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The Chinchilla Local Fauna: an exceptionally rich and well-preserved Pliocene vertebrate assemblage from fluviatile deposits of south-eastern Queensland, Australia

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The Chinchilla Sand is a formally defined stratigraphic sequence of Pliocene fluviatile deposits that comprise interbedded clays, sands, and conglomerates located in the western Darling Downs, south-east Queensland, Australia. Vertebrate fossils from the deposits are referred to as the Chinchilla Local Fauna. Despite over a century and a half of collection and study, uncertainties concerning the taxa in the Chinchilla Local Fauna continue, largely from the absence of stratigraphically controlled excavations, lost or destroyed specimens, and poorly documented provenance data. Here we present a detailed and updated study of the vertebrate fauna from this site. The Pliocene vertebrate assemblage is represented by at least 63 taxa in 31 families. The Chinchilla Local Fauna is Australia's largest, richest and best preserved Pliocene vertebrate locality, and is eminently suited for palaeoecological and palaeoenvironmental investigations of the late Pliocene.

Key words: Mammalia, Marsupialia, vertebrate fauna, Pliocene, Darling Downs, southeast Queensland, Australia.

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Introduction

The Pliocene was the time when most modern Australian mammal genera emerged and began to dominate ecosystems (Black et al. 2012b). While the majority of Earth's landmasses were similar to those of today, by the middle Pliocene global mean annual temperatures were approximately 3°C higher than today (Chandler et al. 1994; Sloan et al. 1996). The late Pliocene (ca. 3.6–2.6 million years ago) represents the last time when the Earth experienced temperatures similar to those predicted for the end of the 21st century (Salzmann et al. 2009). This period represents "an unparalleled paleo-laboratory for testing the sensitivity of models that we rely upon for simulating future climate change" (Salzmann et al. 2009: 190).

In Australia, the Pliocene marked a major turning point in the evolution of terrestrial vertebrates. The late Miocene was characterized by cool and dry conditions (Zachos et al. 2001). Global mean annual temperatures rose during the early to middle Pliocene (Haywood et al. 2009), and several lines of evidence point towards a Pliocene aridification trend in Australia (Krebs et al. 2011). As a result of this shift, woodlands contracted markedly and the first significant grasslands developed (Martin 2006). The transition from closed to more open vegetation saw a major evolutionary change in terrestrial faunas, including not only an increase in the diversity of grazing (grass-eating) species, but also gigantism of several lineages such as the herbivorous diprotodontoids and macropodids (Price and Piper 2009). The Pliocene also saw the emergence of *Macropus*, the long-faced kangaroos that are the most speciose macropodids in Australia today.

Understanding how mammal species responded to Pliocene warming is critical for predicting how future global warming might impact modern species and for "ground-truthing" climate models that seek to simulate future change. Unfortunately, Pliocene vertebrate fossil deposits are relatively rare in Australia, especially in comparison to Miocene and Pleistocene assemblages, making it difficult to track the trends towards modernity of Australian late Cenozoic faunas (Tedford et al. 1992, 2006). One of the richest deposits with Pliocene vertebrates is the Chinchilla Sand, Darling Downs, southeastern Queensland (Fig. 1). This deposit has produced thousands of fossils, many now housed at the Queensland Museum, making it the largest single collection of Pliocene fossil vertebrates in Australia (Price 2012). Many new species have

been described from Chinchilla material, and most previous studies have focussed on the taxonomy of marsupials, such as macropodids (e.g., Bartholomai 1973, 1975).

Despite a voluminous literature on the Pliocene fauna from the Chinchilla Sand, its palaeontological significance is poorly understood. This is because: (i) few studies have provided a detailed overview of the total fauna; (ii) type and referred specimens of some taxa have either not had registration numbers assigned, or numbers have been incorrectly cited; (iii) type material of some taxa has been either destroyed or is missing from collections; and (iv) many taxa supposedly from Chinchilla have poorly constrained collecting information. The result is some uncertainty and probable errors regarding the species present in the fauna (e.g., Mackness and Godthelp 2001). Accurate species lists are critical for making palaeoecological inferences, reconstructing palaeoenvironments and exploring changes in animal communities over time and in response to climatic events. The aim of this paper is to integrate the extensive taxonomic literature of the Pliocene Chinchilla Local Fauna.

Geographic and geological setting

The fossil deposits of the Darling Downs are divided roughly into two major collecting areas: the eastern Darling Downs which contains predominantly Quaternary fossil deposits (Price et al 2005; Webb et al. 2007; Price et al. 2011); and the western Darling Downs (including the township of Chinchilla and surrounds), which are mostly Pliocene (Bartholomai and Woods 1976). The Chinchilla Sand, previously referred to as the Chinchilla Formation by Woods (1956) and incorporating the Chinchilla Conglomerate of Etheridge (1892), is a series of fluviatile deposits exposed along the Condamine River, extending over 65 km from Nangram Lagoon to Warra (Fig. 1) (Bartholomai and Woods 1976; Price 2012).

The Chinchilla Sand is a thick (~30 m) sequence of interbedded gravels, sands and clays exposed in many inter-connected gullies and erosional depressions representing multiple episodes of deposition (Fig. 2). The sands and clays are typically weakly consolidated, whereas the associated gravel conglomerate is heavily cemented by calcium carbonate. The sediments are most likely derived from the Orallo Formation and associated lateritized soil profiles (Bartholomai and Woods 1976). The Chinchilla Sand sits

unconformably on Mesozoic rocks (Bartholomai and Woods 1976), and is overlain by Quaternary alluvia in some parts.

Vertebrate fossils from the Chinchilla Sand are typically referred to as belonging to the Chinchilla Local Fauna (Archer and Bartholomai 1978), although this likely time-averages several faunal components. The Chinchilla Sand has not been directly dated, but the faunal composition is similar to that of the Kanunka and Toolapinna Local Faunas of the Tirari Formation (Tedford et al. 1992), Lake Eyre Basin, central Australia. Combined lithostratigraphic, biostratigraphic and palaeomagnetic analyses suggest that these faunas occur close to the Gilbert-Gauss Boundary (Tedford et al. 1992), at approximately 3.6 Ma (Piacenzian-Zanclean boundary; Ogg 2012). The paleoenvironment of Chinchilla during the period of fossil deposition included tropical forests, wetlands, and grasslands (Montanari et al. 2013).

Associated with the vertebrate fauna are fossil plants of putative Tertiary age. Silicified woods, including *Mesembrioxylon fusiforme* and *M. fluviale*, were described from the Condamine River, west of Fairymeadow, Chinchilla (Sahni and Dunstan 1920). In a foreword of their paper (Sahni and Dunstan 1920), Sahni and Dunstan noted that while the silicified wood occurred with the vertebrates, it might have been derived from the underlying Jurassic sediments. The silicified wood has been referred to the form-genus *Mesembrioxylon*, which is recorded from both Mesozoic and Tertiary sediments. Rigby (1995) also recorded a silicified *Cocos nucifera* L. fruit from the Pliocene sediments at Chinchilla, but Conran and Rozefelds (2003) queried this identification, noting that as the specimen had not been sectioned its affinities were unsubstantiated. They also similarly noted, as Sahni and Dunstan (1920) had much earlier, the likelihood that the silicified material was reworked from Jurassic or older sediments, which makes the identification of the fruit as a palm highly unlikely. Fragments of non-silicified, calcium carbonate-indurated wood occur with the vertebrate material and are possibly Pliocene in age (Andrew Rozefelds personal observation 2013). The Chinchilla plants are probably irrelevant in understanding the palaeoecology of the Chinchilla Sand if the material is reworked from older sediments (Andrew Rozefelds personal communication 2013).

Methods

We have attempted to identify every taxon that has been published from the Pliocene Chinchilla Sand, with the exception of those mentioned only in conference abstracts. We provide an abbreviated systematic palaeontology to the lowest taxonomic levels possible; a list of representative registered specimens for each taxon (where possible); the published authority of each taxon's record; illustrations of representative fossil material as assigned to each taxon (where possible); and brief but pertinent taxonomic, systematic and/or literary remarks for each taxon. Although every effort was made to locate every taxon published from Chinchilla, some specimens are missing from collections. This is noted.

Institutional abbreviations.—BMNH, British Museum of Natural History, London, UK; Cat. No., Queensland Museum Category Number (refers to the old Queensland Museum indexing system), Brisbane, Australia; FV, Private collection, Terry Poole, Brisbane, Australia; QMC, Queensland Museum Collection, Brisbane, Australia; QM F, Queensland Museum Fossil, Brisbane, Australia; UCR, Department of Earth Sciences, University of California, Riverside, USA; WPC, Wilkinson Private Collection, Chinchilla, Australia.

Systematic palaeontology

Class Sarcopterygii Romer, 1955

Subclass Dipnoi Müller, 1845

Family Ceratodontidae Gill, 1873

Genus *Metaceratodus* Chapman, 1914

Type species: *Metaceratodus wollastoni* Chapman, 1914, Lightning Ridge, NSW, early Cretaceous.

Metaceratodus palmeri (Krefft, 1874)

Fig. 3A.

Material.—QM F10537 (upper tooth plate), F10540 (upper jaw), F6564 (upper jaw), F13255 (lower jaw), F13259 (lower jaw) from Chinchilla; Pliocene.

Remarks.—The extant lungfish *Neoceratodus forsteri* was described by Krefft (1870). Later, Krefft (1874: 293) acknowledged receipt of the cast of an extinct species of lungfish found "in the alluvial deposits of the Darling Downs district of Queensland", but without additional locality information. According to the note, Krefft had named the species *Ceratodus palmeri*, after the then Colonial Secretary of Queensland; however, according to de Vis (1884), Krefft did not publish a formal description of the taxon. Further, de Vis (1884) suggested that the range of variation exhibited by *N. forsteri* was sufficient to account for the differences between this species and *Metaceratodus* (then still *Ceratodus*) *palmeri*, and synonymised both taxa. He also provided information on the provenance of additional specimens attributable to *M. palmeri*, including Krefft's holotype, stating that they came from the "Chinchilla conglomerate" (= Chinchilla Sand). *Metaceratodus palmeri* was subsequently mentioned by Turner (1982) and Lees (1986), in their reviews on fossil fish held in the QM. Kemp and Molnar (1981), as part of a study on lungfish from Lightning Ridge, NSW, re-examined the synonymy of *N. forsteri* and *M. palmeri*, and concluded that they were, in fact, distinct species. That taxonomy was later followed in Kemp's (1991) subsequent review of Australian lungfish. Kemp (1997b) later reassigned the original Chinchilla fossil lungfish to the genus *Metaceratodus*, including referral of QM F10537 as a cast of the holotype of *Metaceratodus palmeri* (BMNH 45868). However QM F10537 (Fig. 3A) is not a cast; as such, the reason for its designation as a copy of the holotype is unclear.

