock art or its distribution within the landscape other than on very broad spatial levels (cf. Edwards 1979; Hammond 2016). Elsewhere in Australia, rock art sites often occur in clusters composed of a major site and a suite of smaller satellite sites; these clusters also usually contain a range of other archaeological site types indicating that rock art was not an isolated activity but one undertaken at places that held a range of social and/or economic values (Lorblanchet 1975; Turner 1981; Vinnicombe 1984; Witter 1984; Gunn 1997; Mulvaney 2015). In many cases, however, rock art is the only archaeological component remaining to testify to a shelter's use.

For this study, a major shelter is defined as having greater than 150% more motifs than those within the next most decorated shelter in that site complex. For example, if a secondary shelter has 50 motifs, the major shelter must have >75 motifs. Often, due to erosional processes along an escarpment, the larger site is geographically central, with the number of motifs per site distributed in a standard or slightly skewed bell-curve across the site complex.

Site complexes on the Arnhem Land Plateau are mostly associated with geographically discrete rock outcrops and invariably include rockshelters with rock art, but may also include burial crypts, cached objects, and open sites such as stone arrangements, artefact scatters and grinding areas (Gunn and Whear 2007). Gunn et al. (in press) discuss the nature of rock art

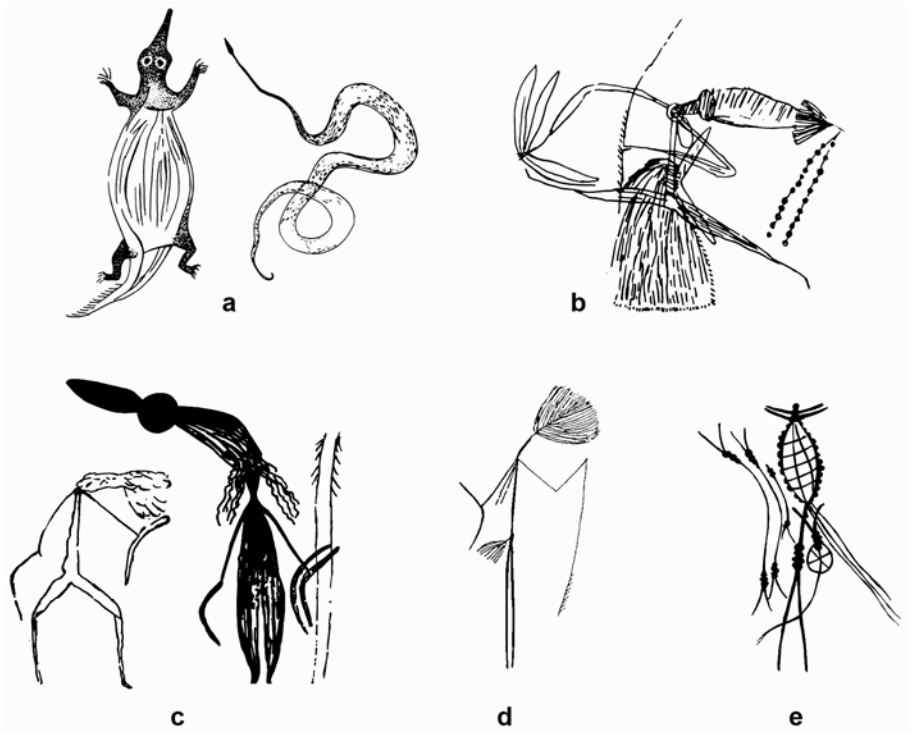

Figure 1. *Mimi Bim rock art styles (from Chaloupka 1983). A: large naturalistic B: dynamic figures C: post-dynamic figures. D: simple figures with boomerangs E: yam figures.*

site complexes in the Jawoyn Lands, while this paper takes a sample of these to investigate the internal spatial patterning of their rock art. The data are derived from site records resulting from the Jawoyn Rock Art and Heritage Project (JRAHP) (Gunn and Whear 2007; Gunn unpublished reports submitted to the Jawoyn Association 2005–2012), but the motif counts have been updated following re-examination of the photographs of the rock art and the use of DStretch enhancement (Harman 2008; Gunn et al. 2010a, 2014).

The earliest rock art within the Arnhem Land Plateau was produced over 28000 years ago (David et al. 2013). Most images on rock faces today are likely to be considerably younger, being less than 13000 years old (cf. Barker et al. in press; Chalmin et al. 2017), including most of the rock art styles and periods identified by Chaloupka (1993) and Lewis (1988). There are, however, numerous problems establishing patterns within this amalgamation of rock art spanning such a time frame. For example, the dense superimpositioning of motifs at many of the larger sites obscures the earliest motifs, thus preventing the full range and quantity of the earlier styles being detected. To minimise this problem, this study will examine one small site complex with little superimpositioning (Jawoyn site ARN-059) in order to account for all of the surviving motifs. The resulting patterns will then be compared with those at six other small site complexes to determine whether there are any patterns that could be applied more generally to other site complexes in the region.

Classifying Arnhem Land rock art

Mountford (1956: 112) recorded that the Aboriginal people in the north-west corner of the Arnhem Land Plateau considered many of the early rock art images (mostly weathered, red monochrome paintings) were not painted by humans but were produced by the Mimi (fairy people or spirits); these were subsequently termed *Mimi Bim* (Mimi rock art) by Chaloupka (1993: 87). Similarly, the Jawoyn today consider paintings that have the appearance of being 'old' were either painted by Mimi spirits, or are their shades, produced as stains as the Mimi characters entered the bedrock, where they continue to live today (Gunn 2016). The term *Mimi Bim* will therefore be used here to include all of the various classes that have been proposed for Mimi rock art. These classes include Chaloupka's dynamic figures, post-dynamic figures, simple figures with boomerangs (SFB), and yam figures (Chaloupka 1984, 1993) (Fig. 1). Chaloupka's claim that the large naturalistic style represents a distinct period has been challenged by Lewis (1988: 66–77) and Chippindale and Taçon (1998: 102), who see it as occurring in both Chaloupka's large naturalistic period and also in his later yam period; the distinction is made on the basis of 'clues as to which of the collected group may be late and which early' (Chippindale and Taçon 1998: 105). Here, only those large naturalistic figures that appear 'early', on the basis of underlying superimpositioning position and poor weathering relative to other motifs on the panel, are placed in the early naturalistic (ELN) class; we similarly differentiate early stencils, including the distinctive 3mf hand stencil (three middle fingers held together, little finger and thumb splayed; Chaloupka 1993: 232) from the dynamic class as, from personal observation, while often in close spatial association, dynamic figures are often found superimposed over hand stencils. In addition, there is no evidence for prints (hands, grass and string skeins) being the oldest rock art as Chaloupka proposes. While we acknowledge that some do appear amongst the earliest rock art, others (particularly hand prints) appear to occur throughout much of the sequence. Consequently, we include early-looking prints with the early stencils as a class of 'early stencils and prints' (ESP), rather than imply that they represent the oldest rock art within the Arnhem Land Plateau region. Mimi Bim images that do not readily fall into currently defined classes

are included within an aggregated class of other-Mimi. As an amalgamation of odd styles, however, other-Mimi images cannot be seen as a stylistically or chronologically unified group.

The more 'recent' rock art, which is dominated by the use of white pigment, is considered by the Jawoyn to be primarily made by their human ancestors: in some cases the names and relationships of the artists are still remembered (cf. Smith 1994: 235). These include a wide range of styles including Chaloupka's x-ray complex and casual painting periods (1993: 89), Taçon's complete figure complex period (Chippindale and Taçon 1998: 106) and Lewis' long spearthrower period (Lewis 1988: 105). These motifs utilise predominantly white-coloured pigment (painted, stencilled or printed), either as monochromes or in white-based polychromes with the addition of contrasting colours. Rather than defining any particular style, these primarily white-based motifs are aggregated into a single class termed *Jawoyn Bim*. Regardless of colour, motifs from this class tend to retain surface pigment, in contrast to the older rock art which exists purely as stains in the rock.

Site complex A059 Penuk

As with most of the site complexes within Jawoyn Lands on the Arnhem Land Plateau, ARN-059 (hereafter abbreviated to either A059 or Penuk) has no surviving Jawoyn traditional name. In reference to a large polychrome image of a bustard-like bird on the ceiling of the main shelter (not illustrated for cultural reasons), the site was called Penuk by the Jawoyn, from their term for bustard. The site complex occurs in a small stack-outcrop (Figs 2 and 3), some 250 × 125 m in area, and contains eight rockshelters, each of which contains rock art

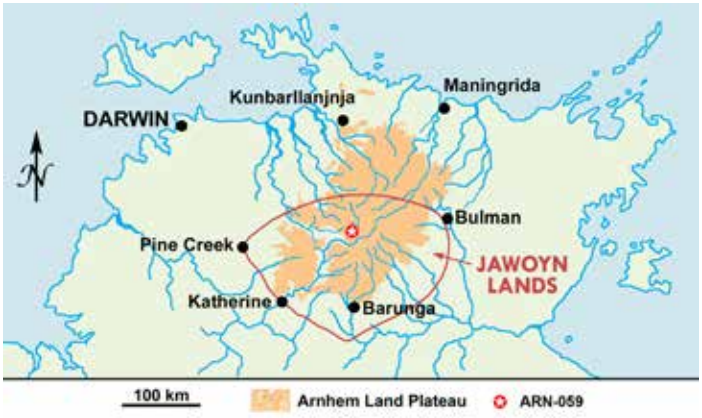

Figure 2. *Location of the Arnhem Land Plateau, the Jawoyn Lands, and the A059 site complex.*

SITE	Width (m)	Depth (m)	Height (m)	Orientation (°)	Motif numbers
A059/1	15	7	2	5	353
A059/2	5	7	3	360	45
A059/3	6	3	3	350	9
A059/4	3	2	1	15	4
A059/5a	4	2	2	305	41
A059/5b	6	1.5	2	155	49
A059/6	8	3	1.5	170	2
A059/7	4	3	2	210	17
A059/8	4	3	2	260	11

