

## The species of *Dasyurus* Peters, 1875 (Marsupialia: Dasyuridae)

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### Abstract

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Two species of *Dasyurus* (mulgaras) are recognised. They can be distinguished by the form of the tail, the number of upper premolar teeth in each jaw and, in the female, by the number of nipples in the pouch. *Dasyurus blythi* has a non-crested tail, two upper premolars (and a diastema between  $P^2$  and  $M^1$ ) and six nipples; *D. cristicauda* has a crested tail, three upper premolars (the third very small and sometimes present on one side only) and eight nipples. Both species have a wide geographic range in the arid zone of Australia, and overlapping distributions. The identity of specimens previously referred to *D. cristicauda* in the W. B. Spencer collection of Museum Victoria has been reassessed and both species found to be represented.

### Keywords

Marsupialia, Dasyuridae, *Dasyurus blythi*, *Dasyurus cristicauda*

### Introduction

Four named forms of small carnivorous marsupials have been assigned to the genus *Dasyurus* Peters, 1875; three concern us here. The first was *Chaetocercus cristicauda* Krefft, 1867. Krefft's description was based on a single specimen sent to him by F. G. Waterhouse of the then Institute Museum of Adelaide (now the South Australian Museum). A second form, *Phascogale blythi* Waite, 1904, was described from specimens collected by A. C. Blyth in the Pilbara district of Western Australia. Two of Blyth's live animals had been left in the care of B. H. Woodward, Director of the Western Australian Museum and Art Gallery, and three were taken to Sydney, where E. R. Waite of the Australian Museum made observations on the live animals before returning them to Blyth, following which they escaped. Soon after, Woodward asked Waite to examine the remaining two specimens, expressing the wish that "if new, Mr Blyth's name might be associated with them". Woodward himself (1902) had mentioned them as "*Phascogale blighi*" without description, thereby erecting a nomen nudum. The third, *Phascogale hillieri* Thomas, 1905, was described from the skin of a specimen from Killalpaninna, South Australia, presented by H. J. Hillier.

Iredale and Troughton (1934) and Tate (1947) recognised two species of *Dasyurus*, namely *D. blythi* and *D. cristicauda* and these authors placed *D. hillieri* in the synonymy of *D. cristicauda*. Ride (1970) referred to only a single species, *D. cristicauda* and later Mahoney and Ride (1988) formally placed all three nominal species in the synonymy of

*D. cristicauda*. Consequently most authors have followed Ride. Mahoney and Ride included *Dasyuroides byrnei* Spencer, 1896 in the same genus but there is no consensus on the inclusion of *byrnei* in *Dasyurus*; *byrnei* is not considered here.

On the basis of unpublished information (received from M. Adams of the South Australian Museum) for the existence of two genetically distinct forms of *Dasyurus*, referred to as *D. cristicauda* and *D. hillieri*, *The 1996 Action Plan for Australian Marsupials and Monotremes* (Maxwell et al., 1996), listed *D. cristicauda* as "vulnerable" and *D. hillieri* as "endangered". Since then, in an unpublished report, Adams et al. (2000) have given their reasons for the names they applied to the two species. Further support for the existence of two genetically distinct forms of *Dasyurus*, based on gene sequences obtained from three whole mitochondrial genes (*cytb*, *12SrRNA* and *16 SrRNA*) has been obtained by M. Westerman and C. Krajewski (pers. comm.).

I first became aware of the existence of two distinct forms of *Dasyurus* when, in 1967, I collected specimens in south-western Queensland that differed from others that I had collected previously in the Northern Territory. The morphology of the tail clearly distinguished them as did the number of nipples in the pouch of females. There were also differences between the two forms in dentition. I maintained animals from both areas in captivity, and reported observations on the reproduction of animals from the Northern Territory (Woolley, 1971) and on the burrows made by animals from both the Northern Territory and Queensland (Woolley, 1990). The different sites reported for the burrows of the two forms suggest a difference

in their habitat requirements. Although I was aware of differences between animals from different localities, I followed Ride (1970) and referred to them as *D. cristicauda*.

Now that two forms of *Dasyurus* are again recognised, the discrepancy between the names applied by earlier authors (Iredale and Troughton, 1934; Tate, 1947) and those by Adams et al. (2000) warrants attention. In the present study, the type specimens of *Chaetocercus cristicauda*, *Phascogale blythi* and *Phascogale hillieri* have been examined and early literature reviewed. This was done to gain an understanding of the morphology of the three previously named forms and the reasons for them being considered to represent only two species. The reasons given for the use of the names *hillieri* and *cristicauda* for the two genetically distinct forms are then discussed. Because Spencer (1896) questioned the accuracy of Krefft's description of *Chaetocercus cristicauda*, the specimens studied by Spencer were examined to gain an understanding of his reasons. Specimens collected by me in south-western Queensland and the Northern Territory and thought to represent two species were compared with the types to establish their identities. Specimens in Museum Victoria (NMV), the Australian Museum (AM), the South Australian Museum (SAM) and the Western Australian Museum (WAM) have also been examined and they provide information on the distribution of the two species.

### The type specimens

*Chaetocercus cristicauda* Krefft, 1867. The holotype (AM M11342) is a mounted skin and skull (cranium and dentaries) of indeterminate sex. Krefft (1867) gave the following dimensions: total length 8 inches (203 mm), tail 3 $\frac{1}{4}$  inches (82.5 mm), tarsi and toes 1 $\frac{1}{8}$  inches (28.5 mm).