Stratigraphic and geographic range.—Pliocene to Pleistocene; eastern mainland Australia.

Family Neoceratodontidae Miles, 1977

Genus *Neoceratodus* de Castelnau, 1876

Type species: *Neoceratodus forsteri* (Krefft, 1870), Burnett River, Qld, Recent.

Neoceratodus forsteri (Krefft, 1870)

Fig. 3B.

Material.—QM F10539 (three toothplates); F56224 (toothplate) from Chinchilla; Pliocene.

Remarks.—Two fossil lungfish specimens (FV O355 and FV O616) from Chinchilla were assigned to *Neoceratodus forsteri* by Kemp (1997a). Unfortunately, both specimens are from the private collection of Terry Poole, and thus not easily accessible. Three toothplates, registered together as QM F10539, (originally described as *M. palmeri*) are referable to *N. forsteri*.

Stratigraphic and geographic range.—Cretaceous to Recent; eastern mainland Australia.

Class Reptilia Laurenti, 1768

Order Testudines Linneaus, 1758

Family Trionychidae Fitzinger, 1826

Trionychidae gen. et sp. indet.

Fig. 4J.

Material.—QM F9037 (carapace fragment) from Fairymeadow near Chinchilla; probably Pliocene.

Remarks.—De Vis (1894b) described seven carapace fragments of a single individual (QM F1101) as *Trionyx australiensis* from the Darling Downs, possibly from the Chinchilla Sand. However, in the absence of locality data, the preservation led Bartholomai (Gaffney and Bartholomai 1979) to suggest that they may have instead come from Tara Creek, Queensland. Gaffney and Bartholomai (1979) concluded that *T. australiensis* was only known from small carapace fragments and referred the taxon to Trionychidae indeterminate. They later described a specimen referred to Trionychidae sp. indet. from the ‘Southwest of Chinchilla”, and hence presumably from the Chinchilla Sand. That specimen was also listed in Gaffney’s (1981) review of Australian turtles. Molnar (1982a) in his review of the reptile fossil material of Queensland lists only *Emydura* sp. as definitively from the Chinchilla Sand, although he also refers the Trionychidae sp. indet. as coming from Fairymeadow near Chinchilla.

Family Chelidae Gray, 1831

Genus *Emydura* Bonaparte, 1836

Type species: *Emydura macquarrii* (Gray, 1830), Maquarie River, NSW, Recent.

Emydura sp.

Fig. 4A.

Material.—QM F7035 (anterior half of carapace), F7034 (anterior half of plastron), F9038 (symphyseal region), F9039 (left dentary) from Chinchilla; Pliocene.

Remarks.—Gaffney (1981) described QM F7034 from Middle Gully, near the type section of the Chinchilla Sand, QM F7035 from Chinchilla Sand, while QM F9038 and F9039 are also presumed to be from Chinchilla Sand based on preservation (Alan Bartholomai personal communication cited in Gaffney 1981).

Order Crocodylia Owen, 1842

Family Crocodylidae Cuvier, 1807

Genus *Pallimnarchus* de Vis, 1886

Type species: *Pallimnarchus pollens* de Vis, 1886, type locality and age unknown.

Pallimnarchus pollens de Vis, 1886

Fig. 4E.

Material.—QM F11612 (symphyseal portion of dentary), F1154 (premaxilla), F1166 (quadrate), F30583 (femur) from Chinchilla; Pliocene.

Remarks.—De Vis (1886) described crocodilian material from the "Condamine drift" to which he assigned the name *Pallimnarchus pollens.* Molnar (1982b: 658) states that “De Vis did not designate a type specimen for *Pallemnarchus pollens* [sic], but described together material from four (possibly five) individuals of at least two, probably three, different taxa. De Vis' intention with regard to the type material cannot be deduced from the labels or the register entries, as the former treat all the specimens described by de Vis (1886), with the exception of the maxillary piece, as syntypes, while the register designates QM F1149 (two articulated dentaries) as the type. The maxillary piece figured by de Vis (1886: pl. X) was not recognised in the collections.” Molnar (1982b) formalised the species *Pallimnarchus pollens* by designating a symphyseal portion of the dentary as the lectotype (F1149), noting that while the type locality was unknown, it was probably from the Darling Downs. He did refer several Chinchilla specimens (including QM F11612,

F1154, and F1166) to this species. Willis and Molnar's (1999) revision of this genus does not change that. Subsequently, Mackness et al. (2010) added an additional pathological specimen (QM F30583) to the hypodigm (a femur showing fracture and puncture wounds).

Stratigraphic and geographic range.—Pliocene to Pleistocene; central and eastern mainland Australia.

Genus *Quinkana* Molnar, 1981

Type species: *Quinkana fortirostrum* Molnar, 1981, Tea Tree Cave near Chillagoe, Qld, Pleistocene.

Quinkana sp.

Fig. 4H.

Material.—QM F10204 (tooth), F10205 (tooth), F1152 (jugal) from Chinchilla; Pliocene.

Remarks.—Molnar (1981) refers to two isolated teeth and a jugal from a ziphodont crocodile from the Chinchilla Sand. He considered them to be referrable to *Quinkana*.

Order Squamata Oppel, 1811

Family Agamidae Hardwicke and Gray, 1827

Agamidae gen. sp. indet.

Fig. 4B–D.

Material.—None known.

Remarks.—Specimens supposed to represent agamids by Hutchinson and Mackness (2002) previously held in a private collection (WPC) were accessioned into the collections of the QM (see SOM: Table 1, Supplementary Online Material available at http://app.pan.pl/SOM/appXX-Louys_Price_SOM.pdf). However the specimen referred to the Agamidae by Hutchinson and Mackness (2002; WPC1354) does not correspond with the specimen of that number donated to the QM by the collectors (Ces and Doris Wilkinson, WPC). The specimen in question (now registered as QM F56197; Fig. 4B–D) is a damaged and poorly preserved fossil in three pieces which can at best be referred to indeterminate ?Reptilia. A similar

error most likely explains the incorrect assignment of several specimens referred to as ?*Megalania* by Hutchinson and Mackness (2002), which are clearly not squamates (see below).

Family Gekkonidae Gray, 1825

Genus *Diplodactylus* Gray, 1832

Type species: *Diplodactylus vittatus* Gray, 1832, Australia, Recent.

Diplodactylus sp. cf. *Diplodactylus steindachneri* Boulenger, 1885

Material.—QM F30573 (right maxilla), F30574 (left parietal), F30572 (partial right mandible) from Chinchilla; Pliocene.

Remarks.—Specimens were recovered from synonymous locations "Wilkinson's Quarry" or "Quarry Site" (Hutchinson and Mackness 2002). Those authors suggest that the specimens are the remains from a single individual.

Family Scincidae Gray, 1825

cf. *Cyclodomorphus* Fitzinger, 1843

Material.—QM F30568 (partial dentary) from Chinchilla; Pliocene.

Remarks.—This specimen was recovered from "Wilkinson's Quarry" (Hutchinson and Mackness 2002).

Genus *Tiliqua* Gray, 1825

Type species: *Tiliqua scincoides* (White, 1790), Australia, Recent.

Tiliqua wilkinsonorum Hutchinson and Mackness, 2002

Material.—QM F30567 (holotype; right dentary) from Chinchilla; Pliocene.

Remarks.—This specimen was recovered from "Wilkinson's Quarry" (Hutchinson and Mackness 2002). While having been assigned a QM specimen number, the specimen has never been received by the museum.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Family Varanidae Merrem, 1820

Genus *Varanus* Merrem, 1820

Type species: *Varanus varius* (White, 1790), Australia, Recent.

Varanus komodoensis Ouwens, 1912

Fig. 4F.

Material.—QM F874 (right maxilla), F42105 (partial right maxilla), F870 (partial left dentary), F871 (partial left dentary), F42156 (quadrate), F25392 supraorbital), F866 (scapulacoracoid), F53954 (partial left humerus), F53955 (partial right humerus) from Chinchilla; Pliocene.

Remarks.—De Vis (1889b) erected the species *Varanus dirus* on the basis of a single tooth from King Creek, Darling Downs. He later assigned the first lizard material described from Chinchilla, a partial maxilla (QM F874) to that species (de Vis 1900), a referral that was later confirmed by Feférváry (1918). Hecht (1975), in his review of *Megalania*, subsumed *Varanus dirus* into *Megalania prisca*; however, he could not confidently refer de Vis's maxillary fragment to either *Megalania* or *Varanus komodoensis*. He also referred four vertebrae from Chinchilla (QM C20 and C106) to *Megalania* sp. (Molnar 1982a; Lees 1986). Several additional varanid specimens were assigned to ?*Megalania* sp. and *Varanus* sp. by Hutchinson and Mackness (2002). Those specimens were then part of a private collection (WPC); however, ten of the twelve specimens were later donated to the QM and have been assigned registration numbers (SOM: table 1). Of those, four are clearly not varanid, (SOM: table 1) and this is probably due to either numbers being incorrectly quoted or the result of typographical errors (see comments for Agamidae gen. et sp. indet.). The six specimens that are varanid (QM F56191–56196) are comparable with *Varanus komodoensis* and are here assigned to that species. Hocknull et al. (2009) referred several QM specimens from Chinchilla, including de Vis's (1900) maxillary fragment and several previously unidentified specimens, to *Varanus komodoensis*.

Stratigraphic and geographic range.—Pliocene to Recent; eastern Australia (fossil only) and Indonesia.

Varanus sp.

Fig. 4I.

Material.—QM F56189 (dorsal vertebra), F56190 (dorsal vertebra) from Chinchilla; Pliocene.

Remarks.—Both specimens were referred to *Varanus* sp. by Hutchinson and Mackness (2002) under WPC numbers (see SOM: table 1).

Family Madtsoiidae Hoffstetter, 1961

Genus *Yurlunggur* Scanlon, 1992

Type species: *Yurlunggur camfieldensis*, Scanlon, 1992, north central Northern Territory, middle Miocene.

Yurlunggur sp.

