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MEGAFAUNA IDENTIFICATION FOR DUMMIES: ARNHEM LAND AND KIMBERLEY 'MEGAFAUNA' PAINTINGS

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Abstract. In 2013 Robert G. Bednarik assessed a century of claims that certain Australian rock art motifs represent extinct megafaunal species, and concluded that none could be substantiated. He believes that recent claims of megafauna in the rock art have been 'used in underpinning questionable rock art chronologies. This includes … three northern Australian regions where megafaunal "identifications" have propped up rock art attributions to the Pleistocene'. This paper builds upon Bednarik's work, focussing particularly on claims that megafauna species are or may be depicted in the rock paintings of Arnhem Land and the Kimberley. The various problems and assumptions involved in making such claims and the methodologies used by various researchers in their identifications are examined in detail, and the appropriateness of an existing methodological approach is reaffirmed.

Introduction

For more than a century claims have been made that particular Australian Aboriginal rock art motifs represent, or might represent, extinct megafaunal species. These motifs range from oversized or unusually shaped engraved footprints (e.g. Basedow 1914; Ouzman et al. 2002) to painted or engraved figurative representations (Brown 1983; McDonald 1983; Murray and Chaloupka 1984; Chaloupka 1993; Akerman 1998, 2009; Walsh 2000; Akerman and Willing 2009; Mulvaney 2009; Gunn et al. 2011). In Arnhem Land and Kimberley rock art the megafauna species claimed to be present, or possibly present, include *Thylacoleo carnifex*, *Palorchestes azael*, *Sthenurus* and *Zaglossus bruijnii* (Murray and Chaloupka 1984), *Genyornis newtoni* (Gunn et al. 2011), *Diprotodon*, *Wakaleo, Propleopus ascillans*, *Ekaltadeta ima*, *Dromornithidae* and *Megalania prisca* (Walsh 2000: 393–401).

In any attempt to identify rock paintings as megafaunal species the following factors must be considered: the appropriate methodology to be used; whether the paintings are old enough for megafauna depictions to be present and, concomitantly, the time of extinction of the megafaunal species under consideration; whether the megafaunal species being considered ever existed in the region where the painting is located or were there when human occupation began; how the physical appearance of that species relates to the painting; the accuracy of palaeontologists' reconstructions of these animals; and palaeontologists' opinions concerning the identification of species depicted. Each of these issues is addressed below.

Methodology for identifying species in rock art

Two marsupial species extinct on mainland Australia are depicted in Arnhem Land and Kimberley rock art. These are the thylacine (*Thylacinus cynocephalus*) and the Tasmanian devil (*Sarcophilus harrisii*), both of which survived on the mainland as recently as 3000 years ago (Owen 2003: 29; Brown 2006). Neither animal is considered to be megafauna, but the research which enabled the thylacine to be identified in Arnhem Land rock paintings established a methodology for identifying paintings of mammal species in general (Brandl 1972; Lewis 1977; Clegg 1978). This methodology enabled paintings of the Tasmanian devil to be identified with a high degree of certainty (Lewis 1988a) and is relevant in any attempt to identify megafaunal species, so it needs to be re-explained here.

The basis for the methodology was established by Eric Brandl (1972, 1980). In his ground-breaking paper on thylacine paintings, Brandl (1972: 28–29) made a number of observations about Aboriginal rock art which must always be borne in mind when considering the identification of depicted species. He noted that, generally speaking, Aboriginal people did not aim for photographic accuracy and that variations in the accuracy of form of the subject could be due to 'local as well as personal stylistic conventions and … from differing degrees of aptitude and skill'. Instead

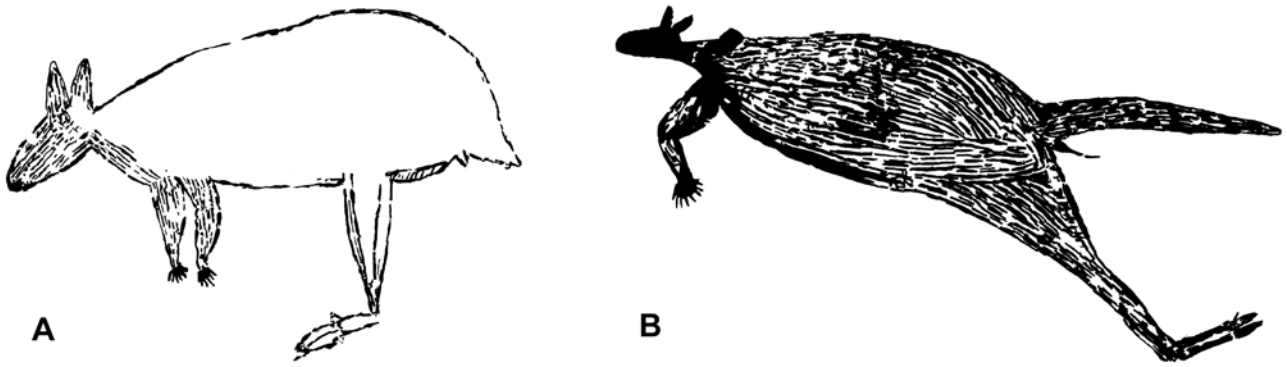

Figure 1. *(A) A stumpy-tailed 'kangaroo' and (B) a 'kangaroo' with the angle between upper and lower limbs reversed; both almost certainly depict mythological creatures.*

the artists emphasised the 'salient features' of the depicted animal. Brandl further remarked that 'certain characteristics of the same subject may be shown or even exaggerated in some paintings and omitted in others (e.g. facial vibrissae)'. Finally, he noted that the artists 'generally paid little attention to such features as, for instance, the natural number of digits'.

In a later paper Brandl (1980: 7) noted that the size difference between related figures seldom, if ever, reflected reality, and he commented (1980: 13) that, '[b]etween … paintings of mythical beings and those that depict natural species "as they are" there is a broad zone where metaphysical concept and zoological reality cannot be kept apart'. Examples of the latter can be seen in Figure 1A, a finely executed dynamic style 'kangaroo' with a deliberately drawn stumpy tail, and Figure 1B, a kangaroo-like animal with both front and rear legs reversed. All of Brandl's points are pertinent in attempts to identify animals in rock paintings, including megafaunal species.

Working on the assumption that Aboriginal depictions of a species would tend to resemble that species, Clegg (1978) carried out a dimensional analysis of rock art depictions identified by others as thylacines. He then compared the results to analysis of equivalent measurements on a range of photographically realistic European outline drawings of thylacines and several other species. Clegg was trying to develop an objective method for identifying animals in rock art, but his method took no account of stylisation, differences in artistic skill, weathering effects, mineralisation or species-specific details encoded in the paintings, and as a result had quite mixed results. In some instances his analysis tended to confirm identification as a thylacine but in others it suggested that different animals could be portrayed. For example, Clegg suggested that a weathered and mineralised painting identified by Brandl (1972: Fig. 8 and 1973: Pl. 37) as a thylacine was more likely to represent a cat (*Felis catus*). Rather than providing a reliable method for species identification, Clegg's work highlighted the fact that, generally speaking, body and head shape, and the relative proportions of different body parts, are unreliable indicators of the species portrayed (Lewis 1986: 140).

From the work of Brandl, Lewis and, by default, that of Clegg, it became clear that while the overall shape of some paintings thought to be thylacines approached photographic realism (e.g. Fig. 2A; Brandl 1972: Fig. 6), most did not. At the extremes their body shapes range from kangaroo-like (Fig. 2B) to excessively long and almost weasel-like (Fig. 2C). Many have bodies more elongated than that of a thylacine as is evident from photographs of live animals and also from preserved specimens (e.g. Figs 2D and 2E; Brandl 1972: Fig. 7). At least one is known which has a 'fat' body (Fig. 2F). Their head shapes can be quite long and pointed or broad and blunt-nosed (cf. Figs 2C and 2G to Figs 2D and 2E). Front legs are frequently longer than hind legs (e.g. Figs 2E, 2H and 2I; Brandl 1972: Fig. 8), a feature which Brandl (1980: 8–9) suggested might be an unconscious exaggeration on the part of the artist to differentiate between, as he put it, 'a rarely depicted motif' (e.g. the thylacine) and 'a frequently painted animal' (e.g. the kangaroo). In some instances the hind legs are larger than the forelegs (e.g. Figs 2B, 2J, 2K) while in others the entire front half of the animal is disproportionately large (Fig. 2L). In Figure 2M the body is quite 'bent' and the legs are disproportionately long.

