KEYWORDS: ***Hand stencil – Measurement – Recording – Central Australia***

HAND SIZES IN ROCK ART: INTERPRETING THE MEASUREMENTS OF HAND STENCILS AND PRINTS

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Abstract. Hand stencils and prints have been long recognised to be ubiquitous throughout most rock art regions of Australia. This study examines the variation in hand stencil measurements of a single individual and then the correlation between hand size and a range of physical anthropological traits from central Australian populations. It concludes that only the broadest age distributions can be discerned from stencils and prints, and also that sex cannot be reliably distinguished. However, the measurement of attributes remains warranted as particular age/sex associations may be confidently proposed when examined in conjunction with other archaeological evidence.

Introduction

Hand stencils and prints have been long recognised to be ubiquitous throughout most rock art regions of Australia (McCarthy 1979). They occur either as a major component (Fig. 1), where they may occur in the thousands (such as at Carnarvon Gorge; Walsh 1988), as minor elements with but a small number of examples (as in western Victoria; Gunn 1981) or, in a very few areas, be absent altogether (e.g. Olary province of South Australia; Nobbs 1984). Indeed, many early recorders gave only casual mention to the presence of hand stencils or hand prints and their visual records illustrated only select examples. Consequently, the study of hand stencil numbers, hands (left or right), along with their location and arrangement within a shelter was rarely considered. While always recognised, they received little detailed study. The most common aspect noted was the presence of very small or very large hands as it was assumed that the smallest hands stencilled or printed were those of infants, while those of the largest were 'big' adult males.

This study first uses personal experiments to establish variability in hand stencil measurements from a single individual. It then examines the correlation between hand size and a range of physical anthropological traits from central Australian populations, in order to examine the types of information that can be gleaned from hand stencils as archaeological artefacts and, consequently, identify which attributes of the art are most likely to be useful for the interpretation of hand motifs.

It was concluded that only the broadest age distributions could be discerned and that sex could not be reliably distinguished.

The interpretation of hand stencils and prints

Dunbar (1943, 1944) recorded women and children producing hand stencils in white pigment at the turn of the 20th century in central western New South Wales. Dunbar mentioned that he knew of no adult males making hand stencils. A subsequent archaeological recording of those sites (Gunn 1983) found a small number of very large hand stencils, suggesting that stencilling was not confined to women and children. However as the recording did not examine hand size by colour, it is possible that the larger hands may be in red and therefore predate the more recent period observed by Dunbar.

In western Arnhem Land, a senior man's claim to a clan area was based in part on the presence of his mother's hand stencil at a central site (Gunn 1989a). In the same area, hand stencils were placed in shelters where particular people camped or with which they had particular associations (Taçon 1989: 137–8), or were 'signatures' of individuals with a special association with a particular area (Roberts

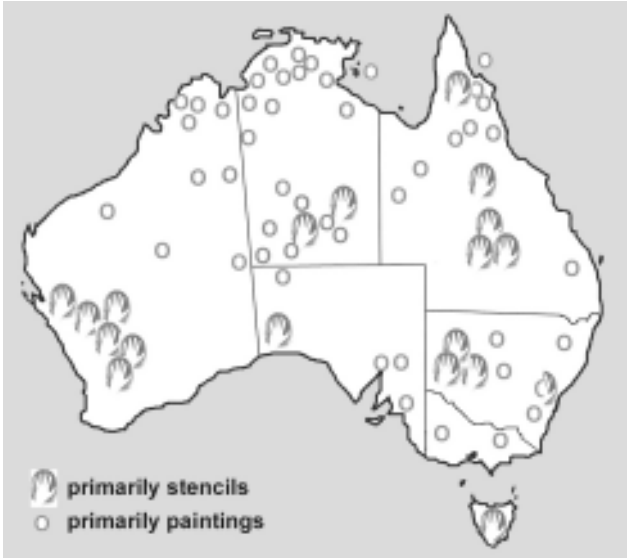


Figure 1. *Areas of Australia where stencils are dominant.*

and Parker 2003: 30).

Trezise (1971) was given the same interpretation for hand and foot stencils in the Gugu-Yulanji area of Cape York. Trezise was also told that weapons were *probably* stencilled for 'good luck' (ibid).

Custodians said that hand stencils and prints in the Dulcie Ranges of central Australia, most of which have the appearance of considerable age, were made by the Weeyi Dreaming Beings during the period of their stay in the region, while others at particular sites (usually known campsites) had purely sentimental value, as they were of particular known individuals (Gunn 1993a). At Illararri, 200 km to the south-west, both the rockshelters and the hand stencils are said to be made by the Kangaroo Dreaming Being who passed through the region (Gunn 1988).

From an examination of ethnographic sources, Moore (1979) found that 'Aborigines themselves were aware of many differing ways in which stencils, and hand stencils in particular, were commonly employed to symbolise ideas far more complex than the simplistic "signature" ones' (p. 324). However, he stressed that the assigned meaning could only be learnt from knowledgeable informants and, consequently, would be inaccessible in a purely archaeological context (see also Mulvaney 1996).

Ross (2003) examined the archaeological context of central Australian rock art. She found a statistically significant relationship between the presence of hand stencils and the presence of grindstones, that she took as an indicator of general habitation. She argued that this, in conjunction with other stone tools present and the presence of very small stencils (of young children) at 62 % of sites, was evidence of open access to such sites, although she was unable to identify any consistency in their overall context. She concluded that hand stencils, hand prints and drawn outlines, were likely to have been produced during mundane (less formal) rituals (Ross 2003: 291).

In most areas of Australia stencilled hands occur in their basic splayed form and occasionally with small numbers of 'variant' hands. Within Carnarvon Gorge, in the Central Queensland Highlands, variant hands seem to be particularly common. Quinnell (1979) found that here, while there were limitations on the range of stencilled motifs, through combination and variation of the finger position, there was also scope for individual design and composition (see also Walsh 1979, 1983, 1988). In this region, 'variant' stencils have been convincingly associated with traditional sign language (Walsh 1979; Wright 1985), while composite stencilled images are closely associated with mortuary crypts (Morwood 1979). These latter motifs are made up of numerous, repeated, and usually diamond shaped, stencilled elements (Walsh 1983). To date these have only been recorded in the Queensland Central Highlands.

Hand stencil measurements have been utilised by a number of rock art researchers to investigate the age and sex of shelter occupants (Flood 1987; Gunn 1987a, 1993b; McDonald 1995; David 2002a). Flood, in a well-elaborated discussion, measured the middle finger of stencils 'to try to determine whether different sites were utilised by one age group' (1987: 103). On the basis of middle finger length, she classified hand stencils into five size classes: very small (<4 cm), small (4.1–6.0 cm), medium (6.1–7.0 cm), large (7.1–8.0 cm) and very large (>8.1). Using statistical data of the physical characteristics of contemporary Aborigines (Abbie 1975), she found that

- it was not possible to distinguish between male and female hands except in the case of extremely large ones, which are likely to belong to adult males, and
- it was difficult to determine people's age from the size of their hands (Flood 1987: 104).

She concluded that some of the smaller sites were 'family sites' as they contained a full range of stencil sizes, including babies' hands and feet, along with women's dilly bags (although only four of the latter were recorded). At other sites she found a correlation of extremely large hands in association with exceptional paintings of 'Mythical Beings', and interpreted this as being related to male ritual sites (Flood 1987: 118).

McDonald (1995) used hand size to conclude that women utilised at least some of the shelters in the Sydney region where hand stencils are a major component of the shelter artwork. In a broad view study, she incorporated hand size (particularly the presence of infant hands) with a number of other archaeological aspects that were known to have been associated with women's activities (such as fishhooks, shellfish and small land mammals). Using hand measurements (recorded by the physical anthropologist A. A. Abbie; 1975), she found an overlap in the hand size of Aboriginal men and women, with the mean size and the range of overlapping varying by only one centimetre (McDonald 1995: 95). She concluded therefore that gender was 'not easily discernible' (p. 95). Using her own sample of three to ten-year-olds, she was confident of distinguishing between infants and children, although she does not provide any supporting data.

Using physical anthropological data from Abbie (1970) and personal observation of hand breadth sizes, Gunn (1993b) derived a tentative hand size/age division: <70 mm = children, 70–90 mm = adolescents or adult females, >90 mm = adult males.

It was concluded that the stencils within Homestead Gorge, at Mutawintji in western New South Wales, were produced by the full range of ages (infants to adult males) but with most being in the indeterminate adolescent to adult age group. The proportion of the indeterminate size class, however, was found to differ between Homestead Gorge and the nearby Ramparts area, suggesting that there may have been a preference for the outlying groups (infants and adult men) to stencil in the more peripheral areas of the site.

A subsequent study of central Australian data on hand breadth, age and sex (Campbell et al. 1936) suggested to Gunn (1995) that there may be a distinct correlation between hand breadth and age (Table 1).