Table 1. *Penuk shelter size and orientation.*

Figure 3. *A059 site complex from the north.*

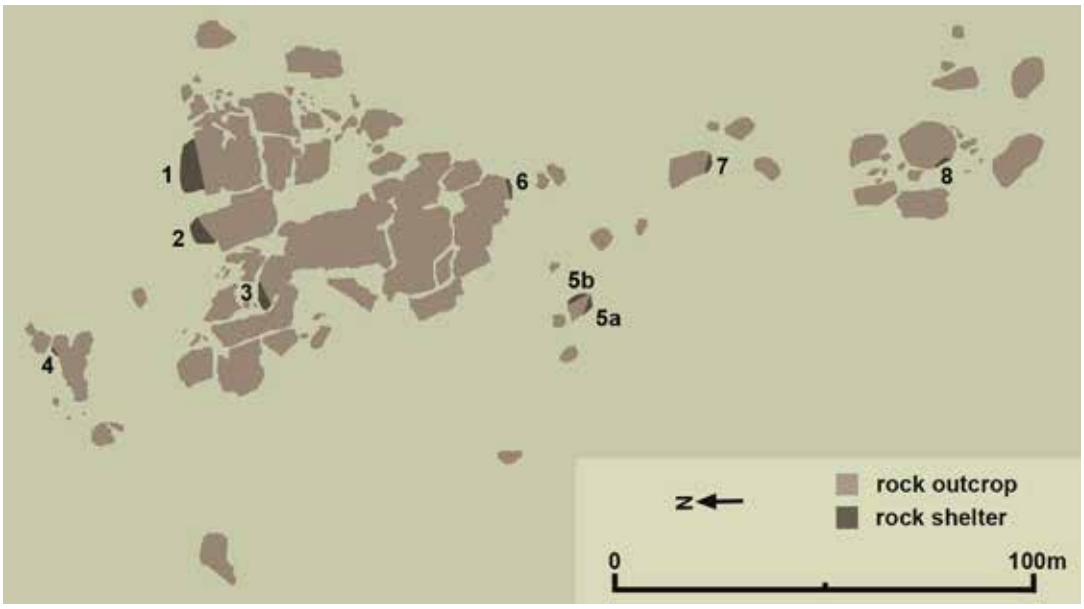

Figure 4. *A059 site plan showing location of rock art shelters.*

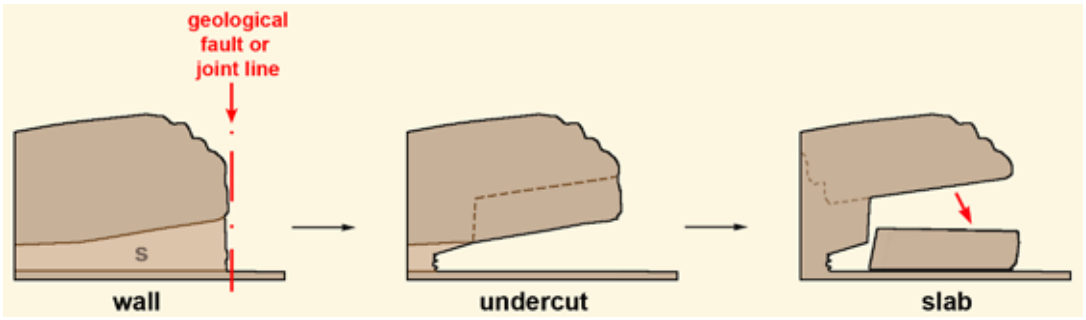

Figure 5. *Formation process of a slab shelter.*

Figure 6. *Selection of shelters showing their slab form.*

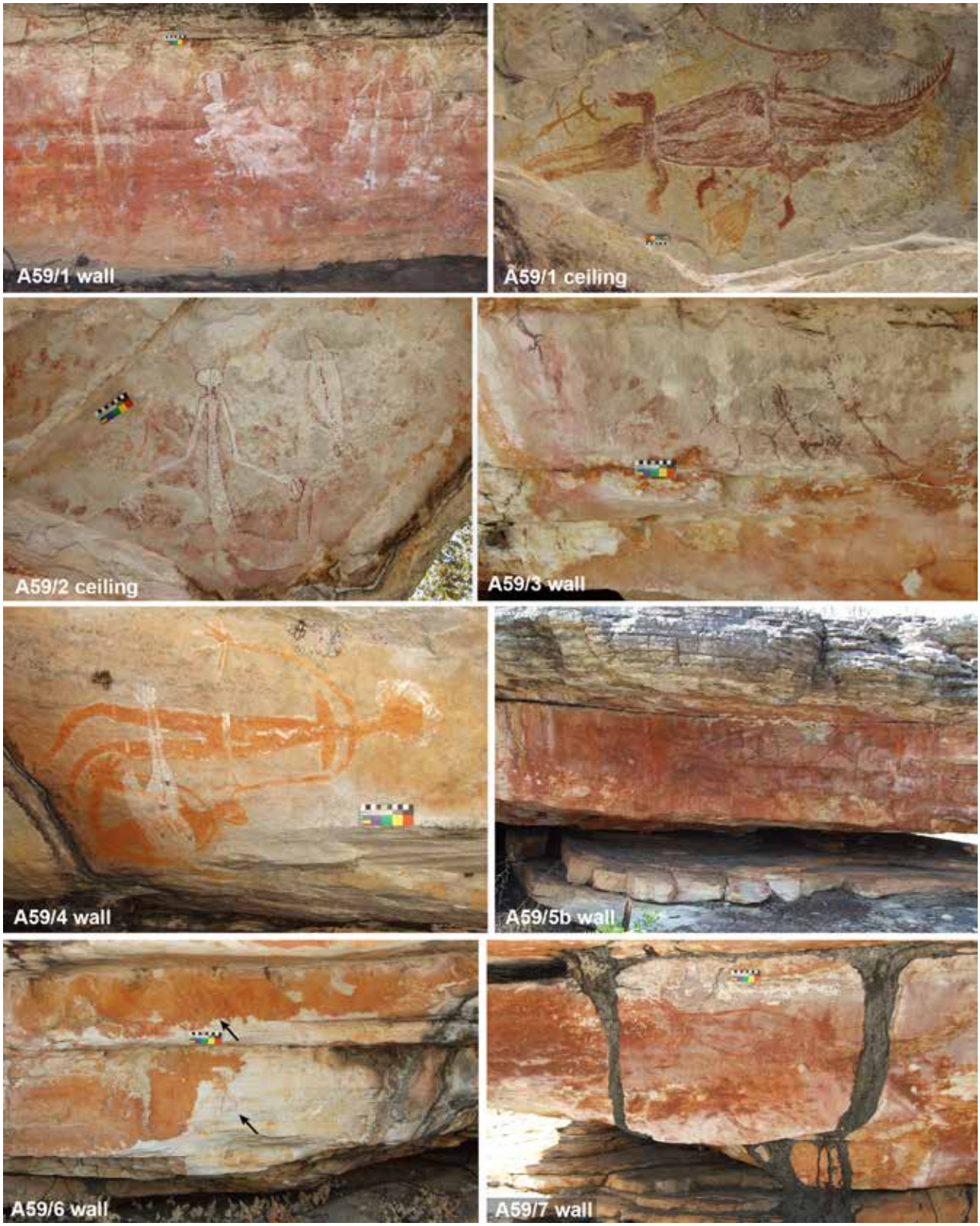

Figure 7. *Representative rock art from the A059 shelters.*

(A059/1–8; Table 1; Fig. 4); it is small in area, with low numbers of shelters and motifs compared with many others on the plateau (cf. Gunn and Whear 2007). The rockshelters here vary in size and orientation, and can be grouped loosely into two sets: those to the north of the central bedrock block (A059/1–4), and those to the south (A059/5–8). The larger shelter, A059/1, holds the greatest concentration of rock art, with the smaller shelters all having notably fewer motifs. All of the shelters have formed by slab-collapse, where an underlying layer has eroded causing one or more of the overlying layers to break from the ceiling (Fig. 5).

Figure 8. *Rock art panels from shelters A059/5a and 8.*

The Penuk site complex has no ready water reserve as it lies a kilometre from the nearest creek line and 1.5 km from the nearest waterholes.

As no comprehensive descriptions of an individual Arnhem Land rock art site complex have been published, an introduction to the small site complex at Penuk and its rock art will be presented to illustrate the range and variety of rock art styles present, prior to examining the spatial patterning of its rock art.

Site A059/1 (Table 1; Fig. 6) has 353 motifs, a total that is more than seven times that of any other shelter in the outcrop. It is the only shelter here with a charcoal-rich archaeological deposit, indicating that it was the focus of at least the most recent occupation at the site complex. The rear wall is 1.5 m high and runs the full 15 m width of the shelter. It has been profusely decorated with paintings (Fig. 7), although most are in poor condition due to partial erasing by animals and water flow. As mentioned, the shelter ceiling contains a large, polychrome painting of a bustard (*penuk*), in good condition and appearing to be one of the more recent paintings. This motif has both x-ray features and spray dots along its neck, indicating a significant Dreaming Being (creation figure) for the Jawoyn. A second large motif on the ceiling is that of a two-metre long 'freshwater crocodile' in red, that at some later time was embellished with white (Fig. 7). Of the other motifs, 'flying fox' are numerous (19). On the rear wall, a large macropod in white has had its head repositioned: the original head was painted extending up and onto the horizontal ceiling but was later orientated downwards to fit onto the wall.

A059/2 is a shelter with a steeply sloping rock-slab floor (Fig. 6). Forty-five paintings either in red, white or yellow occur on the rear wall, including an unusual outlined human lower torso with legs and large feet, underlying other motifs. The half-figure is seen as an intentional composition, as there is no room on the panel for the upper half of the figure. A similar, but not identical, half-figure stands to the right of this motif. The ceiling contains a large male figure and fish ('black bream') in white with intricate red patterned infill (Fig. 7).

A059/3 has rock art on both the rear wall and ceiling. The rear wall contains a 3mf handstencil superimposed by a group of three figures with headdresses and boomerangs in a mulberry pigment in the post-dynamic style (Fig. 7). The ceiling panel has a large painting of a goanna in orange. This motif was later partially refreshed with dry-pigment drawing, the lines of which closely follow the lines of the original painting. Such careful re-marking of a painted motif with dry pigment

is uncommon in Jawoyn rock art.

At the far northern end of the outcrop there is a very low shelter, one metre high and three metres long. This shelter, A059/4, has two horizontal female figures on the rear wall; both are in an orange-yellow pigment, although the larger was subsequently outlined in white (Fig. 7). Superimposed over these is an emu painted in white+red. A second bird (emu or bustard) in white with orange outline occurs on the low ceiling. These motifs appear to have been painted in two sittings but all seem to be of no great age.

A059/5 is a large outlying sandstone block with shelters on two sides (alcoves 5a and 5b). Alcove 5a is a shallow shelter with a well-preserved mural of 'old' red paintings (Figs 6 and 8), dominated by a large outlined macropod with an unusual x-ray-like infill; this has been repainted on several occasions in both red and yellow. To the right of the macropod is an unusual large sinuous design with three claw-like phalanges at one end, suggestive of yam style 'strings' (cf. Hammond 2016: 58). Both these figures appear contemporary with yam class figures on the panel, and both overlie earlier dynamic class figures. The preservation of the motifs here is surprisingly good given the shallow depth of the overhang. Alcove 5b, a wall panel with slight overhang, contains poorly preserved paintings in a range of uncategorised styles, many of which are involved in complex superimposition sequences (Fig. 7).

A059/6 is a low and shallow shelter with two remnant red motifs on its rear wall: a post-dynamic running figure and a hand stencil (Fig. 7).

Shelter A059/7 (Fig. 6) has a rear-wall panel of poorly-preserved red paintings (Fig. 7). Two large termite trails in grey mud cross the panel. The central and largest motif is a left-facing macropod that is superimposed over a second macropod facing right, which in turn is superimposed over a pair of large 'floating' anthropomorphs. This superimposition sequence is particularly distinct.

