Wyulda asherjoeli, a new phalangerid (Diprotodontia:Marsupialia) from the early Miocene of Riversleigh, northwestern Queensland

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A new phalangerid, *Wyulda asherjoeli*, is described from early Miocene limestone deposits on the Riversleigh World Heritage fossil property, northwestern Queensland. The new phalangerid is rare in the Riversleigh deposits, being represented by only three specimens from two sites. *Wyulda asherjoeli* is smaller than the only living species of the genus, *W. squamicaudata*, and is the smallest species in the family Phalangeridae. It is distinguished by its very tall, delicate premolars, and small, rectangular molars. P^3 is buttressed by a small P^2.

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THREE SPECIMENS referable to a new species of phalangerid have been recovered from Tertiary freshwater limestone deposits on the Riversleigh World Heritage fossil property in northwestern Queensland. The specimens are from Mike's Menagerie Site and Camel Sputum Site, two fossil-rich deposits interpreted to be early Miocene in age (Archer *et al.* 1995, 1997; Creaser 1997).

The Australasian family Phalangeridae includes the cuscuses, scaly-tailed and brushtail possums. The new Riversleigh species is the fifth fossil phalangerid to be described from Australia, and is the first fossil record for the genus *Wyulda*. The living *W. squamicaudata* Alexander, 1919 is today restricted to rocky outcrops, vine thickets and low, open woodland in the Kimberley region of northwestern Western Australia (Calaby 1957, Bradley *et al.* 1987, Runcie 1999).

Molecular data indicate a sister-group relationship between the living Scaly-tailed Possum *Wyulda squamicaudata* and species of *Trichosurus* (brushtail possums) but recognise their generic distinction (Baverstock 1984). On the basis of morphological similarity, Flannery *et al.* (1987a) synonymised *Wyulda* with *Trichosurus*, but this has not been followed by recent authors (e.g. Burbidge 1995, Runcie 1999).

In this paper, the new phalangerid is described and palaeoecolgical inferences are made about the presence of a species of *Wyulda* in early Miocene deposits at Riversleigh.

Fossil material referred to here is housed in the Queensland Museum fossil collection (QMF). Comparative material was borrowed from the Western Australian Museum, CSIRO Wildlife and the Australian Museum. Measurements were made using a Leica Video Microscaler and PAV electronic calipers.

SYSTEMATIC PALAEONTOLOGY

Family PHALANGERIDAE Thomas, 1888
Subfamily PHALANGERINAE Thomas, 1888
Tribe TRICHOSURINI (Flynn, 1911)

Wyulda Alexander, 1919

Type species. *Wyulda squamicaudata* Alexander, 1919

Diagnosis. Species of *Wyulda* differ from other species of phalangerid in having a P^3 that is much longer than the M^1, elongated vertically and has a narrow crest; and in the acute angle of the P^3 to the molar row, and can be further differentiated from *Trichosurus* in having upper molars that are square rather than rectangular.

Wyulda asherjoeli sp. nov. (Fig. 1)

Holotype. QMF23943, left maxillary fragment with P^{2-3} and M^{1-4}, the infraorbital foramen and the maxillary root of the zygomatic arch.

Type locality. Mike's Menagerie Site, Godthelp Hill, Riversleigh World Heritage fossil property, northwestern Queensland. The fossils occur in an unnamed formation of freshwater Tertiary limestone.

Other referred material. QMF23028, right maxillary fragment with P^3 and M^1 from Camel Sputum Site, Godthelp Hill, Riversleigh; QMF24006, right P^3 from Mike's Menagerie Site, Godthelp Hill, Riversleigh.

Distribution and age. Mike's Menagerie Site and Camel Sputum Site, Godthelp Hill, Riversleigh World Heritage fossil property, Lawn Hill National Park, northwestern Queensland: System B deposits, early Miocene (Archer *et al.* 1995, 1997; Creaser 1997)

Etymology. The species is named for Sir Asher Joel, environmentalist, organiser of major civic events, member of the NSW Parliament and founder of Carpentaria Newspapers, a supporter of the Riversleigh Centre, Mount Isa, Queensland, and the Riversleigh Project.