Krefft founded the genus and species "upon a very singular animal, approaching in its dentition *Dasyurus* proper much more closely than any other known genus" [of the Dasyuridae], in reference to the reduction in the number of premolar teeth. In *Dasyurus* there are two upper and two lower premolar teeth. Key features of Krefft's description are: (i) the form of the tail, described as thick and compressed [i.e., having the two opposite sides nearly plane or flat] with a crest of black hair upon the apical half [my emphasis]; and (ii) the presence of three premolars in the upper jaw, the third being "diminutive and tubercular", and only two in the lower jaw. The general colour of the fur was described as leaden grey at the base, tipped with sandy and rufous, darker towards the tip. A colour plate accompanied the description and is reproduced here (Fig. 1a). The specimen was said by Krefft to be in not very good condition when it was received by the Museum, where it was mounted.

Examination of the holotype revealed that the mounted specimen bears little resemblance to the animal illustrated but part of the diagnostic crest of black hairs upon the apical half of the tail can be seen, and the hairs, at least on the head and back where the pelage has not been patched, are of the colour described, but are very much less rufous than depicted by the artist who prepared the colour plate. The compressed nature of the tail is not apparent because it appears to have been overstuffed during preparation, and the left foot appears to be a

mismatched addition. The specimen was originally illustrated with the left foot partly obscured, perhaps because it was missing. All teeth ( $I^{\frac{4}{3}}$ ,  $C^{\frac{1}{1}}$ ,  $PM^{\frac{3}{2}}$ ,  $M^{\frac{4}{4}}$ ) have erupted in the holotype but some upper and all lower incisors have been lost. The right and left third upper premolars are present, and are small and tubercular as described by Krefft. Although it is unlabelled, I have no reason to doubt the association of the skull with the mount. It complies with Krefft's description, and in later studies by Iredale and Troughton (1934), Tate (1947) and Jones (1949), no doubts have been raised.

The type locality "South Australia, probably the neighbourhood of Lake Alexandrina" was considered doubtful by Jones (1949), "since *Dasyurus* is typically an inhabitant of the arid and semi-arid Centre and has since been obtained only from such environment, no specimen having been subsequently recorded from localities within 200 miles of the Coorong Lakes". Calaby (1996) expressed the same opinion, noting that Lake Alexandrina is "ecologically a most unlikely locality and almost certainly an erroneous one". Perhaps, in the absence of precise information from F.G. Waterhouse, who sent the specimen to him, Krefft may have seized on the comment "I hope soon to be able to send you some good skins of animals and some skeletons as my man is going to settle down near Lake Alexandrina . . .", made by Waterhouse in a letter dated 21 June 1895 (Archives of the Australian Museum C.20.65.21). In an earlier letter, 14 May 1865 (C.20.65.19), Waterhouse expressed disappointment that he had been unable to proceed, because of drought, on a trip from Port Augusta to Coffin Springs where he had hoped to trap some small mammals is suggestive of a more likely source area. Waterhouse said "I am convinced that the small marsupials and rodents of the northern part of South Australia are but little known – I know of several that are not described in Gould's work and I intend to do my best to procure them". Letters written by Waterhouse (held in the State Archives of South Australia) and by Krefft (held in the Mitchell Library, Sydney), even after the date of publication of the description, might yield information on where the specimen was collected.

Jones (1923) provided a very detailed description of the external characters of specimens of *Dasyurus* from Ooldea, South Australia collected by A.G. Bolam, referring to them as Krefft's Pouched Mouse, *Chaetocercus cristicauda*. Jones added some details to the description of the form of the tail. He noted that "The terminal half of the tail is ornamented with a large dorsal and a small ventral crest of shining black hairs. The ventral crest is inconspicuous, and consists of short stiff hairs which do not increase in length as they are followed towards the tip of the tail. The dorsal crest consists of long hairs which, starting as a mere ridge of fine black hairs, increases in length towards the tip of the tail and constitutes a fine fin-like crest." The 'inconspicuous' ventral crest may not have been obvious to Krefft (1867) because of the poor condition of the specimen upon which his description was based, or he may have overlooked it, as commented on by Spencer (1896: 22). Illustrations of the skull by Jones (1923, 1949) show three upper, and two lower, premolar teeth in each jaw. Jones also noted that the central area of the pads of the pes were striated and those of the manus, unstriated.