At the southern end of the outcrop, the underside of a collapsed stack forms shelter A059/8. The suspended panel contains a row of finely-painted figures in the post-dynamic style, all wearing tasselled headdresses (Fig. 8).

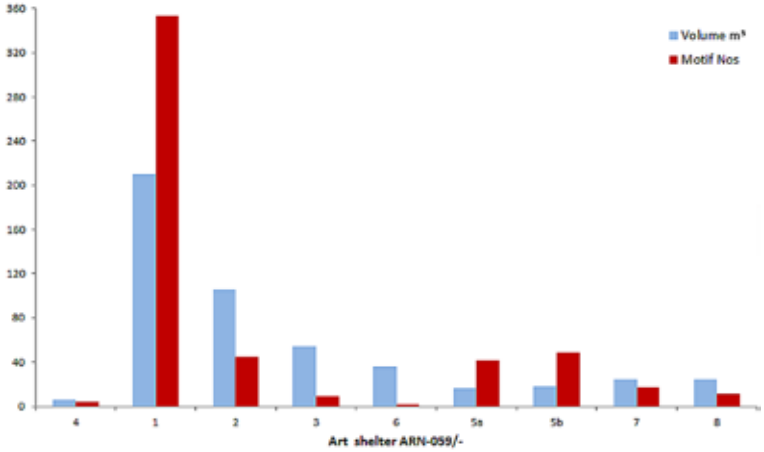

Figure 9. *A059 motif numbers by shelter volume (m^3). Shelters arranged linearly from north to south.*

Characteristics of the rock art shelters

A previous study found no correlation between the number of motifs per shelter and the shelters' width (also termed length: Gunn and Whear 2007: 16). Given the common form of the shelters in Penuk (vertical back wall, horizontal ceilings and mostly flat floors), the rectangular volume (width × depth × height) provides a comparable measure of their size. While the rectangular volume is a suitable measure of size here, this may not be so for other analyses, given that the rectangular volume does not give a true 'human' measure of a shelter's liveability; it ignores factors such as rock infill (as at A059/2), very low ceilings in wide shelters (A059/6), the nature of the floor (irregular, smooth, seasonally wet), and so forth. Further, as most shelters tend to taper towards their margins, the calculated volume tends to overestimate their real volume. For this exercise, where the measure is to be used relatively, these errors in size are not considered relevant.

The shelters, then, vary greatly in size (Table 1); A059/1 has the greatest interior volume and is by far

Rock art class	Shelter A059/-									Total
	4	1	2	3	6	5a	5b	7	8	
Early large naturalistic (ELN)		1								1
Early stencils and prints (ESP)		1	19	3	1					24
Dynamic			4			7				11
Post-dynamic				5	1	1		10	11	28
Simple figures with boomerangs (SFB)										0
Yam		1				12				13
Other Mimi		226	16	1		21	49	7		320
Jawoyn Bim	4	124	6							134
Total	**4**	**353**	**45**	**9**	**2**	**41**	**49**	**17**	**11**	**531**

Table 2. *Penuk rock art classes numbers by shelter. Shelters arranged linearly from north to south.*

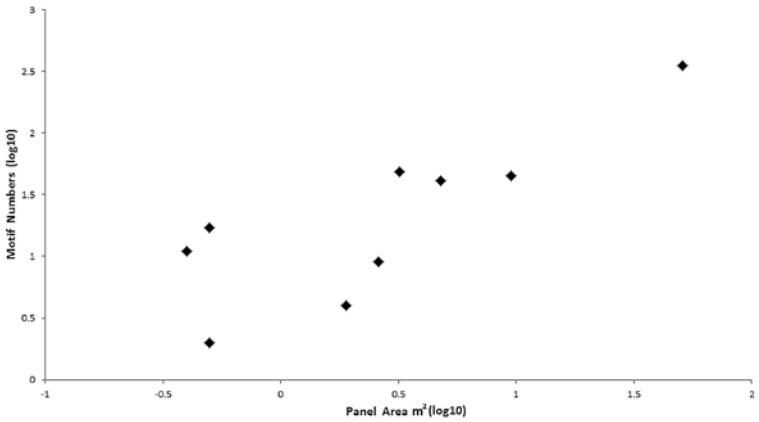

Figure 10. *A059 shelter rock art panel areas (m²). Shelters arranged linearly from north to south.*

Figure 11. *Recognised 'early' classes at Penuk. A: large naturalistic (A059/1) B: dynamic (A059/2) C: post-dynamic (A059/7).*

the roomiest rock shelter in the Penuk site complex, while A059/4 is the smallest. As shelter sizes tend to decrease with distance from the largest shelter, they here conform to a bell-curve distribution (Fig. 9).

Comparing shelter size with the number of motifs present indicates that the pattern of shelter size decreasing with distance from the largest shelter is not reflected in the quantity of rock art each shelter contains (Fig. 9). While the largest shelter (A059/1) contains the greatest number of motifs, the next-most decorated shelters are amongst the smallest (A059/5a and 5b), neither of which is in close proximity to the major shelter. The number of motifs tends more to reflect the available area of the rock art panels within each shelter (Fig. 10). Despite this trend, however, the ceiling of A059/1, which is the largest panel within the site complex at 30 m², holds only 56 motifs, while the adjacent wall panel, at 20 m², holds 273 motifs. Three of the ceiling motifs are large (5 m, 2.1 m and 1.5 m in length respectively), while the largest on the wall panel is 1.3 m long. Consequently, the total motif/area count is an average that is only representative for comparative purposes with other shelters. These examples also indicate that shelter size is not an indicator of the available panel areas the shelter contains.

Art variation across the Penuk site complex

The occurrence of the various rock art classes is very irregular across the Penuk site complex (Table 2), with post-dynamic and other-Mimi being the most widely represented. The distribution of each class will be briefly described to illustrate the range within each class.

Early large naturalistic

A single example of an ELN class motif was located on the ceiling of A059/1. This large motif, a coiled snake in yellow (210 × 135 cm), underlies all other motifs on the panel and its full form was only detected with DStretch enhancement (Fig. 11A).

Early stencils and prints

Twenty-four early stencils were located at four shelters: A059/1, 2, 3 and 6. One of these, at A059/3, is a 3mf hand stencil. These four shelters are all located around the main rock mass of the site complex, rather than throughout, with the hand stencils concentrated in site A059/2. No examples of early prints were recorded.

Dynamic

Eleven dynamic figures were recorded at two shelters: A059/2 and 5a. In both sites the figures are 'running' and hold 'spears' and 'boomerangs' (Fig. 11B). Shelter A059/5a also has at least one standing 'female' figure in the dynamic style. The variation in the manner in which the line-work is painted on at least three of these dynamic figures suggests that they are not the work of the one artist.

Post-dynamic

Twenty-eight post-dynamic figures were recorded in five shelters: A059/3, 5a, 6, 7 and 8. Twenty-one of these occur in sites A059/7 and 8 where they occur as rows of small figures (7 and 3; and 11 respectively). The other two examples are a pair of large anthropomorphs with complex headdresses at A059/7, both of which are superimposed by two large, striped macropods

Colour	No.
White	112
White+red	8
Red+white	4
Red	3
Black	2
Orange	1
Yellow	1
Orange+white	1
White+orange	1
Red+yellow+white	1
White-based	121
Red-based	8
Other	5
TOTAL	134

Table 3. *Jawoyn Bim colours.*

(Fig. 11C).

Simple figures with boomerangs

No motifs from this class were recognised.

Yam

Yam class motifs occur in two shelters: 12 at A059/5a and one at A059/1. These motifs consist of individual 'round yams' with characteristic peripheral nodules, and long and winding tendrils. No anthropomorphs with Yam-style headdresses are present.

Other-Mimi

Other-Mimi motifs consist of motif types that do not fall into any of the above categories and lack any other uniting stylistic character. This class accounts for 81% of the Mimi Bim here, and includes the various rock art styles within Lewis's 'broad spearthrower period' (Lewis 1988). Silhouette and striped fauna (particularly macropods, possum and echidna) are common, as are individual or rows of stick figures, and many uninterpretable fragments. Of note is a single horizontal, profile anthropomorph at A059/5b, painted in cream with a red outline, 75 cm long, which underlies a range of motifs from other Mimi Bim classes.

Jawoyn Bim

Three shelters contain a total of 134 Jawoyn Bim motifs, with the greater majority (93%) occurring in the main occupation shelter (A059/1) (Table 2). All Jawoyn Bim occur at the northern end of the outcrop, in close proximity to each other (Fig. 3). The motifs are dominated by white monochromes (84%), although red, orange and black pigments have also been used, both as monochromes and in polychrome combinations (Table 3). Over half of the 15 polychrome combinations are white with outline and fine infill in red (white+red).

Motif type	Motif sub-type	No.
'Flying fox'		18
Anthropomorph	stick-figure (8)	
	solid-bodied (3)	
	elongated (2)	
	'female' (6)	
	'male' (1)	
	profile (1)	21
Hand stencil	left (9)	
	unknown (4)	
	right (1)	14
'Snake'		7
'Geometric'		6
'Macropod'		3
'Bird'	'bustard' (4)	
	other (2)	6
'Fish'		3
'Possum'		2
'Turtle'		2
Unknown		8
Fragment		44
TOTAL		**134**

Table 4. *Jawoyn Bim motif type numbers.*

As expected, a great variety of styles and motif types is present within the Jawoyn Bim at Penuk. Indeed, apart from two rows of 'flying fox' motifs at A059/1 (4 and 4), and three motif pairs (two pairs of 'flying fox' and one of 'bustard'), most Jawoyn Bim motifs are idiosyncratic in style and depict a wide variety of subject matter (Table 4). This diversity is suggestive of a range of different artists working at different times with each adding only one to four motifs per production event.

The rock art of Penuk

Overall, Penuk shows a pattern of a major rock art shelter surrounded by a suite of smaller rock art shelters. While shelter size tends to a bell-curve distribution, that of motif numbers does not (Table 2; Fig. 9). The wide range of rock art classes represented, from amongst the earliest to the most recent, indicates that Penuk has been used over a large portion of the time that rock art has been produced within the Arnhem Land region (cf. Chippindale and Taçon 1998), with most classes less than 13 000 years old (Gunn 2016; Barker et al. in press). The individual rock art shelters, however, show no consistency in the frequency of each of these rock art classes (Table 2). The main shelter, A059/1, is the focal site for Jawoyn Bim and other-Mimi motifs, while dynamic/yam and post-dynamic motifs are concentrated at the southern end of the site complex. The main dynamic, post-dynamic and yam shelters also contain numbers of other-Mimi motifs,

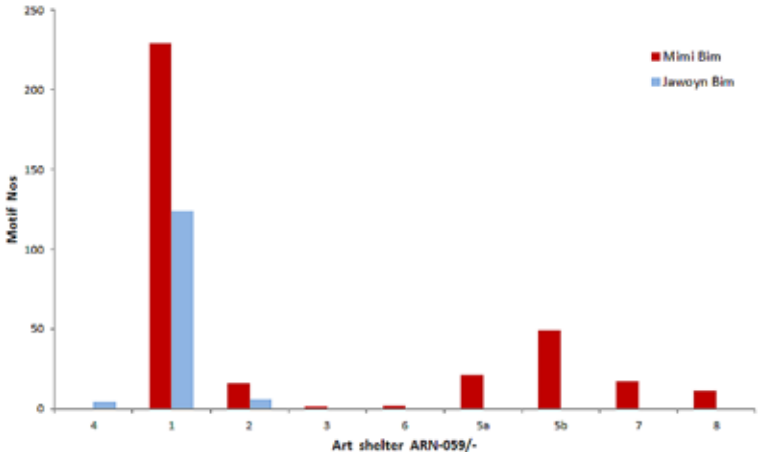

Figure 12. A059 shelter rock art contents by period. Shelters arranged linearly from north to south.