Taking a different approach, South African physical anthropologists Henneberg and Mathers (1994) measured hand prints made by children to see if they could detect a relationship between children's age and height. They col-

Knuckle size (mm)	45 - 50	55 - 65	70 - 80	85 - 90	> 90
AGE / SEX	**infant**	**child**	**adolescent or adult female**	**adolescent or adult**	**adult male**
Stencil knuckle size	50 - 55	60 - 70	75 - 85	90 - 95	> 95
Print knuckle size	40 - 45	50 - 60	65 - 75	80 - 85	> 85

Table 1. *Hand breadth measurements (mm) and interpretations for hand stencils and prints (data taken from Campbell et al. 1936).*

lected a series of hand prints from 196 children and youths who were partly descendants of the people who are thought to have made the rock art of the Cape Province. They measured the length of the print from the tip of the finger to an estimated point on the distal flexion crease on the wrist, as well as palm length and sub-digital length. They found that hand length was the most reliable indicator of age and height, but also that they could not distinguish between males and females on the basis of hand size. They did, however, conclude that hand print lengths <149 mm were most likely those of a child (95 % confidence) and >184 mm were probably those of an adult male. They also found that while most people produced hand prints at about eye level, this could range from shoulder height to the level of the top of the head. Consequently, they were unable to associate print height above the ground with stature.

This present paper then re-examines the validity of the previous age-sex assessments and introduces the range of variability of a single individual in making stencils and prints.

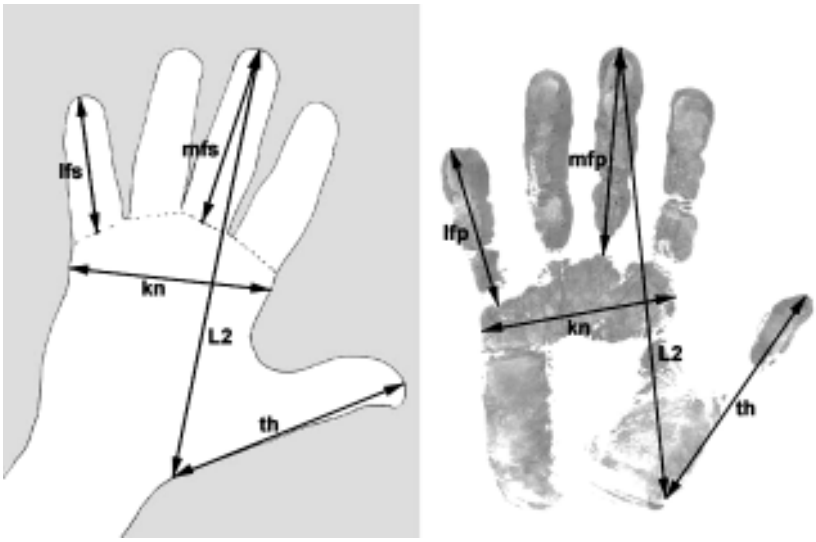


Figure 2. *Hand measurements.*

Hand stencil and print sizes

Firstly, the variation of repeated stencils and prints of the same hand was measured and compared with the measurements of the actual hand size. Then, the variability of the stature of Indigenous Australians throughout the continent was examined; and finally, the pattern of hand size in relation to age, stature and sex was assessed.

Measuring hands

Various recorders have measured a number of different attributes of hand stencils and prints. The most common measurement is knuckle width, although middle finger length, overall hand length (tip to wrist), little finger length, and span, have also been used (Flood 1987; McDonald 1995; David 2002a). (The term knuckle width refers to the measurement taken from hand stencils and prints, while hand breadth refers to measurements taken from real hands, and which is invariably different to knuckle width).

For this project, measurements of the hand breadth, middle finger, little finger, thumb and hand length were recorded (Fig. 2). Finger length was measured differently for stencils and prints as the location of the base of the fingers could not be reliably located on prints, while the top of the palm could not be reliably located on stencils. Hence, for prints the length was taken from the tip to the top of the pigment on the top of the palm, while for stencils it was taken from the tip to the base of the webbing between the fingers. All measurements were recorded to the nearest millimetre. Accurately measuring hand length from the tip of the middle finger to the centre of the wrist was not possible on most examples and so a substitute measurement (L2) was taken from the fingertip to the base of the thumb. This is the same length as hand length. This length was too large for the callipers and so was measured by ruler to the nearest millimetre.

Hand stencil variation

It had been found through preliminary experiments that stencils tend to have a knuckle width five millimetres broader than hand breadth, while for prints the knuckle tends to be five millimetres narrower (Gunn 1993b). To test the validity of these conclusions, and to determine the range of variation of a single hand, a range of measurements were taken from multiple stencils and prints of the same hand.

Forty-eight stencils from the same hand were produced, with the hand being washed clean after each stencil. These included seventeen 'variant' hands, where the fingers were held in different positions other than the standard splay (Figs 3 and 4). As large quantities of ochre were not available, a water-based ink was used as the pigment. To save time and taste, the pigment was applied using an atomiser spray. The stencils were produced on paper sheets held

Figure 3. *Ochre hand stencil on cardboard.*

vertically on an easel at what was considered to be a 'comfortable' height (centred at 1.65 m for a 1.83 m tall person). While the product was visually and texturally different from the mouth-sprayed ochred stencils, the measurements were not compromised.

In contrast to the expected similarity of measurements from the same hand, the measurements showed considerable variation at the 0.1 mm level. For example, the stencilled knuckle measurements ranged from 84.4 mm to 98.1 mm, or 0.8 mm to 14.0 mm larger than that of the 'real' knuckle (83.6 mm). While most of the measurements indicate, as expected, that the stencilled measurements are all larger than the real hand, those of the middle finger can actually be smaller than the real hand due to pigment bleeding. Also, as the variability for the different measurements is inconsistent, no generalisation can be made from one attribute to the next.

The Coefficient of Variance (CV = [s/mean] × 100) for

	Knuckle	Middle finger	Little finger	Thumb	Hand length
Actual stencils	**83.6**	**81.2**	**62.2**	**113.7**	**197**
Min.	84.4	79.5	56.8	116.9	203
Max.	98.1	90.6	65.8	137.4	228
Mean	92.8	85.1	61.8	127.1	218
sd	3.7	2.2	2.3	5.4	8.0
CV	4.0	2.6	3.7	4.2	3.6

Table 2. *Hand stencil measurements (mm) from a single hand (n = 30).*

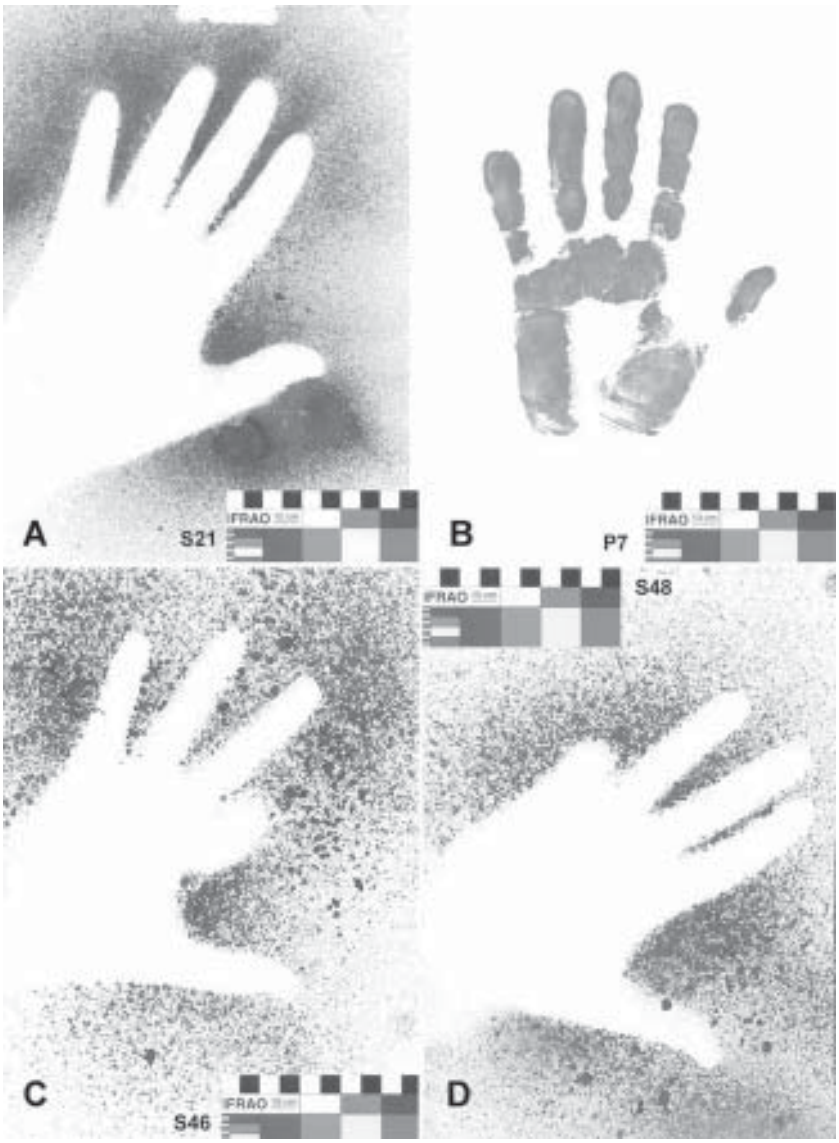


Figure 4. *Hand forms in watercolour pigment on paper; A: standard hand stencil; B: standard handprint; C and D: variant hand stencils*

the attributes indicates that the middle finger length is the most reliable measurement (CV = 2.6; Table 2), followed by hand length. Thumb length was the most variable and therefore the least reliable (CV = 4.2).

In the field, irregularities in the rock face, due to surface texture and topography, generally preclude any measurement finer than 5 mm. Consequently, all of the measurements given above (Table 2) were rounded to the nearest 5 mm (Table 3). At this coarser level, knuckle size varies up to 15 mm greater than the real size, but with mean and median 10 mm larger. Middle finger measurements were mostly around 5 mm larger than the real measurement, with little finger measurement ranging around the real size. Hand length varied up to three centimetres larger than the real, with most around two centimetres larger.