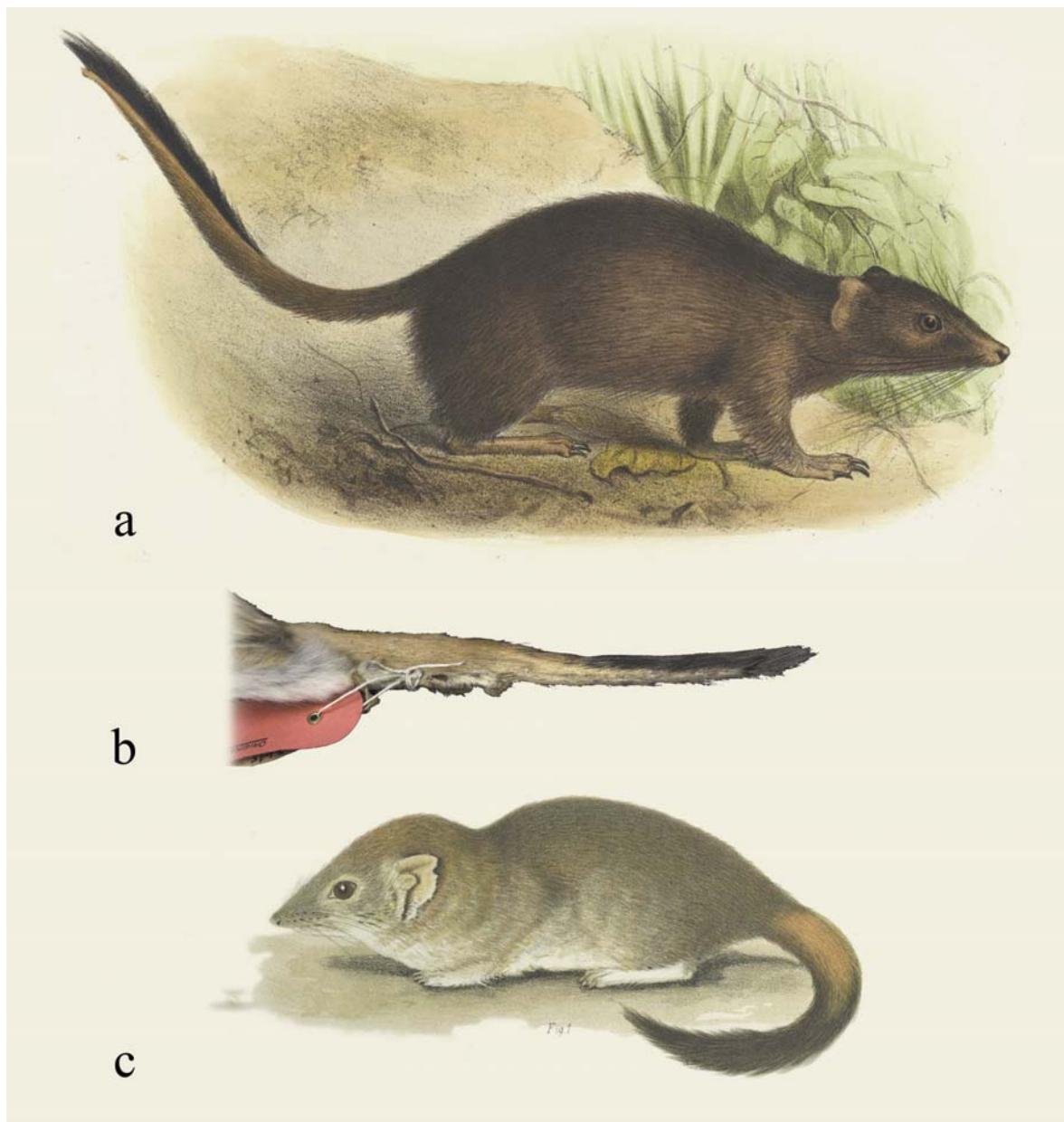


Figure 1. a, *Chaetocercus cristicauda* (= *Dasyurus cristicauda*) from Krefft (1866). b, tail of *Phascogale hillieri* Thomas, 1905 (= *D. cristicauda*) (photograph of type specimen © The Natural History Museum, London). c, *Phascogale cristicauda* (= *D. blythii*) from Spencer (1896).



Figure 2. Tails of *Dasycercus* species. a, *D. cristicauda* (NMV C5385). b, *D. blythii* (NMV C5340).

*Phascogale blythi* Waite, 1904. The syntypes, held in the Western Australian Museum, are mounted skins of a male M578 (renumbered M41476) and a female M579 (renumbered M41477), together with the skull (cranium only) of one bearing the label 'Type *Phascogale blighi* (Waite)', the nomen nudum introduced by Woodward. The dimensions of the specimens recorded by Waite (1904) were, for the male (adult); head and body 150 mm, tail 102 mm and hind foot 27.8 mm, and for the female (juvenile); head and body 132 mm, tail 95 mm and hind foot 26.5 mm. They were collected in the Pilbara region of Western Australia. Waite described the tail as: "... of moderate length, shorter than the head and body, incrassated; the proximal two-fifths above covered with short stiff yellow hairs, the remainder with gradually lengthening black hairs that do not however form a crest [my emphasis]. The whole of the lower surface is black, with the exception of a small proximal portion which is yellow." The colour of the pelage was given as "upper parts sandy, speckled with brown, the basal portion of the fur being dark grey and the whole of the under parts, together with the inner side of the limbs and the lining of the pouch is pure white". The footpads of both the fore and hind feet were said to be striated. He recorded various dimensions of the skulls of the two specimens, giving the 'basal length' of the skull of the male as 35.0 mm, and that of the female as 33.0 mm. Based on my measurement of the basicranial length (32.5 mm), the single skull now in the collection is probably that of the female. Details of the dentition are given. There are only two premolar teeth in the upper jaw, the first smaller than the second and, if as it appears that a superscript rather than a subscript has been used in error, two in the lower jaw. The lower premolars touch each other, and the first is in contact with the canine and the second with the first molar tooth. Jones (1949), without making specific reference to the apparent error, also interpreted this part of the description as a reference to the lower premolars.

Jones (1949) commented that Waite became acquainted with *Dasyurus cristicauda* during the time he was in charge of the Adelaide Museum (1914–1928), but never suggested that it was in any way akin to the Western Australian form that he had described in 1904.