Site complex	No. of rock art shelters	Total No. of motifs
A019	22	599
A043	12	286
A066	16	755
A107	17	568
A128	14	463
A138	16	550
Total	97	3221

***Table 5.** Additional site complexes analysed.*

while post-dynamic motifs tend to be differentiated from dynamic and yam motifs; this differentiation may be purely a result of low numbers from these motif classes. Each of the motif classes has one site where they are prominent and one or more sites where they occur in lower numbers. Hence, while the site complex as a whole consists of a major rock art shelter and a number of smaller satellite shelters, the same pattern applies to each of the individual rock art classes, although the focal site for each may be different.

This different focal location of the dynamic/yam, post-dynamic and Jawoyn Bim motifs suggests that shelter location was an important factor in their placement. If, as has been proposed, the different Mimi styles also represent discrete periods of time, then variation in the placement of the styles should also represent changes in site preference over time (regardless of the specific age of the periods). Whether these differences reflect discrete functions for the rock art in relation to place, or just variations in occupation patterns over time, remains to be resolved. What does stand out is the restricted range of the Jawoyn Bim compared to that of the Mimi Bim overall (Fig. 12). Given the potential time differences for each period of the rock art classes, this restricted range may simply be a factor of time: the majority of Mimi Bim has been produced over a period of 12 500 years (c.13 000–500 years ago; Barker et al. in press), while the period of Jawoyn Bim only began some 500 years ago (Gunn 2016).

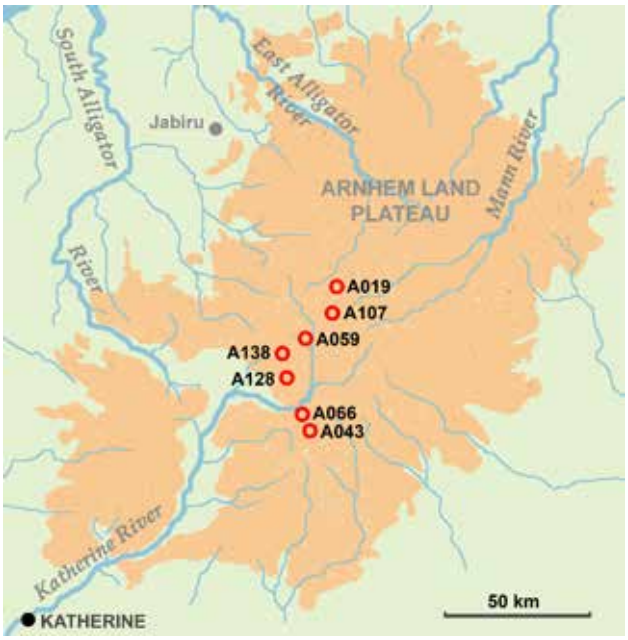

Figure 13. Location of Jawoyn site complexes mentioned in the text.

Additional site complex summaries

Ninety-six archaeological site complexes with rock art shelters were recorded during the JRAHP from

Figure 14. Jawoyn Bim period emu motif in the Jawoyn x-ray form (A019/6a).

PERIOD	SITE A019/-																					Total
	1	2	3	5a	5b	5c	4	7	6a	6b	9	8	10	11	12a	12b	12c	12d	13	14	15	16	
ELN																			1		1		2
ESP									9					3									12
Dynamic																					1		1
Post-dyn.																1							1
SFB									4										4	2			10
Yam																							
Other-Mimi	1	17	8	11	23	32	5	9	30	32	5	8	77	1	19	48	29	32	7	6	16	7	423
Jawoyn Bim		2		2	1	4	1	22	36	21	6		23		4	17	1	9	1				150
Total	1	19	8	13	24	36	6	31	79	53	11	8	100	4	23	66	30	41	13	8	18	7	599

Table 6. *A019 rock art period numbers.*

within the Arnhem Land Plateau. The number of rock art sites within each ranged from one to 35, with a median number of nine. To assess the Penuk findings as a general model, the patterns from six other small site complexes are compared (Table 5; Fig. 13). It was obvious on seeing the data that the various classes of Mimi Bim were poorly represented numerically, and therefore could not be individually analysed. Consequently in the following, particular attention will be given to a comparison of the aggregate of all Mimi Bim classes and the more recent Jawoyn Bim, to highlight potential spatial, and therefore probable chronological, variation: the earlier Mimi Bim period and the later Jawoyn Bim period.

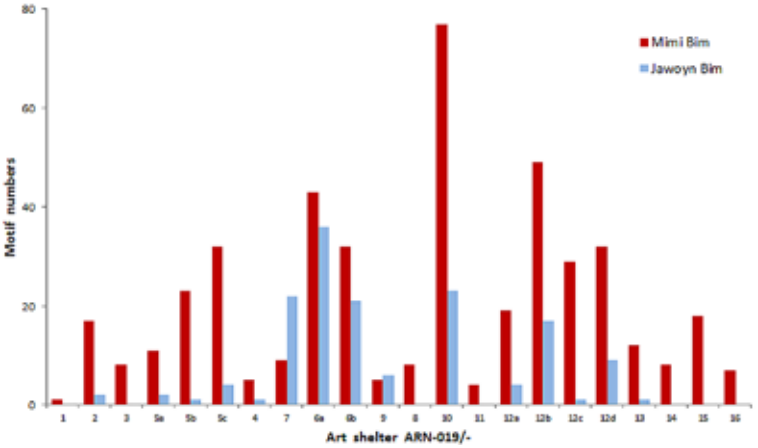

Figure 15. *A019 shelter rock art contents by period. Shelters arranged linearly from south to north.*

A019

Site complex A019 is within a low cliff-line along the western face of a large bedrock outcrop. There are no outstanding physical features within the complex and a substantial but ephemeral creek drains past the outcrop. The rockshelters were all formed by the undercutting of the cliff-line and house 16 rock art sites with 22 distinct alcoves that, together, contain 599 motifs.

The most prominent image is a large depiction of an 'emu' in Jawoyn x-ray form on the ceiling of the main rock art shelter (A019/6a; Fig. 14). Numerous other polychrome motifs in this shelter include anthropomorphous figures and other fauna, but elsewhere Jawoyn Bim is represented only by small monochrome white paintings.

Of the Mimi Bim, five of the seven recognised styles are represented, although only in low numbers (Table 6). Of these styles the ESP and SFB periods are most represented. Motifs of both the Mimi Bim and Jawoyn Bim are widespread across the site complex.

The distributions of both rock art groups (Mimi Bim and Jawoyn Bim) plot a simple bell-curve but with the nodes of each group occurring at different shelters: Mimi Bim at A019/10 and Jawoyn Bim at A019/6a,

Rock art class	Site A043/-											Total
	1	3	2	8	7	6	4	5	9	10	11	12	
ELN						1	1	1				1	4
ESP							3						3
Dynamic													
Post-dyn.													
SFB	2			2			6	3			2	2	17
Yam													
Other-Mimi		6	5	39	6	28	39	17	1	10	3	42	196
Jawoyn Bim				5	14	16	28				1	2	66
Total	2	6	5	46	20	45	77	21	1	10	6	47	286

Table 7. *A043 rock art period numbers.*

Figure 16. *The mushroom-form shelter A043/4.*

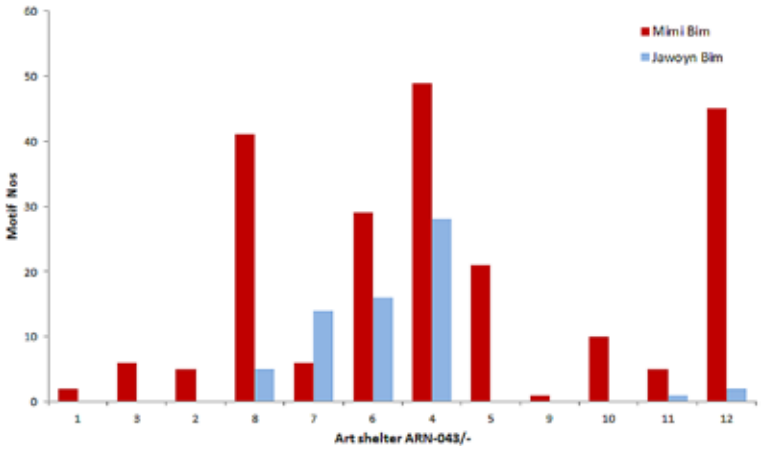

Figure 17. *A043 shelter rock art contents by period. Shelters arranged linearly from west to east.*

which also has a high number of Mimi Bim (Fig. 15).

A043

This site complex sits within a low north-westerly facing cliff-line with an ephemeral creek at the south-western end. It is dominated by a large, centrally located mushroom-rock formation (A043/4) (Fig. 16). The 12 rock art shelters here contain 286 motifs. Apart from A043/4, the shelters are mostly long and shallow (<2 m), nine being between 14 m and 23 m in length.

Three of the recognised Mimi Bim classes are represented by 24 motifs (Table 7), of which SFB is the most common. All three classes are represented within the central shelter, which also contains a high number of other-Mimi motifs. The dominant Jawoyn Bim motif in this shelter is a 2.5 m long 'male' anthropomorph in white+red. A low number of small bichrome motifs also occur. At other shelters here, the Jawoyn Bim motifs are represented by monochrome white paintings and a single bright red anthropomorph that appears to be of relatively recent origin.

The Mimi Bim motifs show an irregular distribution across the site complex (Fig. 17), with three separate shelters having similarly high motif numbers. In contrast, the distribution of the Jawoyn Bim motifs forms a crude bell-curve with a node at A043/4; a shelter that also has a high proportion of Mimi Bim motifs. Within this site complex then, the Mimi Bim and Jawoyn Bim show distinctly different, yet overlapping, distribution patterns.

A066

This site complex lies along the northern face of a low cliff line with a small ephemeral creek some 50 m in front of the rockshelters. It contains nine rock art shelters with 16 alcoves and a total of 755 motifs. While most of the shelters are undercut forms, one is a poorly protected cliff-wall (A066/3) and another was formed following a collapsed section of the cliff (A066/2).