Material.—QM F30560 (cast of a vertebra) from Chinchilla; Pliocene.

Remarks.—Mackness and Scanlon (1999) referred the first snake fossil described from the Chinchilla Sand to *Yurlunggur* sp. While assigned a QM number, the specimen has never been received by the museum.

Class Aves Linneaus, 1758

Order Casuariiformes Sclater, 1880

Family Casuariidae Kaup, 1847

Genus *Dromaius* Vieillot, 1816

Type species: *Dromaius novaehollandiae* (Latham, 1790), Syndey, NSW, Recent.

Dromaius novaehollandiae (Latham, 1790)

Fig. 5K.

Material.—QM F56203 (third trochlea of the tarsometatarsus) likely from Chinchilla; Pliocene.

Remarks.—De Vis (1892: 446) described several specimens (QM F1121, F56202 [originally F1143, in part], F56204 [originally F1143, in part] and a “calcaneal region of another metatarse” [specimen missing] which he referred to *Dromaius patricius*. De Vis (1892) also erected a new species of emu, *D. gracileps* (QM F1142) and kiwi, *Metapteryx bifrons* (QM F1135). All three species were synonymised with the modern

emu *D. novaehollandiae* by Patterson and Rich (1987). These authors described an additional specimen, also originally numbered QM F1143—a third trochlea of the tarsometatarsus (QM F56203)—and assigned it to *D. novaehollandiae*. Confusingly, three *D. novaehollandiae* specimens were registered, in addition to a specimen referred to *Leipoa (Progura) gallinacea*, as QM F1143. In order to avoid further confusion, all the *D. novaehollandiae* specimens have now been assigned new, individual QM F numbers (QM F56202-56204).

De Vis (1892) did not give a location for any of these specimens, but it is likely that all his specimens came from Chinchilla, following Olson's (1975) inference regarding the origin of the specimens described by de Vis (1888c) (see Remarks for *Gallinula morterii*). It is unclear why Patterson and Rich (1987) only identified one of the original QM F1143 specimens (the third trochlea of the tarsometatarsus, QM F56203) as coming from Chinchilla, the other two being ascribed to the eastern Darling Downs. That designation is reflected on both on the specimen labels, and yet the QM registry book records all four specimens originally registered as QM F1143 as coming from the "Darling Downs". We accept a "Darling Downs" provenance (inclusive of both the Pleistocene eastern Darling Downs and the Pliocene western Darling Downs), although we consider it likely that all four specimens (three *D. novaehollandiae* and one *L. gallinacea*) originally registered as QM F1143, are from Chinchilla.

Finally, it does not appear that de Vis (1892) mentioned the third trochlea of the tarsometatarsus (QM F56203) described by Patterson and Rich (1987); however, de Vis probably recorded this specimen as a "calcaneal region of another metatarse" (de Vis 1892: 446). If correct, this would: (i) explain why all three QM F1143 emu specimens were given the same registration number; (ii) account for the missing "calcaneal region" specimen; and (iii) resolve the disparity in locations recorded for the different specimens.

Stratigraphic and geographic range.—Pliocene to Pleistocene; Australia.

Order Galliformes Temmink, 1820

Family Megapodiidae Lesson, 1831

Genus *Leipoa* Gould, 1840

Type species: *Leipoa ocellata* Gould, 1840, Australia, Recent.

Leipoa gallinacea (de Vis, 1888)

Fig. 5D.

Material.—QM F1132 (partial carpometacarpus), F5558 (partial scapula) from Chinchilla; Pliocene.

Remarks.—These two Chinchilla specimens, one assigned to *Chosornis praeteritus* by de Vis (1889a) and the other to Otididae sp. indet. by de Vis (1888c) were subsequently referred to *Progura gallinancea* by van Tets (1974). *Progura* was subsumed into *Leipoa* by Boles (2008).

Stratigraphic and geographic range.—Pliocene to Pleistocene; eastern Australia.

Order Anseriformes (Wagler, 1831)

Family Anatidae (Leach, 1819)

Genus *Biziura* Stephens, 1824

Type species: *Biziura lobata* Shaw, 1796, Australia, Recent.

Biziura lobata Shaw, 1796

Fig. 5B.

Material.—QM F1125 (partial left humerus), F1133 (left tarsometatarsus), F7057 (left femur) from Chinchilla; Pliocene.

Remarks.—Olson (1977) referred species formerly assigned to *Dendrocygna validipinnis* and *Biziura exhumata* by de Vis (1888c) to the extant Musk duck, *Biziura lobata*. Olson (1977) noted that one specimen (QM F5551), supposedly from Chinchilla, had a different preservation, and might come from the late Pleistocene Darling Downs deposits.

Stratigraphic and geographic range.—Pliocene to Recent; Australia.

Genus *Anas* Linneaus, 1758

Type species: *Anas platyrhynchos* Linneaus, 1758, Europe, Recent.

Anas superciliosa Gmelin, 1789

Fig. 5F.

Material.—QM F1122 (partial right humerus), F5550 (left coracoid) from Chinchilla; Pliocene.

Remarks.—De Vis (1888c) described a new species of duck, *Nyroca robusta*, from Chinchilla. This species was considered by Olson (1977) to be indistinguishable from the living Pacific black duck, *Anas superciliosa*.

Stratigraphic and geographic range.—Pliocene to Recent, Australia, New Guinea, New Zealand, Indonesia, Pacific.

Genus *Aythya* Boie, 1822

Type species: *Aythya marila* (Linneaus, 1761), Europe, Recent.

Aythya australis Eyton, 1838

Fig. 5A.

Material.—QM F1123 (left coracoid), F1124 (left tibiotarsus) from Chinchilla; Pliocene.

Remarks.—Olson (1977), continuing his review of de Vis's (1888c) ducks, referred two other Chinchilla species (*Nyroca recluse* and *Anas elapsa*) to the extant White-eyed duck *Aythya australis*.

Stratigraphic and geographic range.—Pliocene to Recent; Australia.

Order Phalacrocoraciformes Christidis and Boles, 2008

Family Phalacrocoracidae Reichenbach, 1850

Genus *Microcarbo* Bonaparte, 1856

Type species: *Microcarbo pygmaeus* (Pallas, 1773), Europe, Recent.

Microcarbo melanoleucos Vieillot, 1817

Fig. 5E.

Material.—QM F1130 (right humerus) from Chinchilla; Pliocene.

Remarks.—De Vis (1888c) described a species of Anhingidae on the basis of a specimen from Chinchilla which he called *Plotus parvus*. Miller (1966a) revised that diagnosis and assigned the specimen to *Halietor* (now *Microcarbo*) *melanoleucos*, synonymising *Plotus parvus* with the extant species.

Stratigraphic and geographic range.—Pliocene to Recent; Australia, Indonesia, New Guinea, New Zealand, Pacific.

Order Pelecaniformes Sharpe, 1891

Family Pelecanidae Rafinesque, 1815

Genus *Pelecanus* Linneaus, 1758

Type species: *Pelecanus onocrotalus* Linneaus, 1758, Europe, Recent.

Pelecanus proavus de Vis, 1892

Material.—Unknown missing specimen (holotype) probably from Chinchilla; Pliocene.

Remarks.—De Vis (1892) described a new species of pelican on the basis of two specimens possibly from Chinchilla (see remarks in *Gallinula morterii*). Miller (1966b) reviewed the one remaining specimen available for study (QM F1141), and concluded that it was not referable to Pelicanidae. He compared de Vis's (1892) illustration of the other specimen, the holotype of *Pelicanus proavus*, with the modern pelican and could find no characters to distinguish them. However, Rich and van Tets (1981) disagreed with that assessment due to the quality of de Vis's illustrations, and reserved judgement on *P. proavus* until the original specimen is located, a view we support.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Ciconiiformes Bonaparte, 1854

Family Ciconiidae Sundevall, 1836

Genus *Ciconia* Brisson, 1760

Type species: *Ciconia ciconia* (Linneaus, 1758), Europe, Recent.

Ciconia nana (de Vis, 1888)

Fig. 5H.

Material.—QM F1131 (lectotype; distal right tibiotarsus), QM F5514 (paralectotype; proximal right ulna) from Chinchilla; Pliocene.

Remarks.—De Vis's (1888c) description of a stork from Chinchilla (*Xenorhynchus nanus*) was reviewed by Boles (2005), who agreed with the specific diagnosis, but assigned the species to the extant genus *Ciconia*. Boles (2005) erected the appropriate lectotypes on the basis of Chinchilla material from the north bank of the Condamine River, 5 km from the town of Chinchilla.

Stratigraphic and geographic range.—Pliocene to Pleistocene; central and eastern Australia.

Order Falconiformes Sharpe, 1874

Family Accipitridae Vigors, 1824

Genus *Necrastur* de Vis, 1892

Type species: *Necrastur alacer* de Vis, 1892, type locality unknown but probably Chinchilla; Pliocene.

Necrastur alacer de Vis, 1892

Fig. 5I.

Material.—QM F1136 (proximal right humerus), F5552 (distal right ulna) probably from Chinchilla, Pliocene.

Remarks.—The species was described de Vis (1892), and is therefore of possible Chinchilla provenance (see remarks in *Gallinula morterii*). These two specimens were listed by Rich and van Tets (1982), but as *?Harpyopsis* and Butonidae. They stated that a revision of the taxon was in preparation at the time, presumably by them. We were unable to locate the material, and until a revision is published, we follow the taxonomy as currently published.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Gruiformes Bonaparte, 1854

Family Rallidae Rafinesque, 1815

Genus *Fulica* Linneaus, 1758

Type species: *Fulica atra* Linneaus, 1758, Europe, Recent.

Fulica atra Linneaus, 1758

Fig. 5C.

Material.—QM F1129 (proximal right humerus) from Chinchilla; Pliocene.

Remarks.—Olson (1975) synonymised *Fulica prior*, originally described by de Vis (1888c), with *Fulica atra*.

Stratigraphic and geographic range.—Pliocene to Recent; Europe, Asia, Australia, Africa.

Genus *Gallinula* Brisson, 1760

Type species: *Gallinula chloropus* (Linnaeus, 1758), Europe, Recent.

Gallinula mortierii du Bus, 1840

Fig. 5G.

Material.—F1138 (distal right humerus), F1144 (right humerus), F1128 (left tarsometatarsus), F5554 (tibia), F5555 (tibia), F1126 (distal right tarsometatarsus), F7008 (femur), F7007 (femur), F7009 (tibia), F7029 (proximal tibiotarsus), F7030 (distal tibiotarsus), F7058 (partial humerus) from Chinchilla, Pliocene.