Again, middle finger length was the most consistent and hence the more reliable measurement (CV = 2.1; Table 3) followed by hand length (CV = 3.6), with little finger the least reliable (CV = 4.5). Knuckle width, which is most

	Knuckle	Middle finger	Little finger	Thumb	Hand length
REAL stencils	**85**	**80**	**60**	**115**	**200**
Min.	85	80	55	115	200
Max.	100	90	65	135	230
Mean.	95	85	60	125	220
sd	3.9	1.8	2.7	5.0	8.0
CV	4.1	2.1	4.5	4.0	3.6

Table 3. *Hand stencil measurements rounded to the nearest 5 mm.*

	Knuckle	Middle finger	Little finger	Thumb	Hand length
REAL prints	**82.3**	**81.2**	**62.2**	**113.7**	**197**
Min.	70.0	80.0	55.9	96.3	180
Max.	83.6	89.2	71.4	116	193
Mean	76.6	83.9	63.6	107.1	188
sd	3.2	2.0	2.7	3.0	2.4
CV	4.2	2.4	4.2	2.8	1.3

Table 4. *Hand print measurements (mm) from a single hand (n = 47).*

commonly used by archaeologists (particularly myself), was again among the least reliable (CV = 4.1). This is demonstrated visually by graphing the measurement classes for each attribute by the frequencies (Fig. 5).

Hand print variation

Forty-seven prints from the same hand were produced, with the hand being washed clean after each print. A water-based poster paint pigment was used as its texture and consistency was similar to that of natural ochre pigments but was more readily available and required less preparation. The pigment consistency was deliberately varied from that of coloured water to that of very thick cream, and applied in both a very dilute (with very little pigment on the palette) and very viscous state, but with the majority of examples produced from a slurry of medium thickness. Again, measurements were taken of the knuckle, middle finger, little finger and L2 length (Fig. 2).

As with the stencils, the measurements obtained from the repeated prints varied considerably (Table 4). During production it was noted that this was not related to the state of the print pigment (thick, runny, thin), but more to how much pigment coated the hand. This variable cannot be measured for rock art examples and so in the field a similar range of variability should also be expected for any one individual. At the finer level (0.1 mm), the results indicate that there is little correlation between the real and printed hand sizes, but suggest that hand length (CV = 1.3) is the more reliable measurement for hand prints (Table 4).

Again rounding the measurements to the nearest 5 mm (Table 5) reaffirmed hand length was the most consistent (CV= 1.5) and only reliable measurement. Again, knuckle measurement, which is the most commonly taken measurement, was found to be the least representative measurement (CV = 4.2).

A side observation of the replications was that both hand stencils and prints tended to be orientated away from vertical (Table 6). This contrasts with the general field observation that hand stencils on rock surfaces are usually orientated vertically (if not inclined acutely, horizontally or in-

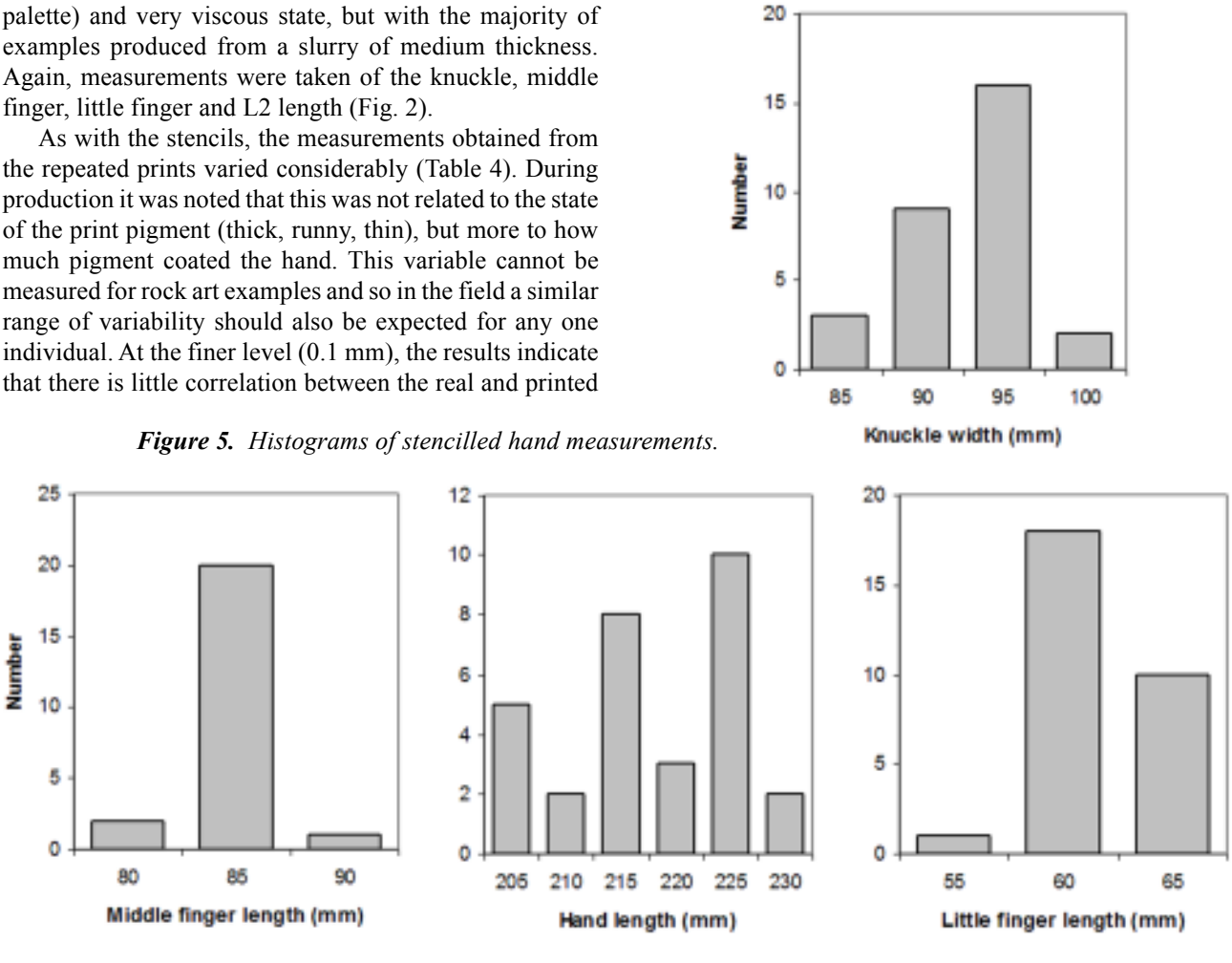


Figure 5. *Histograms of stencilled hand measurements.*

	Knuckle	Middle finger	Little finger	Thumb	Hand length
REAL prints	**80**	**80**	**60**	**115**	**200**
Min.	70	80	60	95	180
Max.	85	90	70	115	195
Mean	75	85	65	105	190
sd	3.3	2.9	2.7	3.6	2.9
CV	4.4	3.4	4.2	3.4	1.5

Table 5. *Hand print statistics from measurements rounded to the nearest 5 mm.*

verted). To what degree the angle of inclination is significant is unknown. It was also noted, in confirmation of Henneberg and Mathers' finding (1994), that stencils and prints are most easily produced at face level (within the area of chin to eye).

Aspects of Aboriginal morphological variation

Human populations invariably show clinal variation across space. Relevant anthropometric variation shows the same to be true among Indigenous populations of Australia (Macho and Freeman 1987; Birdsell 1993). Although Abbie (1975) had previously suggested that Indigenous Australia was very homogeneous, subsequent re-analysis of his data (Macho and Freeman 1987) concluded that his results were ill founded. Macho and Freeman found Abbie's data in fact showed a north-south cline through the centre of Australia that they interpreted as being consistent in part with 'climatic influences through natural selection or morphological plasticity. Local differences however, sometimes very large, could be due to "random genetic drift" ' (p. 78).

	Stencils	Prints
Min.	4º	-10º
Max.	60º	+30º
Range	56º	40º
Mean	32º	8º
sd	11º	11º
n	42	47

Table 6. *Hand orientation.*

Birdsell (1993: 308–11) also found stature (overall height) varied from north-west to south-east, with males in the north-west ranging from 1.74 m to 1.76 m (Fig. 6). Those in the south ranged from 1.60 m to 1.62 m, and with a pocket of significantly shorter males in the Queensland rainforest (1.54 m to 1.56 m). However, if stature is related to hand size, then, in the recent art at least, northern hands should be generally larger than those in the south. The recording of hand sizes from different time periods might indicate changes in the resident populations (such as in the long history of hand stencils in western Arnhem Land; cf. Chaloupka 1993).

Birdsell further suggested greater sexual dimorphism in many desert dwellers living a traditional lifestyle (1993: 308). He attributed this to the fact that women were generally less well nourished than men were. Since contact with white society, this instance has been lowered, suggesting that using modern populations for some regions might not provide a representative sample of the pre-contact situation.