*Phascogale hillieri* Thomas, 1905. The holotype is an adult male, skin without right hind foot and part of leg (Natural History Museum, London, no. 5.3.28.1). It was collected by H. Hillier at Killalpaninna, east of Lake Eyre, South Australia. Dimensions of the type (measured in the flesh): head and body 150 mm, tail 100 mm and hind foot 30 mm. The skull is lost.

Thomas (1905) considered the specimen to be "near *Ph. cristicauda*, but considerably paler in colour" [presumably by comparison with the colour plate accompanying the description by Krefft (1867)]. He described the tail as "slightly incrassated basally; crested above for its terminal two inches [my emphasis], the hairs attaining a length of 16 mm, nothing that can be called a crest below although some of the hairs are slightly longer than in the proximal part. In colour the main part of the tail is rather more rufous than the general body colour, though nothing like the corresponding part in *cristicauda*; under surface indistinctly darker, not black; crest glossy black".

Photographs of the holotype show the tail to be as described by Thomas (lateral aspect, Fig. 1b), and very like the tail of *D. cristicauda* described and illustrated by Krefft (1867) and Jones (1923). Dorsal fur colour of *D. hillieri* is similar to that of the type specimen of *Chaetocercus cristicauda* Krefft and thus only paler in reference to the colour plate.

On the morphological evidence, the type of *P. hillieri* cannot be distinguished from that of *C. cristicauda*. Iredale and Troughton (1934) therefore seem to have been fully justified in placing *P. hillieri* in the synonymy of *D. cristicauda*, a decision with which Jones (1949) agreed, having pointed out that in the intensity of coloration "*cristicauda* is a very variable animal, and that specimens that are considerably lighter in colour than usual are often captured with the more normal coloured individuals".

**Conclusion.** From the foregoing it is clear, based on morphological features, that there are two species of *Dasyurus*, namely *D. blythi* and *D. cristicauda*, as recognised by Iredale and Troughton (1934). The two are distinguishable by the form of the tail (not crested in *blythi*, crested in *cristicauda*), by the dentition (PM  $\frac{2}{2}$  in *blythi*, PM  $\frac{3}{2}$  in *cristicauda*) and to a lesser extent by their general body coloration (*blythi* a little less rufous than *cristicauda*). By association of their other morphological characteristics with those of the type specimens, for which nipple number was not available, the females of the two species can be distinguished by nipple number (six in *blythi*, eight in *cristicauda*).

#### On the names of the genetically distinct forms

Adams et al. (2000) presented evidence for the existence of two clades using DNA sequence data for a small part of the mitochondrial gene *cytb* of 33 specimens of *Dasyurus* in museum collections. They were able to obtain DNA for sequencing from the type specimens of *Phascogale hillieri* and *Phascogale blythi*, but not from *Chaetocercus cristicauda*, and to establish that one clade includes the holotype of *hillieri* and the other, the syntypes of *blythi*. They presented a subset of the gene sequences of 171 base pairs from four specimens of each clade to illustrate the genetic differences between them.

Various morphological attributes of the 23 genetically typed individuals in the clade containing the type specimen of *hillieri* and the 10 in the clade containing the syntypes of *blythi* were then examined. They found that the two clades could be distinguished morphologically, the most diagnostic features being "creasing on tail", distribution of hair on the pes and nipple number. Specimens in the clade containing the holotype of *hillieri* had uniformly long black hairs on the dorsal surface of the tail [which, by reference to illustrations in their report, means crested]; hairs from the outer side of the foot covering 33% of the sole, and seven or eight nipples. Those in the clade containing the syntypes of *blythi*, on the other hand, had black hairs covering most of the tail with the hairs increasing in length on the distal third [which, by reference to illustrations in their report, means non-crested], hairs from both sides of the feet covering 75% of the sole and six nipples.

Then, without any specific reference to the characteristic

features of the species given in the original descriptions, Adams et al. attempted to associate the type specimens with the specimens in each of their two clades. They stated, in reference to the clade containing the holotype of *hillieri*, "The cabinet skin of the holotype, *Phascogale hillieri*, appeared similar to the bodies (cabinet skins and spirit bodies) of animals referred to *Dasyurus hillieri* in Australian Museum collections. This diagnosis was fully supported by its DNA profile." Further, in reference to the clade containing the syntypes of *blythi*, "The cabinet skin of the holotype" [of *Dasyurus cristicauda*] "was referable to the bodies of animals assigned to *Dasyurus cristicauda* in this study," and "The cabinet skins of the holotypes, *Phascogale blighi blythi*, are similar to the bodies of animals referred to *Dasyurus cristicauda*, a result consistent with the DNA profiles for both specimens."

The association of the name *hillieri* with one clade is supported by genetic evidence, "cresting on tail" and by the distribution of hair on the feet. Nipple number is not useful because it cannot be established in the holotype. However, the association of the name *cristicauda* with the other clade containing the syntypes of *blythi* has no support from either genetic or morphological evidence. Despite repeated attempts, DNA could not be extracted from the holotype of *cristicauda* and the tail of *cristicauda* is crested whereas that of *blythi* is non-crested. Distribution of hair on the pes and nipple number cannot be used in support of the association because these attributes cannot be assessed in the mounted type specimens of *cristicauda* and *blythi*. It is my conclusion that Adams et al. (2000) misplaced *cristicauda* in the clade containing the syntypes of *blythi*. The number of premolar teeth, a character not considered by them, differs and the tail of *cristicauda* has a crest like that of *hillieri*, which allies *cristicauda* with the clade containing *hillieri*. The correct name for specimens in this clade is therefore *D. cristicauda* (with which *hillieri* has been synonymised in the past) and, for the specimens in the other clade, *D. blythi*.