Diagnosis. *Wyulda asherjoeli* differs from *W. squamicaudata* in retaining P^2, having much smaller molars, and in P^3 being much taller than the molars, with a more curved crest, enlarged stylar cusps B and E, smaller metaconules and protoconules, and a more distinct anterior cingulum.

Description. Maxilla. The maxillary root of the zygomatic arch is positioned above the posterior of M^2 and the anterior of M^3. There is no ventral process on the zygomatic arch. The internal and external openings of the infraorbital canal are visible. The external opening is a circular foramen above and anterior to P^2. It is quite low on the face. The internal opening is quite large. The molar row is curved, being lingually concave. M^4 is much smaller than M^2, which is the largest molar.

Dentition. A small P^2 is present at the base of P^3, with the tip of the crown reaching the level of the base of the crown of P^3. QMF23943 is double-rooted, with a large proportion of the anterior root visible. QMF23028 has a single alveolus for this tooth.

P^3 is subovate in outline, tending towards triangular. It is set at an oblique angle to the molar row. The crest of the tooth is very narrow. The apex is ornamented with five cuspules in QMF23943 and six in QMF23028, descending posteriorly. The anterior cuspule has two ridgelets that descend to the crown base, one on the anterior face, one on the buccal face. QMF23028 has a third ridgelet lingual to the anterior ridgelet, that runs halfway down the crown. The other cuspules have small ridgelets on the buccal and lingual surfaces. There is a buccal cingulum and a less well defined lingual cingulum. P^3 is set very low in the maxilla, with the crown base being much lower than that of M^1. The crown apex is much higher than that of M^2, making a very tall tooth. QMF23028 is a much taller but slightly shorter tooth.

M^1 is a rectangular tooth. The paracone is slightly higher than the metacone. The protocone and metaconule are similar in height and lower crowned relative to the paracone and metacone. The parastyle is prominent and the anterior cingulum runs past it to the buccal side of the paracone. Stylar cusp E is also large. The ectoloph is not continuous, there being a gap between the para- and metacristae. The anterior and posterior cingula are well defined. The anterior cingulum runs buccally past the parastyle. The lophs are well developed. The anterior basin (between the anterior cingulum and the protoloph) is very small, whereas the posterior basin (between the metaloph and the posterior cingulum) is very large.

M^2 is a large, square tooth, slightly wider anteriorly than posteriorly. Stylar cusps B and E are very well defined. The paracone is distinctly higher than the metacone. The protocone and metaconule both have distinct ridges on the lingual face that run anteriorly. Other molars have faint ridges only on the protocone. As in M^1, the cristae, cingula and lophs are well developed.

M^3 is a smaller, rectangular tooth. The metacone is reduced relative to the paracone. The protoloph and metaloph are less well defined. The stylar cusps are poorly developed. M^4 is a much smaller tooth. The metaloph is absent and the protoloph poorly developed. The metacone and metaconule are very small and close together, making the tooth narrower posteriorly.

Table 1 gives tooth dimensions of *Wyulda asherjoeli* sp. nov.

Remarks. Morphological differences observed between the holotype QMF23943 and paratype QMF23028 fall within the bounds of intraspecific variation found in the modern species *W. squamicaudata*. QMF23028 has broader and shorter molars than in QMF23943 which has longer but narrower ones. In the holotype QMF23943, P^3 is longer but not as tall as that in QMF23028.