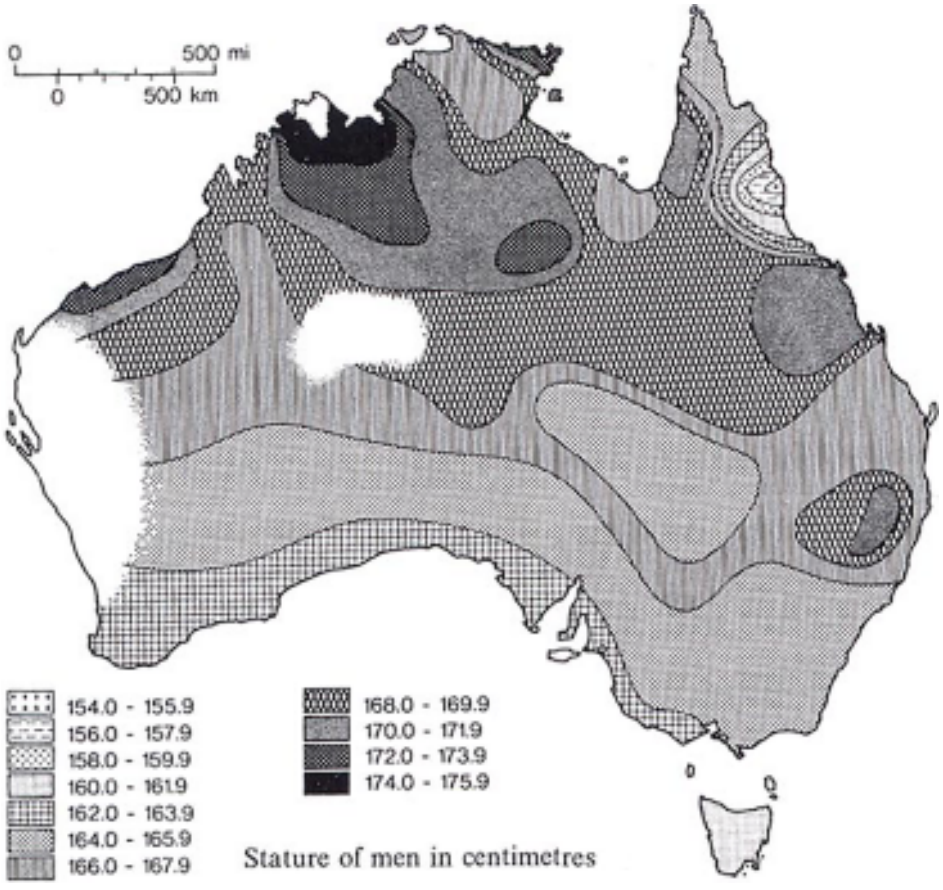


Figure 6. *Birdsell's map of Indigenous male stature.*

Of particular relevance to the present study area is Birdsell's 'paradox of the Aranda scarp' (1993: 453–5). He found that the western boundary of the Arrernte (Aranda) area parallels a major break in clinal topography, including blood types. He interprets this as a result of the recent clash of two populations with very different demic genes (Arrernte and Western Desert groups). This division is also apparent linguistically (McConvell 1996) and culturally (Strehlow 1947, 1965). His model suggests that the Arrernte were the

	Males	Females	TOTAL
Cockatoo Ck	36	14	50
Diamantina	38	43	81
Hermannsburg	57	39	96
Mann Ranges	103	58	161
McDonald Downs	27	23	50
Mt Leibig	38	18	56
The Granites	17	9	26
Warburton		1	1
TOTAL	316	205	521

Table 7. *Number of individuals measured by Tindale at each community.*

initial inhabitants and that contact with the Western Desert people occurred around the period 1200–500 BP. This is also the time when major changes occurred in the central Australian archaeological record (Smith 1988; Thorley and Gunn 1996; Thorley 1998, 2004; David 2002b). It is possible, therefore, that this Arrernte/Western Desert boundary may be further elaborated through the measurement of stencil and print hand sizes.

As Birdsell (1993) found that stature and hand size varied across the continent, a study of central Australian hand stencils and prints should ideally be undertaken, using measurements taken from central Australian populations. Such measurements were collected by the anthropologist

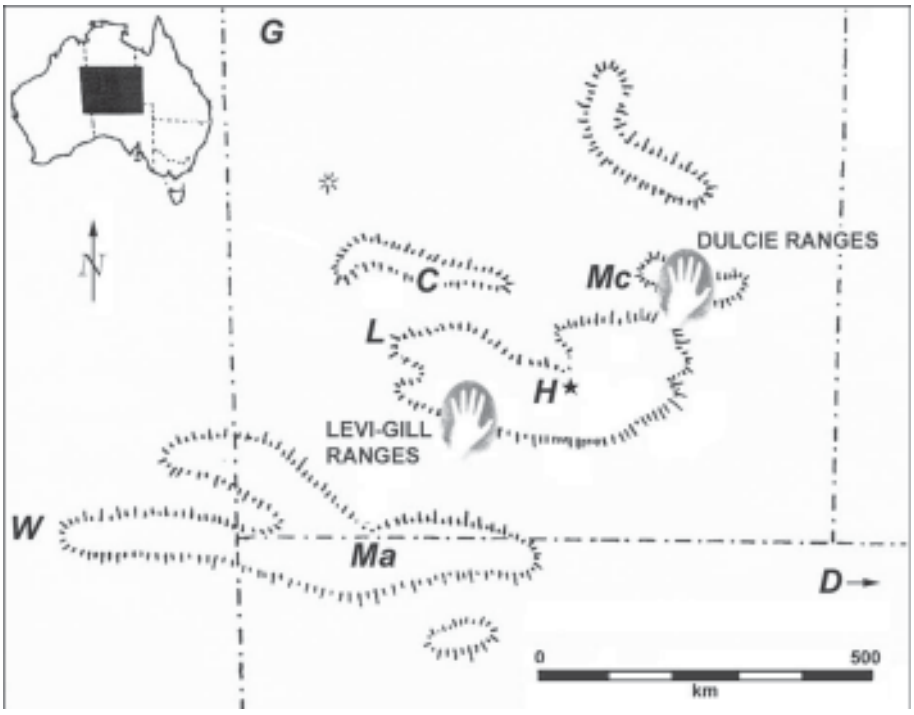


Figure 7. *Central Australia, showing its ranges and places mentioned in the text: C = Cockatoo Creek; D = Diamantina Creek (200 km east of NT border); G = The Granites; H = Hermannsburg; L = Mt Leibig; Ma = Mann Ranges; Mc = McDonald Downs; W = Warburton.*

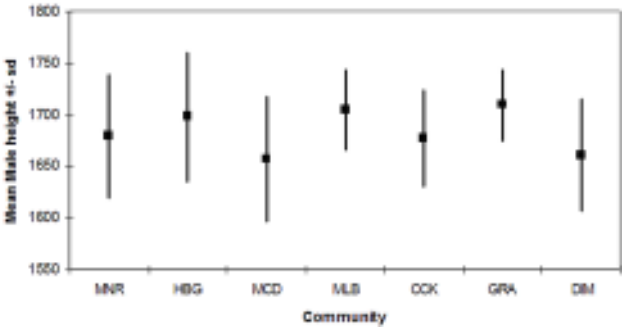


Figure 8. *Range and mean height of males by community. See Table 7 for community codes. Data from Tindale 1929–1935 (unpublished).*

Norman Tindale from a number of different central Australian Indigenous communities between 1929 and 1935 (Jones 1987). His unpublished records are on file at the South Australian Museum, Adelaide. The data from eight of these communities (Table 7) provided an exceptionally good base from which to examine the relationship between individual hand size and stature (height), age and sex. Also, given that these samples were from regions in which there are high numbers of hand stencils and prints (Figs 1 and 7), they provided a basis from which to investigate the age and sex of the stencil and print producers.

Comparison of the range and median heights for individuals from the seven communities showed that they overlapped at one standard deviation (Figs 8 and 9). Consequently, it can be concluded that there is no significant size difference between the seven communities, including between the Arrernte and Western Desert groups. This then suggests that the 'Aranda scarp' identified by Birdsell would not be detectable in the hand stencil sizes in the rock art. The measurements from all groups were therefore amalgamated to provide a greater sample number. This was particularly helpful for the pre-adult group (<17 yrs) where the total from all communities was only 62 males and 44 females. Overall it provided a population of 316 males and 205 females (Table 7).

The age-height graph for these combined populations rises rapidly from birth to 17 years. After 17 years it flattens out, indicating that an individual's maximum height is usually attained by this age (Fig. 10). From this age, male hands are generally larger than females by 12 mm, with the mean male length being 186 mm (sd = 9 mm), while mean female length was 174 mm (sd = 9 mm). Hand length and breadth also attain their maximum length around 17 years (Fig. 11). After age 17 male hands are generally broader than female hands by 9 mm. The mean hand breadth

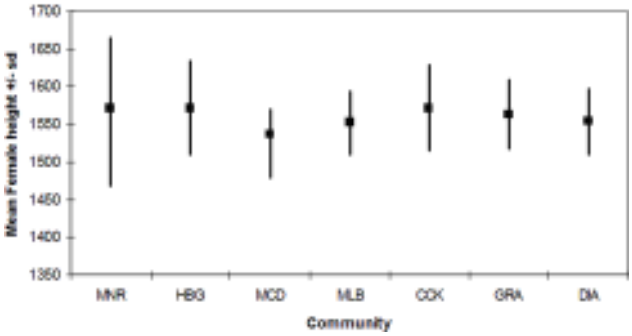


Figure 9. *Range and mean height of females by community. See Table 7 for community codes. Data from Tindale 1929–1935 (unpublished).*

for adult males was 84 mm (sd = 5 mm) while for female the mean breadth was 75 mm (sd = 4 mm). The increase in hand length is notably greater than hand breadth, suggesting that hand length may be a more reliable indicator of age than hand breadth.