Figure 2 shows the wide variation in the overall shape and the relative proportions of different parts of paintings identified as thylacines, and leaves no doubt that many have been 'distorted' through the factors outlined by Brandl, or perhaps the indifference of a skilled artist to create an image with a high degree of realism. In most cases the artists placed primary importance on details encoded in the paintings — features such as male marsupial genitalia, a pouch line, paws on the hind feet, stripes, a tail with a broad base and long hairs at the end of the tail. The presence of these salient features in a painting facilitates a process of elimination — paws on the hind feet exclude macropods, a pouch line excludes dingos, and so on. In this way Figures 2F, 2H and 2I were conclusively identified as thylacines — in other words, irrespective of body shape and proportions, they possessed a combination of anatomical details unique to thylacines. Because some paintings can be conclusively identified as thylacines, many portrayals that possess a less

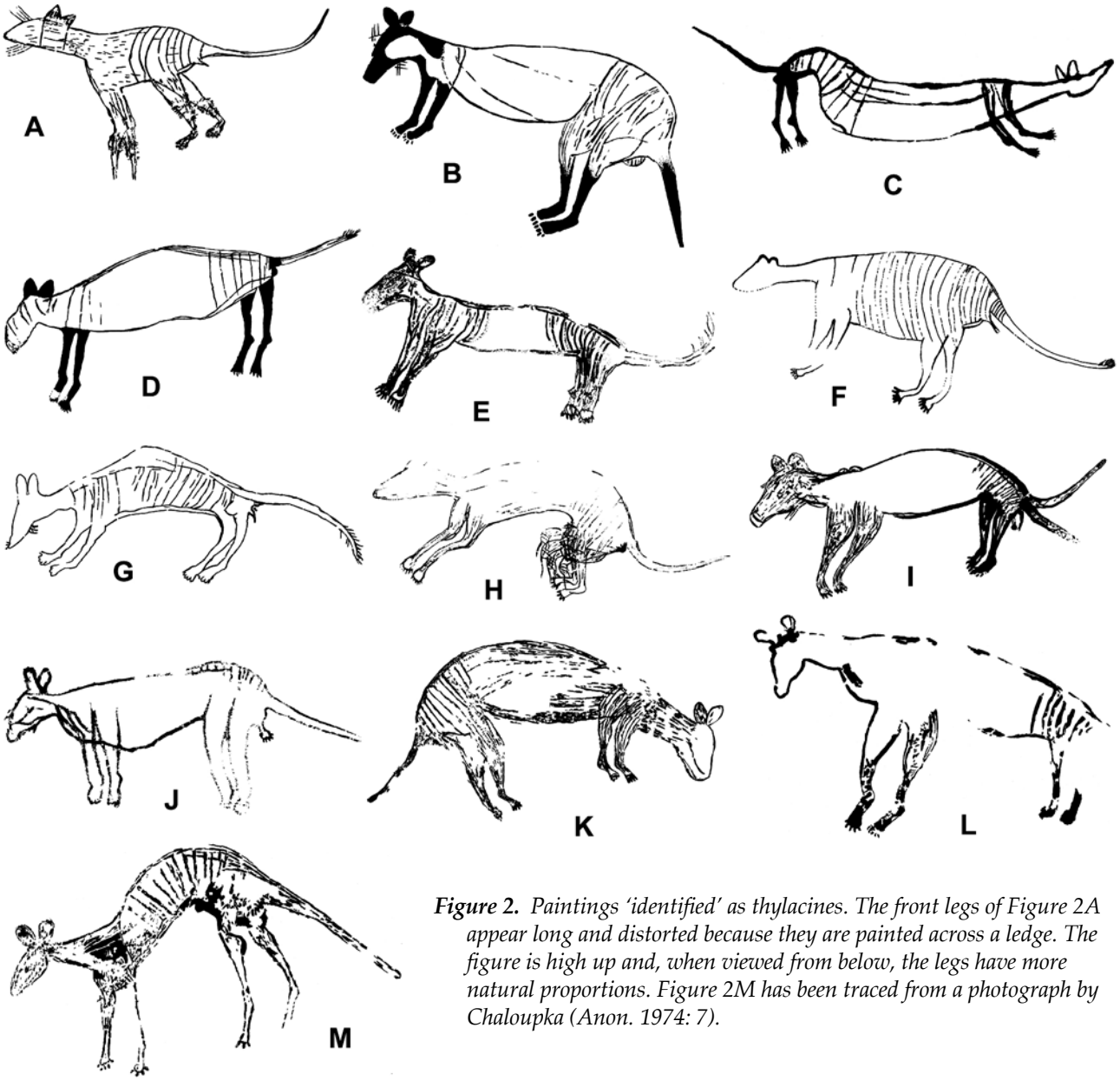

Figure 2. *Paintings 'identified' as thylacines. The front legs of Figure 2A appear long and distorted because they are painted across a ledge. The figure is high up and, when viewed from below, the legs have more natural proportions. Figure 2M has been traced from a photograph by Chaloupka (Anon. 1974: 7).*

than conclusive combination of such features can, nevertheless, be given a high probability of representing this animal.

It must be noted that if knowledge of the thylacine was limited to fossil skeletal material, only the overall shape and proportions of the animal would be known and, if the foot bones were available, that it had dog-like paws rather than macropod feet on the hind legs. Nothing could be said about features such as the size and shape of the ears, facial vibrissae and markings on the fur — indeed, whether it had fur at all. Because it was a marsupial it could be assumed that the arrangement of male genitalia would be with testicles anterior to penis, and that females probably possessed a pouch. With only this information available the combination in a rock painting of either paw on hind foot and male marsupial genitalia, or paw on hind foot and pouch, would narrow the possible identifications to thylacine or Tasmanian devil. Beyond this, there would only be the overall shape of the portrayal left to be considered for identification, but owing to the factors outlined by Brandl, body and head shape and relative proportions of different body parts could only be taken to suggest a higher probability that the painting represented one species as opposed to the other.

While the methodology described above was developed for identifying thylacines, it is equally applicable to other mammal species in Arnhem Land rock art and to animals depicted in Kimberley rock paintings (Lewis 2016). For example, the two animals illustrated in Figure 3 do not have the body shape and proportions of any known Australian animal. Although the shape of one animal is completely different from the other, by applying the method discussed above the configuration of the hind feet with one large toe and a small side toe suggests that they both represent stylised versions of a macropod. In this instance the absence of additional features on either painting makes it impossible to be more specific.

When it comes to identifying possible megafaunal

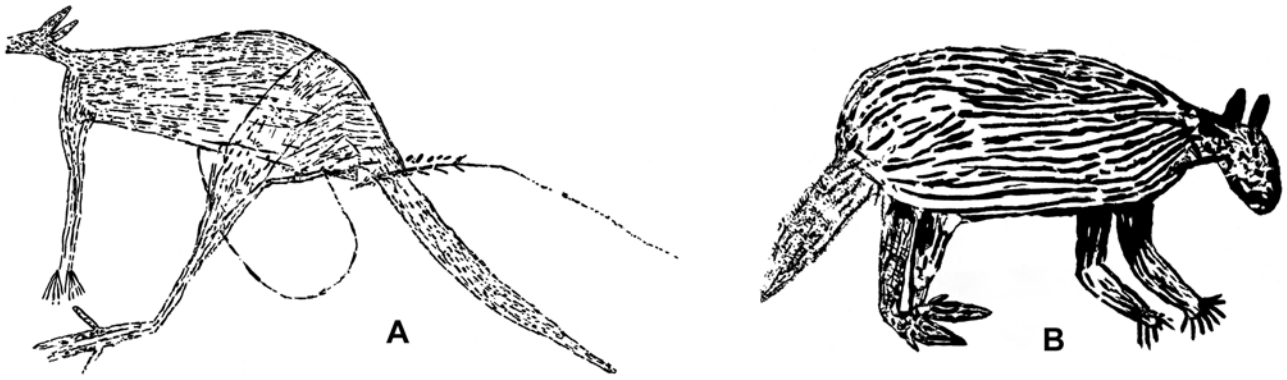

Figure 3. *Arnhem Land rock paintings of macropods showing quite different body shape and proportions. Note: the end of the nose on the left hand dynamic-style animal and the end of the tail on the right hand animal have weathered away.*

species in the rock art, the methodology outlined above has not been followed by subsequent researchers. Instead, their various methodologies have been haphazard or confused and often place too much emphasis on criteria previously shown to be unreliable. For example, Murray and Chaloupka (1984: 107) state that, '[h]ead shape, ear shape and general body outline form are the primary discriminating features', but they then confuse the issue by saying (1984: 106) that '[t]he recognition of a species depends on a combination of a few distinctive features rather than overall attention to detail'. Walsh (2000) does not clearly articulate a particular methodology for identifying species, but uses features such as the relative size of one figure to another (2000: 393, Pl. 571), or a single anatomical feature (e.g. his Pls 573 and 574) to suggest that a megafaunal species might be depicted. Akerman (2009) identifies an animal as *Thylacoleo* largely because of its size relative to the human figure spearing it, and Akerman and Willing (2009) make a similar identification of another painting largely because of the oversized forepart of the animal when compared to the hind part.

Rock art researchers who identify megafaunal species on the basis of head size or the overall shape and proportions of the depicted animal have, to their own detriment, overlooked Brandl's case study of thylacine paintings. They may also, as Bednarik (2013: 203–204) has pointed out, focus on features they believe correspond with alleged features of an extinct species, but ignore or somehow overlook other features that negate identification as that species.

Identifying the earliest surviving rock art

If depictions of megafauna exist in the rock art of Arnhem Land and/or the Kimberley, it is *a priori* that some or all will occur in the earliest surviving figurative art, so a pertinent question is: what constitutes the earliest figurative rock art in both regions? This is not as clear-cut as the proposed sequences of art styles in both regions suggest. In Arnhem Land, Chaloupka's (1993: 89) sequence of painted art styles begins with imprints of objects (e.g. hands, grass), followed by large paintings of naturalistic animals and humans. In the Kimberley, Walsh (2000: 113–133) has object imprints and large paintings of naturalistic animals occurring together in his earliest painted art period (his 'Irregular Infill Animal Period').