All of the recognised Mimi Bim rock art classes are represented (Table 8). ESP is the most numerous class, with a concentration in shelter A066/2a, where there is also a concentration of dynamic figures and a high number of other-Mimi. Five examples of early prints were recorded at shelter A066/7c. All but one of the

Rock art class	Site A066/-																Total
	9a	9b	8	2a	2b	3	4	5	6	7a	7b	7c	7d	7e	7f	10	
ELN					1					1		1					3
ESP			3	35	1	3	13	1	1	7		14	2	1		14	95
Dynamic			3	14			1										18
Post-dyn.							9		4			6		4			23
SFB			1							21	1						23
Yam											1					2	3
Other-Mimi	2	19		65	9		59	1	33	72	9	49	1	17	4	168	508
Jawoyn Bim	4			11					11	4		3				49	82
Total	6	19	7	125	11	3	82	2	49	105	11	73	3	22	4	233	755

Table 8. *A066 rock art period numbers.*

SFB figures occurs in shelter A066/7a, while post-dynamic figures are evenly spread in four separate shelters. ELN motifs occur in two shelters, with yam motifs in only one.

The Jawoyn Bim images are concentrated in shelter A066/10, where they are represented by several bichrome figures in white+red and numerous small monochrome paintings in white, yellow or red. At shelter A066/6 there is a recent large macropod in yellow and a suite of smaller yellow Jawoyn Bim paintings. The shelters with Jawoyn Bim do not form a close spatial group, occurring irregularly along the length of the outcrop (Fig. 18). There is also a tendency for them to occur within shelters with high numbers of Mimi Bim, although A066/4 with 82 Mimi Bim motifs contains no Jawoyn Bim.

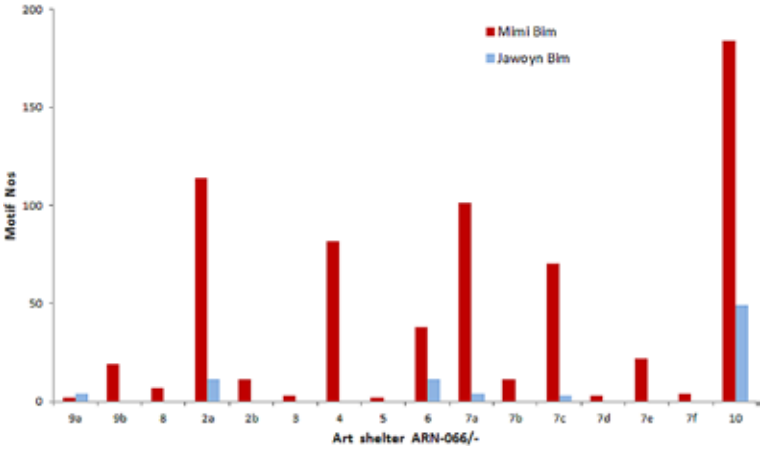

Figure 18. *A066 shelter rock art contents by period. Shelters arranged linearly from west to east.*

A107

The A107 site complex is on the northern edge of an extensive cluster of scattered remnant rock stacks separated by scrubby woodland. Eleven of the 12 rock art sites occur in close proximity, while site A107/1 is in an isolated outlier some 200 m to the south; this also contains the remains of an interred dingo burial (Gunn et al. 2010b). Many of the sites cannot be seen from each other due to the dense scrub, and there is no reliable water source in the immediate vicinity. The twelve rock art sites have 17 rock art alcoves and contain a total of 568 motifs. A figure in white wearing a top hat and standing with arms akimbo is interpreted as a European man, indicating its production to sometime after 1845 CE (Gunn 2016). One shelter A107/7 does not contain any rock art.

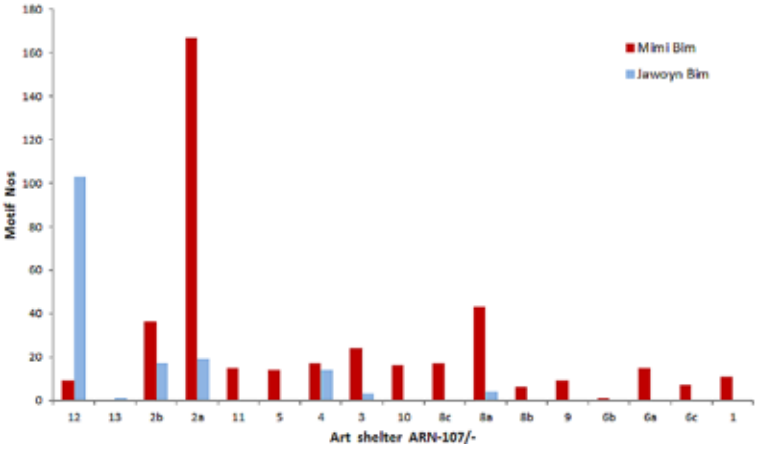

Figure 19. *A107 shelter rock art contents by rock art period. Shelters arranged linearly from west to east.*

Four of the Mimi Bim classes are represented; only ESP occur in any number (n=24; Table 9). Other-Mimi are concentrated at A107/2a (n=164), which is the most decorated shelter within the site complex and also the main occupation shelter. Jawoyn Bim motifs occur in six of the 17 alcoves and are only numerous in one: A107/12, at the far western end (Fig. 19). Both Mimi Bim and Jawoyn Bim motifs are in highly decorated shelters, also at the western end: Mimi Bim at A107/2a

Rock art class	Site A107/-																	Total
	12	13	2b	2a	11	5	4	3	10	8c	8a	8b	9	6b	6a	6c	1	
ELN					1		1	1										3
ESP			1		3	8							7	1	4			24
Dynamic																		
Post-dyn.																		
SFB			4	3														7
Yam												1						1
Oth-er-Mimi	9		31	164	11	6	16	23	16	17	43	5	2		11	7	11	372
Jawoyn Bim	103	1	17	19			14	3			4							161
Total	112	1	53	186	15	14	31	27	16	17	47	6	9	1	15	7	11	568

Table 9. *A107 rock art period numbers.*

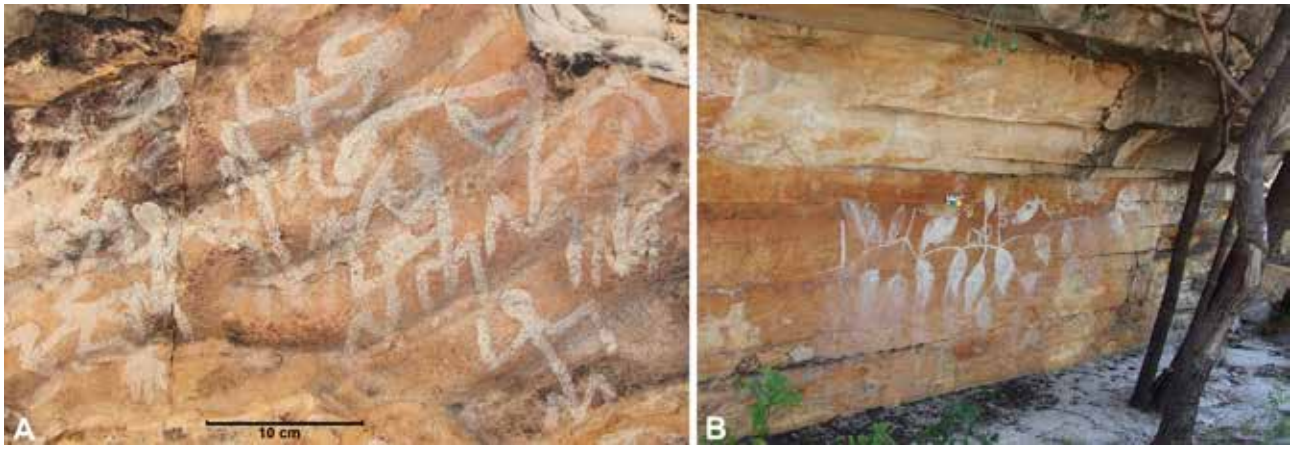

Figure 20. *Small and large white paintings at site complex A107. A: ceremony with didjeridu, shelter A107/12. B: large yam plant motif shelter A107/13 (2.2 × 0.9 m).*

Rock art class	Site A128/-														Total
	5	12	10	9	8	7	1	2	3	13	14	18	19	20	
ELN							4						1		5
ESP				1			3			5	1		1		11
Dynamic										1					1
Post-dyn.		2		3											5
SFB												1	4	3	8
Yam							1								1
Other-Mimi	16		4	18	13	6	151	10	36	3	5	76	59	25	422
Jawoyn Bim							10								10
Total	16	2	4	22	13	6	169	10	36	9	6	77	65	28	463

Table 10. *A128 rock art period numbers.*

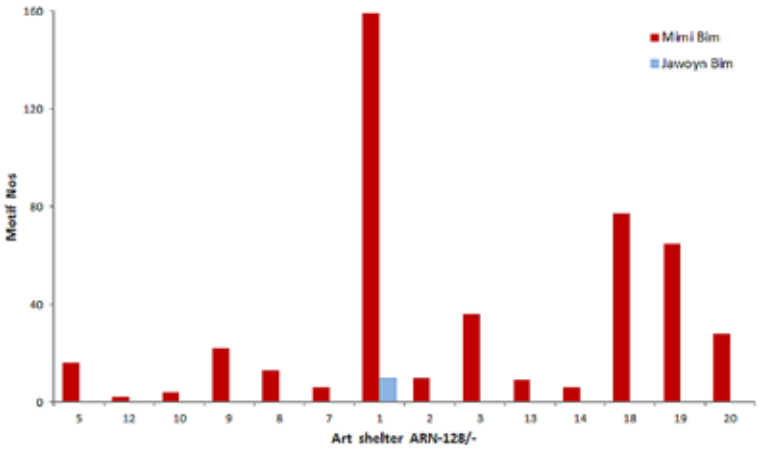

Figure 21. *A128 shelter rock art contents by rock art period. Shelters arranged linearly from east to west.*

and Jawoyn Bim at A107/12. The high number of Mimi Bim at A107/2a is the result of an array of small stick-figures arranged in rows across narrow horizontal panels. The low number of Jawoyn Bim motifs in this shelter, however, is somewhat compensated for by the presence of four large (50–130 cm) bichrome fauna.

A107/12, a shallow shelter, contains a proliferation of small white stick figures placed low on the rear wall. Seventeen of these small figures are arranged around a central figure playing a didgeridoo (Fig. 20a). These, as well as some 50 other motifs in the shelter, appear to have been painted by the same person, possibly at the one sitting. In contrast, the vertical wall of an adjacent shelter, A107/13, contains only a single image: a long 'yam plant' in white 2.2 × 0.9 m in size (Fig. 20b; cf. Hammond 2016: 12–14). As a consequence, although the painted surface area in both shelters is similar, the motif count is vastly different, highlighting one of the problems of dealing with numerical motif counts when there are exceptional size differences involved.

Both Jawoyn Bim and Mimi Bim have a major shelter and smaller satellite shelters and, while the two periods have different focal sites, there is considerable overlap in the use of the satellite shelters.

A128

A128 is a small site complex whose rockshelters occur in a line of fallen blocks and small remnant rock stacks, 250 × 50 m in area, adjacent to a small creek; it has 14 rock art shelters and a total of 463 motifs.