Comparison of the age-height plot for the pre-adult sample (n = 106; Figs 12 and 13) shows considerable overlap of individuals. Consequently, it is not possible to differentiate between the two sexes over these age ranges. It is possible, however, because of the tight clustering of the hand length — height plots, to predict stature from hand size (Fig. 14). Pre-adult hand lengths cluster more tightly than hand breadths with respect to both height and age (Figs 15 and 16), again reinforcing the assumption that hand

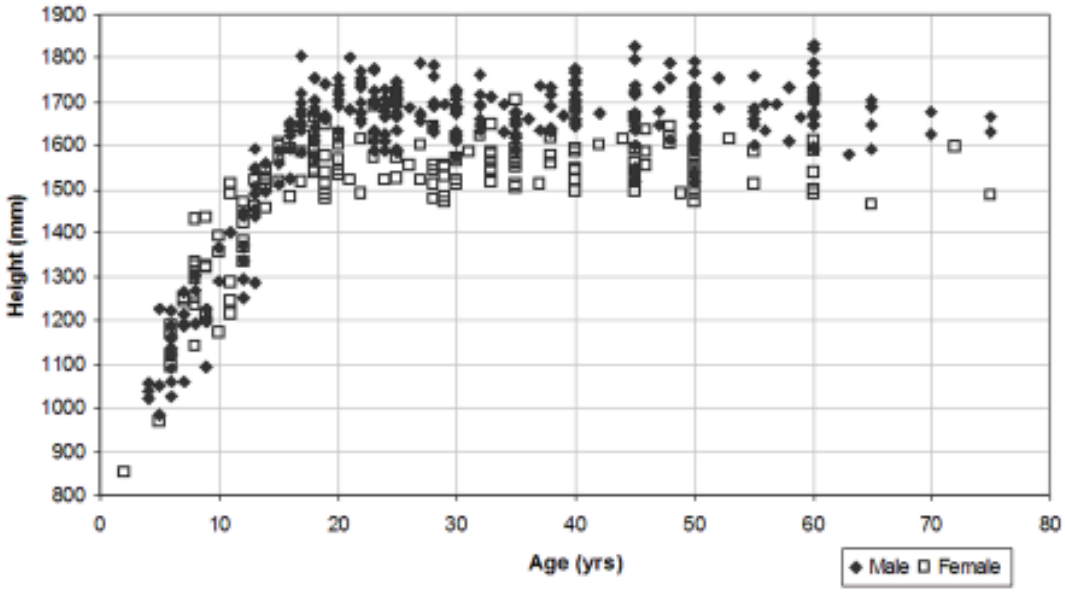


Figure 10. *Height by age and sex for all communities. Data from Tindale 1929–1935 (unpublished).*

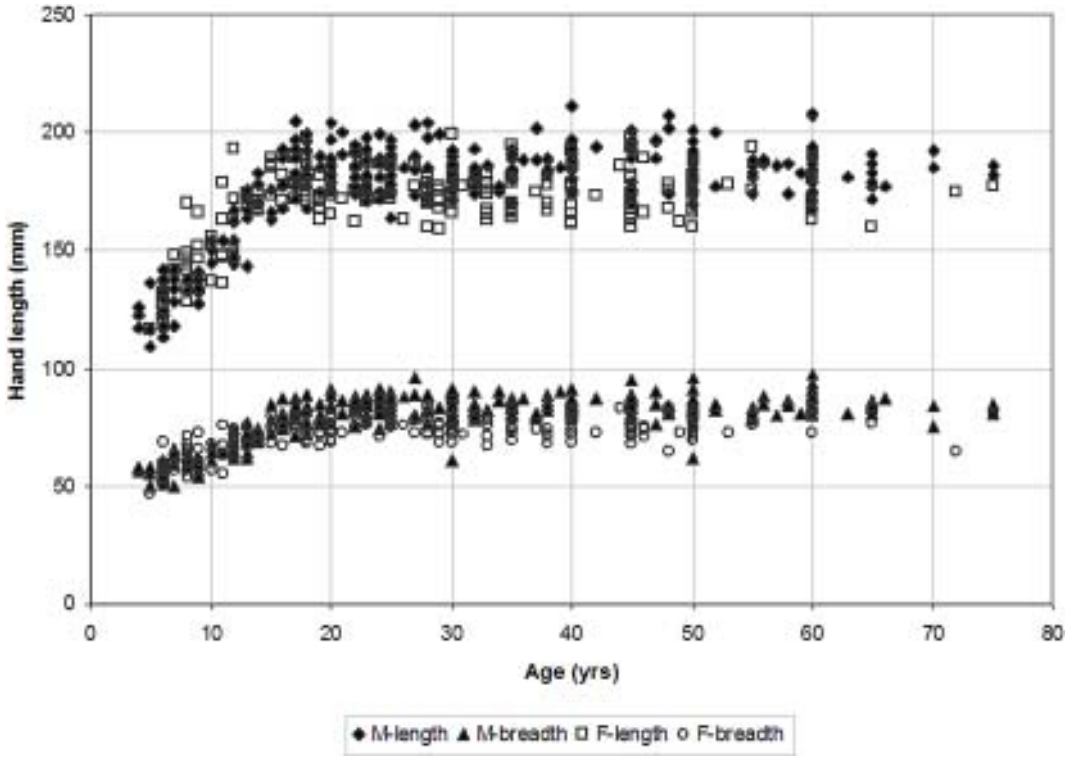


Figure 11. *Hand measurements by age and sex. Data from Tindale 1929–1935 (unpublished).*

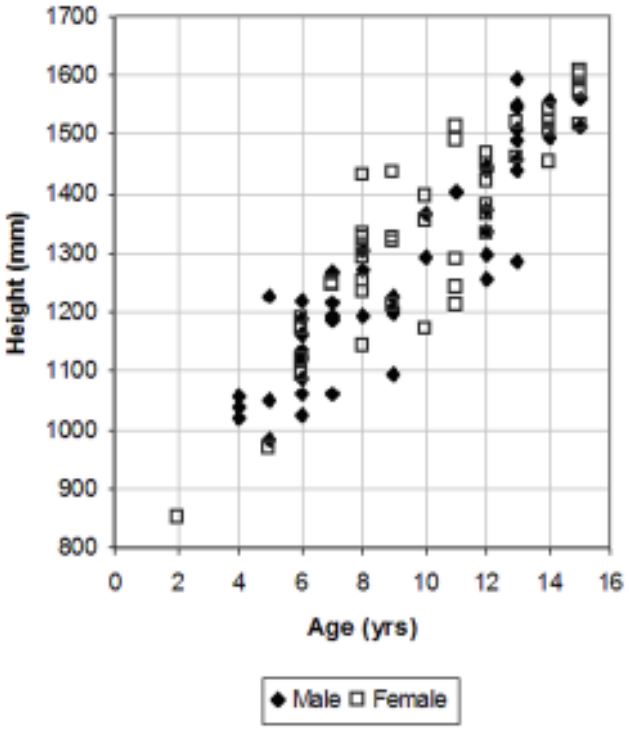


Figure 12. *Pre-adult height by age. Data from Tindale 1929–1935 (unpublished).*

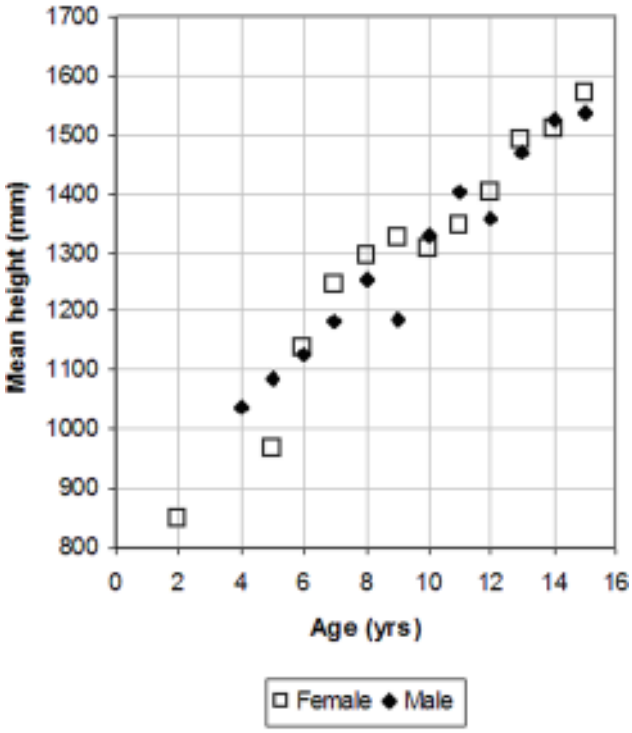


Figure 13. *Pre-adult mean height by age. Data from Tindale 1929–1935 (unpublished).*