Both Walsh and Chaloupka have their respective large naturalistic animal periods followed by a period when generally small, monochrome red, detailed human figures were painted in highly formalised styles — known in Arnhem Land as dynamic figures and in the Kimberley as Gwion figures (formerly Bradshaw figures). These figures are succeeded by human figures in very different styles, marked, among other changes, by the addition to the previous toolkit of a 'hooked stick' — a simple stick-like spear thrower. Chaloupka named these styles 'Post-Dynamic Figures' and 'Simple Figures with Boomerangs', while Walsh named them 'Clothes Peg Figures' (now referred to by some Kimberley Aborigines as Wararrajai Gwions). There is general agreement that the close equivalence of the two sequences strongly indicates cultural and temporal links between the two regions when this early rock art was being produced (Crawford 1968: 82; Brandl 1973: 186–187; Lewis 1988b: 82–84, 110; Welch 1990: 123; Chaloupka 1993: 118; Morwood 2002: 52; Taçon and Chippindale 2008: 75; Watchman et al. 2010). In turn, this suggests that evidence for the age of an art period in one region is likely to have general application to the equivalent rock art period in the other region.

Both Walsh and Chaloupka claimed that megafaunal species could be depicted in their respective large naturalistic animal periods (Chaloupka 1993: 94, 98–100; Walsh 2000: 393–401). However, the position of large naturalistic animal paintings at or near the beginning of their rock art sequences is based on visual assessment of superimpositioning — which painting overlies the other. This method can be successful when paintings of different colours or of coarse-grained pigments are superimposed (e.g. Gunn et al. 2010), but when old and weathered red paintings are found superimposed, reliably determining the sequence of superimposition by visual assessment is at best difficult and often impossible (Brandl 1973: 172–174; Lewis 1988b: 13).

In 1988 I argued (Lewis 1988b: 66–68) that the style which makes up Chaloupka's supposedly discrete

'Large Naturalistic Animals Period' was ill-defined, and that material culture associations and other features showed that at least some post-dated dynamic rock art. In 1993 Chippindale and Taçon used Harris matrices in an attempt to objectively order early styles at two Arnhem Land sites (Chippindale and Taçon 1993). They agreed with my assessment that some large 'naturalistic' animal paintings were younger than dynamic period rock art, but suggested that others were earlier. However, their findings were still ultimately based on visual assessment of the overlay sequence. In a later paper Chippindale and Taçon (1998: 99) acknowledged the difficulties of using visual assessment, but suggested that if 'multiple observations can be made at a single panel' or if 'a pattern of sequence is repeated at several panels', one could have greater confidence that the apparent sequence is correct. Their suggestion took no account of Walsh's (1994: 268) experience that where 'ancient Kimberley paintings' are superimposed it is common for visual assessment of the sequence to be wrong. Walsh considered that, '[s]uch recurring evidence seriously questions the validity of statistical analysis based on field observations without technical assistance' and added that, '[s]uperimposition can only be based on exceptionally well-preserved panels or exceptional circumstances' which, with respect to Gwion figures and Wararrajai Gwion figures, he claimed to have found.

Second, the perceived order of styles is also based on the assumption that only one style or type of painting can exist at any one time, but there is no reason why two or more styles cannot coexist, perhaps performing different social functions. With respect to his 'Bradshaw' and 'Clothes Peg Figures' periods, this possibility was acknowledged by Walsh (2000: viii) and recently confirmed by Ross et al. (2016). In Arnhem Land rock art the contemporaneity of different styles in various periods has long been established (Brandl 1977: 233–234; Lewis 1988b: 86, 101; Chippindale and Taçon 1998: 106).

Third, even if a claimed superimposition sequence is correct, the time difference between the painting events remains unknown — it could be minutes or millennia (Brandl 1973: 172, 1977: 234). If megafaunal species are depicted in large 'naturalistic' style in both regions and the time difference between that style and the claimed subsequent styles was only a matter or decades or even centuries, then one could expect such species to be present in Gwion and dynamic rock art. In Arnhem Land dynamic rock art there are many 'scenes' where mammals, birds, fish or reptiles are held, hunted or otherwise associated with human figures (e.g. Brandl 1973: Fig. 73; Lewis 1988b: Figs 28, 29). In addition, the artistic convention peculiar to dynamic rock art where the lines of the legs on humans and the hind legs on animals are shown crossing at the thighs enables paintings of animals with this feature, and not otherwise associated with human figures in that style, to be identified as belonging to the dynamic rock art period (Brandl 1973: 172–173). With the exception of the recently extinct thylacine and Tasmanian devil, all dynamic period animal depictions so far recorded are of extant species. This suggests that there were no megafaunal species in Arnhem Land when this rock art was being produced. In Gwion period rock art, depictions of animals directly associated with Gwion figures are known but uncommon, and they are usually very small and stylised which makes species identification difficult (Walsh 2000: 136 and Pls 374, 493 and 523; Schmiechen 1993: Pls 2.17 and 2.22). As a result, comparatively little can be said about the range of species present when this rock art was being produced, but the apparent close cultural and temporal relationship between Gwion and dynamic rock art suggests a similar assessment might apply — that is, megafauna depictions are absent.

If depictions of megafauna do exist in Arnhem Land rock art they would have to significantly predate dynamic figures. At this time there is no worthwhile evidence to suggest with certainty whether *any* paintings, large 'naturalistic' animals or otherwise, are older than dynamic rock art or, if the temporal and cultural links with the Kimberley are accepted, older than Gwion figures. However, if, for the sake of argument it is assumed that some large 'naturalistic' animal depictions are the oldest surviving paintings, then two more questions require attention: (1) exactly how old are such paintings and (2) when did megafauna extinction occur in the Arnhem Land-Kimberley region?

Maximum age of the rock paintings

Ochre pieces with ground facets have been recovered in Arnhem Land archaeological deposits more than 50 000 years old (Roberts et al. 1990: 153; Roberts et al. 1994: 577; Clarkson et al. 2015: 62), and in the Kimberley a piece of ground ochre and a small ochre-covered slab have been excavated and dated to about 40 000 BP (O'Connor and Fankhauser 2001). There are many uses for pigments other than rock art, so the presence of these ochre pieces and the ochre-stained palette does not prove that rock paintings were being created 40 000 and 50 000 years ago, or that any surviving paintings are of that age (Lewis 1988b: 64; Chippindale and Taçon 1998: 101–102). It may be considered a reasonable assumption that some of this ochre was used to make rock paintings, but it would be an assumption nevertheless.

Dating surviving rock paintings

Direct dating

Direct dating of surviving rock paintings can be achieved in two ways. One is by dating deposits containing buried rock art-bearing slabs. The other is by taking a small sample directly from the painted surface and subjecting it to one or more of various available dating techniques (Bednarik 2012: 65). These samples can consist of the pigment, mineral accretions such as oxalates and carbonates, biological material (beeswax)

above or below the pigment, or fossil wasp nests on top of or under the pigment (Chippindale and Taçon 1998; David et al. 2013a).

In 2011 a small, flat rock bearing charcoal lines was excavated at Nawarla Gabarnmang, a site in the centre of the Arnhem Land plateau (David et al. 2013b). The slab was found at a level dated to 28 000 BP (calibrated), which documents when the slab fell from the roof and not when the charcoal lines were placed on it. It is the oldest direct evidence of rock art production in Arnhem Land. Not enough of the motif remains to show what was represented and in what style, so it cannot be related to the existing chronology of styles.

In Arnhem Land attempts to directly date paintings on the shelter walls began more than 30 years ago (Watchman 1985, 1987). This initial work showed the potential for dating mineral accretions on painted walls, but did not provide a specific date for any motif. From 1993 onwards radiocarbon dates have been determined for beeswax figures, some of which overlie paintings and some that are themselves over-painted (Nelson et al. 1993; Nelson et al. 1995; Taçon et al. 2004; Gunn and Whear 2008; Taçon et al. 2010). The oldest date secured was 4040±80 years BP (Nelson et al. 1995; Watchman and Jones 2002), but most were less than 500 years old (Nelson et al. 1995; Taçon et al. 2004). All the paintings associated with these dates were from recent rock art periods.

In recent years work has been carried out to date earlier styles of painted rock art. The only results yet published are those of Jones et al. (2017) who achieved eight radiocarbon dates for calcium oxalate overlying an Arnhem Land style known generally as 'Northern Running Figures', and a ninth date for calcium oxalate underlying such a figure. These figures are believed to post-date dynamic rock art (Lewis 1988b: 38; Chaloupka 1993: 92; Chippindale and Taçon 1998: 107). The oldest date achieved was 9402 cal. BP and the youngest (for the calcium oxalate underlying a figure) was 5922 cal. BP, giving a date range of 3500 years during which 'Northern Running Figures' were produced. A date of 9400 cal. BP provides strong support for a minimum age of at least 10 000 years for the earlier dynamic rock art, and by extension, Gwion rock art.

In the Kimberley, analysis of samples of surface accretions collected in 1994 suggested that Gwion figures and paintings of large naturalistic animals were a minimum of 4000 years old (Watchman et al. 1997). In 1997 an OSL date of 16 400±1800 years ago was obtained for a fossil mudwasp nest believed to overlie a Gwion figure (Roberts et al. 1997). Later, questions were raised as to whether the nest really did overlie the painting and whether the painting really was a Gwion figure (Aubert 2012: 575–576; Welch 2014: 31–32). Bednarik also questioned the reliability of the technique for dating and warned that a single direct date from any dating method could not be taken to apply to other rock paintings in the same style, particularly when a 'new' material is being dated (Bednarik n.d., 2012). Recently a similar OSL date (16+/-1ka) was obtained for a mudwasp nest clearly overlying a 'yam-like figure' (Ross et al. 2016). Unfortunately, the painting in question cannot be reliably placed in Walsh's chronology of Kimberley styles, but if either or both the mudwasp nest dates are reliable they indicate that Kimberley rock paintings can survive on the rock face for more than 16 000 years. How much more is an open question.