Remarks.—Olson (1975) synonymised four species described by de Vis (1888c), namely *Gallinula strenuipes, Gallinula peralata, Tribonyx effluxus*, and *Porphyrio mackintoshi* into *Gallinula (Tribonyx) mortierii*. Olson (1975) also drew attention to the fact that de Vis's (1892) account of fossil birds lacked an introduction, and inferred that it was meant as a continuation of de Vis (1888c). In the introduction, de Vis (1888c: 1277) refers to specimens "yielded by the Darling Downs in the immediate neighbourhood of Chinchilla". It is therefore probable that all the specimens mentioned by de Vis (1892) came from the

Chinchilla Sand. QM F7029 and F7030 represent two parts (proximal and distal tibiotarsus, respectively) of the same specimen.

Stratigraphic and geographic range.—Pliocene to Recent; Australia.

Order Charadriiformes Huxley, 1867

Charadriiformes gen. et sp. indet.

Fig. 5J.

Material.—QM F5543 (proximal left femur) from Chinchilla; Pliocene.

Remarks.—The specimen referred to *Anas elapsa* by de Vis (1888c) was identified by Olson (1977) as Charadriiformes indeterminate.

Family Charadriidae Leach, 1820

Genus *Vanellus* Brisson, 1760

Type species: *Vanellus vanellus* (Linnaeus, 1758), Europe, Recent.

Vanellus sp.

Material.—None (destroyed).

Remarks.—De Vis (1892) described a species of lapwing (*Lobivanellus* sp., now *Vanellus* sp.), but stated in his description that the specimen was destroyed before a full taxonomic assignment could be made. As this specimen was published in de Vis's 1892 treatise, it is possible that it was derived from the Chinchilla Sand (see remarks in *Gallinula morterii*).

Class Mammalia Linneaus, 1758

Infraclass Marsupialia Illiger, 1811

Order indeterminate

Genus *Archizonurus* de Vis, 1889

Type species: *Archizonurus securus* de Vis, 1889, Chinchilla, Pliocene.

Archizonurus securus de Vis, 1889

Fig. 8A.

Material.—QM F682 (holotype, proximal left scapula fragment) from Chinchilla; Pliocene.

Remarks.—Meston (1895) suggested *Archizonurus securus* could be a possum, whereas Mahoney and Ride (1975) regard this species as Marsupialia incertae sedis. The specimen is clearly from a taxon much larger than a possum (e.g., large-bodied macropodid or wombat-sized individual). We follow the latest taxonomic authority on the species, but nevertheless consider *Archizonurus securus* as a species inquirenda.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Dasyuromorphia Gill, 1872

Family Dasyuridae Goldfuss, 1820

Genus *Dasyurus* Geoffroy Sainte-Hilaire, 1796

Type species: *Dasyurus maculatus* (Kerr, 1792), type locality not given, Recent.

Dasyurus dunmalli Bartholomai, 1971

Fig. 6A.

Material.—QM F6579 (holotype; left mandibular ramus), F742 (right mandibular ramus), F6580 (left mandibular ramus), F12682 (dentary fragment), F30477 (dentary fragment), F57539 (="W3357" and "QM F3357" in Wroe and Mackness 1998, and Wroe and Mackness 2000a, respectively; dentary fragment) from Chinchilla; Pliocene.

Remarks.—A species of extinct quoll from Chinchilla, *Dasyurus dunmalli*, was described by Bartholomai (1971). An additional specimen (lower right mandibular fragment) from Chinchilla was later referred to *D. dunmalli* by Wroe and Mackness (2000a), who listed the specimen as QM F3357. However, QM F3357 is actually a specimen of the diprotodontid, *Euryzygoma dunense*, as registered in the QM catalogue. Confusingly, Wroe and Mackness (1998) had earlier noted the same specimen as "W3357", so part of the Wilkinson Private Collection (i.e., WPC 3357), not the Queensland Museum (i.e., QM F), thus providing an explanation for the inconsistency in the QM registration book. Even more confusingly, the WPC registration

book lists the number “3357” as a vertebra, not a jaw, and certainly not *D. dunmalli*. However, the transfer of the number “3357” to the *D. dunmalli* specimen is an error, for the WPC registration book lists specimen “3356” as a jaw fragment of *D. dunmalli*. The description of WPC 3356 in the registration book appears to be consistent with the figured specimen (i.e., “QM F3357”) featured in Wroe and Mackness (2000a). To avoid confusion, the specimen is renumbered as QM F57539.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Archerium* Wroe and Mackness, 2000

Type species: *Archerium chinchillaensis* Wroe and Mackness, 2000, Chinchilla, Pliocene.

Archerium chinchillaensis Wroe and Mackness, 2000

Fig. 6K.

Material.—QM F39847 (holotype; left maxillary fragment) from Chinchilla Rifle Range; Pliocene.

Remarks.—A new genus and species of dasyurid, *Archerium chinchillaensis*, was erected by Wroe and Mackness (2000b) on the basis of Chinchilla material.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Family Thylacinidae Bonaparte, 1838

Genus *Thylacinus* Temmink, 1824

Type species: *Thylacinus cynocephalus* (Harris, 1808), Tasmania, Recent.

Thylacinus cynocephalus (Harris, 1808)

Fig. 6B.

Material.—QM F3741 (right maxillary fragment), F9476 (right mandibular fragment) from Chinchilla; Pliocene.

Remarks.—De Vis (1894a) described two specimens of thylacine from Chinchilla (namely Cat. No. 12, 029 = QM F726 in part, and Cat. No. 12, 031 = QM F3744) which he attributed to a new species, *Thylacinus rostralis*. Ride (1964) referred an additional specimen (QM F2159) to that species. *Thylacinus rostralis* was later considered a junior synonym of the modern species *T. cynocephalus* by Dawson (1982). Mackness et

al. (2002) reviewed the history and occurrence of *Thylacinus* at Chinchilla, and concluded that QM F726 and Cat. No. 12, 026 were not from Chinchilla, but rather from the Darling Downs, on the basis of label information and preservation. However, they did not realise that Cat. No. 12, 026 was also registered as QM F726, and that 12, 026 and 12, 029 are very likely part of the same specimen. It is worth citing the complete label information attached with QM F726: "Only the anterior portion of this specimen was listed by de Vis (1894[a]) as being in the Museum collections. He claimed that it came from the ?Pliocene Chinchilla Sand at Chinchilla, N.W. Darling Downs. It bears the de Vis number 12029. Preservation indicates it has been derived from the Pleistocene fluviatile deposits [of the eastern Darling Downs]. The posterior portion of the ramus was associated during the early period of Longman's time and I think there will be no hesitation about accepting the association. This portion bears the de Vis number 12026 but was not listed in de Vis' (1894[a]) paper. The numbering indicates that he most certainly had the specimen. Longman noted that the posterior portion was from Pilton, S.E. Darling Downs and registered the specimen as such. Remains of the purchase number are still visible on the posterior portion, and this locality represents a much more likely source for the ramus" (Alan Bartholomai, undated). Mackness et al. (2002) did not discuss the other specimen described by de Vis (QM F3744); its label information indicates that it was recovered from the ?Pliocene Chinchilla Sand. They also suggest that the specimen described by Ride (1964) was not derived from the Chinchilla Sand on the basis of preservation. Mackness et al. (2002) described material from Chinchilla (registered WPC), but suggested that it was only attributable to *Thylacinus* sp. However, two additional specimens in the QM collection, recovered in 1962 and 1977, and identified as *T. rostralis* (= *T. cynocephalus*) are definitely from Chinchilla.

Stratigraphic and geographic range.— Pliocene-Holocene; mainland Australia and New Guinea (fossil only), and Tasmania.

Order Peramelemorphia Kirsch, 1968

Family Peramelidae Gray, 1825

Genus *Perameles* Geoffroy, 1804

Type species: *Perameles nasuta* Geoffroy, 1804, New South Wales, Recent.

Perameles bowensis Murihead, Dawson, and Archer, 1997

Material.—QM F30580 (left M1), F30581 (left dentary) from Chinchilla; Pliocene.

Remarks.—Mackness et al. (2000b) described the only known bandicoot from Chinchilla as *Perameles bowensis*, and referred two specimens to the species, QM F30580 and QM F30581. QM F30580 could not be located, and QM F30581 is a specimen of a snake, *Liasis*. Both registration numbers have also inadvertently been assigned to two fossil bat specimens, *Icarops* sp. cf. *I. paradox* and *I. paradox*, respectively, from Miocene deposits of Riversleigh (Hand et al. 2005). An erratum is currently being prepared by Sue Hand (personal communication) to correct the registration discrepancy.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Diprotodontia Owen, 1866

Suborder Vombatiformes Woodburne, 1984

Family indeterminate

Genus *Koalemus* de Vis, 1889

Type species: *Koalemus ingens* de Vis, 1889, unknown location, but likely Chinchilla, Pliocene.

Koalemus ingens de Vis, 1889

Fig. 8B.

Material.—QM F683 (partial right fibula), locality uncertain; ?Pliocene.

Remarks.—Bartholomai (1968) considered the specimen to be from Chinchilla on the basis of its preservation. Although de Vis (1889c) suggested affinities of the species with the modern koala, Bartholomai (1968) suggested it be referred to Diprotodontidae incertae sedis. We consider *Koalemus ingens* a as species inquirenda.

Stratigraphic and geographic range.—Uncertain, possibly Pliocene, eastern Australia.

Family Phascolarctidae Owen, 1839

Phascolarctidae gen. et sp. indet.

Fig. 6D.

Material.—QM F52287 (left dentary fragment) from Chinchilla; Pliocene.

Remarks.—This large dentary fragment appears to be morphologically distinct from all other known koala dentaries (Price et al. 2009). However the lack of diagnostic characters on the specimen means it can only be referred to Phascolarctidae gen. et sp. indet.

Genus *Koobor* Archer, 1977

Type species: *Koobor notabilis* (de Vis, 1889), unknown location, but likely Chinchilla; Pliocene

Koobor notabilis (de Vis, 1889)

Fig. 6C.

Material.—QM F691 (holotype; left maxillary fragment), F8976 (P^3), from Chinchilla, Pliocene.