All of the recognised Mimi Bim periods are represented here, with ESP and SFB the most numerous (Table 10). A single early hand print was recorded at shelter A128/1. The site with the highest number of Mimi Bim (A128/1) is central to the site complex, while two other shelters with high motif numbers (A128/18 and 19) lie

Figure 22. *Scratched fish (A128/1).*

	Site A138/-																Total
Rock art class	**1**	**2**	**4**	**5a**	**5b**	**6**	**7**	**8**	**17**	**9**	**10a**	**10b**	**11**	**12**	**13**	**16**	
ELN																	
ESP	2	3		3	13	3	4		2	4	6	4		7			51
Dynamic	1									4		1			1		7
Post-dyn.																	
SFB	3			5							1						9
Yam												1					1
Other-Mimi	62	8	3	60	11	3	5	54	7	5	155	63	7		1	6	450
Jawoyn Bim	5										25	2					32
Total	73	11	3	68	24	6	9	54	9	13	187	71	7	7	2	6	550

Table 11. *A138 rock art period numbers.*

Figure 23. *Composition of 'broad spearthrower' figures (A138/10a).*

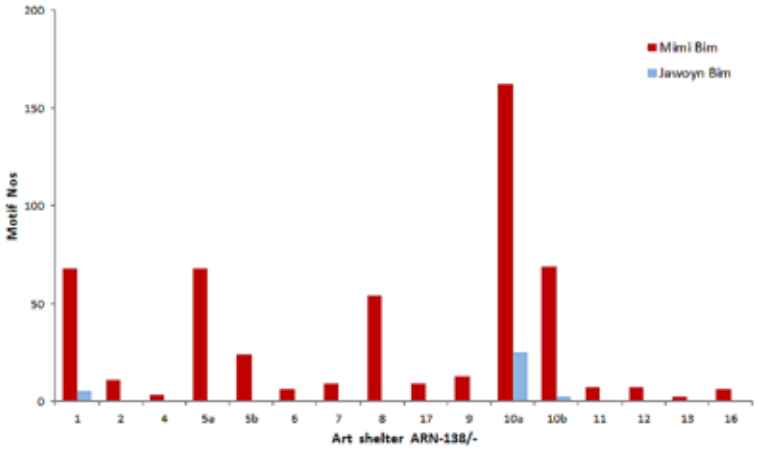

Figure 24. *A138 shelter rock art contents by period. Shelters arranged linearly from east to west.*

at the western end (Fig. 21). The Mimi Bim, then, has a central major site and a surrounding suite of smaller satellite sites.

Jawoyn Bim occur in only one shelter (A128/1) and are represented by a painted silhouette fish in white and, uncommonly, nine unpatinated scratchings (a large emu track, three infilled fish and six irregular geometric designs; Fig. 22).

The major rock art shelter sits atop of a rocky slope and has no floor deposit. No other shelters here have substantial floor deposits, and four are not suitable for general occupation as they are only protected wall panels with depths between 0.2 m and 0.5 m (A128/10, 12, 14 and 20). Motif numbers are low on three of these panels but one, A128/20, has a dense aggregate of 28 heavily superimposed Mimi Bim images.

A138

Site complex A138 occurs within a group of some 20 small rock stacks (most c. 20 m diameter and 5 m high) within an area 250 × 150 m in extent, in an otherwise sandy, open woodland, with the surrounding trees being taller than the rock stacks. There is no ready water supply within a kilometre of the outcrop. The site complex contains 14 rock art sites, with 16 alcoves and a total of 550 motifs, as well as a number of small stone arrangements. A138/1 is the largest shelter, with similar motif numbers to three other shelters, but only half the number of motifs in the smaller A138/10a shelter. A138/10a is the main rock art shelter and located central to the site complex, whereas A138/1 is at the far

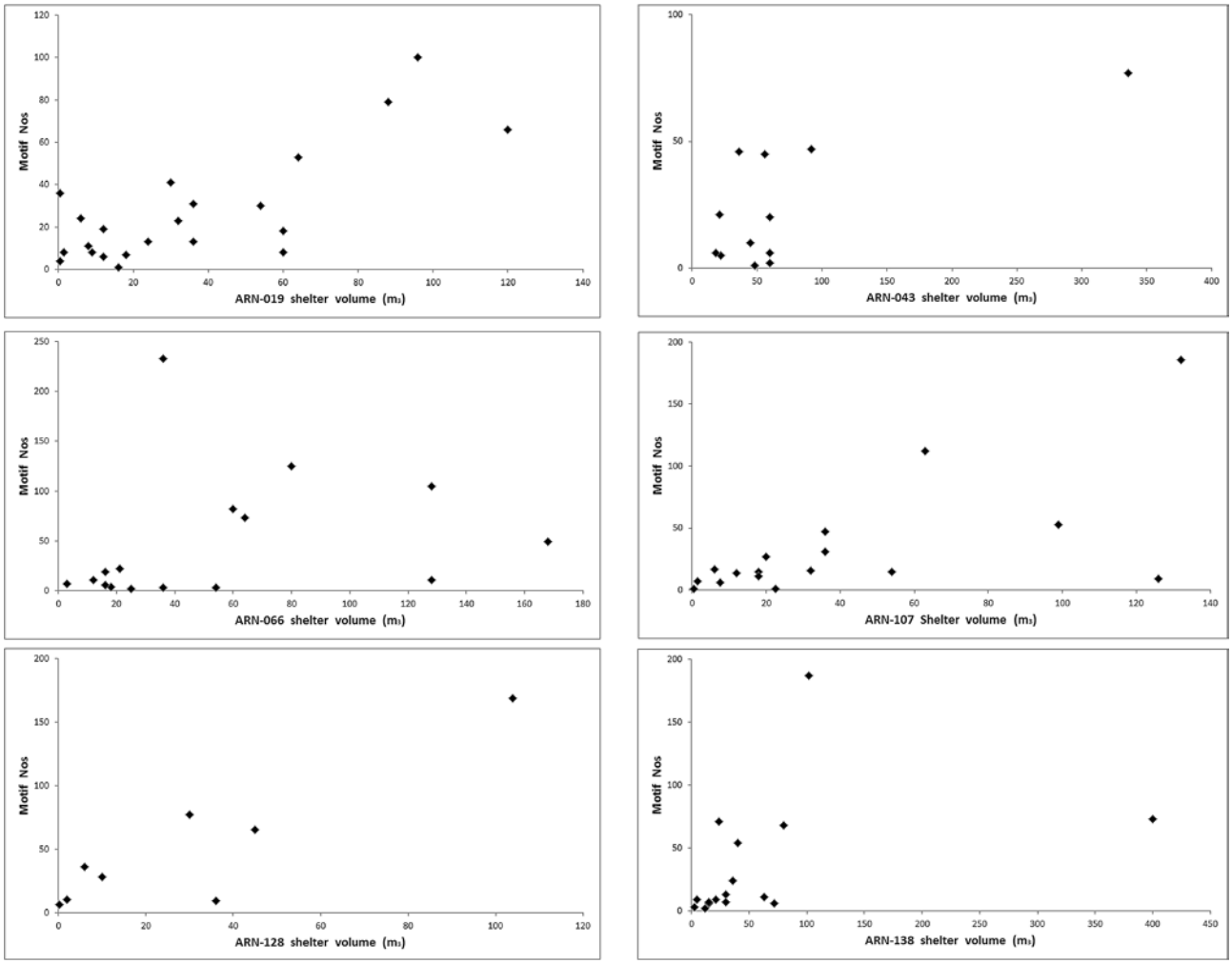

Figure 25. *Shelter volume (m^3) and motif numbers by site complex.*

eastern end.

Five Mimi Bim periods are represented (Table 11), with ESP and other-Mimi motifs in most shelters, and two early hand prints in shelter A138/5a. The other four Mimi Bim classes are poorly represented. The Mimi Bim motifs are most prolific in shelter A138/10a, but have an irregular distribution pattern across the site complex.

Shelter A138/10a has an impressive panel of red figures with broad spearthrowers and crossed sticks (Fig. 23; cf. Lewis 1988: 95). As figures with broad spearthrowers are not specifically categorised here, they are included in the class of other-Mimi.

Rock art class	Site Complex							Total No. of shelters
	A019	A043	A059	A066	A107	A128	A138	
ELN	2	4	1	3	3	5		18
ESP	14	3	24	95	24	11	51	222
Dynamic	1		11	18		1	7	38
Post-dyn.	1		28	23		5		57
SFB	10	17	13	23	7	8	9	87
Yam				3	1	1	1	6
Other-Mimi	421	196	320	508	372	422	450	2689
All Mimi Bim	449	220	397	673	407	453	518	3117
Jawoyn Bim	150	66	134	82	161	10	32	635
All motifs	3716	506	928	1428	975	916	550	3752

Table 12. *Number of shelters with rock art class representations.*

Three shelters contain Jawoyn Bim motifs; A138/10a has a notable suite of bichrome paintings, including a horizontal Jawoyn Lady motif and a number of large monochrome paintings of fauna in white or yellow (Fig. 24). The other two shelters contain a suite of small yellow paintings (A138/1b) and a large white+red anthropomorph and a white fragment (A138/10b).

Discussion

Shelter volume and rock art quantity

In the analysis of the Penuk site complex, shelter volume was found to be a poor indicator of the quantity of rock art present. Results from the six other site complexes (Fig. 25) indicate that while there is a trend towards a positive correlation between volume and motif numbers, there are too many exceptions for the relationship to be taken as a general rule. Consequently, within a rock art site complex, shelter volume cannot be used as a ready measure of rock art quantity.

Site complex motif distributions

Each of the seven site complexes shows an overall pattern of a major rock art site within a cluster of minor rock art sites. While the major site is typically the largest shelter in the site complex, this is not always the case. The largest shelters tend to be either in the centre of the site complex or at one end: a pattern typical of sandstone erosion. Of the satellite shelter sites, there is no consistency in the relationship between shelter size and motif numbers, or in their respective distances from the major rock art site. Hence, the model of a simple bell-curve distribution of motif numbers noted in regions of Australia with poorly-cemented rock types is not generally applicable in the well-cemented quartzites of the Arnhem Land Plateau; individual cases however, such as at A019, may occur.

Mimi Bim

The number of representative motifs from each of the Mimi Bim classes within each site complex is too small to permit any spatial patterns of motif distribution to be determined. In fact, the collective number of motifs from these recognised periods is very small compared with the number of Mimi Bim motifs overall, ranging from 6–31% with an overall representation of 14% (Table 12). Hence, within the Jawoyn Lands of the Arnhem Land Plateau at least, the rock art classes highlighted by previous researchers, such as the dynamic and yam figures, constitute only a minor component

Rock art class	ELN	ESP	Dyn	P-Dyn	SFB	Yam	Other	Jawoyn	No. of shelters per rock art class	Single rock art class shelters
ELN		10	1	1	7	3	17	10	15	
ESP	10		9	8	10	6	43	16	43	3
Dynamic	1	9		2	2	2	10	3	11	
P-dyn	1	8	2			1	10	3	12	2
SFB	7	10	2			1	21	11	22	1
Yam	3	6	2	1	1		10	5	5	
Other Mimi	17	43	10	10	21	10		36	96	25
Jawoyn Bim	10	16	3	3	11	5	36		41	2

Table 13. *Rock art class site correlations.*

Site Complex	All Classes	ELN	ESP	Dyn	P-dyn	SFB	Yam	Oth-er-Mimi	JWB
A019									a
A043	a					a			a
A059	a		b		c			a	a
A066	a		b	b		c		a	a
A107	a							a	b
A128	a		b						

Letters indicate different shelters within each site complex.
Repeated letters indicate multiple rock art class use in the one shelter.