A major research project to date Kimberley rock art by direct means was launched in 2015 (Kimberley Foundation website n.d.). Work is in its early stages, but in both Arnhem Land and the Kimberley it is likely to be a long time before the reliability of the various proposed or recently applied dating methods has been established and sufficient dates have been achieved to provide a reliable time frame for the different styles of rock art (O'Connor and Fankhauser 2001; Ross et al. 2016). Until this is done, the best age estimates available for the different styles of rock paintings in both regions will remain those derived from indirect dating, itself an inexact method.

Indirect dating

Indirect dating relies on consideration of varied lines of independent evidence, including analysis of the subject matter depicted and the distribution patterns of different styles, and relating these to ethnographic information or archaeological, geomorphological and zoological data of known age. Features such as relative weathering and mineral coatings on some styles but not on others can also be taken into account. If these different lines point to a similar conclusion, in combination they provide a strong argument for the age of different styles of rock art, an epistemological process that Alison Wylie (1989) described as 'cabling'. This methodological process underpinned Chippindale and Taçon's (1998) discussion of the fundamental basis of indirect dating of rock art in Arnhem Land.

In Arnhem Land, paintings of thylacines and Tasmanian devils occur in large 'naturalistic' style (Chaloupka 1993: 94, 99), but this again raises the question of whether such paintings constitute a distinct period in the Arnhem Land sequence and whether such a period would predate or post-date dynamic rock art. Both the thylacine and the Tasmanian devil became extinct in the mid- to late Holocene, so paintings of them could be as young as a few thousand years. Depictions of both animals also occur in dynamic rock art and there are lines of evidence which suggest a minimum age for this style. The suggested dates have implications for the age of any earlier paintings, and for dating Kimberley Gwion rock art.

Dynamic figures are found throughout the Arnhem Land plateau. This distribution pattern, the content of the rock art and other features have led Lewis (1988b: 60, 81–86, 105), Chaloupka (1993: 89, 91) and Chippindale and Taçon (1998: 107) to suggest that the style is the product of a society adapted to a climate and ecology substantially drier than that which has prevailed for

most of the Holocene. On this basis these researchers have suggested various ages for dynamic rock art. In 1988 I suggested a minimum of 9000 to 10 000 BP (Lewis 1988b: 80), but found no evidence to suggest a maximum age. Chaloupka (1993: 106) was not specific as to age, but believed dynamic rock art was produced over 'a very long period of time'. Without offering any particular evidence he placed dynamic figures as the second oldest of six periods he claimed existed between 20 000 and 8000 years (1993: 89). Taçon and Brockwell (1995: 684, 687) suggest a minimum of at least 10 000 and a maximum of 12–13 000 years but offer no evidence for the upper age estimate. As noted above, the work of Jones et al. (2017) supports a minimum date of 10 000 BP. If dynamic paintings are at least 10 000 years old then paintings of megafaunal species, if they do exist, must be considerably older than 10 000 years or alternatively, the species depicted became extinct much more recently than currently believed, or both.

The minimum age of megafauna in the Arnhem Land-Kimberley region

Of 88 taxa of megafaunal species known to have existed in Pleistocene Greater Australia, 54 disappeared within the past 450 000 years and on current evidence most became extinct before human occupation (Wroe et al. 2013). The timing of extinction of the last megafaunal species and the cause or causes for their extinction is a matter of ongoing debate. Roberts et al. (2001) argue that due to human impact the megafaunal species still present when Aboriginal people arrived had all disappeared by about 46 000 years ago. Field et al. (2001) and Fillios et al. (2010) believe that some species may have persisted as recently as 35 000 BP. They suggest increasing aridity was likely to be a key factor in their extinction, though human impact may also have played a role.

Wroe et al. (2013: 8778–8779) believe that at least 14 and possibly 22 species were present when humans arrived; nearly half are known only from New Guinea. On mainland Australia all of the megafaunal fossil sites dated to human settlement times are located in the south and east of the continent. This is likely to be due to a lack of palaeontological sampling in northern Australia and/or poor fossilisation conditions, rather than an indication that megafauna species were rare or absent in human times, but some species may have been restricted to the temperate zone, or to specialised environments outside the savannah lands of the tropics. For example, on present evidence sthenurine species and *Procoptodon goliah* are believed to have been restricted to eastern and southern Australia (Rich and van Tets 1985: 236, 249; Prideaux et al. 2009: 11646).

At the present time megafaunal fossils are known from only four sites in the Arnhem Land-Kimberley region. Various species have been found on Quanbun station in south-west Kimberley and at Bullock Creek on Camfield station in the southern Victoria River district, but the Quanbun material is believed to be of Pliocene age, 5–2 million years old (McNamara and Murray 2010: 25) and the Bullock Creek site is approximately mid-Miocene, about 12 million years old (Murray and Megirian 1992). A *Zygomaturus trilobus* lower jawbone found near Kununurra in 1989 (Western Australian Museum No. 89.6.1) and the articulated partial skeleton of a *Diprotodon* found on Auvergne station in the northern Victoria River district in 2012 (*Northern Territory News*, 20-12-2013) remain undated. In the absence of dates it thus remains unknown if either of these species was present in the Arnhem Land-Kimberley region when Aboriginal people arrived there.

Palaeontologist Steve Webb has carried out field surveys in Arnhem Land, along Sturt Creek and around Lake Gregory in the south-east Kimberley, explicitly to look for megafauna fossils and *Genyornis* eggshell. The soils he examined were suitable for preservation of fossil remains, but he found none (Webb 2013: 183, 273). The absence of fossil evidence and a variety of other factors led him to suggest that if megafauna was present in these areas at all, the range of species may have been quite limited and their numbers may have been low (Webb 2013: 182). Researchers who claim that particular Arnhem Land or Kimberley rock paintings might represent a species of megafauna are assuming that the species was adapted to tropical conditions and inhabited these regions when humans arrived.

Identifying megafauna in rock paintings

It is one thing to identify thylacines in rock art and quite another to identify species of extinct megafauna. Because the thylacine survived in Tasmania until at least the 1930s, precise details of its appearance are known and can be related to depictions in rock art. This cannot be said for extinct megafauna where in many cases only partial skeletal remains are available. Some extinct megafaunal species closely resemble extant species and because of this they would be very difficult to identify in rock art (Murray and Chaloupka 1984: 108). It is also apparent that many megafaunal species resemble each other so closely that even if they were painted in a realistic manner they could not be differentiated in rock art. Brandl (1973: 72 and 193, documentation for Fig. 20) encountered a similar problem when he asked Aboriginal informants to identify which of four (extant) species of eel-tailed catfish was depicted in apparently old red ochre rock paintings. Although intimately familiar with the animals and fish in their environment, the Aborigines could not do so because the only difference between these species was size and, as discussed above, size in the rock art is an unreliable indication of the species portrayed.

Use of palaeontology in rock art studies

To assist in identifying rock paintings as extinct species, researchers sometimes resort to comparison with palaeontologists' interpretations of the appearance of extinct species (e.g. Murray and Chaloupka 1984:

110, 111, 115; Gunn et al. 2011: 4). However, the reliability of any reconstruction is inextricably connected to the amount of skeletal material available — the more complete the skeleton, the more reliable the reconstruction is likely to be — and also to reinterpretations of phylogenetic relationships. Unfortunately, few megafaunal species are known from complete or largely complete fossil remains. Exceptions include *Diprotodon optatum*, *Thylacoleo carnifex* and *Sthenurus occidentalis* (pers. comm. Stephen Wroe).

Whether palaeontologists' reconstructions are based on complete or incomplete fossil skeletal material, Bednarik (2013: 204, 211) notes that they are only artists' impressions and that 'any reconstruction needs to be regarded as provisional, especially in such details as soft tissue, hair and colouring'. Similarly, Switek (2010) observes that, '[a]ny restoration is a combination of fact, theory, hypothesis, and imagination'. This has been demonstrated by Mackness (2008) who documented changes in artistic reconstructions of *Palorchestes azeal* as more skeletal remains were discovered and different or more efficient analyses made. The appearance of these reconstructions ranged 'from giant kangaroos, long-necked llama like-forms, bizarre okapians to their present popular image as quadrupedal marsupial 'tapirs' (Mackness 2008: 21; Bednarik 2013: Fig. 9). Changes through time are apparent in other palaeontological interpretations. For example, reconstructions of *Thylacoleo* range from possum-like (Murray 1978: 81) to Tasmanian devil-like (Murray and Chaloupka 1984: 111). Likewise, reconstructions of *Genyornis* initially were emu-like (e.g. Rich and van Tets 1985: 189) but now are goose-like (e.g. Clode 2009: 35, 37; Webb 2013: 161).