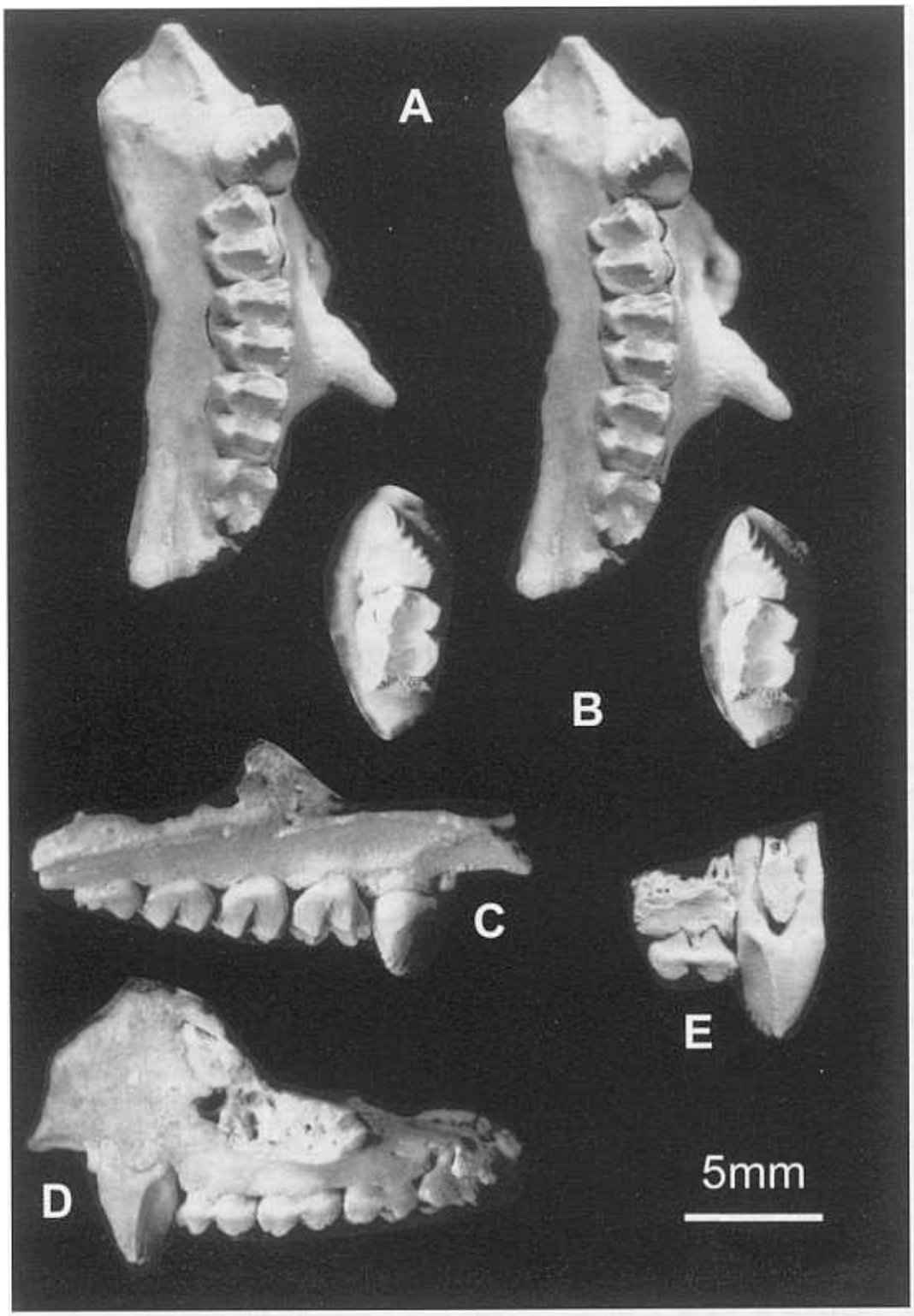

Fig. 1. Wyulda asherjoeli sp. nov. A, QMF23943, holotype, occlusal stereopair. B, QMF23028, occlusal stereopair. C, QMF23943, holotype, lingual view. D, QMF23943, holotype, buccal view. E, QMF23028, lingual view.

	QMF23943	QMF23028	QMF24006
MLR	13.76		
P3L	4.10	3.73	4.14
P3W	3.59	3.28	3.49
P3H	4.29	4.36	4.65
M1L	3.79	3.58	
M1A		3.02	
M1P		2.86	
M2L			
M2A			
M2P	3.06		
M3L	3.36		
M3A	3.03		
M3P	2.79		
M4L	2.81		
M4A	2.82		
M4P	2.11		

Table 1. Tooth measurements (in mm) of *Wyulda asherjoeli*. Abbreviations: MLR, molar row length; L, length; W, maximum width; A, anterior width; P, posterior width.

Based on the size of their teeth, *W. asherjoeli* is a much smaller and more gracile possum than its congener *W. squamicaudata*.

Synapomorphies shared by *Wyulda asherjoeli* and *W. squamicaudata* include the large size and marked elongation of P^3 relative to the M^1, and the particularly acute angle of P^3 to the molar row. Autapomorphies distinguishing *W. asherjoeli* from *W. squamicaudata* include its relatively small molars, large parastyle on M^1 and stylar cusp B on M^2, very well defined stylar cusp E, the presence of a small P^2 at the base of P^3 and the delicate nature of P^3.