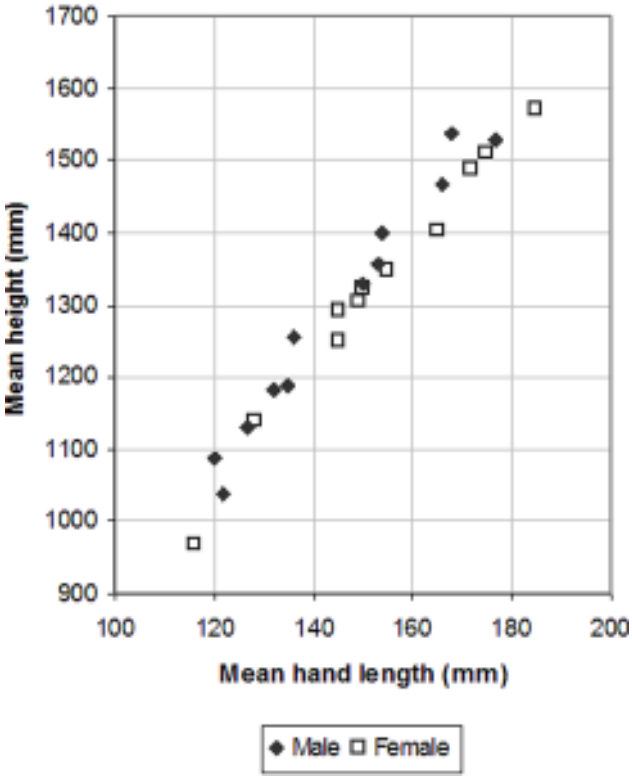


Figure 14. *Pre-adult mean height by mean hand length. Data from Tindale 1929–1935 (unpublished).*

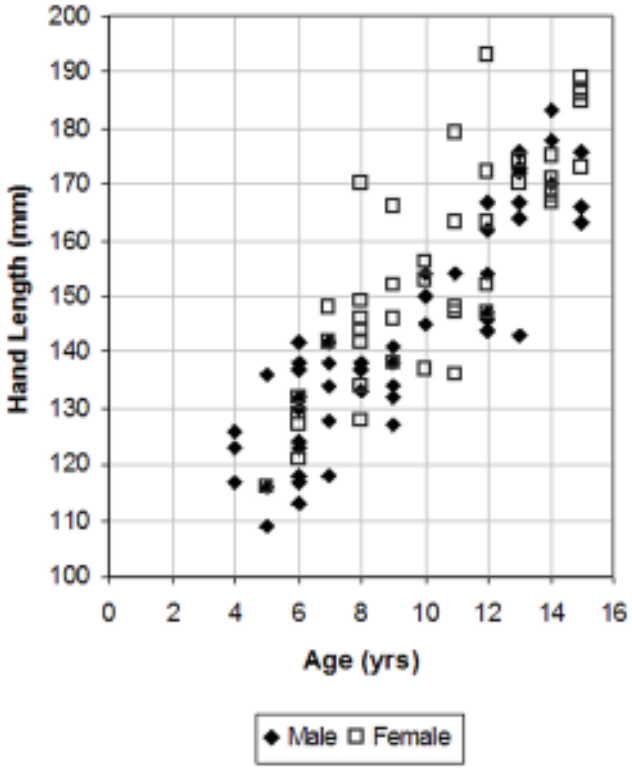


Figure 15. *Pre-adult hand length by age. Data from Tindale 1929–1935 (unpublished).*

length is a more reliable measurement for predicting age. In both plots, there is again a considerable overlap of the two sexes at all ages until 17 years.

Mean hand lengths (with one standard deviation) from 4 to 15 years (Fig. 17) suggest that it may be possible to differentiate hand sizes for three pre-adult groups (4–6 years; 7–12 years and 13–15 years: Fig. 18). However, when these groups are plotted out to two standard deviations (95% confidence: Fig. 19), again there is considerable overlap. It is apparent that:

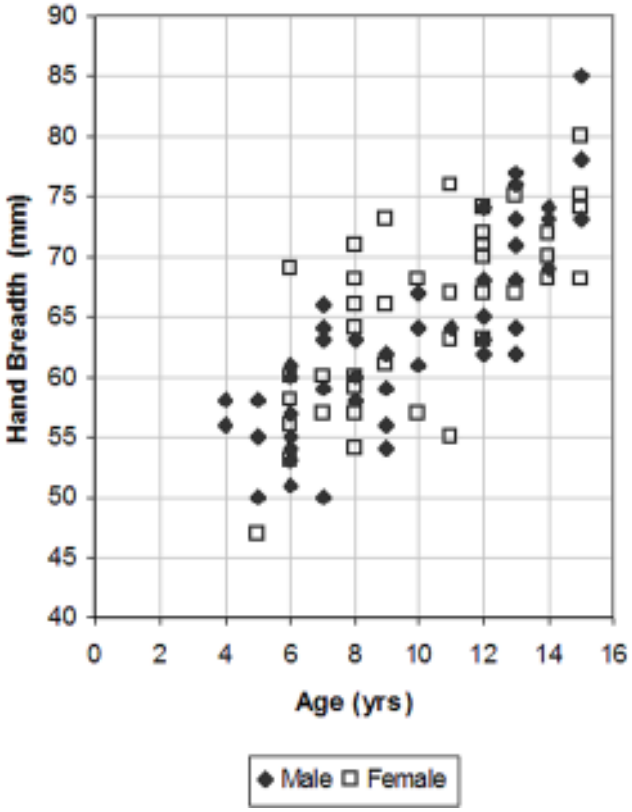


Figure 16 (above). *Pre-adult hand breadth by age. Data from Tindale 1929–1935 (unpublished).*

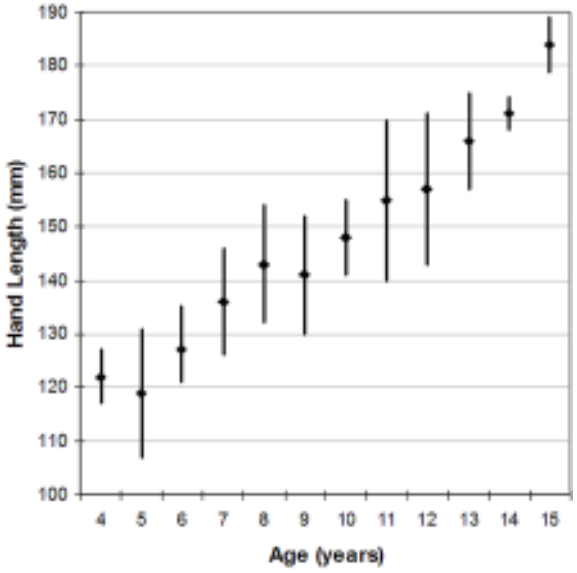
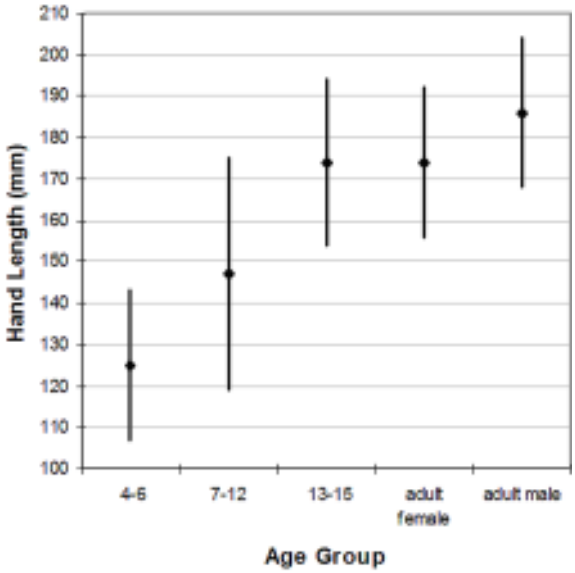
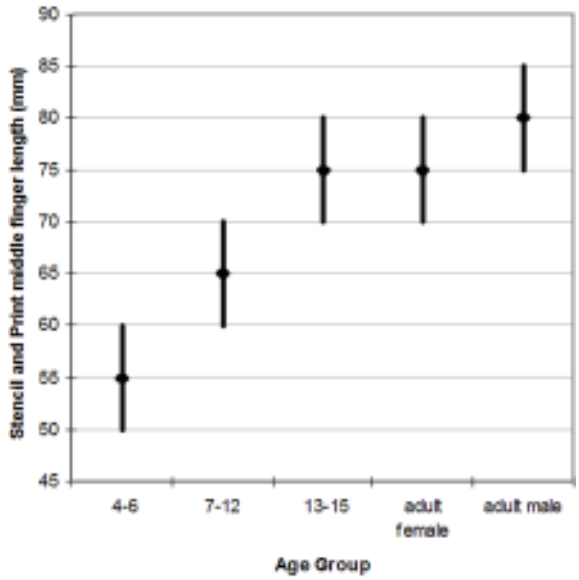


Figure 17 (above). *Pre-adult hand lengths mean ± sd by age. Data from Tindale 1929–1935 (unpublished).*

Figure 18 (on right). *Hand lengths (mean ± 2 sd) by age group. Data from Tindale 1929–1935 (unpublished).*





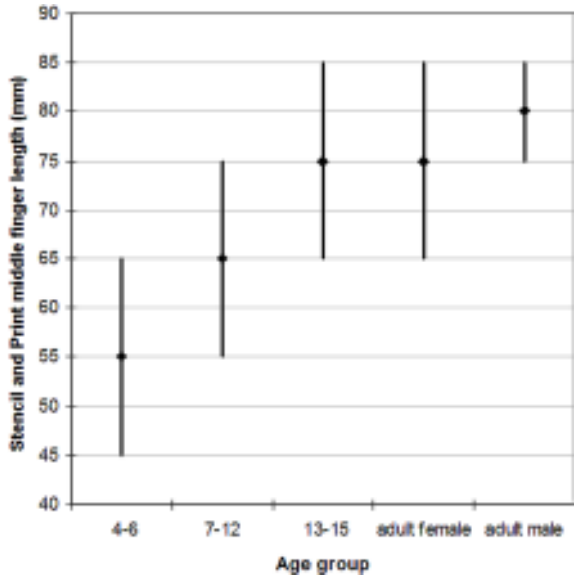


Figure 19. *Stencil and print middle finger lengths by age group. Data from Tindale 1929–1935 (unpublished).*

- the early teenagers cannot be differentiated from later teenagers or adults,
- a hand length less than 150 mm is highly likely to be that of a child under 12 years of age,
- a hand less than 120 mm is highly likely to be a child under 6 years old, and
- a hand less than 105 mm is most probably that of an infant (less than 4 years old).