A complicating factor with using palaeontologists' reconstructions for rock art research is that most have been made for purposes other than comparison with rock paintings and, on mammals, usually include characteristics such as the size and shape of the ears and nose, the presence of vibrissae and other variations in body hair, and markings on the fur. Two reconstructions of extinct species that Murray and Chaloupka (1984) provided expressly for comparison with particular rock paintings (their figures 6c and 11) included distinctive features and fur patterns which mimicked what appeared to be such features on the paintings. Particularly in their Figure 11, this effectively created a misleading and mutually reinforcing feedback loop — the reconstruction looked like the painting which looked like the reconstruction which looked like the painting. Obviously such features are speculative and should be excluded or ignored if a palaeontological reconstruction is being used to show a supposed similarity between the extinct animal and a rock art motif.

As well as resorting to palaeontologists' reconstructions of the appearance of extinct species, rock art researchers sometimes seek the opinion of a palaeontologist to help identify animals depicted in rock paintings (e.g. Gunn et al. 2011: 1; Akerman and Willing 2009). However, it is likely that few, if any, palaeontologists are familiar with the variables that need to be taken into account when attempting to identify animals in rock art. Bednarik (2013: 201, 211) gets right to the heart of the matter: 'it needs to be considered that the opinions of specialist zoologists about what is depicted in Aboriginal-created imagery are not relevant in identifying such motifs' and further that, 'palaeontologists or zoologists … are trained to identify the species [of animals] or their remains; they have no innate understanding whatsoever of alien palaeoart imagery, and their pronouncements about it are less relevant than those of illiterates'. To highlight the problems involved in attempting to identify megafaunal species in rock paintings, in the following I examine a number of such claims from Arnhem Land and the Kimberley — sthenurine kangaroos, *Zaglossus brunijnii*, *Thylacoleo carnifex* and diprotodontids, including *Palorchestes azeal*. Gunn et al.'s (2011) claim that *Genyornis newtoni* may be depicted in Arnhem Land rock art is not addressed here because this identification has already been comprehensively disputed by Bednarik (2013) and Welch (2016: 184–191).

Sthenurine kangaroos

Eight species of macropod are found in Arnhem Land today (Press 1998) and seven in the northern Kimberley (Karadada et al. 2011: Appendix 1). Six of these species are common to both areas. This number makes it very difficult to identify individual macropod species in the rock paintings, particularly when features that differentiate one species from another can be as subtle as long hairs depicted on the ears (Murray and Chaloupka 1984: 108, 111). Trying to identify extinct species of macropod in the rock art is equally difficult, particularly when considering the complicating factors outlined by Brandl.

In Kimberley rock art Walsh (2000: 344–345) noted paintings of kangaroos with 'cropped' ear tips and because no Kimberley kangaroo species has square-tipped ears he suggested this feature might be a marker for an extinct species. Paintings of kangaroos with 'cropped' ear tips also exist in recent phases of Arnhem Land rock art (e.g. Brandl 1973: 18), so cropped ears are likely to represent something other than an extinct species.

The extinct kangaroo-like animals in the genera *Procoptodon*, *Sthenurus* and *Simosthenurus* are all short-faced, heavily built animals with long arms and a single toe on each hind foot. All have long claws on the digits of the front paws. The largest of these animals, *Procoptodon goliah*, and perhaps some of the other extinct kangaroos, had two extra-long middle digits with large claws on the front paws, possibly to help bring leafy branches within reach when browsing (Tedford 1967). Paintings of single-toed kangaroos are also known in Kimberley rock art, but the sole example illustrated by Walsh (2000: 394) is stylised and its shape

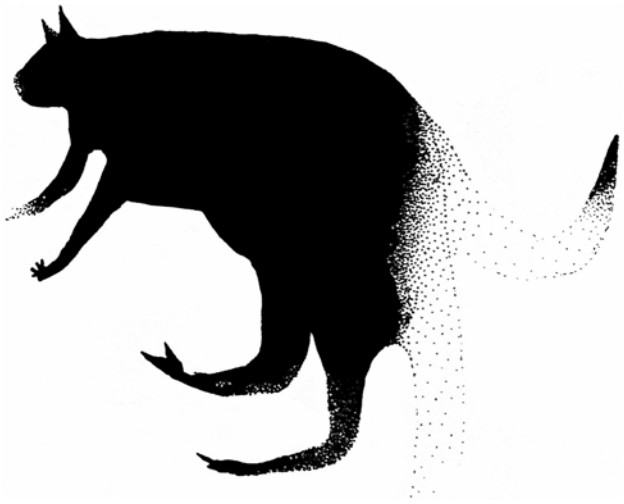

Figure 4. *A large weathered red silhouette of a kangaroo which has the bulky body and head shape typical of* Procoptodon *or* Simosthenurus*, but which has the two-toed hind foot typical of extant species of macropods.*

and proportions do not resemble any known species, extinct or otherwise.

Of the various features possessed by the sthenurine kangaroos, the most distinctive for identification purposes in rock art is the single-toed foot, but by itself a single-toed foot does not necessarily indicate an extinct species. Murray and Chaloupka (1984: 111) note that in Arnhem Land, paintings of kangaroos are known where only a single toe is depicted, but the body of the animal resembles those of extant kangaroos, i.e. it is relatively gracile. They also note the occurrence of paintings of kangaroos which have a bulky body and a blunt face (features reminiscent of various species of *Procoptodon* or *Simosthenurus*), but the hind foot has two toes (e.g. see Fig. 4). Because of such ambiguities, Murray and Chaloupka (1984: 111) could not identify any paintings as sthenurine kangaroos.

For a painting to have any chance of being identified as a sthenurine species it would need to have a single toe on each hind foot, large digits or claws depicted on each front paw, a bulky body, short face and relatively long forearms. If such a painting also had two extra-long digits on the front paws there would be a reasonable probability that it represented an extinct kangaroo. No such painting has yet been discovered.

Zaglossus

In 1984 Murray and Chaloupka claimed that a rock painting in Arnhem Land almost certainly represented a species of *Zaglossus*, or long-beaked echidna (Murray and Chaloupka 1984: 107). At least one and possibly three species of long-beaked echidnas survive in New Guinea (Augee et al. 2006: 9), but on the Australian mainland, until recently, *Zaglossus* species were known only from fossil remains and only the short-beaked echidna (*Tachyglossus aculeatus*) was believed to be extant. A paper by Helgen et al. (2012) raises the possibility that a species of *Zaglossus* may still be, or have very recently been, present in the Kimberley (see discussion below).

Generally speaking, *Zaglossus* species are similar to *Tachyglossus*, but they are larger-bodied, have proportionally longer legs, a relatively small tail that is usually directed ventrally, a head that appears to project well forward of the body, and as its name indicates, a longer rostrum or beak (Murray and Chaloupka 1984: 108; Augee et al. 2006: 7–10). In contrast, Murray and Chaloupka (1984: 108) describe *Tachyglossus* as having a short, straight beak and a spindle-shaped body with its tail directed horizontally in line with its beak. Both long-beaked and short-beaked echidnas have stiff spines covering their bodies and both have hind feet with digging claws directed posteriorly, but the spines and rear-facing claws are similar on both species and would not distinguish one species from the other in rock paintings. The beaks on *Zaglossus* species are described as downward curved while that of *Tachyglossus* is said to point forward. These may be characteristic positions, but photographs reveal that both animals can hold their beaks and tails at a range of angles (cf. Carnivoraforum n.d.), so the angle of these features in rock paintings is not a reliable identifier.

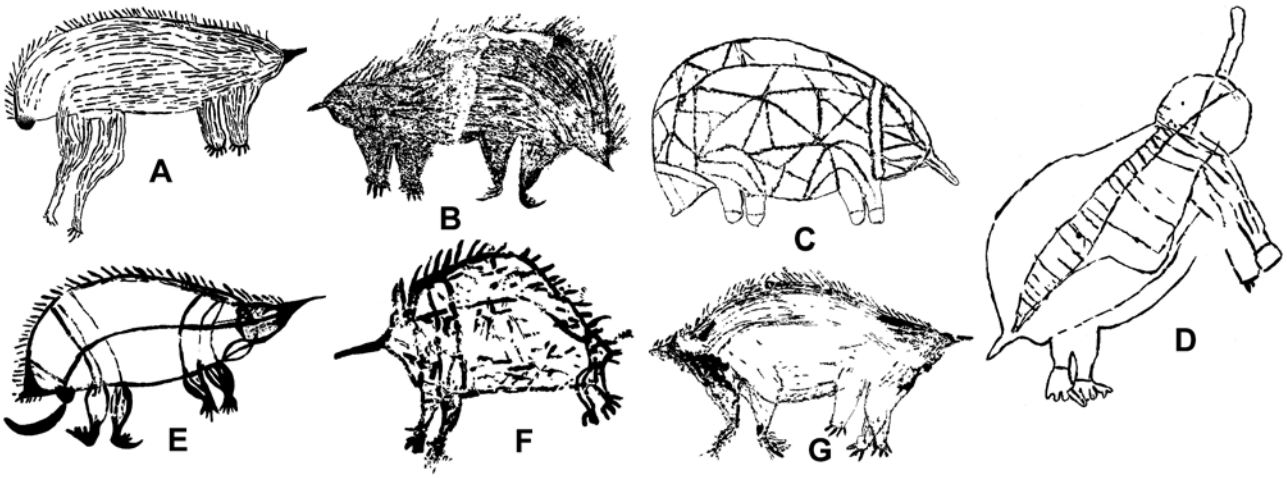

Figure 5. *Arnhem Land echidna paintings.*

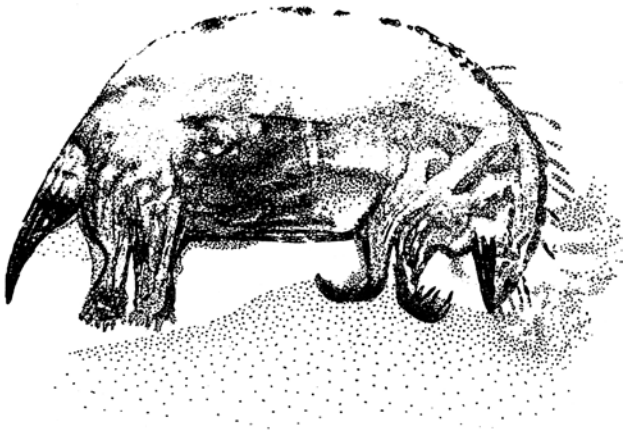

Figure 6. *The echidna identified by Murray and Chaloupka as* Zaglossus. *The painting is in superposition with a forearm and hand stencil with the fingers to the right (from Lewis 1986).*

In Arnhem Land rock art, features that differentiate the two species in life are often found mixed together in rock paintings — echidnas with short beaks may have disproportionately long legs (Fig. 5A), a ventrally directed tail (Figs 5B and 5C), a prominent head (Figs 5D and 5E), virtually no head (Fig. 5F) and the beak can be held slightly upright (Figs 5A and 5D), horizontal (Figs 5F and 5G) or downwards (Fig. 5C).