#### Spencer collection

W. Baldwin Spencer, Professor of Biology at Melbourne University, was the zoologist on the Horn Expedition to Central Australia, May–August 1884. No *Dasyurus* were obtained in the course of the expedition but soon after Spencer started receiving specimens from friends. These post-Horn Expedition 'collectors' included P.M. Byrne of Charlotte Waters, C.E. Cowle of Illamurta and F.J. Gillen of Alice Springs. The real collectors were the Aboriginal people and precise localities where the specimens were found were not recorded. The exact number sent to Spencer is not known (Calaby, 1996) but 28 specimens (not including pouch young) of *Dasyurus* acquired between November 1894 and September 1895 can be found in the Spencer collection of Museum Victoria. Nineteen of the 28 were from Charlotte Waters, two from Crown Point and seven from Illamurta, all in southern Northern Territory.

Spencer (1896) identified them as *Phascogale cristicauda* Krefft, the Crest-tailed Phascogale, based on the "peculiarity of the dentition [a reference to the reduction in the number of premolar teeth], the crested tail and the general measurements

of the body." However, variability in form of the tail, dentition, nipple number and colour among the specimens he studied led him to give an amended description of the species (Spencer, 1896: 21–23).

Most of Spencer's specimens are intact (in spirit). The tail was examined and classed as either C (to denote the crested form of the tail of *D. cristicauda*) or B (the non-crested form of the tail of *D. blythi*). The dentition was examined in prepared skulls and intact specimens with particular reference to the upper third premolar tooth position ( $P = P^3$  present,  $NP = P^3$  not present,  $dP^3$  = deciduous tooth in place). Tooth nomenclature follows Luckett (1993). Body measurements (total length, tail length and foot length in mm) of spirit specimens were taken, if not previously recorded. The reproductive status of individuals was assessed by examination of the pouch area and reproductive organs of both females and males. Females were assessed as mature if they were lactating or showed signs of having reared young previously (nipples elongated, pouch fur stained), or, in one case, the appearance of the uteri indicating that the individual had very recently given birth. Nipple number was determined in most immature and mature females. Males were assessed as mature if the scrotum was large and the prostate gland developed and showing zonation. The size of the scrotum alone is not a good indicator of maturity because development of the prostate occurs after the testes have reached full size.

Two species of *Dasyurus* can be recognised (Table 1), five specimens (four from Charlotte Waters and one from Crown Point) of *D. cristicauda* (crested tail,  $P^3$  present) and 23 of *D. blythi* (non-crested tail,  $P^3$  not present). This agrees with the Spencer's (1896) observation that  $P^3$  was absent in most of his specimens. Females identified as *D. cristicauda* have eight nipples and *D. blythi* have six. None was found to have four nipples as reported by Spencer; he may have overlooked very small, unsuckled nipples in the pouch of lactating females. In this sample, specimens of *D. cristicauda* are larger than *D. blythi*; two mature males of *D. cristicauda* having head-body lengths of 180 and 185 mm and foot length of 33.5 mm, and two *D. blythi* with a head-body length of 135 mm and foot lengths of 26.5 and 27.5 mm. In both species tail length is less than head-body length. I was unable to distinguish between the pads of the manus of the two species (said to be unstriated in *D. cristicauda* and striated in *D. blythi*) but in this long preserved material it was difficult to see striations on any pads.

Spencer (1896) failed to recognise that the variability he saw could be accounted for by two species. The specimen that he illustrated, as *Phascogale cristicauda* (Fig. 1c), has the tail of *D. blythi*. A skull of a specimen from Charlotte Waters (C.6158, not included in Table 1), is labelled in Spencer's hand "Fig. spec." It has the characteristics of *D. blythi* (ie  $P^3$  absent, diastema between  $P^2$  and  $M^1$ ) and may be the missing skull of C.5388 (see Table 1). If so, specimen C.5388 would be the specimen illustrated. The tails of the two species are illustrated in Fig. 2 and dentition in Fig. 3.

In a further 120 specimens, identified as either *D. blythi* or *D. cristicauda* on the form of the tail,  $P^3$  was absent from all specimens of *D. blythi* except one (SAM M3115).

Table 1. Data for 28 specimens of *Dasyurus* from Charlotte Waters, Crown Point and Illamurta held in the Spencer collection, Museum Victoria. See text for explanation of assessment of reproductive status, form of the tail (B = *D. blythi* and C = *D. cristicauda*) and P<sup>3</sup>.