Remarks.—De Vis (1889c) described a maxillary fragment, probably from Chinchilla (see discussion in Archer 1977), as *Pseudochirus ?notabilis*. Archer (1977) re-assigned it to *Koobor*, and referred another specimen (QM F8976) of definite Chinchilla provenance to the species. *Koobor* was assigned to Phascolarctidae by Black et al. (2012a).

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Phascolarctos* Blainville, 1816

Type species: *Phascolarctos cinereus*, Blainville, 1816, New South Wales, Recent.

Phascolarctos ?*stirtoni* Bartholomai, 1968

Fig. 6G.

Material.—QM F52289 (isolated $RM^{1, 2 \text{ or } 3}$ fragment) from Chinchilla; Pliocene.

Remarks.—Assigned to *Phascolarctos* ?*stirtoni* by Price (2008a) and Price et al. (2009).

Family Diprotodontidae Gill, 1872

Genus *Euowenia* de Vis, 1891

Type species: *Euowenia grata* (de Vis, 1887), Chinchilla; Pliocene.

Euowenia grata (de Vis, 1887)

Fig. 6H.

Material.—QM F519 (holotype; mandible) from Chinchilla; Pliocene.

Remarks.—*Euowenia* was first named *Owenia*, in honour of Sir Richard Owen, by de Vis (1887, 1888a), but the name was preoccupied, and de Vis (1891a) changed it to *Euowenia.*

Stratigraphic and geographic range.—Pliocene-?Pleistocene; central and eastern Australia.

Genus *Euryzygoma* Longman, 1921

Type species: *Euryzygoma dunense* (de Vis, 1888), Chinchilla, Pliocene

Euryzygoma dunense (de Vis, 1888)

Fig. 6J.

Material.—QM F376 (holotype; left mandible) from Chinchilla; Pliocene.

Remarks.—De Vis (1888b) described *Euryzygoma dunense* as a species of *Nototherium*. Longman (1921), who had access to more complete cranial material, assigned the species to its own genus, *Euryzygoma*.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Zygomaturus* Macleay, 1857

Type species: *Zygomaturus trilobus* Macleay, 1858, King Creek, Darling Downs, Qld, Pliestocene.

Zygomaturus sp.

Material.—QM F3829 (upper premolar) from Chinchilla; Pliocene.

Remarks—Archer and Wade (1976) discussed a *Zygomaturus* specimen from the Chinchilla Sand, drawing similarities between it and an isolated premolar from the early Pliocene Allingham Formation. The specimen could not be located in the QM collection.

Family Palorchestidae Tate, 1948

Genus *Palorchestes* Owen, 1873

Type species: *Palorchestes azael* Owen, 1873, Victoria, Pleistocene.

Palorchestes parvus de Vis, 1895

Fig. 6I.

Material.—QM F783 (lectotype; left mandibular fragment) from Chinchilla; Pliocene.

Remarks.—*Palorchestes parvus* was named by de Vis (1895) on the basis of material from the "Darling Downs". In his review of *Palorchestes,* Woods (1958) suggested that the species was derived solely from specimens from Chinchilla and designated a lectotype for the species. However, it is noted that small-bodied species of *Palorchestes* potentially referable to *P. parvus* do occur in younger, Pleistocene deposits of the Darling Downs (Price and Hocknull 2005). Rich et al. (1991) also listed cf. *Palorchestes* sp. from Chinchilla, but we could find no further reference to that taxon.

Stratigraphic and geographic range.—Pliocene to ?Pleistocene; eastern Australia.

Family Vombatidae Burnett, 1830

Genus *Vombatus* Geoffroy, 1803

Type species: *Vombatus ursinus* (Shaw, 1800), Tasmania, Recent.

Vombatus ursinus (Shaw, 1800)

Fig. 6F.

Material.—QM F743 (proximal right tibia) from Chinchilla; Pliocene.

Remarks.—De Vis (1883c) erected *Sarcophilus prior* (marsupial devil) on the basis of a tibia fragment. Bartholomai and Marshall (1973) referred the specimen to ?*Vombatus prior* (wombat) noting marked similarities with the common wombat, *V. ursinus*, although they did not assign it to that species due to the paucity of fossil *Vombatus* material. Murray (1998) regarded *?Vombatus prior* as a nomen dubium, and

listed it as a junior synonym of *V. ursinus*. Other *Vombatus* material from Chinchilla is currently under study.

Stratigraphic and geographic range.—Pliocene to Holocene; eastern and southeastern mainland Australia, and Tasmania (extant).

Family Thylacoleonidae Gill, 1872

Genus *Thylacoleo* Gervais, 1852

Type species: *Thylacoleo carnifex*, Owen, 1858, Lake Colongulac, Victoria, Pleistocene.

Thylacoleo crassidentatus Bartholomai, 1962

Fig. 6E.

Material.—QM F3565 (holotype; right mandibular ramus), QM F2957 (mandibular ramus), F2961 (mandibular ramus), F2962 (mandibular ramus), F2960 (mandibular ramus), F2964 (mandibular ramus), F2963 (P_3), F2495 (mandibular ramus), F2941 (partial maxilla), F2954 (partial maxilla), F2955 (partial maxilla) from Chinchilla; Pliocene.

Remarks.—In his revision of *Thylacoleo* in the QM collections, Woods (1956) suggested that specimens from Chinchilla warranted specific designation. This was supported by Bartholomai (1962), who erected *T. crassidentatus* for the Chinchilla material.

Stratigraphic and geographic range.— Pliocene; eastern Australia.

Suborder Phalangerida Aplin and Archer, 1987

Family Phalangeridae Thomas, 1888

Genus *Phalanger* Storr, 1780

Type species: *Phalanger orientalis* (Pallas, 1766), Ambon Island, Indonesia, Recent.

Phalanger procuscus (de Vis, 1889)

Fig. 8C.

Material.—QM F687 (holotype, right scapula) from Chinchilla; Pliocene.

Remarks.—De Vis (1889c) originally named the specimen *Cuscus procuscus.* Referral to *Phalanger* here is based on the priority of the name. Mahoney and Ride (1975) referred this species to Marsupialia incertae sedis. Similar to *Archizonurus securus*, the specimen is clearly from a large-bodied taxon, much larger than any known phalangerid. We consider *Phalanger procuscus* as a species inquirenda.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Family Macropodidae Gray, 1821

Genus *Brachalletes* de Vis, 1883

Type species: *Brachalletes palmeri* de Vis, 1883, Chinchilla, Pliocene.

Brachalletes palmeri de Vis, 1883

Fig. 8D.

Material.—QM F3308 (holotype, right femur) from Chinchilla; Pliocene.

Remarks.—Described by de Vis (1883b), the taxon was included in the family Macropodidae by Mahoney and Ride (1975), although they also suggested that it might be better placed in the Diprotodontidae. Dawson and Flannery (1985) suggested it possessed no characters diagnostic of the Macropodinae (long-faced kangaroos), and its placement remains uncertain, if indeed it is a valid taxon. We consider *Brachalletes palmeri* as a species inquirenda.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Synaptodon* de Vis, 1888

Type species: *Synaptodon aevorum* de Vis, 1888, Chinchilla, Pliocene.

Synaptodon aevorum de Vis, 1888

Fig. 8F.

Material.—QM F811 (holotype, right dentary fragment) from Chinchilla; Pliocene.

Remarks.—Both Bartholomai (1975) and Dawson and Flannery (1985) argued that the taxon is based on inadequate, poorly preserved and undiagnostic material. Dawson and Flannery (1985) suggested that it bears no characters that allow it to be referred to *Macropus.* We consider *Synaptodon aevorum* as a nomen dubium.

Subfamily Lagostrophinae Prideaux and Warburton, 2010

Genus *Troposodon* Bartholomai, 1967

Type species: *Troposodon minor* (Owen, 1877), Talbragar country, New South Wales, ?Pleistocene.

Troposodon minor (Owen, 1877)

Fig. 7J.

Material.—QM F4389 (right maxillary fragment) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1967) erected the genus *Troposodon* and assigned many Chinchilla specimens to the species.

Stratigraphic and geographic range.—Pliocene to Pleistocene; eastern Australia.

Troposodon gurar Flannery and Archer, 1983

Fig. 7F.

Material.—QM F4609 (holotype; right dentary) most likely from Chinchilla; Pliocene.

Remarks.—Flannery and Archer (1983) described this new species on the basis of material of probable Chinchilla provenance.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Subfamily Sthenurinae (Glauert, 1926)

Genus *Sthenurus* Owen, 1873

Type species: *Sthenurus atlas* (Owen, 1838), Wellington Valley, late Pleistocene.

Sthenurus notabilis Bartholomai, 1963

Fig. 7D.

Material.—QM F3817 (holotype; right mandibular ramus) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1963) erected this species on the basis of Chinchilla material.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Sthenurus andersoni Marcus, 1962

Fig. 7A.

Material.—QM F813 (right adult dentary), F814 (left juvenile dentary), UCR 23029 (right lower molar), UCR 23033 (left incisor) from Chinchilla; Pliocene.

Remarks.—Prideaux (2004) assigned several specimens from Chinchilla to this species.

Stratigraphic and geographic range.—Pliocene to Pleistocene; central to southeastern mainland Australia.

Genus *Simosthenurus* **(**Tedford, 1966)

Type species: *Simosthenurus occidentalus* (Glauret, 1910), Mammoth Cave, Western Australia, late Pleistocene.

Simosthenurus antiquus (Bartholomai, 1963)

Fig. 7B.

Material.—QM F3818 (right P_3), F3816 (partial left M^2) from Chinchilla, Pliocene.

Remarks.—Bartholomai (1963) erected this species with a holotype (QM F2975) probably from Chinchilla. The species was subsequently assigned to the new genus *Simosthenurus* by Pledge (1980) and later "*Simosthenurus*" by Prideaux (2004). Other specimens (e.g., those listed above) are of definite Chinchilla provenance.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Subfamily Macropodinae Gray, 1821

Genus *Wallabia* Trouessart, 1905

Type species: *Wallabia bicolor* (Desmarest, 1804), type locality unknown, Recent.

Wallabia indra (de Vis, 1895)

Fig. 7I.

Material.—QM F3595 (holotype; left mandibular ramus) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1976) reassigned material previously attributed to *Halmaturus indra* by de Vis (1895) to *Wallabia indra*.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Macropus* Shaw, 1790

Type species: *Macropus giganteus* Shaw, 1790, Cooktown, Qld, Recent.

Macropus pan de Vis, 1895

Fig. 7N.