Murray and Chaloupka (1984: 108) state that paintings resembling *Zaglossus* are 'at least as common as the *Tachyglossus*-like form in the early art styles', but this is not my experience of Arnhem Land rock art. In 1986 I highlighted various problems with their '*Zaglossus*' illustration and suggested that they produce a more convincing example (Lewis 1986: 144–145). This never happened. By the time Chaloupka (1993) published his magnum opus, *Journey in time,* he had documented 2000

Figure 8. *An echidna with a short, downward directed beak and an extremely large tail, from the same rock face as Figure 6.*

sites, but he republished the same '*Zaglossus*' painting and identified it with more certainty (1993: 88). No other supposed long-beaked echidna painting has been published by any other researcher. The painting in question (Fig. 6 and Fig. 7, top right) has a ventrally directed tail and what appears to be a long, downward directed beak, features which led Murray and Chaloupka (1984: 108) to conclude 'that *Zaglossus* was indeed the target animal'. However, on the same rock face and directly below the supposed *Zaglossus* there is another 'old' red echidna painting with a short beak and an excessively large tail (Fig. 7, bottom right, and Fig. 8). The over-sized tail begs the question: is the long beak on Murray and Chaloupka's '*Zaglossus*' an exaggeration and is the depicted animal really *Tachyglossus*? In the absence of other, more convincing paintings, the claim that *Zaglossus* is depicted in Arnhem Land rock art cannot be sustained.

In 2012 a specimen of *Zaglossus bruijnii*, said to have been collected in the Kimberley in 1901, was discovered in a collection in the Natural History Museum, London

Figure 7. *A thylacine with four pups (see Fig. 2G), two echidnas (Figs 6 and 8) and other motifs. The echidna at top right (see Fig. 6) was identified by Murray and Chaloupka (1984) as* Zaglossus. *The lower echidna is reproduced as Figure 8.*

(Helgen et al. 2012: 108). If the provenance of this specimen is correct it could be seen to give credence to Murray and Chaloupka's identification. While evidence appears to be strong that the specimen was indeed collected in the Kimberley, only the merest hint that Kimberley Aboriginal people knew of the animal has been documented (Helgen et al. 2012: 122–123). In the century-plus since the specimen was collected a great deal of rock art research has been carried out in the Kimberley. For example, Mike Donaldson (pers. comm.) has photographed over 900 sites while David Welch (2015b: 118) and Joc Schmiechen (pers. comm.) have both recorded in the vicinity of 2000 sites (see also Walsh 1994 and 2000). None of these researchers has found an echidna painting that could be a *Zaglossus* species.

Likewise, a great deal of anthropological research has been carried out (see Craig 1967 where numerous references are given) and various wildlife surveys conducted (e.g. Miles and Burbidge 1975; Kabay and Burbidge 1977; McKenzie 1981; Woinarski and Start 1997), but no Aboriginal mythology or traditional knowledge about a second species of echidna has been published and no other specimen of *Zaglossus* has been collected. After publication of the Helgen et al. (2012) paper Andrew Burbidge, a conservation biologist with over 30 years' experience in the Kimberley, circulated photos of *Zaglossus bruijnii* and *Tachyglossus aculeatus* to support staff working with Aboriginal rangers in the region (Burbidge pers. comm.). He asked the staff support people to make enquires with elderly traditional owners. Not all replied, but those who did said that no one recognised or had any knowledge of *Zaglossus*. The Nyikina Mangala Rangers, whose country is where the *Zaglossus* specimen is said to have been collected, were emphatic that the species was not part of their oral tradition. Burbidge also talked with Sylvester Mangolamara (a Wunambal man from the north-west Kimberley) shortly before his death. Sylvester's father and grandfather lived in the bush and his grandfather spent a lot of time educating him about their country, but it was clear Sylvester did not know the species.

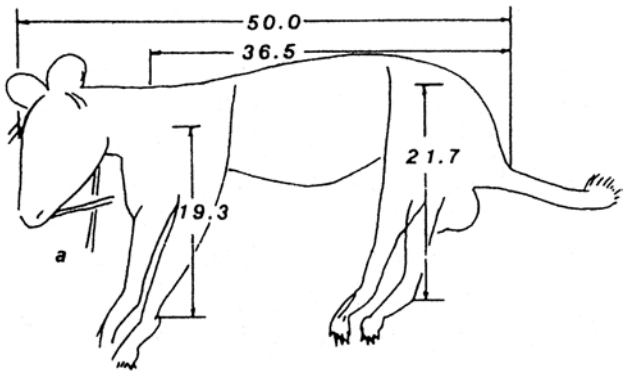

***Figure 9**. Line drawing of an animal which Murray and Chaloupka suggested could represent* Thylacoleo *(after Murray and Chaloupka 1984: Fig. 6a).*

Until another specimen of *Zaglossus* is found in the Kimberley the provenance of the one collected in 1901 will remain, at best, problematic. Of course, if the specimen really was collected in the Kimberley in 1901 then the animal would qualify either as an extant though extremely rare species or as one recently extinct, rather than as an ancient extinct species, and it would not necessarily be the case that any rock paintings of it would be extremely ancient.

To return briefly to the issue of identifying depictions of *Zaglossus* in Arnhem Land or Kimberley rock paintings, unless the painting approached photographic realism — and as Brandl (1972) noted and Figure 5 shows, this degree of realism is rarely, if ever, the case in the rock art — differentiating *Zaglossus* species from *Tachyglossus* probably will not be possible.

The 'marsupial lion' (*Thylacoleo carnifex*)

Thylacoleo carnifex is the largest carnivorous marsupial known to have existed in Australia. Almost complete skeletons have been recovered which show that it was a powerfully-built animal with an estimated maximum weight of more than 160 kilograms (Wroe et al. 1999: 492). It had a compact, cat-like skull with greatly enlarged third premolars and incisors, the forelimbs were extremely strong and the front and hind paws had retractable claws. The front paws had massive semi-opposable thumbs, each with a huge claw. A long, kangaroo-like counter-balancing tail contained specialised bones called chevrons which enabled *Thylacoleo* to prop itself while standing on its hind legs. This freed the front legs for slashing and grasping (Wells et al. 2009: 1335; *Catalyst* 2006). Fossil distribution ranges from the Darling Downs in southern Queensland, through New South Wales, Victoria (Vickers-Rich et al. 1991: 305), the Nullarbor Plain (*Catalyst* 2006) and on to south-western Australia (Arman and Prideaux 2016).

In 1984 Murray and Chaloupka discussed the possibility that two Arnhem Land rock paintings could represent *Thylacoleo carnifex* (Murray and Chaloupka 1984: Figs 6a and 6d). Their illustrations are reproduced here as Figures 9 and 10. A reconstruction of *Thylacoleo* presented by Murray and Chaloupka (1984: Fig. 6c) for comparison with the paintings included long hairs that replicated those on their drawings of the paintings. Measurements on their Figures 6a, 6b (a reconstruction of *Thylacoleo* with skeletal remains included) and 6d indicate that they attempted a metrical comparison similar to that advocated by Clegg (1978), though this is not discussed in their text with respect to these particular figures. They noted that both paintings have features consistent with the thylacine — stripes, tail tuft and dog-like paws on the hind feet — but considered that the relative proportions of the legs and the placement of tail was wrong for the thylacine. Although the authors believed that both paintings might represent *Thylacoleo* they conceded that they were suggestive rather than conclusive (1984: 111–112).

As discussed above, features such as the proportions of the legs and the placement of the tail may be due to stylisation, poor draughtsmanship or other factors. The two paintings discussed by Murray and Chaloupka lack an unambiguous kangaroo-like tail and also, as Bednarik (2013: 205) has noted, do not possess the massive, semi-opposable thumbs with huge claw on the front paws, a key diagnostic feature of *Thylacoleo*. Figure 11 is my own version of Murray and Chaloupka's Figure 6d, drawn from a photograph of the painting. As might be expected there are various differences between the two illustrations, but their version includes digits with sharp ends, and an eye and a nose, features that do not exist on the painting, and they do not include the surrounding stick figures and the 'spears' that pierce or overly the image. One of the 'spears' (in the back of the animal) appears to have a multi-pronged head, a type known to post-date dynamic rock art and on current understandings less than 10000 years old (Lewis 1988b: 25, 86). In addition, the painting technique, strength of pigment and state of preservation of the painting strongly indicate a relatively young age.