Table 14. *Major motif class representation by site complex.*

of the total Mimi Bim corpus.

No Mimi Bim period was found to be exclusively isolated from any other Mimi Bim period (Table 13). Hence, none of the periods are seen as being preferentially spatially discrete. In this sample, early stencils and prints are the most widely associated of the Mimi Bim class; this most likely reflects their greater representation overall in this sample (but see discussion below in relation to major shelters for the individual rock art styles). There is likewise no spatial isolation of Jawoyn Bim from any of the earlier Mimi Bim classes.

All site complexes have one shelter with a relatively high number of Mimi Bim motifs (usually the main rock art shelter); in the other shelters no regular pattern is evident in the distribution of motif numbers. While A019 shows an approximation to a standard bell-curve distribution around the main rock art shelter (Fig. 15), others present distinctly different and irregular distribution patterns. In all but one case, however, the shelters with the highest number of Mimi Bim motifs are also the largest shelters within the site complex. The exception, shelter A066/2a, is commodious and immediately adjacent to a waterhole, suggesting a practical explanation for its greater use here. In contrast, the largest shelters here, A066/6 and 7, lie more than a hundred metres to the east of the waterhole.

It was also found that the ratio of Mimi Bim motifs in the major shelter to that in the site complex as a whole is not consistent, with the proportion varying between 22–89%. In some site complexes the total number of motifs in all the minor shelters well exceeds that in the major shelter, while in others it is far less. Overall the number of Mimi Bim motifs within the major shelters averages around a third of the total Mimi Bim: a figure that corresponds with the personal impression gathered from the JRAHP surveys at most other site complexes.

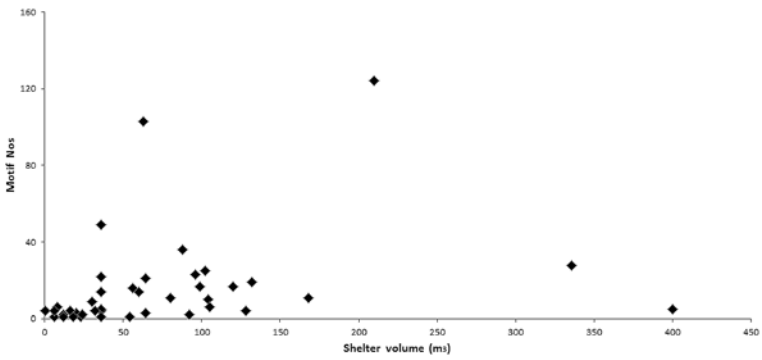

Figure 26. *Jawoyn Bim motif numbers by shelter volume from all seven site complexes.*

As mentioned above, within these site complexes Jawoyn Bim occur in fewer shelters than Mimi Bim. Most shelters with high numbers of Jawoyn Bim also have high numbers of Mimi Bim, although the major Jawoyn Bim shelters may or may not be a major shelter for Mimi Bim. In marked contrast to the distribution of Mimi Bim motif numbers, in five of the seven site complexes the Jawoyn Bim are distributed within a single major shelter and surrounding satellite shelters, forming a distribution that approximates the standard bell-curve. Of the exceptional site complexes, one contains only a single Jawoyn Bim shelter, and the other, A066, has a major shelter at the far eastern end of the site complex, plus five other shelters with lower Jawoyn Bim motif numbers.

Six of the seven site complexes contain a major rock art shelter and a suite of shelters with lower motif numbers (Table 14). The exceptional site complex, A019, does contain one shelter with more motifs than the others, but in this case, with the largest shelter having 100 motifs and the secondary shelter 77, it does not meet the >150% requirement of the definition of a major rock art shelter.

Four site complexes contain a major ESP shelter (Table 14). In each case, the major ESP shelter is a different shelter from that of the major shelter for the all other Mimi Bim and Jawoyn Bim rock art classes. This suggests that there was a preferred separation of major ESP shelters from that of the more graphic rock art classes. None of the major shelters from the other motif classes show any such distinction.

On a shelter by shelter comparison, there is a tendency for Jawoyn Bim to be at least under-represented, if not totally absent, in shelters with dynamic, post-dynamic and yam figures (Tables 2, 5–10). This discrimination is suggestive of an avoidance or appreciation of the earlier rock art.

Jawoyn Bim

Jawoyn Bim is the most recent of the rock art classes represented here and generally oc-

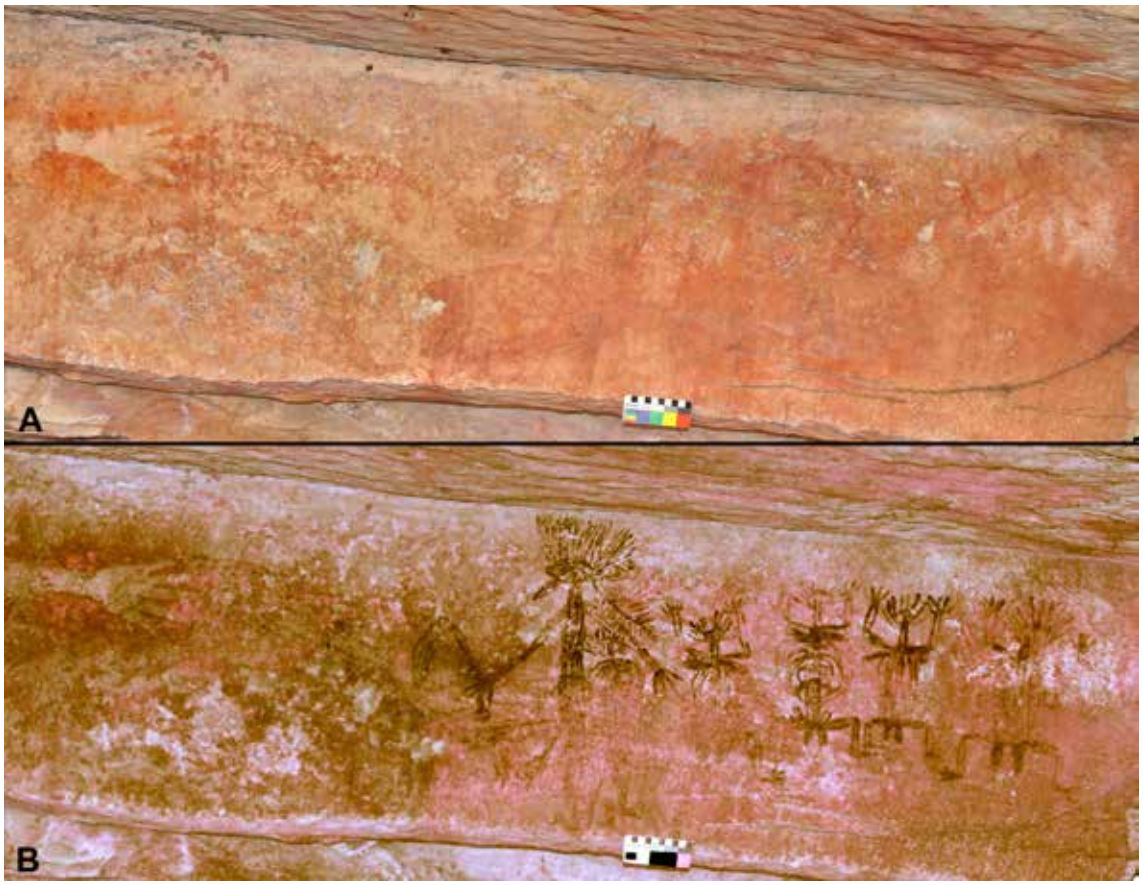

Figure 27. *Rock art panel at A066/10. A: flash photograph; B: DStretch_lye10.*

curs in less than half the shelters containing the earlier Mimi Bim rock art (range 7–68%; average 41%). Ethnographic records indicate that during the period of the Jawoyn Bim at least, rockshelters were primarily used as retreats during the summer wet season (e.g. Tindale 1928: 35). Consequently, it was expected that, with a range of shelters to choose from in each site complex, Jawoyn Bim would be concentrated in the largest and most 'comfortable' shelters. This expected pattern, however, was not confirmed by this study. At all seven site complexes, there is no preference for Jawoyn Bim to occur in shelters with larger internal areas (Fig. 26), nor is their occurrence related to larger water reserves although, during the wet season, rainfall provides abundant surface water throughout the region.

The motivation behind the selection of shelters for Jawoyn Bim production has yet to be determined. In keeping with the Australia-wide practices of traditional Aboriginal groups, the Jawoyn and other western Arnhem Land groups practised social avoidance (Elkin 1979: 147–149). The practice prevented a husband looking at or speaking to his mother-in-law, but also applied to brother/sister and nephew/uncle relationships. As such the two parties generally camped separately, but Berndt and Berndt (1977: 82) record that in western Arnhem Land the mother-in-law travelled and camped in the same party as her daughter and son-in-law. While it is tempting to assume that the major shelter was used by the primary family members with any avoidance members in the side shelters, the lack of any documentation of the relationships between people living in rockshelters makes drawing conclusions on this pattern somewhat speculative at this stage.

Yellow pigment

The number of yellow motifs within the Mimi Bim, revealed through DStretch enhancement, far exceeded anticipated numbers (Fig. 27). Yellow motifs (paintings and stencils) account for 7–25% of the Mimi Bim within each site complex, with an overall average of 16%. These yellow motifs occurred in 43 (41%) of all rock art shelters. Hence, yellow pigment was used far more frequently than is generally apparent from the published literature on Arnhem Land rock art. Further, yellow paintings from the dynamic (A066/8), post-dynamic (A066/4) and SFB (A066/4) periods indicate that the pigment's use is a long-standing one.

Conclusions

A study of seven small site complexes on the Arnhem Land Plateau found that:

- The site complexes mostly consist of a single shelter with a high quantity of rock art, and a number of other shelters with notably fewer motifs. While the major rock art shelters are usually amongst the largest within the complex, others of equal volume may contain far less rock art. Indeed, many very small and limited access shelters contain high numbers

of motifs. Hence, the interior volume of a shelter alone cannot be taken as a guide to the amount of rock art it might contain.