Material.—QM F2925 (holotype; partial right maxilla) probably from Chinchilla; Pliocene.

Remarks.—Bartholomai (1975) referred several specimens from Chinchilla to *M. pan*. Although the provenance of the material had not been noted before, Bartholomai (1975) suggested that the type specimen exhibits preservation consistent with other undoubted Chinchilla specimens.

Stratigraphic and geographic range.—Pliocene; eastern and northwestern Australia.

Macropus agilis siva (de Vis, 1895)

Fig. 7C.

Material.—F4733 (right mandibular fragment), F4735 (left mandibular fragment) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1975) examined material from Chinchilla and attributed it to *M. agilis siva*, noting that the variation in the Chinchilla material was insufficient to warrant specific distinction.

Stratigraphic and geographic range.—Pliocene to Pleistocene; central, eastern and southeastern Australia.

Macropus dryas de Vis, 1895

Fig. 7H.

Material.—QM F3582 (lectotype; partial right maxilla) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1966) selected this lectotype on the basis of material of probable Chinchilla provenance, and subsequently (Bartholomai 1975) assigned several additional Chinchilla specimens to the species.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Macropus woodsi Bartholomai, 1975

Fig. 7M.

Material.—QM F3920 (holotype, partial right mandibular ramus), F5465 (partial left maxilla) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1975) erected this species on the basis of Chinchilla material, and referred several Chinchilla specimens to the species.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Prionotemnus* Stirton, 1955

Type species: *Prionotemnus palankarinnicus* Stirton, 1955, Lake Palankarinna, South Australia, early Pliocene.

Prionotemnus palankarinnicus Stirton, 1955

Fig. 7O.

Material.—QM F3589 (partial right mandibular ramus) most likely from Chinchilla; Pliocene.

Remarks.—Bartholomai (1975) assigned two specimens to *Macropus (Prionotemnus) palankarinnicus*, but only one (QM F6989) is of definite Chinchilla provenance. Bartholomai (1975: 232) incorrectly identified this specimen as QM F6869, but the correct number is provided later (Bartholomai 1975: 233). Bartholomai

(1975) strongly suggested that the other specimen (QM F3589; Fig. 7O) was also derived from the Chinchilla Sand.

Stratigraphic and geographic range.—Pliocene; central and eastern Australia.

Genus *Protemnodon* Owen, 1874

Type species: *Protemnodon anak* Owen, 1874, eastern Darling Downs, Pleistocene.

Protemnodon devisi Bartholomai, 1973

Fig. 7E.

Material.—QM F4710 (holotype; partial left mandibular ramus) from Chinchilla; Pliocene.

Remarks.—Bartholomai (1973) revised the genus *Protemnodon*, and erected two new species on the basis of Chinchilla material.

Stratigraphic and geographic range.— Pliocene; central and eastern Australia.

Protemnodon chinchillaensis Bartholomai, 1973

Fig. 7G.

Material.—QM F5246 (holotype; partial right mandibular ramus) from Chinchilla; Pliocene.

Remarks.—See above.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Genus *Bohra* Flannery and Szalay, 1982

Type species: *Bohra paulae* Flannery and Szalay, 1982, Cathedral Cave, New South Wales, Pleistocene.

Bohra wilkinsonorum Dawson, 2004

Fig. 7L.

Material.—QM F43277 (holotype; right maxillary fragment) from Chinchilla; Pliocene.

Remarks.—Dawson (2004b) described the first tree kangaroo from Chinchilla. Hocknull (2005) later confirmed the presence of *Bohra* sp. in the Chinchilla Local Fauna on the basis of an isolated calcaneum (QM F49543). Its relationship to *B. wilkinsonorum* is unclear.

Stratigraphic and geographic range.—Pliocene; Chinchilla.

Genus *Silvaroo* Dawson, 2004

Type species: *Silvaroo bila* Dawson, 2004, Chinchilla, Pliocene.

Silvaroo bila Dawson, 2004

Fig. 7K.

Material.—QM F43280 (holotype; left mandibular ramus), QM F43276 (paratype; left maxillary fragment), F43292 (paratype; incisor) from Chinchilla; Pliocene.

Remarks.—Dawson (2004a) described the above material as a new genus and species of wallaby.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Silvaroo sp.

Fig. 7P.

Material.—QM F43281 (right mandibular ramus) from Chinchilla; Pliocene.

Remarks.—Dawson (2004a) described a right mandibular ramus from Chinchilla, which she suggested might represent a second, smaller species of *Silvaroo*.

Infraclass Eutheria Huxley, 1880

Order indeterminate

Genus *Chronozoon* de Vis, 1883

Type species: *Chronozoon australe* de Vis, 1883, Chinchilla, Pliocene.

Chronozoon australe de Vis, 1883

Fig. 8E.

Material.—QM F610 (holotype, calvarium) from Chinchila; Pliocene.

Remarks.—De Vis (1883a) originally suggested the species might share affinities with sirenians. Mahoney and Ride (1975) suggested that it might be part of the skull of a giant wombat, whereas Reinhart (1976) interpreted it as a likely sirenian of unknown affinity. We consider *Chronozoon australe* as species inquirenda.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Rodentia Bowdich, 1821

Family Muridae Illiger, 1811

Genus *Pseudomys* Gray, 1832

Type species: *Pseudomys australis* Gray, 1832, Liverpool Plains, eastern New South Wales, Recent.

Pseudomys vandycki Godthelp, 1990

Material.—QM F16834 (holotype; right maxillary fragment) from Chinchilla; Pliocene.

Remarks.—Godthelp (1990) described the only species of rodent from Chinchilla. This specimen could not be located in the QM collection. Rich et al. (1991) suggested that there might be other *Pseudomys* species in the Chinchilla deposits.

Stratigraphic and geographic range.—Pliocene; eastern Australia.

Order Chiroptera Blumenbach, 1779

Family Molossidae Gray, 1821

Genus *Mormopterus* Peters, 1865

Type species: *Mormopterus jugularis* Peters, 1865, Madagascar, Recent.

Mormopterus sp.

Material.—QM F30575 (left upper canine) from Chinchilla; Pliocene.

Remarks.—Hand et al. (1999) described the first bat from Chinchilla, a species of *Mormopterus*, and referred the specimen, QM F30575 (canine), to the genus. The registration number QM F30575 has also inadvertently been assigned to two different fossil bats: a maxilla of *Hipposideros winsburyorum* (Hand and Godthelp 1999) and an isolated molar of *Icarops aenae* (Hand et al. 2005); both fossils are from Pliocene and Miocene sites, respectively, of Riversleigh. An erratum is currently being prepared by Sue Hand (personal communication) to correct the registration discrepancy.

Discussion

Sixty-three taxa have been reported in the literature from the Chinchilla Sand (SOM: tables 2, 3). There are two families of fishes (Ceratodontidae, 1; Neoceratodontidae, 1), although a conference abstract by Mackness et al. (1999) also mentioned the occurrence of catfish (Plotosidae). There are 11 reptile taxa, comprising two families of Testudines (Trionychidae, 1; Chelidae 1), one family of Crocodylia (Crocodylidae, 2), and five families of Squamata (Agamidae, 1; Gekkonidae, 1; Scincidae, 2; Varanidae, 2; Madtsoiidae, 1). Thirteen bird taxa have been described from Chinchilla, comprising one family each of Anseriformes (Anatidae, 3), Ciconiiformes (Ciconiidae, 1), Galliformes (Megapodiidae, 1), Gruiformes (Rallidae, 2), Charadriformes (Charadriidae, 1) and one Charadriformes indeterminate, Casuariiformes (Casuariidae, 1), Pelecaniformes (Pelecanidae, 1), Phalacrocoraciformes (Phalacrocoracidae, 1), and Falconiformes (Accipitridae, 1). The fauna includes 39 mammal taxa, including one order indeterminate; two families of Dasyuromorphia (Dasyuridae, 2; Thylacinidae, 1), seven families of Diprotodontia (Phascolarctidae, 3; Diprotodontidae, 3; Palorchestidae, 1; Vombatidae, 1; Thylacoleonidae, 1; Phalangeridae, 1; Macropodidae, 18; Phalangeridae, 1), and one Diprotodontia indeterminate, and one family each of Peramelemorphia (Peramelidae, 1), Rodentia (Muridae, 1), and Chiroptera (Molossidae, 1).

Nineteen species have been erected on the basis of specimens undoubtedly from the Chinchilla Sand: *Metaceratodus palmeri, Tiliqua wilkinsonorum, Dasyurus dunmalli, Archerium chinchillaensis, Euowenia grata, Thylacoleo crassidentatus, Sthenurus notabilis, Wallabia indra, Macropus woodsi, Protemnodon devisi, Protemnodon chinchillaensis, Bohra wilkinsonorum, Silvaroo bila, Pseudomys vandycki, Archizonurus securus, Phalanger procuscus, Brachalletes palmeri, Synaptodon aevorum,* and *Chronozoon*

australe. Taxonomic revision of some of those species, in particular the last five, is urgently needed and will probably reduce this number. Type specimens of ten additional species are most likely derived from the Chinchilla area: *Ciconia nana, Pelecanus proavus, Necrastur alacer, Koalemus ingens, Koobor notabilis, Euryzygoma dunense, Troposodon gurar, Simosthenurus antiquus, Macropus pan* and *Macropus dryas*.

Uncertainties exist regarding the provenance of certain species supposedly from Chinchilla (SOM: table 3), and in almost all cases, of provenance within the Chinchilla area itself (Price 2012). Most early collecting did not differentiate between Chinchilla and the eastern Darling Downs, so confusing Pliocene and Pleistocene localities respectively. Bartholomai, Olsen, Boles, van Tets, and others have provided some clarification on provenance. Later collectors differentiated between Chinchilla and the eastern Darling Downs, but precise geographic or stratigraphic information for most specimens in the QM is lacking. Most are listed as coming from the Chinchilla Rifle Range, and derived from the Chinchilla Sand Formation (sensu Woods 1960); exact horizons within the Pliocene stratigraphic sequence is rarely documented. Therefore, the Chinchilla Local Fauna may represent an assemblage with considerable temporal and spatial averaging (Price 2012). These problems have arisen because of the lack of stratigraphically controlled, systematic excavation. Difficulties of dating the site add to the problems, with age differences of up to ca. 500 ka between biocorrelated Local Faunas (Tedford et al. 1992; Mackness et al. 2000a).