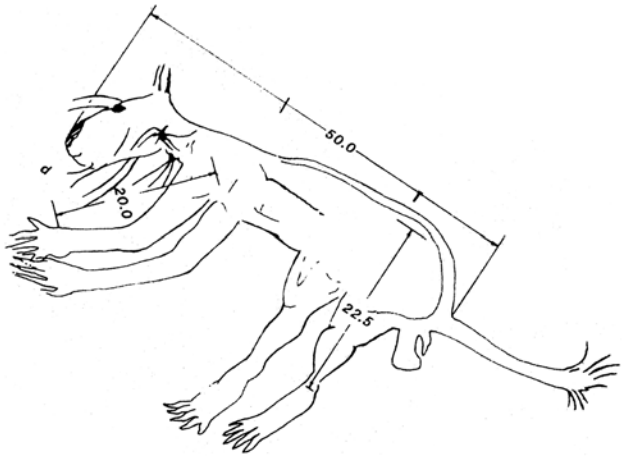

Figure 10. *Line drawing of a second painting which Murray and Chaloupka suggested might represent* Thylacoleo *(after Murray and Chaloupka 1984: Fig. 6d).*

Figure 11. *The painting identified by Murray and Chaloupka (1984) as a possible* Thylacoleo *(their Fig. 6d). Their line-drawing does not include the human figures and spears. The orange-red image has a relatively fresh appearance and is painted with a relatively crude technique using the palm of the hand and fingers.*

In Kimberley rock art Walsh (2000: 398) discussed the possibility that *Thylacoleo* might be present in his irregular infill animal period and provides three illustrations which he suggested could represent this animal. However, he was commendably cautious and made no firm claim that *Thylacoleo* or any other extinct megafaunal species was depicted. Akerman (1998, 2009) and Akerman and Willing (2009) clearly stated their belief that three other Kimberley paintings could represent *Thylacoleo*. As discussed above they use features such as the overall shape and relative proportions of the body and legs, the oversized forepart when compared to the hind part of one depiction, and the size of another depiction relative to an associated human figure. I have already noted that none of these characteristics constitute reliable evidence for identifying species in rock art. As support for one identification, Akerman (1998: 118) incorrectly states as fact that paintings of *Thylacoleo* exist in Arnhem Land. None of the images presented have the key diagnostic feature for *Thylacoleo* of the massive opposable 'thumb' with large claw, or the large kangaroo-like tail. Without these features the images are impossible to identify as *Thylacoleo* and, as Bednarik (2013) and Welch (2015a) have suggested, are more readily identified as thylacines.

Figure 12. *The painting identified in the program* First footprints *(Episode 2) as a* Thylacoleo. *Image traced from a photograph provided by Daryl Wesley.*

More recently, in a widely acclaimed and award-winning television series (*First footprints* 2013, Episode 2), the claim was made that a striped, more or less dog- or thylacine-like Arnhem Land rock painting (Fig. 12) represented *Thylacoleo*. Subsequently, a book based on the series was published with the statement that the painting represented a 'marsupial lion' and that it 'may be over 45000 years old, one of the oldest paintings in existence' (Cane 2013: Pl. 12). No evidence was provided for these claims.

In the television series the reasons given for identifying the depiction as *Thylacoleo* were that the size of the head was 'massive' in proportion to its body and that the nose was 'too big for a thylacine'. The skull of *Thylacoleo* is compact and cat-like (Wells et al. 2009: 1335), unlike the longer, dog-like skull of a thylacine. Following the 'logic' of using the relative size and

shape of the head to identify the species portrayed, the painting should not have been identified as *Thylacoleo*. If the methodology discussed earlier had been followed, primary significance would have been placed on details other than the shape of the body, and no importance on the size of the head in comparison to the body. The front paws appear to be dog- or thylacine-like, with no large opposable thumb indicated. Unfortunately, due to weathering the detail of the hind feet is unclear. No pouch line is visible and if male genitalia was ever depicted it is no longer recognisable, but the more or less horizontal tail and the stripes on the rear half of the animal are known features of the thylacine.

If a painting was found depicting an animal with a bulky body, a short head, legs of sub-equal proportions and a horizontal or downward angled, kangaroo-like tail, the species portrayed could not be identified with certainty because these features might be the result of stylisation or poor skill on the part of the artist. If the same painting also had dog-like paws on the hind feet, it would narrow possible identifications to the Tasmanian devil, thylacine or possibly *Thylacoleo*. The only way that such a painting could be identified as *Thylacoleo* rather than as thylacine or devil would be if the front paws had clearly defined semi-opposable thumbs, particularly if the thumbs and perhaps the other digits also had large claws depicted. None of the claimed *Thylacoleo* representations have these features. Large incisors extending from the lower jaw would also support identification as a *Thylacoleo*, but in Arnhem Land rock art the depiction of mammals with teeth is rare and where they are shown, the teeth are generalised rather than anatomically accurate (e.g. Lewis 1988b: 405). In Kimberley rock art the depiction of teeth on mammals is either absent or extremely rare (pers. comm. Joc Schmiechen).

Diprotodontids

The various diprotodontids, including *Palorchestes azeal*, had a more or less wombat-like appearance — a bulky body and head, thick legs of sub-equal proportions, paws with four or five digits bearing long claws, and a short, thin tail. In northern Australia there are no extant marsupial species with this anatomical structure. A number of diprotodontid species resemble each other sufficiently closely in shape and specific details that it would be difficult or impossible to differentiate them in rock art. These include *Diprotodon optatum*, *Phascolonus gigas*, *Vombatus hacketti* and *Maokopia ronaldi*. A distinctive feature of some diprotodontids is the structure of the head. In some species, particularly *Zygomaturus trilobus* and *Diprotodon optatum*, the dorsal side of the head was concave, a feature most marked in the case of *Zygomaturus* (Murray 1985: 21–23). *Palorchestes azeal* may have differed from the others through possession of a short, tapir-like trunk (Rich and van Tets 1985: 236). Less certain is the possibility that both *Diprotodon* and *Zygomaturus* also had a short trunk (Aplin 1983: 58; Rich 1983: 263; Rich and van Tets 1985: 242) though alternatively, *Zygomaturus* may have had short horns (Long et al. 2002: 99).

If an apparently well-executed painting of an animal was found which possessed the features described above, including the concave dorsal side of the head, it would have a reasonable probability of representing one of these extinct species. If such a painting possessed an unambiguous trunk or short horns, identification either as *Diprotodon*, *Palorchestes* or *Zygomaturus* would have to be considered. No such painting has yet been discovered.

In his discussion of the possibility that megafauna is depicted in Kimberley rock art, Walsh (2000: 394–395) illustrates a small painted 'scene', the central figure of which he suggests represents 'a large, heavy-set quadruped marsupial, but unlike any known extant species'. He makes no further comment regarding specific identification of the species portrayed. The depicted animal has a balloon-like body with very short legs and a short, thin tail. Detail of the head is difficult to see in the photograph, but Walsh describes the ears as short and rounded and the head as 'dog-like'. The depicted animal is enigmatic — it has no species-specific feature or combination of features that point to a particular species, and its balloon-like shape does not resemble any known species, extant or extinct. It is at least as likely to depict a mythological animal as an extinct species.

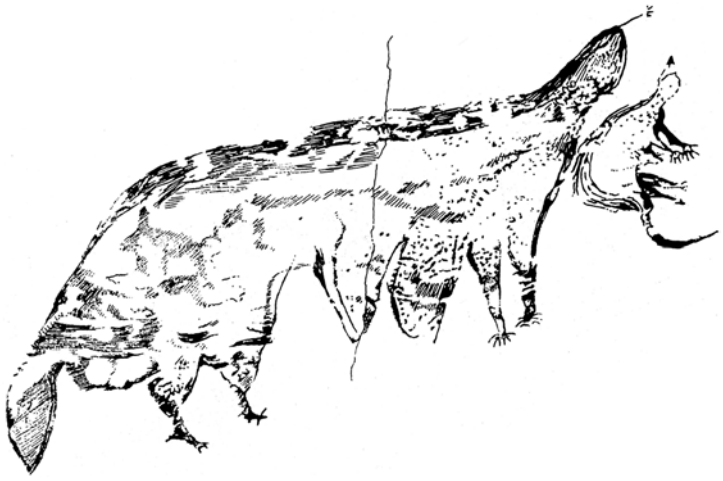

Figure 13. *The two animals that Murray and Chaloupka suggested might represent Palorchestes (after Murray and Chaloupka 1984: Fig. 7).*

The only serious claim that a painting might represent a particular *Diprontodon*-like species is Murray and Chaloupka's (1984: 112–115) suggestion that the 'marsupial tapir' (*Palorchestes azael*) could be represented in Arnhem Land rock art. There are in fact two possible *Palorchestes* paintings on the one rock face, a large version and below it a similar smaller image which could represent a juvenile, both in red pigment (Fig. 13; see also Chaloupka 1993: Pl. 95). The larger animal has a bulky body, a short, thick tail and short legs of sub-equal

proportions with very thin ankles. It has what may be a long tongue extending from a rounded, up-raised head and hanging down from the chest immediately behind the front legs are two large, roughly triangular projections. The smaller animal has a thin tail and does not have the long tongue, but otherwise is broadly similar, with an upraised rounded head, legs of sub-equal proportions and triangular projections hanging down from the chest.