Reg. no. C	Accession date	Specimen	Sex	Reproductive status	Form of tail	No. of nipples	P <sup>3</sup>	H-B mm	Tail mm	Foot mm
Charlotte Waters (25°55'S, 134°56'E)										
234	23.3.1916	spirit, skull	♀	mature	B	6	NP	—	75	24.5
5336	—9.1895	spirit	♀	mature	B	6	NP	130	85	24.5
5337	—12.1894	spirit	♀	mature	B	6	NP	125	85	25.5
5338	—9.1895	spirit	♀	mature	B	6	NP	130	80	25.0
5339	—9.1895	spirit	♀	mature	B	6	NP	125	85	24.0
5340	—9.1895	spirit	♂	mature	B	—	NP	135	100	26.5
5359	—2.1895	spirit	♀	mature	B	6	NP	130	75	23.5
5360	—2.1895	spirit	♀	weaner	B	—	dp <sup>3*</sup>	85	45	19.5
5361	—2.1895	spirit	♂	immature	C	—	P	125	85	25.5
5369	—2.1895	spirit	♀	mature	B	6	NP	125	85	24.5
5370	—2.1895	spirit	♀	mature	B	6	NP	130	70	25.0
5371	—12.1894	spirit	♀	mature	B	6	NP	120	80	23.5
5372	—2.1895	spirit	♀	immature	B	6	NP	115	75	25.5
5384	18.12.1895	spirit	♀	mature	B	6	NP	130	90	26.0
5385	18.12.1895	spirit	♂	mature	C	—	P	180	110	33.5
5387	1895	spirit	♀	weaner	B	6	dp <sup>3*</sup>	80	50	19.5
5388	1895	spirit (-head)	♀	mature	B	6	—	—	80	26.0
5391	1.7.1895	spirit	♀	immature	C	8	P	155	100	30.5
5392	—7.1895	spirit	♂	mature	C	—	P	185	120	33.5
Crown Point (25°30'S, 134°23'E)										
5357	—8.1895	spirit	♀	mature	C	8	P	150	100	30.5
5358	—8.1895	spirit	♂	mature	B	—	NP	135	95	27.5
Illamurta (24°18'S, 132°41'E)										
4828	—11.1895	spirit	♀	immature	B	6	dp <sup>3(L)</sup>	75	65	23.0
4829	—11.1895	spirit	♂	immature	B	—	dp <sup>3(R)</sup>	105	70	25.0
4830	—11.1895	spirit	♂	immature	B	—	NP	105	65	24.5
4831	—11.1895	spirit	♂	immature	B	—	dp <sup>3(L)</sup>	100	70	23.0
5362	4.10.1895	spirit (-gut)	♂	—	B	—	NP	150	90	27.0
5380	16.11.1894	spirit	♂	immature	B	—	dp <sup>3</sup>	90	65	21.5
5381	16.11.1894	spirit (-tail)	—	immature	—	—	NP	—	—	21.5

\*not erupted – gum previously cut to expose the tooth

A characteristic feature of *D. blythi* is the presence of a diastema between P<sup>2</sup> and M<sup>1</sup> in mature specimens. P<sup>3</sup> was present in both mature and immature specimens of *D. cristicauda* with the exception of two mature specimens (SAM M3106, M3154). These three aberrant individuals formed part of a collection from the Canning Stock Route (Table 2), which raises the possibility that the skins and skulls of two (M3106 and M3115, both with adult dentition) were mismatched, but provides no obvious explanation for the absence of P<sup>3</sup> in the mature specimen (M3154). However, the teeth of this specimen were very worn, and the rough appearance of the bone between P<sup>2</sup> and M<sup>1</sup> suggested that P<sup>3</sup> might have been lost. In specimens of *D. blythi* the deciduous third premolar was found unerupted (Table 1) in ‘weaners’, young close to independence in which all upper incisor teeth except the first pair had erupted. The eruption of I<sup>1</sup> later than the other incisor teeth is thought to be an adaptation for suckling (Luckett and Woolley, 1996). Deciduous premolar teeth were seen in some immature

individuals of *D. blythi* (Table 1), and *D. cristicauda* (e.g., SAM M19672, M20913 and M20925) and the right dP<sup>3</sup> was seen in a mature *D. blythi* (SAM M3146).

#### Woolley specimens

Specimens collected on Sandringham Station, south-western Queensland (Woolley, 1990) have features characteristic of *D. cristicauda* (Western Australian Museum, M8207, M9670-73, M13716; Queensland Museum, JM5532). Specimens collected in the vicinity of Papunya, near Uluru, on the old Docker River Road west of Uluru, and near Refrigerator Well, Tanami Desert, all Northern Territory (see Woolley, 1990 for details of localities) have features characteristic of *D. blythi* (Museum Victoria, Uluru, C35885, C35886; Papunya, C35887-C35895; Tanami Desert, C35896, C35897; Queensland Museum, Docker River Road, JM1443; Tanami Desert, JM2311, JM2312, JM2317).