Several other taxa are not discussed above, but have been listed by others as from Chinchilla. Three species of birds are mentioned by Rich et al. (1991) in their species list for Chinchilla fossils: a magpie goose (cf. *Anseranas semipalmata*), a probable Cape Barren goose (cf. *Cereopsis*), and a black swan (*Cygnus* sp. cf. *C. atratus*), none of which are represented by fossil material in the Queensland Museum. Although de Vis (1905) was responsible for erecting those three taxa, he based his descriptions on specimens from the late Pleistocene Lake Eyre Basin of central Australia, and we can find no evidence that these three birds are part of the Chinchilla fauna.

De Vis (1892) described a number of fossil bird species, but with no introductory remarks, so the provenance of the fossils described therein is uncertain. Olson (1975) noted the similarity between the 1892 paper and de Vis's (1888c) previous treatise on fossil birds, and inferred that the 1892 paper was a continuation of the 1888 paper. De Vis (1888c: 1277) referred to specimens "yielded by the Darling Downs

in the immediate neighbourhood of Chinchilla", and we follow Olson (1975) in assigning all fossils described in de Vis (1888c) and de Vis (1892) to the Chinchilla Sand.

Dawson and Flannery (1985) mistakenly listed *Macropus thor* as being restricted to the Chinchilla Sand, incorrectly citing Bartholomai (1975), who in fact stated that the species is restricted to Pleistocene deposits. Bartholomai (1975) referred a juvenile mandibular ramus (QM F4230) supposedly from Chinchilla to *Macropus titan* (=*M. giganteus titan*; Dawson and Flannery 1985), but suggested that on basis of its preservation, the specimen was more likely from Pleistocene deposits.

Flannery and Archer (1983) recognised *Troposodon kenti* among the Chinchilla fossil material in the QM, but did not refer any specimens to the species. A search of the collections did not locate any specimens of definitive Chinchilla provenance.

Tedford et al. (1992) suggested that two specimens (QM F5580 and F10293) attributable to *Diprotodon* sp. cf. *Diprotodon optatum* are from Chinchilla. Mackness and Godthelp (2001) later concluded that those specimens were more likely from the Pleistocene site of Warra, and hence that *Diprotodon* is exclusively Pleistocene (Price 2008b).

Both Bartholomai and Marshall (1973) and Archer and Bartholomai (1978) noted *Phascolonus* from Chinchilla. Ride (1964) suggested that the "Darling Downs" term used by de Vis (1891b) in his description of Queensland wombats might include the Chinchilla Sand. Fossil material attributable to large-bodied wombats that are of definitive Chinchilla provenance are currently under study.

Gaffney (1981) reported a specimen of giant horned turtle (meiolanid) supposedly from the Chinchilla Sand, but coming from Armour Station, near Macalister, over 50 km southeast of the known exposures of the Chinchilla Sand. Molnar and Kurz (1997) also recorded *Diprotodon* from Armour Station, which on the basis of biostratigraphy, suggests that the meiolanid is actually Pleistocene, not Pliocene, and certainly not from the Chinchilla Sand.

Tedford et al. (1992) reported *Zygomaturus* sp. cf. *Zygomaturus trilobus* in the Chinchilla deposits. It is unclear whether this is the same specimen examined by Archer and Wade (1976) who assigned it to *Zygomaturus* sp. (listed above).

Finally, Rich et al. (1991) and Archer and Hand (1987) both mention unidentified phalangerids from Chinchilla; however, the only potential phalangerids from Chinchilla are the equally problematic *Phalanger procuscus* and *Archizonurus securus*. Undoubted phalangerid material from Chinchilla is in the QM collection, but is currently unregistered and awaits detailed study.

Despite these limitations and uncertainties, Chinchilla remains one of, if not the most important Pliocene sites in Australia. Its faunal diversity is unparalleled amongst current Australian Pliocene vertebrate records, and the preservation of its fossil material is largely excellent. Moreover, due to its richness and long history of collection, abundant specimens are available for study.

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FIGURE CAPTION

Fig. 1. Physiography of the Chinchilla local area, showing the location of Chinchilla relative to the Condamine River System. Redrawn after Reiser (1971). [planned for column width]

Fig. 2. Part of the Chinchilla gully system showing the dominant sedimentary units present. [planned for column width]

Fig. 3. Lungfish (Chinchilla, Pliocene). **A**. *Metaceratodus palmeri* QM F10597, toothplate. **B**.*Neoceratodus forsteri* QM F56224, toothplate. Scale bars 1 cm. [planned for column width]

Fig. 4. Reptiles (Chinchilla, Pliocene). **A**. *Emydura* sp. QM F7035, anterior half of carapace. **B**–**D**. ?Reptilia QM F56197, unidentified fragments, showing the WPC registration numbers of Agamidae sp. indet. cited by Hutchinson and Mackness (2002). **E**. *Pallimnarchus pollens* QM F11612, symphyseal portion of dentary. **F**. *Varanus komodoensis* QM F874, right maxilla. **G**. *Quinkana* sp. QM F10204, isolated tooth. **H**. *Varanus* sp. QM F56189, dorsal vertebra. **I**. Trionychidae sp. indet. QM F9037, carapace fragment. Scale bars 2 cm. [planned for page width]

Fig. 5. Birds (Chinchilla, Pliocene). **A**. *Aythya australis* QM F1124, left tibiotarsus. **B**. *Biziura lobata* QM F1125, partial left humerus. **C**. *Fulica atra* QM F1129, proximal right humerus. **D**. *Leipoa gallinacean* QM F1132, partial carpometacarpus. **E**. *Microcarbo melanoleucos* QM F1130, right humerus. **F**. *Anas superciliosa* QM F5550, left coracoid. **G**. *Gallinula morterii* QM F1138, distal right humerus. **H**. *Ciconia nana* QM F1131, distal right tibiotarsus. **I**. *Necrastur alecer* QM F1136, proximal right humerus. **J**. Charadriiformes gen. et sp. indet. QM F5543, proximal left femur. **K**. *Dromaius novaehollandiae* QM F56203, third trochlea of the tarsometatarsus. Scale bars 1 cm. [planned for page width]

Fig. 6. Non-macropodid marsupials (Chinchilla, Pliocene). **A**. *Dasyurus dunmalli* QM F6579, left mandibular ramus. **B**. *Thylacinus cynocephalus* QM F9476, right mandibular fragment. **C**. *Koobor notabilis* QM F691, left maxillary fragment. **D**. Phascolarctidae gen. et sp. indet. QM F52287, left dentary fragment. **E**. *Thylacoleo crassidentatus* QM F3565, right mandibular ramus. **F**. *Vombatus ursinus* QM F743, proximal right tibia. **G**. *Phascolarctos ?stirtoni* QM F52289, isolated $RM^{1, 2 \text{ or } 3}$ fragment. **H**. *Euowenia grata* QM F519, mandible. **I**. *Palorchestes parvus* QM F783, left mandibular fragment. **J**. *Euryzygoma dunense* QM F376, left mandible. **K**. *Archerium chinchillaensis* QM F39847, left maxillary fragment. Scale bars A–D, 1 cm; E, F, K, 2 cm; G, 5 mm; H–J, 5 cm. [planned for page width]

Fig. 7. Macropodids (Chinchilla, Pliocene). **A**. *Sthenurus andersoni* QM F814, left juvenile dentary. **B**. *Simosthenurus antiquus* QM F2975, partial left maxilla of probable Chinchilla provenance. **C**. *Macropus agilis siva* QM F4733, right mandibular fragment. **D**. *Sthenurus notabilis* QM F3817, right mandibular ramus. **E**. *Protemnodon devisi* QM F4710, partial left mandibular ramus. **F**. *Troposodon gurar* QM F4609, right dentary of probable Chinchilla provenance. **G**. *Protemnodon chinchillaensis* QM F5246, partial right mandibular ramus. **H**. *Macropus dryas* QM F3582, partial right maxilla of probable Chinchilla provenance; **I**. *Wallabia indra* QM F3595, left mandibular ramus. **J**. *Troposodon minor* QM F4389, right maxillary fragment. **K**. *Silvaroo bila* QM F43276, left maxillary fragment. **L**. *Bohra wilkinsonorum* QM F43277, right maxillary fragment. **M**. *Macropus woodsi* QM F5465, partial left maxilla. **N**. *Macropus pan* QM F2925, partial right maxilla of probable Chinchilla provenance. **O**. *Prionotemnus palankarinnicus* QM F3589, partial right mandibular ramus. **P**. *Silvaroo* sp. QM F43281, right mandibular ramus. Scale bars 1 cm. [planned for page width]

Fig. 8. Enigmatic de Vis species (Chinchilla, Pliocene). **A**. *Archizonurus securus* QM F682, proximal left scapula. **B**. *Koalemus ingens* QM F683, partial right fibula. **C**. *Phalanger procuscus* QM F687, right scapula. **D**. *Brachalletes palmeri* QM F3308, right femur. **E**. *Chronozoon austral* QM F610, calvarium. **F**. *Synaptodon aevorum* QM F811, right dentary fragment. Scale bar 1 cm. [planned for page width]