DISCUSSION

Wyulda asherjoeli is the fifth extinct phalangerid to be described from Australian Tertiary deposits. The brushtail possum *Trichosurus dicksoni* and cuscus *Strigocuscus reidi* have been described previously from early to middle Miocene sediments at Riversleigh (Flannery & Archer 1987), and *T. hamiltonensis* and *S. notialis* from early Pliocene deposits at Hamilton, Victoria (Flannery *et al.* 1987b). Isolated teeth of a late Oligocene possible phalangerid are known from the Geilston Bay Local Fauna (Tedford *et al.* 1975). Tedford & Kemp (1998) suggested that these belonged to a species of petauroid, but the well defined lophs on some of the isolated teeth are much more characteristic of phalangerids. A number of phalangerid taxa from Riversleigh remain to be described. The precise relationships of Tertiary phalangerids to each other, and to modern species, are currently being examined (by K.C.) as part of a broader research project.

Wyulda asherjoeli is the smallest phalangerid known, living or extinct. Its estimated body weight, based on molar measurements, is 660 g (Myers 2001). All other phalangerids weigh, or are interpreted to weigh, more than one kilogram. Within the broader group of phalangeroids, the only species that is smaller is the extinct miralinid *Durudawiri inusitatus*, also from the Miocene of Riversleigh (Crosby & Archer 2000), with an estimated body weight of 440 g (Myers 2001).

Another striking feature of the new fossil species *W. asherjoeli*, possibly related to its diet, is its very tall but narrow and gracile P^3. In the modern *W. squamicaudata* P^3 is similarly gracile but it is not as tall and is longer with respect to its width. In *D. inusitatus* P^3 is very tall with respect to its molars but is very robust. The living *W. squamicaudata* feeds on eucalypt blossoms (Calaby 1957, Burbidge 1995) and the leaves of *Xanthostemon* spp. and *Planchonia* sp. (Runcie 1999). In captivity, it has been observed to eat fruits, nuts and insects (Burbidge 1995).

The living *W. squamicaudata* is restricted to the Kimberley region of northwestern Western Australia and is described as being rare within its range with a patchy distribution (Burbidge 1995). *Wyulda asherjoeli* appears to be similarly rare within the Riversleigh deposits, with only three specimens being known from two sites, despite large collections of fossil vertebrates being made from each of these sites and dozens of other sites. Camel Sputum Site in particular has produced many vertebrate species including a high diversity of possums. Represented are two cuscus species and possibly two brushtail possum-like species, as well as *Wyulda asherjoeli*. The brushtail possum-like species are the most abundant, based on number of specimens collected, while the cuscus species are represented by a small number of specimens. Other possums described from Camel Sputum site are the Riversleigh *Burramys*, *B. brutyi* (Brammall & Archer 1997), the pseudocheirids *Paljara maxbourkei*, *P. nancyhawardae* (Bassarova *et al.*, this volume) and the petaurid *Djaludjangi yadjana* (Brammall, 1998). This array of possums is consistent with the suggestion that Riversleigh sites of this age represent rainforest faunas (Archer *et al.*, 1989, 1995).

Mike's Menagerie and Camel Sputum Sites lie at approximately the same stratigraphic level within the Riversleigh sequence and are interpreted to be early Miocene in age (Creaser 1997). The depositional environment at Riversleigh in the early Miocene is interpreted to have been rainforest (Archer *et al.* 1995). The preferred habitat of the extant *W. squamicaudata* in the Kimberley area is quite different, being described as low open woodland and vine thickets (Humphreys *et al.* 1984, Burbidge 1995, Runcie 1999) in a region experiencing a monsoonal climate, with a wet and a dry season. Within that habitat it uses crevices in rocky outcrops as dens rather than tree hollows which are rare in that area (Runcie 1999).

The early Miocene rainforests of Riversleigh grew on a limestone substrate riddled with caves, crevices and rocky outcrops (Archer *et al.* 1989, 1997). A penchant for using rock crevices as dens may have characterised early members of this lineage.

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