The length-breadth ratio of male and female hands was examined in an attempt to distinguish sex from hand sizes. While a general separation of the two clusters was apparent by height (Fig. 20), the length-breadth ratios indicate that males tend to have broader hands than females, but with a broad range of overlap. However, while women and children generally have longer and narrower hands than men, there is a degree of overlap and the broadest male hands are not appreciably broader than female hands.

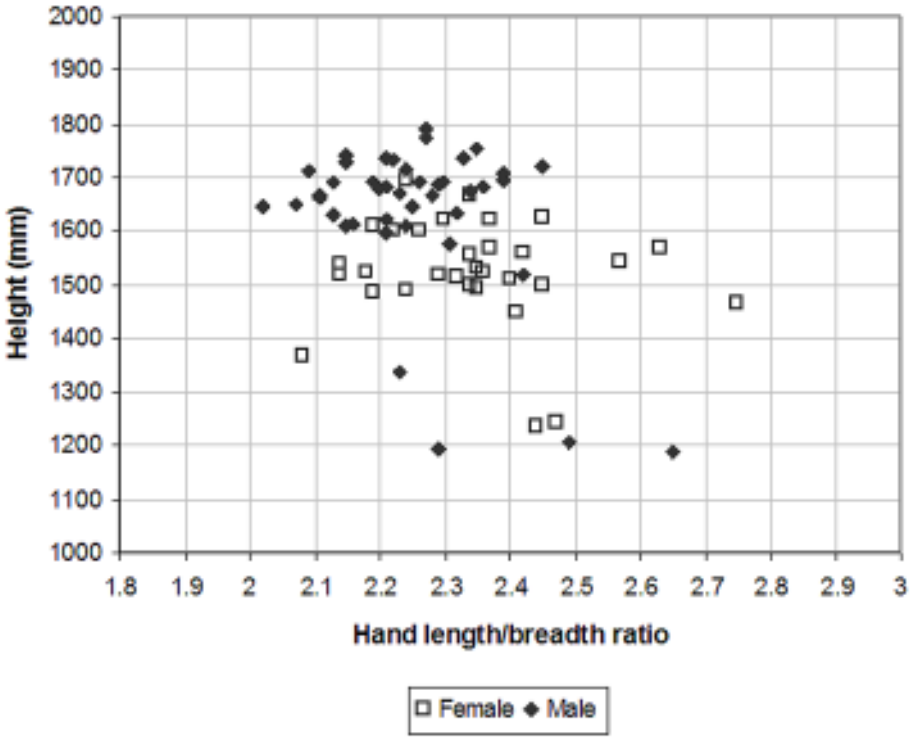


Figure 20. *Hand length-breadth ratios by height for males and females. Data from Tindale 1929–1935 (unpublished), (n = 71).*

Stencil measurement studies

In central Australia there are two major areas of hand stencils and prints: the Dulcie Ranges in the north-east and Levi-Gill Ranges in the south-west (Figs 7, 21–22) (Gunn 1989b, 1995, 2004; Smith and Rosenfeld 1992; Ross 2003). Today, the Dulcie Ranges are within the country of the Akarre Arrernte people, while the latter are in the country of the Luritja people, one of the Western Desert groups

Figure 21. *Hand stencils on a regular vertical surface at Irtikiri in the Levi Range.*

Figure 22. *Hand stencils and prints on an irregular wall surface at Kulpi Mara in the Levi Range.*

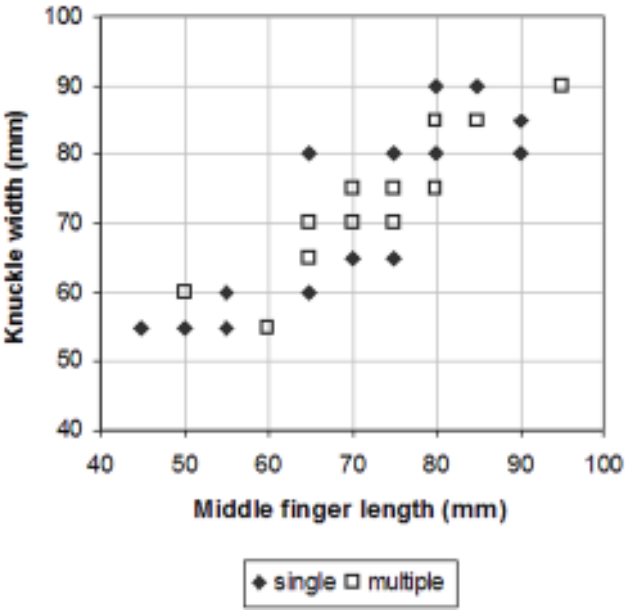


Figure 23. *Kulpi Mara stencilled middle finger and knuckle measurements (n = 74).*

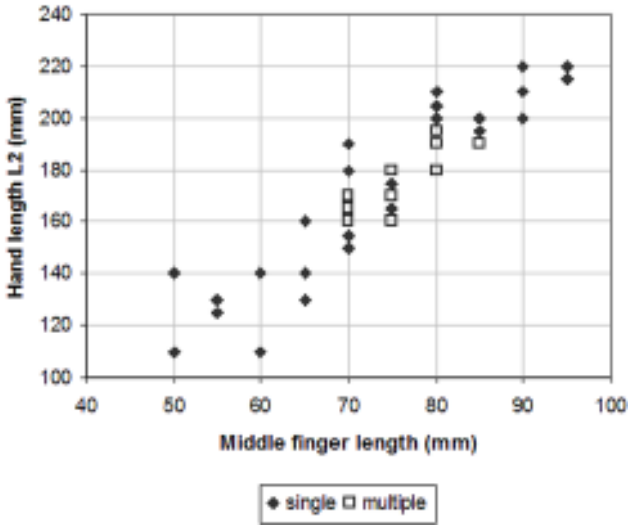


Figure 24. *Kulpi Mara stencilled middle finger and hand length measurements (n = 51).*

(Gunn 2002).

A suite of measurements was taken from fifty-three stencils at two sites at Kulpi Mara in central Australia, to compare middle finger with knuckle widths and hand length, and also middle finger length with height above the floor. While there was a loose positive trend in each case, the range of variability indicates that there is no close correlation, although the trend of middle finger length was more tightly correlated with hand length than knuckle width (Figs 23 and 24). Similarly, and in contrast to expectations, there was no correlation between hand size and height above floor (Fig. 25).

As a complimentary study, a similar suite of measurements was recorded from ninety-two stencils at three large stencil sites in the Murchison region of south-west Western Australia (Reedy's Rockhole and Poona shelter, Figs 26 and 27; Gunn and Webb 2003). The resulting analysis supported the findings of the central Australian study with knuckle measurements varying considerably about the middle finger length, and no correlation between middle

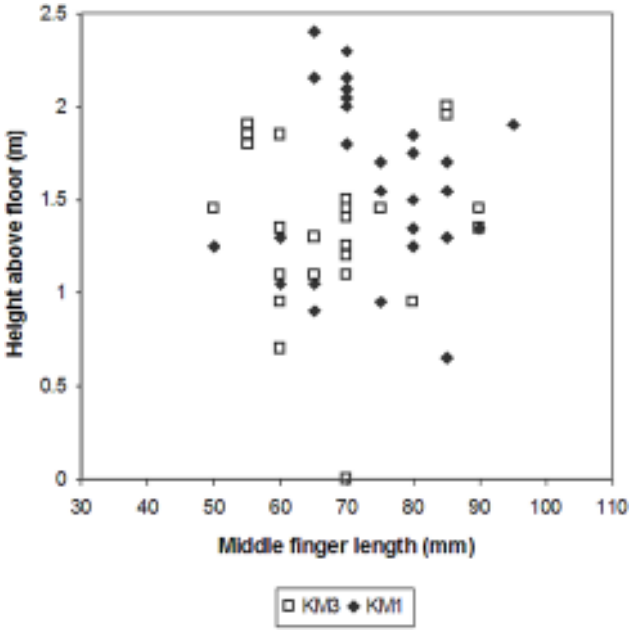


Figure 25. *Kulpi Mara stencilled middle finger lengths and height above floor at shelters KM1 and KM3 (n = 53).*

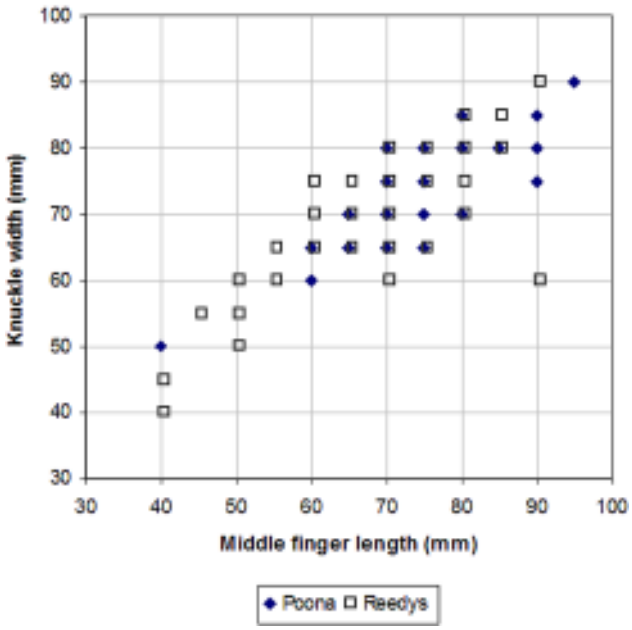


Figure 26. *Middle finger and knuckle measurements from two Western Australian stencil sites (n = 92).*

finger length and height above ground. In one instance at Reedy's Rockhole, an infant's hand has been placed on the shelter ceiling 1.75 m above the ground. Rather than indicating a very large infant, this would have had to have been a case of an adult lifting and holding the infant while the stencil was produced (see also Mulvaney 1996).