- The rock art represented at these site complexes incorporates all of the documented Arnhem Land rock art classes. The various rock art classes are not equally represented within each site, and very few sites contain motifs from all classes. The site complexes all contain motifs from the early hand stencil period, indicating that all have been in use over the past 13 000 years, although not all contain images from the apparently earlier large naturalistic rock art class.
- Sites with Jawoyn Bim motifs tend to cluster around a 'major' site; the Mimi Bim show no such pattern of style/shelter aggregation. This pattern reflects Taçon's broad-scale findings that recent and earlier rock art are not equally distributed across the landscape.
- Mimi Bim motifs are generally three times more numerous than Jawoyn Bim motifs in all of these site complexes.
- The prominent styles/periods recognised by previous researchers represent only a small proportion of western Arnhem Land rock art and, while they may prove to be the more common and distinctive, the identification of other, possibly regionally or locally discrete rock art classes, is regarded as an essential requirement for the fuller understanding of the use of Arnhem Land site complexes over time.
- The high proportion of yellow pigment motifs account for a much higher proportion of the Mimi Bim than previously recognised (c. 16%). The yellow motifs here were represented within most of the recognised Arnhem Land rock art styles/periods, indicating that the use of yellow pigment was concurrent with that of red pigment throughout most of Arnhem Land's rock art history.
- Many of the yellow motifs recorded were all but undetected during the fieldwork, being found through the later use of DStretch enhancement on photographs, confirming the need to utilise enhancements in the field during recording (see Harman 2015).

While the period of the Jawoyn Bim flourished over the past 500 years (Gunn et al. in press), definite time spans can be given to only three of the Mimi Bim styles. Examples of 'hooked stick' figures from the SFB were painted less than 9000 years ago (David et al. in press), the northern running figures style, a Mimi Bim style that is not represented in any Jawoyn rock art sites, from 9000 to 6000 years ago (Jones et al. 2017), and the yam style around 7000 years ago (Hammond 2016).

Overall, the findings of this study are considered to also be applicable to the larger site complexes within Jawoyn Lands although, because of the greater use of these site complexes, such patterns may be more difficult to disentangle. Whether or not such patterns are also applicable to site complexes around the northern and western perimeter of the Arnhem Land Plateau, where the geomorphological settings are somewhat different, remains to be seen. Given that the pattern of a complex consisting of a major and satellite sites has been recorded elsewhere in Australia, it appears that the pattern may be a universal given the appropriate geomorphological conditions.

While this study has opened more questions than it has answered, it has reinforced the value of small-scale archaeological landscape studies in interpreting changes in rock art and place use over time. It is expected that a more detailed comparative analysis of the rock art within the major and minor shelters will further assist in these interpretations.

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REFERENCES

Barker, B., L. Lamb, J.-J. Delannoy, B. David, R. G. Gunn, E. Chalmin, G. Castets, K. Aplin, B. Sadier, I. Moffat, J. Mialanes, M. Katherine, J.-M. Geneste and S. Hoerlé in press. Archaeology of the '*Genyornis*' site, western Arnhem Land: determining the age of the '*Genyornis*' painting. In B. David, P. Taçon, J.-J. Delannoy and J.-M. Geneste (eds), *The archaeology of rock art in western Arnhem Land*. ANU Press, Canberra.

Berndt, R. M. and C. H. Berndt 1977. *The world of the first Australians*. Ure Smith, Sydney (second edn).

Brandl, E. J. 1972. Thylacine designs in Arnhem Land rock paintings. *Archaeology and Physical Anthropology in Oceania* 7(1): 24–30.

Brandl, E. J. 1973. *Australian Aboriginal paintings in western and central Arnhem Land*. Australian Institute of Aboriginal Studies, Canberra.

Brandl, E. J. 1977. Human stick figures in rock art. In P. J. Ucko (ed.), *Form in indigenous art*, pp. 220–242. Australian Institute of Aboriginal Studies, Canberra.

Brandl, E. J. 1980. Some notes on faunal identification and Arnhem Land rock paintings. *Australian Institute of Aboriginal Studies Newsletter New Series* 14: 6–13.

Chalmin, E., G. Castets, J.-J. Delannoy, B. David, B. Barker, L. Lamb, F. Soufi, S. Pairis, S. Cersoy, P. Martinetto, J.-M. Geneste, S. Hoerlé, T. Richards and R. G. Gunn 2017. Geochemical analysis of the painted panels at the '*Genyornis*' rock art site, Arnhem Land, Australia. *Quaternary International* 430(2017): 60–80.

Chaloupka, G. 1984. Kakadu rock art: its historic and prehistoric significance. In D. Gillespie (ed.), *The rock art sites of Kakadu: some preliminary research findings for their conservation and management*, pp. 1–33. Australian National Parks and Wildlife Service, Canberra.

Chaloupka, G. 1993. *Journey in time: the World's longest continuing art tradition*. Reed, Chatswood, NSW.

Chippindale, C. and P. S. C. Taçon 1998. The many ways of dating Arnhem Land rock art. In C. Chippindale and P. S. C. Taçon (eds), *The archaeology of rock-art*, pp. 90–111. Cambridge University Press, Cambridge.

David, B., B. Barker, F. Petchey, J.-J Delannoy, J.-M Geneste, C. Rowe, M. Eccleston, L. Lamb and R. Whear 2013. A 28 000 year old excavated painted rock from Nawarla Gabarnmang, northern Australia. *Journal of Archaeological Science* 40: 2493–2501.

David, B., J.-J. Delannoy, R. Gunn, L. Brady, F. Petchey, J. Mialanes, E. Chalmin, J.-M. Geneste, I. Moffat, K. Aplin and M. Katherine in press. Determining the age of paintings at JSARN-113/23, Jawoyn country, central-western Arnhem Land plateau. In B. David, P. Taçon, J.-J. Delannoy and J.-M. Geneste (eds), *The archaeology of rock art in western Arnhem Land, Australia*. ANU Press, Canberra.

David, B. and M. Wilson 1999. Re-reading the landscape: place and identity in NE Australia during the late Holocene. *Cambridge Archaeological Journal* 9(2): 163–188.

Edwards, R. 1979. *Australian Aboriginal art: the art of the Alligators Rivers region, Northern Territory*. Australian Institute of Aboriginal Studies, Canberra.

Elkin, A. P. 1979. *The Australian Aborigines*. Angus & Robertson, Melbourne (5th edn).

Gunn, R. G. 1997. Rock art, occupation and myth: the correspondence of symbolic and archaeological sites within the Arrernte rock art complexes of central Australia. *Rock Art Research* 14(2): 124–136.

Gunn, R. G. 2016. Art of the ancestors: spatial and temporal patterning in the rock art of Nawarla Gabarnmang, a major Jawoyn cultural site on the Arnhem Land plateau. Submitted PhD thesis, Monash University.

Gunn, R. G., B. David, J.-J. Delannoy, F. Petchey, J.-M. Geneste and M. Katherine in press. The past 500 years of rock art at Nawarla Gabarnmang, central-western Arnhem Land. In B. David, P. Taçon, J.-J. Delannoy and J.-M. Geneste (eds), *The archaeology of rock art in western Arnhem Land*. Terra Australia, ANU Press.

Gunn, R. G., L. C. Douglas and R. L. Whear 2014. 'Interpreting' polychrome paintings using DStretch. *Rock Art Research* 31(1): 101–104.

Gunn, R. G., L. C. Douglas and R. L. Whear in press. Art islands on the plateau: rock art site complexes in the Jawoyn lands of the Arnhem Land Plateau. *Australian Archaeology*.

Gunn, R. G., C. L. Ogleby, D. Lee and R. L. Whear 2010a. A method to visually rationalise superimposed pigment motifs. *Rock Art Research* 27(2): 131–136.

Gunn, R. G., R. L. Whear and L. C. Douglas 2010b. A dingo burial from the Arnhem Land Plateau. *Australian Archaeology* 71: 11–16.

Gunn, R. G. and R. L. Whear 2007. The Jawoyn Rock Art and Heritage Project. *Rock Art Research* 24(1): 5–20.

Hammond, J. W. 2016. Yam culture in Arnhem Land: an analysis of cultural life related to *Dioscorea* yams from the 'yam figure' rock paintings to the present day. Unpubl. MA thesis, University of New England, Armidale, NSW.

Harman, J. 2008. Using decorrelation stretch to enhance rock art images. *http://www.dstretch.com/AlgorithmDescription.html*. Paper presented at American Rock Art Research Association Annual Meeting, 2005.

Harman, J. 2015. Using DStretch for rock art recording. *International Newsletter on Rock Art* 72: 24–30.

Jones T., V. A. Levchenko, P. L. King, U. Troitzsch, D. Wesley, A. Williams and A. Nayingull 2017. Compound-specific radiocarbon age constraints for a Pleistocene – Holocene transition rock art style: the northern running figures of the East Alligator River region, western Arnhem Land, Australia. *Journal of Archaeological Science* 11: 80–89.

Lewis, D. 1986. The Dreamtime animals: a reply. *Archaeology in Oceania* 21(2): 140–145.

Lewis, D. 1988. *The rock paintings of Arnhem Land, Australia*. BAR International Series 415, British Archaeological Reports, Oxford.

Lorblanchet, M. 1975. Erosion in the Grampians Mountains. Unpubl. report to AIATSIS, Canberra.

May, S. K., P. S. C. Taçon, A. Paterson and M. Travers 2013. The world from Malarrak: depictions of South-East Asian and European subjects in rock art from the Wellington Range, Australia. *Australian Aboriginal Studies* 2013/1: 45–56.

Mountford, C. P. 1956. *Art, myth and symbolism*. Records of the American-Australian Scientific Expedition to Arnhem Land, Vol. 1. Melbourne University Press, Melbourne.

Mulvaney, K. 2015. *Murujuga Marni: rock art of the macropod hunters and mollusc harvesters*. UWA Publishing, Crawley, WA.

Murray, P. and G. Chaloupka 1984. The Dreamtime animals: extinct megafauna in Arnhem Land rock art. *Archaeology in Oceania* 19(3): 105–116.

Smith, C. 1994. Situating style: an ethnoarchaeological study of social and material context in an Australian Aboriginal artistic system. Unpubl. PhD thesis, University of New England, Armidale, NSW.

Taçon, P. S. C. 2002. Rock-art and landscapes. In B. David and M. Wilson (eds), *Inscribed landscapes: marking and making place*, pp. 122–138. University of Hawaii Press, Honolulu.

Tindale, N. B. 1928. Native rock shelters at Oenpelli, Van Diemen Gulf, North Australia. *South Australia Naturalist* 9(2): 35–37.

Turner, J. 1981. Murujuga: a spatial analysis of the engraved rock art of Withnell Bay. Unpubl. B.A. Hons thesis, University of Western Australia.

Vinnicombe, P. 1984. Single sites or site complexes? In S. Sullivan and S. Bowdler (eds), *Site surveys and significance assessment in Australian archaeology*, pp. 107–118. Australian National University, Canberra.

Wesley, D. 2013. Firearms in rock art of Arnhem Land, Northern Territory, Australia. *Rock Art Research* 30(2): 235–247.

Wilson, M. and B. David 2002. Introduction. In B. David and

M. Wilson (eds), *Inscribed landscapes: marking and making place*, pp. 1–9. University of Hawaii Press, Honolulu.

Witter, D. 1984. Providing a regional context for management archaeology. In S. Sullivan and S. Bowdler (eds), *Site surveys and significance assessment in Australian archaeology*, pp. 48–54. ANU, Canberra.

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