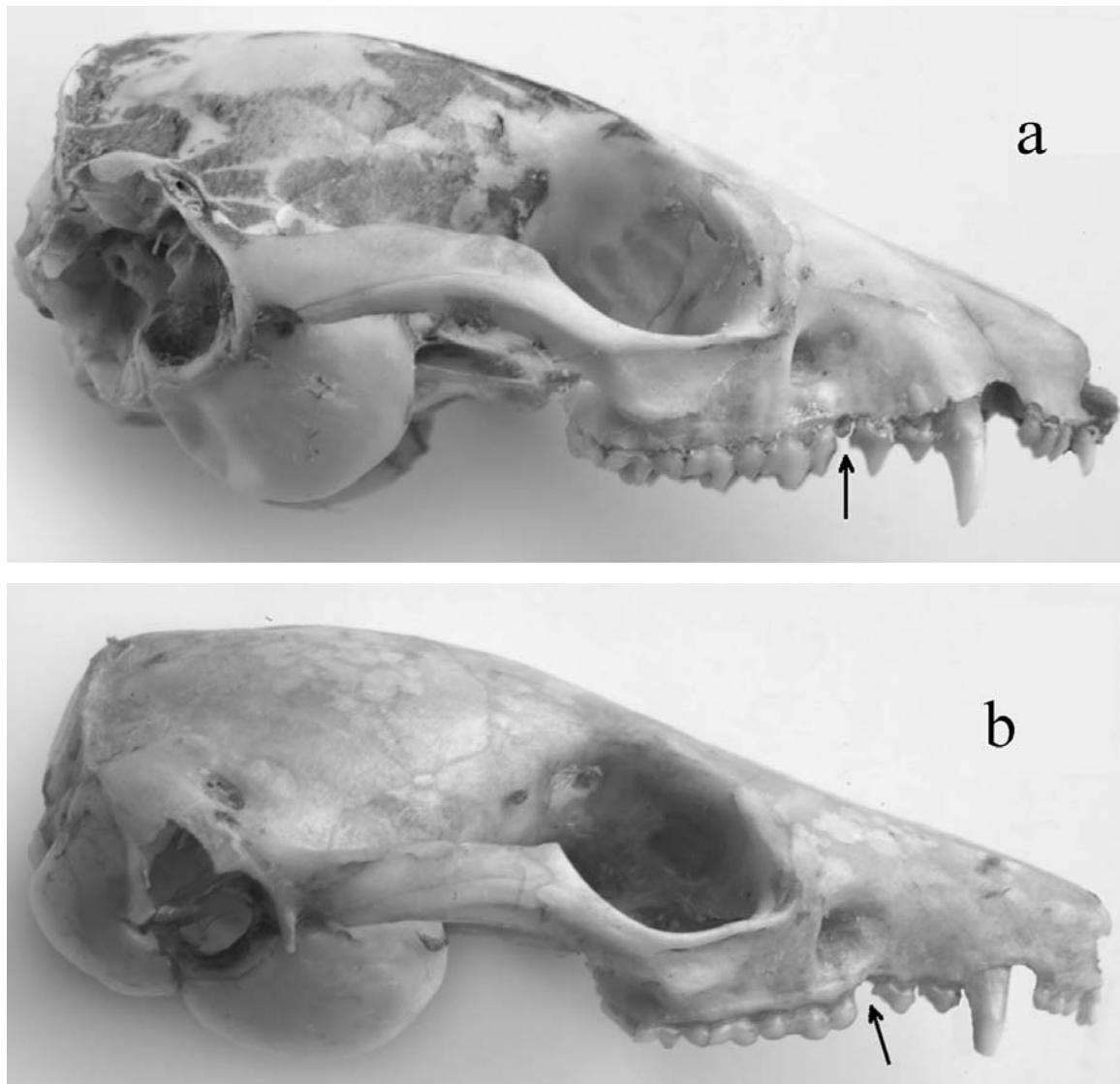


Figure 3. Lateral view of the skulls of *Dasycercus* species. a, *D. cristicauda* female (NMV C676), showing  $P^3$  (arrowed). b, *D. blythi* female (NMV C234), showing the diastema (arrowed) between  $P^2$  and  $M^1$ .

### Distribution

*Dasycercus* has a wide distribution across the arid zone of Australia (see maps in Woolley, 1995 and Australian Mammal Map Updates at <http://www.naturebase.net/science/mupdates.html>). The past and present distribution of each species requires clarification to assess their conservation status. Of the many museum specimens available, those from two areas at the species' north-western and south-western limits have been examined, in addition to those above from central Australia in the Spencer collection.

*Canning Stock Route*. Otto Lipfert, taxidermist of the Western Australian Museum, accompanied the Canning Stock Route Expedition of 1930–1931 through the north of Western

Australia. Twenty-four specimens collected by him and lodged in the South Australian Museum have been examined (Table 2). Based on the form of the tail, 13 were identified as *D. cristicauda* and 11 as *D. blythi*. The specimens were collected along the Stock Route, from Well 27 to Well 49, and both species were found in the vicinity of Wells 27, 35 and 45. Lipfert reported that he collected specimens up to 2–3 miles from well sites (McKenzie and Youngson, 1983). An indication that the two species may occupy different habitats comes from the collector's notes on two specimens: *D. cristicauda* M3107 – "top of sandhill" and *D. blythi* M3144 – "spinifex flat". The annotated map of the Stock Route accompanying the article on Mr Canning's Expeditions in Western Australia 1906–1907 and 1908–1910 (Anon, 1911) shows the positions of the wells and

Table 2. Data for 24 specimens of *Dasyurus* from the Canning Stock Route held in the South Australian Museum. Explanation as for Table 1.  
\* aberrant specimens referred to in text