The variation in height above ground, rather than being related simply to production at the optimum level, in shelters with large numbers of stencils and in cases of walls without topographic features, would also be dependent on placement in relation to surrounding artwork (Clegg 1978). Such a scenario suggests that, while the initial stencil placements were most probably related to the stenciller's height, subsequent stencils would have to be placed elsewhere. For most people, this would be below eye height rather than straining to higher places. Consequently, in shelters with hundreds of stencils, a band of stencils could be expected between 0.5 m and 2.0 m across the shelter, with occasional examples both higher and lower. This is certainly the case at Irtikiri, central Australia (Gunn and Thorn 1997), and also elsewhere at shelters heavily decorated with paintings (Gunn et al. 1997). What has not yet been examined is the height of hand motifs in shelters with very few stencils or prints. In shelters with vertical walls and few stencils, it is expected that height would more directly correlate with hand size.

Discussion

Interpreting hand sizes

Relating Tindale's data to that of hand stencil and print sizes is not as straightforward as might be hoped.

The hand length of stencils and prints of a single individual can vary considerably (with stencils ranging from 5 mm to 25 mm larger than the real hand, and prints from 5 mm to 15 mm shorter). Middle finger length was the least variable for both techniques, varying from 0 mm to 10 mm larger than the real hand. On the real hand, the middle finger is 0.40 times the hand length (L2), and L2 is consistently the same as the actual hand length.

Using the mean and standard deviation plots for the five age groups (Fig. 21), the associated middle finger lengths for the groups can be predicted (Table 8; Fig. 22). Rounded to the nearest 5 mm and then adding 5 mm equates the actual middle finger length with that recorded for most stencils and prints (cf. Fig. 8).

At one standard deviation (65 % confidence) there is a

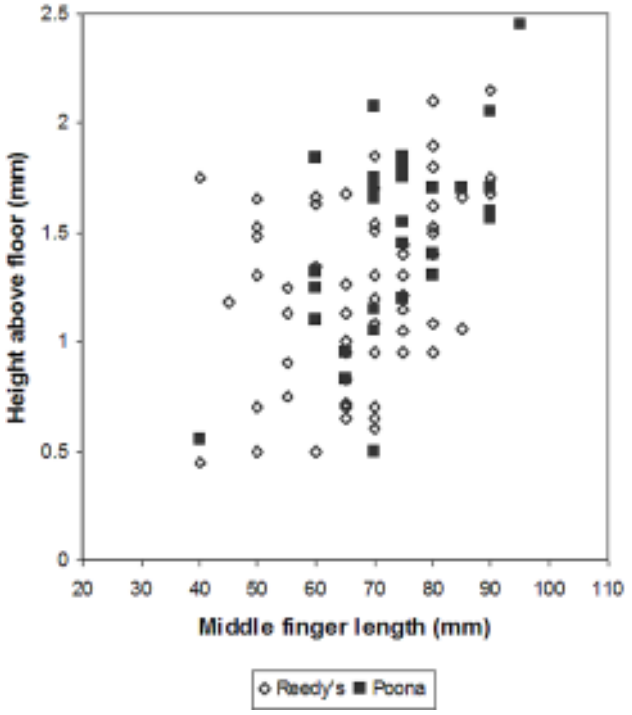


Figure 27. *Stencil heights above floor by middle finger length from two Western Australian sites (n = 92).*

	+ 2sd	-2sd	Mean
4-6	57	43	50
7-12	70	48	59
13-15	78	62	70
Adult female	77	62	70
Adult male	82	67	74
Rounded to 5 mm			
4-6	60	40	50
7-12	70	50	60
13-15	80	60	70
Adult female	80	60	70
Adult male	80	70	75
For stencils + 5 mm			
4-6	65	45	55
7-12	75	55	65
13-15	85	65	75
Adult female	85	65	75
Adult male	85	75	80
For prints - 5 mm			
4-6	55	35	45
7-12	65	45	55
13-15	75	55	65
Adult female	75	55	65
Adult male	75	65	70

Table 8: *Middle finger lengths by age: mean ± 2 standard deviations.*

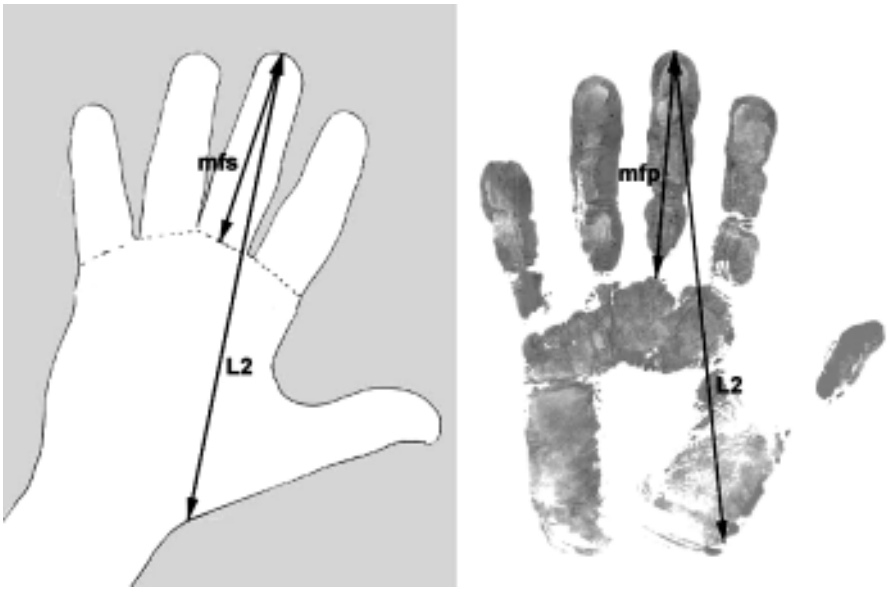


Figure 28. *Recommended hand stencil and print measurements (mfs = middle finger stencil; mfp = middle finger print; L2 = hand length).*

clear separation of pre-adults from adults and the 4–6 age group from 7–12 age group. The middle finger lengths of teenagers for both sexes are the same and are indistinguishable from adult women. For adult men, the middle finger length is generally larger, although it does have some overlap with both teenagers and adult women.

At two standard deviations (95 % confidence) there is no clear separation of any of the groups. The positive findings are that any length less than 55 mm is most probably that of an individual less than 6 years old, and any length less than 45 mm is most likely an infant's hand. Also, any length greater than 85 mm is doubtless that of an adult male.

Recommendations for recording hand stencils and prints

From this project it is recommended that a range of attributes be included when recording hand stencils and prints. The two hand size measurements of hand length (L2) and middle finger length (mfs or mfp) (Fig. 28) should be recorded rather than the more commonly recorded knuckle width. However, in interpreting the data in relation to stature, sex and/or age, middle finger length should be used for hand stencils, while hand length should be used for hand prints. Although not conclusive, these measurements can still provide a reasonable estimate of the age-range of people imaging their hands. Consequently, it is recommended that the following attributes be recorded for hand stencils and prints:

- Technique
- Colour (sub-dividing colour by hue; such as red-brown, red-purple etc.)
- Type (left, right or indeterminate)
- Form (standard with splayed fingers, fist, or variant with fingers curled under etc.)
- Additional decoration (if present; Gunn 1998)
- Middle finger length and hand length (L2)
- Forearm (if present)
- Orientation
- Height above floor
- Condition
- Superimposition
- Composition (cf. Maynard 1976)
- Archaeological context (such as other shelter contexts)
- Any Indigenous interpretations of the motifs or ancillary details of shelter use if available

Conclusion

It has not been possible to determine either the age or sex of a person from their hand stencil or print. However, broad-scale identification of infants, young children and adult males is possible.

From variability in the above data — while the height of Aborigines across Australia was variable — hand-size/age patterns can be considered similar, especially in the

case of pre-pubescent children.

Henneberg and Mathers (1994) conclude that hand print lengths <149 mm were most likely those of a child (95 % confidence) and >184 mm were probably those of an adult male. From this study, stencilled and printed hand lengths less than 105 mm are most probably those of an infant, while those >190 mm are highly likely to be adult males. For those sizes in between, neither age nor sex can be ascribed with confidence.

The measurement of attributes remains warranted as, in conjunction with other archaeological evidence, particular age/sex associations may be proposed as more probable than others (as was effectively argued by MacDonald 1995).

In addition, given that some ochre pigments are reported to have been prepared with saliva or urine, it is possible that DNA may exist within the pigments. Comparison of the DNA might then be used to assess the familial or group relationships between people using one or a number of shelters, and also changes in group affiliations over time.

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