Murray and Chaloupka (1984: 112) acknowledged that (at the time they published) '[s]o little is known of the extinct genus *Palorchestes*, a large tapir-like marsupial, that there may not be much gained by attempting to compare this unique and intriguing painting with perhaps the most poorly known species in the megafaunal assemblage'. Ne-vertheless, they went on to discuss various features of the painting which they thought might represent hair or flesh, and for comparative purposes they presented a reconstruction of *Palorchestes* which included similar features and had a similar pose (Murray and Chaloupka 1984: Fig. 11). At the end of their discussion (1984: 114) they concluded that any connection between the painting and *Palorchestes* 'is of the most tenuous kind.'

Fossil remains indicate that the hind feet of *Palorchestes* had five toes, all of which bore massive claws similar to those on the front feet (Mackness 2008: 29). Murray and Chaloupka (1984: 114) state that on the larger of the animals, the 'manus and pes are clawed, with clearly delineated digits'. There certainly are very long, straight digits on the front feet of this painting, but these do not bear clearly delineated claws. Examination of the painting in situ shows that, due to weathering, detail of the hind feet is unclear and no unambiguous digits or claws are recognisable, even when processed using DStretch (Fig. 14). The smaller animal also has very long digits on the front feet, but the hind feet clearly have a single large toe and a smaller side toe, neither of which has claws indicated (Fig. 15). In other words they resemble painted representations of the feet of a macropod rather than those of *Palorchestes*.

In a recent reappraisal of the dates for *Palorchestes* fossils Price et al. (2013: 6) have concluded that they are all unreliable and that it is not possible to place *Palorchestes* within the past 100 000 years. Bednarik's opinion (2013: 204) that the painting 'is not a naturalistic image of any creature' and the suggestion by Welch and Welch (2015) that it is a mythical being combining parts of various extant species would appear to be justified.

Conclusions

The traditional aphorism that, 'absence of evidence is not evidence of absence', may generally be correct. However, attempts to identify megafaunal species in

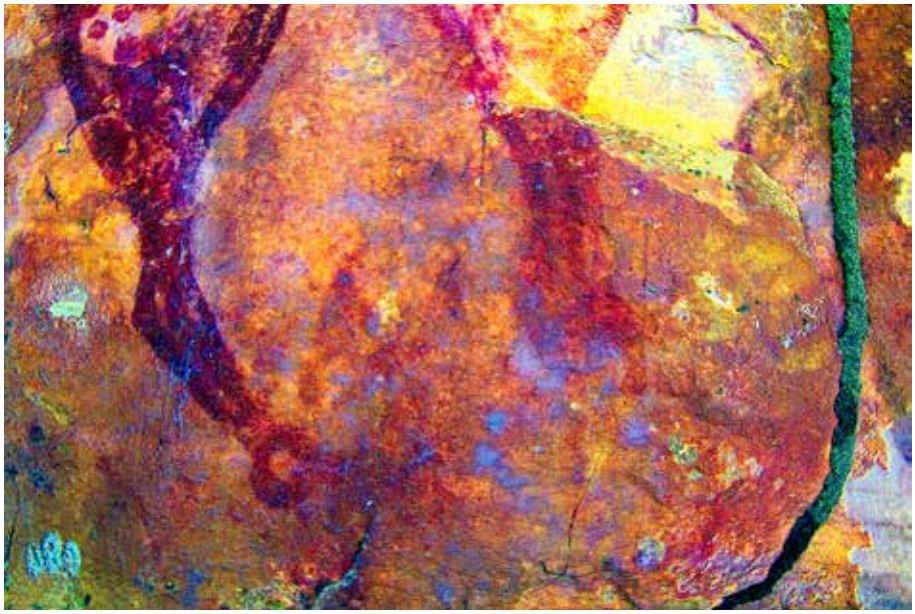

Figure 14. *The hind feet of the larger animal in Figure 13, enhanced using DStretch. Detail of the pes is unclear due to weathering.*

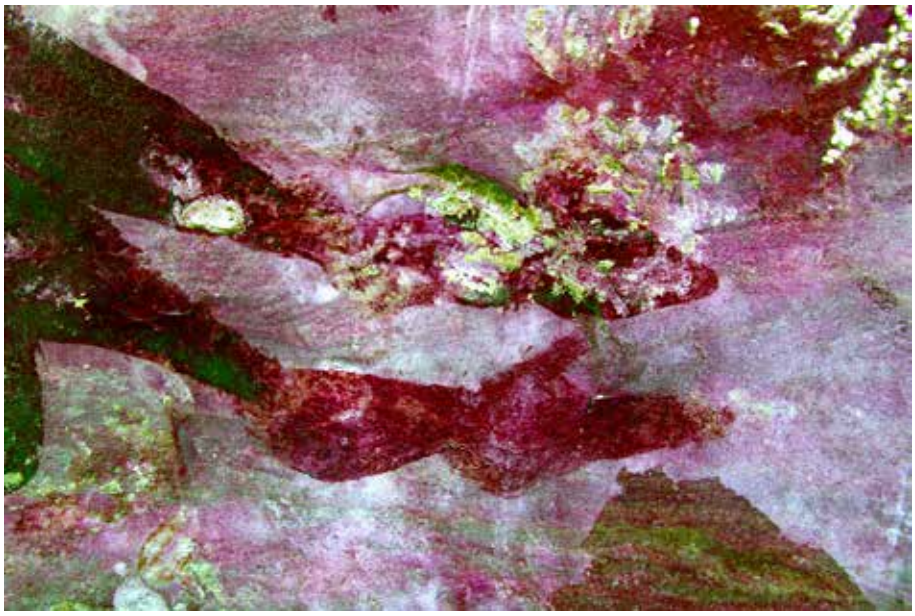

Figure 15. *The hind feet of the smaller animal in Figure 12, enhanced using DStretch.*

the rock art of Arnhem Land and/or the Kimberley are constrained by lack of evidence in a number of crucial areas, and depend on a series of assumptions. Due to lack of fossil discoveries, in most instances it has to be assumed that the target animal once existed in Arnhem Land and/or the Kimberley, and that it was present when human occupation began. The *Zygomaturus* jawbone from Kununurra and the *Diprotodon* remains from Auvergne show that these animals once existed in the Arnhem Land-Kimberley region, but they are undated and may predate human occupation.

If all megafaunal species were extinct by 46 000 years ago, as Roberts et al. (2001) suggest, or even as recently as 35 000 as Fillios et al. (2010) suggest, a megafauna painting would have to be that old or older. Whether rock paintings were being produced 35 000 or more years ago is another assumption and whether any surviving paintings could be that old has yet to be demonstrated.

Where identifications are attempted by comparing a painting with a palaeontological reconstruction, the usual assumption is that the reconstruction really does resemble the animal portrayed, but such reconstructions are artists' interpretations based on available skeletal material and may change substantially as more fossil remains are discovered or analytical methods improve (Mackness 2008: 32; Bednarik 2013). Depending on how complete fossilised skeletal remains are it may be possible to determine body and limb shape and proportions, the shape of the feet and perhaps other physical peculiarities, but palaeontologists' reconstructions usually include details such as fur markings, the length of fur on different parts of the body, the size and shape of the ears, and whether an animal carried significant fat deposits on parts of it body. Such details are complete speculation.

Apart from the assumptions outlined above, recent attempts to identify megafauna species in the rock art have been hampered through the use of inappropriate methodologies. The most reliable way to identify extinct species in the rock art is to identify a physical feature or combination of physical features unique to an extinct species or shared by a group of extinct species. To do this the researcher must have a detailed knowledge of the range of species, extinct and extant, that might be portrayed, and possess as much knowledge as possible of the anatomical characteristics of each possible target species. In addition, the researcher must always bear in mind that in rock art, relatively subtle details may be exaggerated, as demonstrated in Brandl's thylacine study and noted by Murray and Chaloupka.

It is possible that head or body shape, or the relative proportions of one body part to another, may eventually prove to be important identifying features for some species. It is clear, however, that such features may also be the result of stylisation, poor draughtsmanship, the indifference of an artist to produce a relatively realistic image, or reflect aspects of mythology. Because of this, in most cases the shape and proportions of the image, or of different parts of the image, should only be considered as secondary backup to identification based on species-specific details. The peculiar shape of the head of some diprotodontid species could prove an exception to this rule. Finally, Brandl's comment that there is a broad zone where 'metaphysical concept' and 'zoological reality' cannot be kept apart must always be kept in mind. With these limitations, and considering the number of assumptions that have to be made, very few extinct species would stand a chance of being identified beyond reasonable doubt.

'Occam's razor' is the idea that the simplest or most obvious explanation of several competing ones is the one that should be preferred until it is proven wrong. From this principle, if details of a painting suggest identification either as an extant or recently extinct species or a species apparently extinct for at least 35 000 years, and possibly for 46 000 years, the simplest explanation would be that the painting represents the extant or recently extinct species. On the basis of current evidence the probability that paintings of megafaunal species exist in Arnhem Land or Kimberley rock art is low, and with all the variables known to affect the appearance of a painting, the odds that a depiction of a megafaunal species could be identified with certainty are extremely low.

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