Well no. (coordinates)	Reg. no. M	Date	Specimen	Sex	Reproductive status	Form of tail	No. of nipples	P <sup>3</sup>
27 (22°48'S, 123°39'E)	3140	-7.1930	spirit, skull	♀	immature	B	6	NP
"	3141	-7.1930	skin, skull	♀	-	C	-	P
28 (22°39'S, 123°45'E)	3142	-8.1930	spirit	♀	mature	C	8	P
29 (22°34'S, 125°53'E)	3143	-8.1930	skin, skull	♀	-	C	-	P
"	3144	-8.1930	skin, skull	♀	-	C	-	P
"	3154*	-8.1930	spirit, skull	♂	mature	C	-	NP
33 (22°20'S, 124°44'E)	3145	-10.1930	skin, skull	♂	-	B	-	NP
34 (22°16'S, 124°54'E)	3146	-10.1930	spirit, skull	♀	mature	B	6	dp <sup>3</sup> R
35 (22°13'S, 125°03'E)	3105	29.10.1930	skin, skull	♂	-	C	-	P
"	3147	-10.1930	skin, skull	♀	-	B	-	NP
36 (22°08'S, 125°17'E)	3106*	5.11.1930	skin, skull	♂	-	C	-	NP
"	3148	-10.1930	skin	♂	-	B	-	-
41 (21°33'S, 125°51'E)	3107	4.6.1931	skin, skull	♂	-	C	-	P
"	3150	-6.1931	skin, skull	-	-	C	-	P
42 (21°19'S, 125°53'E)	3108	24.5.1931	skin, skull	♂	-	B	-	-
43 (21°12'S, 125°54'E)	3109	17.5.1931	skin, skull	♂	-	C	-	P(L)
44 (20°02'S, 126°04'E)	3110	2.5.1931	skin, skull	♂	-	C	-	P
45 (20°48'S, 126°11'E)	3111	6.5.1931	skin, skull	♀	-	C	-	P
"	3112	18.4.1931	skin, skull	♀	-	B	-	NP
"	3113	19.4.1931	skin, skull	♂	-	B	-	NP
"	3114	18.4.1931	skin, skull	♂	-	B	-	NP
47 (20°26'S, 126°18'E)	3115*	1.4.1931	skin, skull	♂	-	B	-	P
49 (20°10'S, 126°41'E)	3117	2.3.1931	skin, skull	♀	-	B	-	NP

Table 3. Data for 13 specimens from Ooldea, Fisher and Rawlinna held in the Australian Museum. Explanation as for Table 1. \* Too young for P<sup>3</sup> to have erupted. (I<sup>1</sup> not erupted in M4923; partially erupted in others).

Locality	Reg. no. M	Date	Specimen	Sex	Reproductive status	Form of tail	No. of nipples	P <sup>3</sup>
Ooldea (30°27'S, 131°50'E)	2987	12.8.1921	skin, skull	♂	-	C	-	P
"	2988	12.8.1921	spirit, skull	♂	mature	C	-	P
"	3025	29.8.1921	spirit, skull	♂	mature	C	-	P
"	4923	23.10.1921	spirit	♂	immature	C	-	*
Fisher (30°33'S, 130°58'E)	4862	22.10.1921	skin, skull	♂	-	C	-	P
"	4863	23.10.1921	skin, skull	♀	mature	C	-	P
"	4864	23.10.1921	skin	♀	mature	C	8	-
"	4865	23.10.1921	skin, skull	♂	immature	C	-	*
"	4866	24.10.1921	skin, skull	♀	immature	C	-	*
"	4924	24.10.1921	spirit	♀	immature	C	8	*
"	31546	20.10.1921	spirit	♀	mature	C	-	P
Rawlinna (31°01'S, 125°20'E)	4355	30.7.1928	spirit, skull	♀	mature	C	8	P
"	4356	30.7.1928	skin, skull	♀	-	C	-	P

gives details of the country traversed, which includes a mixture of spinifex flats and sand-ridge country.

*Ooldea, Fisher, Rawlinna.* These localities are near the south-western limit of the distribution of *Dasyurus*. It was from Ooldea that Jones (1923) obtained his specimens of *D. cristicauda* but his material has not been located. Thirteen specimens (four from Ooldea, seven from Fisher and two from Rawlinna) held in the Australian Museum have been identified as *D. cristicauda* based on the crested tail, presence of P<sup>3</sup> in mature specimens and eight nipples in females (Table 3).

Remarks by Bolam (1925) suggest that *D. blythi* may also occur in the area. He wrote (p. 25) "This animal [the Crested-tailed phascogale], which bears the scientific name of *Dasyurus cristicauda*, is known to the blacks as Mul-gurra. Two species of the Phascogale family are found on the Nullarbor Plain and the sandhills of Ooldea. These are the Crested-tailed and the Brush-tailed; but with the exception of a small difference in the hair on the tail the species are alike in appearance and habits" [my emphasis].

The presence of the two species, *D. cristicauda* and *D. blythi*, in central Australia (the Spencer collection) and

north-western Australia (the Canning Stock Route collection) together with the possibility that both may be found in the south-western limit of the range (Ooldea/ Nullarbor Plain), suggests that the two could occur throughout much of the range.

### Common names

Mulgara, the name by which *Dasycercus cristicauda* was known to the Aboriginal people at Ooldea, has been used as its common name. Spencer (1896) knew that the Aborigines at Charlotte Waters and Illamurta used the name Amperta but it is impossible to know to which of the two species this might have applied. Many Aboriginal names for *Dasycercus* have been recorded by Finlayson (1961) and Burbidge et al. (1988), one of which, Ampurta, has been used as the common name for *D. hillieri*, here no longer recognised as distinct from *D. cristicauda*. With his recognition of two species, Troughton (1965) referred to them as the Crest-tailed Marsupial Mouse (for *D. cristicauda*) and the Western Crest-tail (for *D. blythi*). The latter common name is inappropriate because *D. blythi* is not restricted to the western part of the range, and it does not have a crested tail. Because Mulgara was a familiar common name for *Dasycercus* when it was thought by some to be a monotypic genus I propose that it be retained; with *D. blythi* to be known as the Brush-tailed Mulgara and *D. cristicauda* as the Crest-tailed Mulgara. Both species have black hairs on the distal half of the tail but the dorsal, fin-like crest of *cristicauda* provides a simple means of differentiating between the two species in the field.

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