Figure 1

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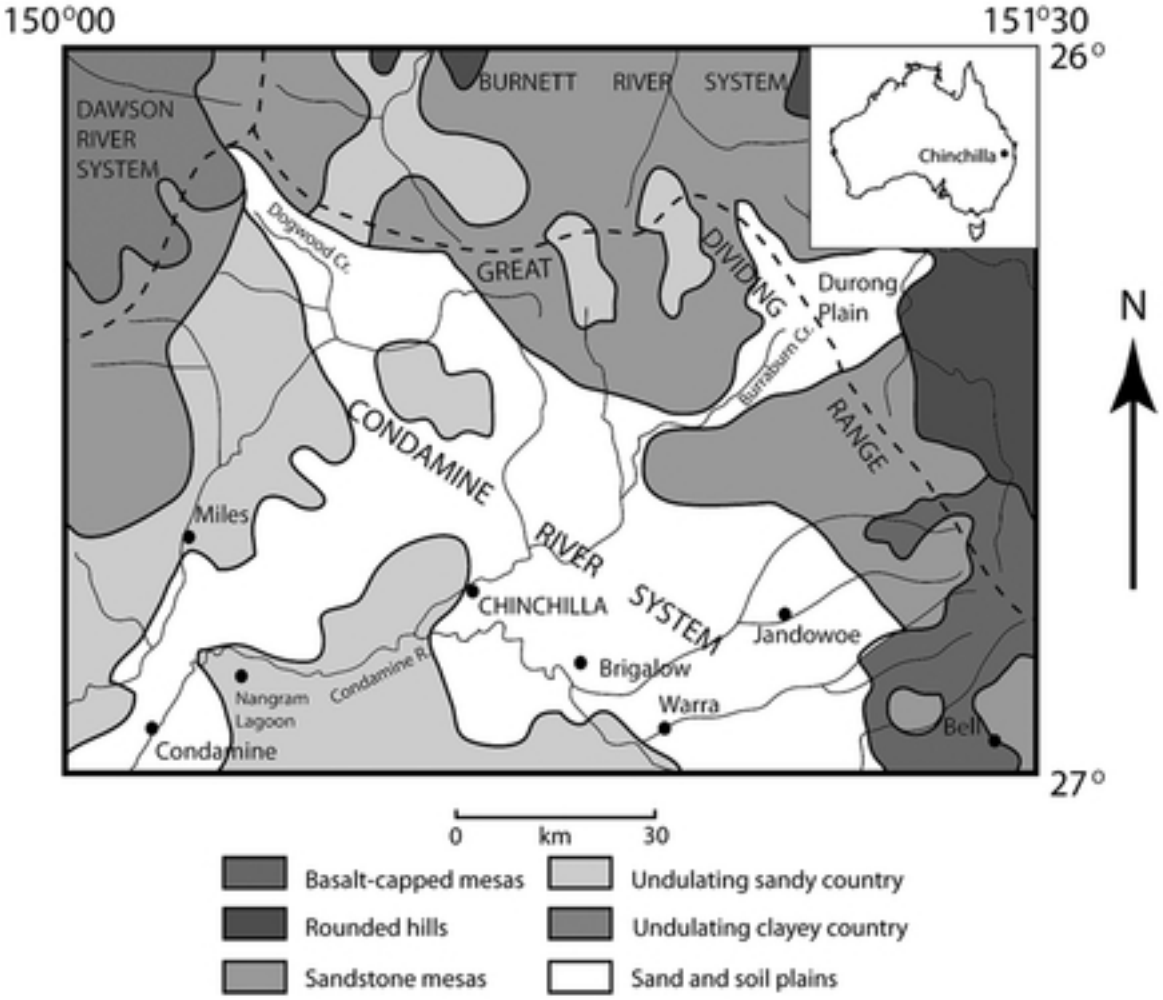

FIGURE 1. Physiography of the Chinchilla local area, showing the location of Chinchilla relative to the Condamine River System. Redrawn after Reiser (1971). [planned for column width]

Figure 2

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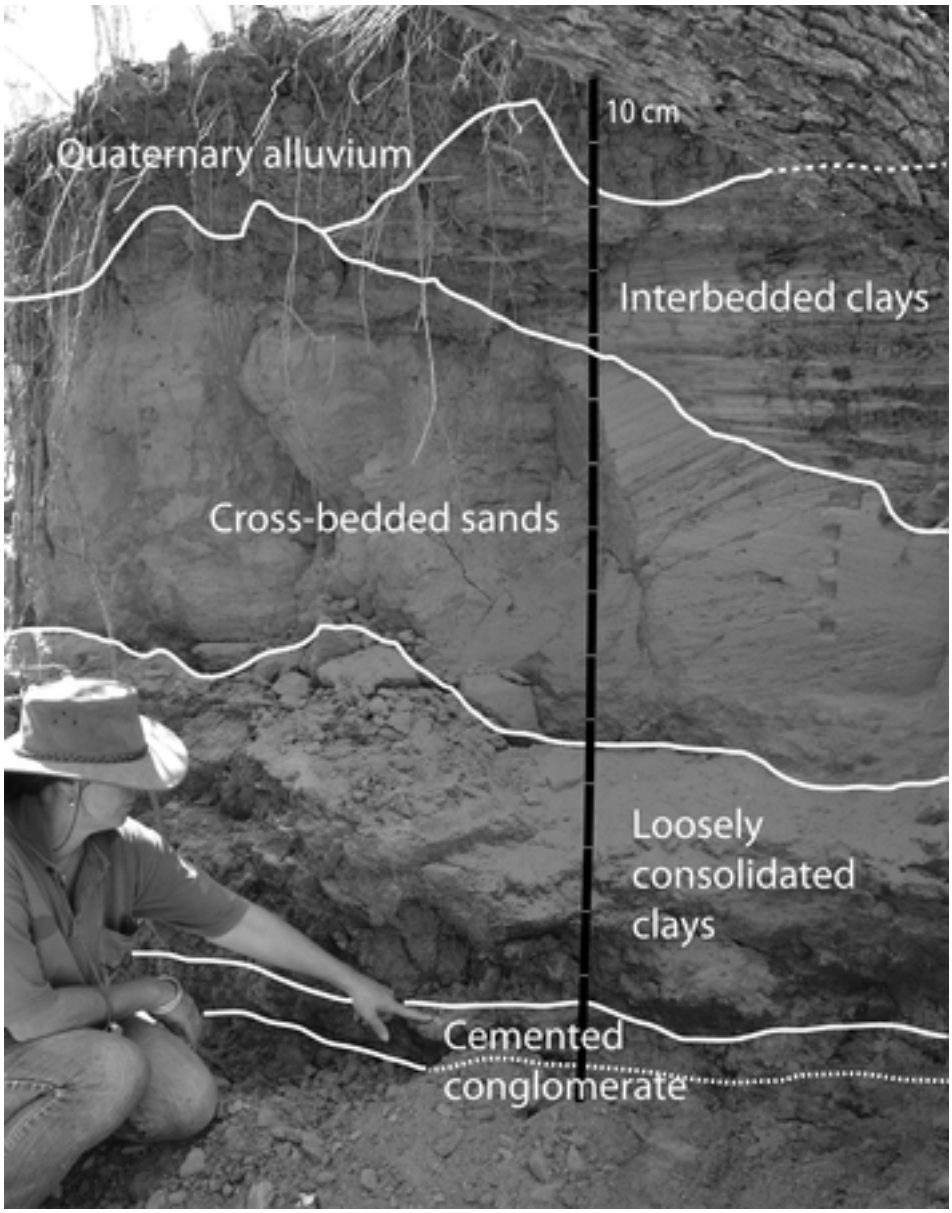

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FIGURE 3. Lungfish. A, Metaceratodus palmeri QM F10597, toothplate; B, Neoceratodus forsteri QM F56224, toothplate. Scale bar equals 1 cm. [planned for column width]

Figure 4

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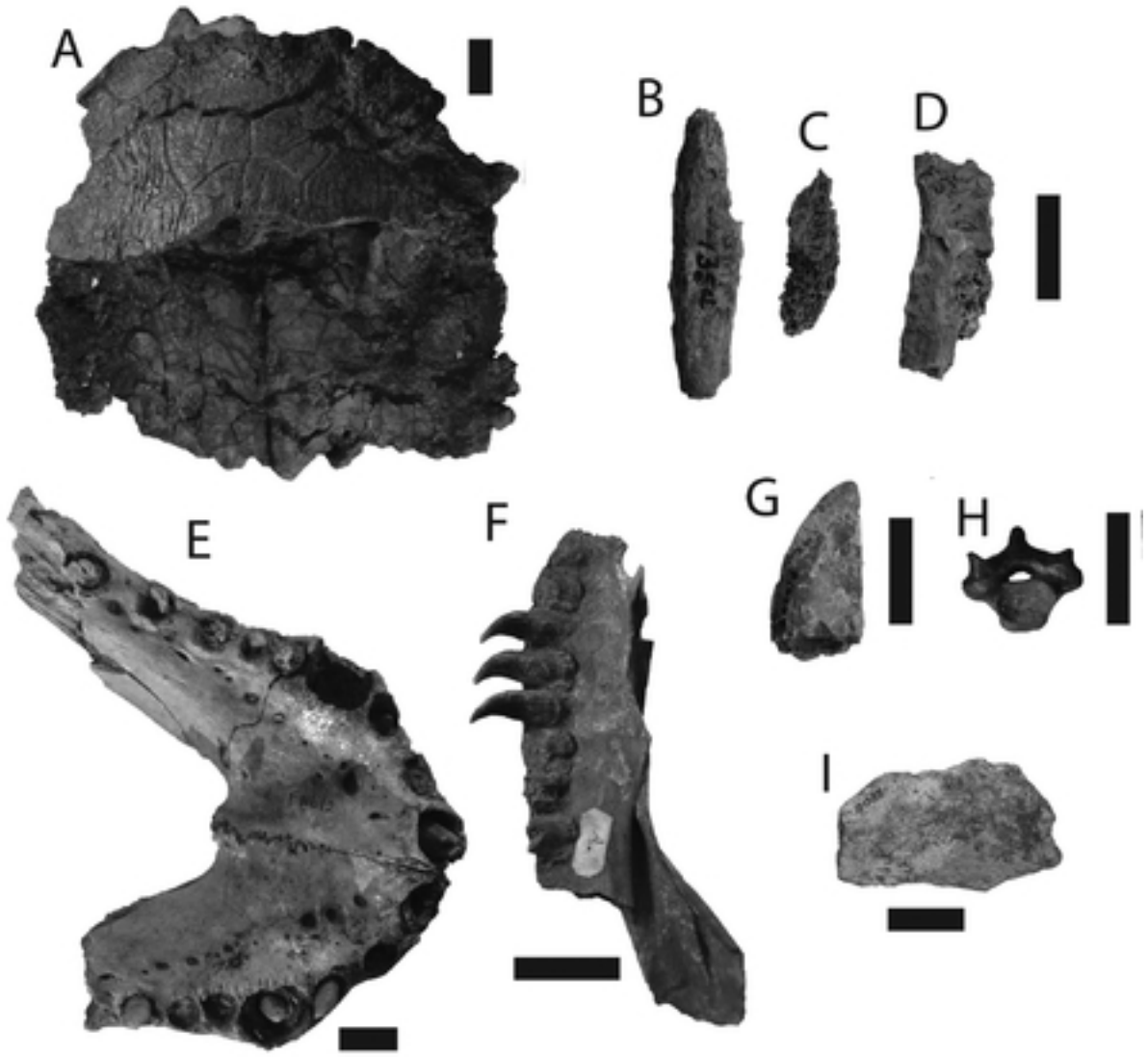

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Figure 5

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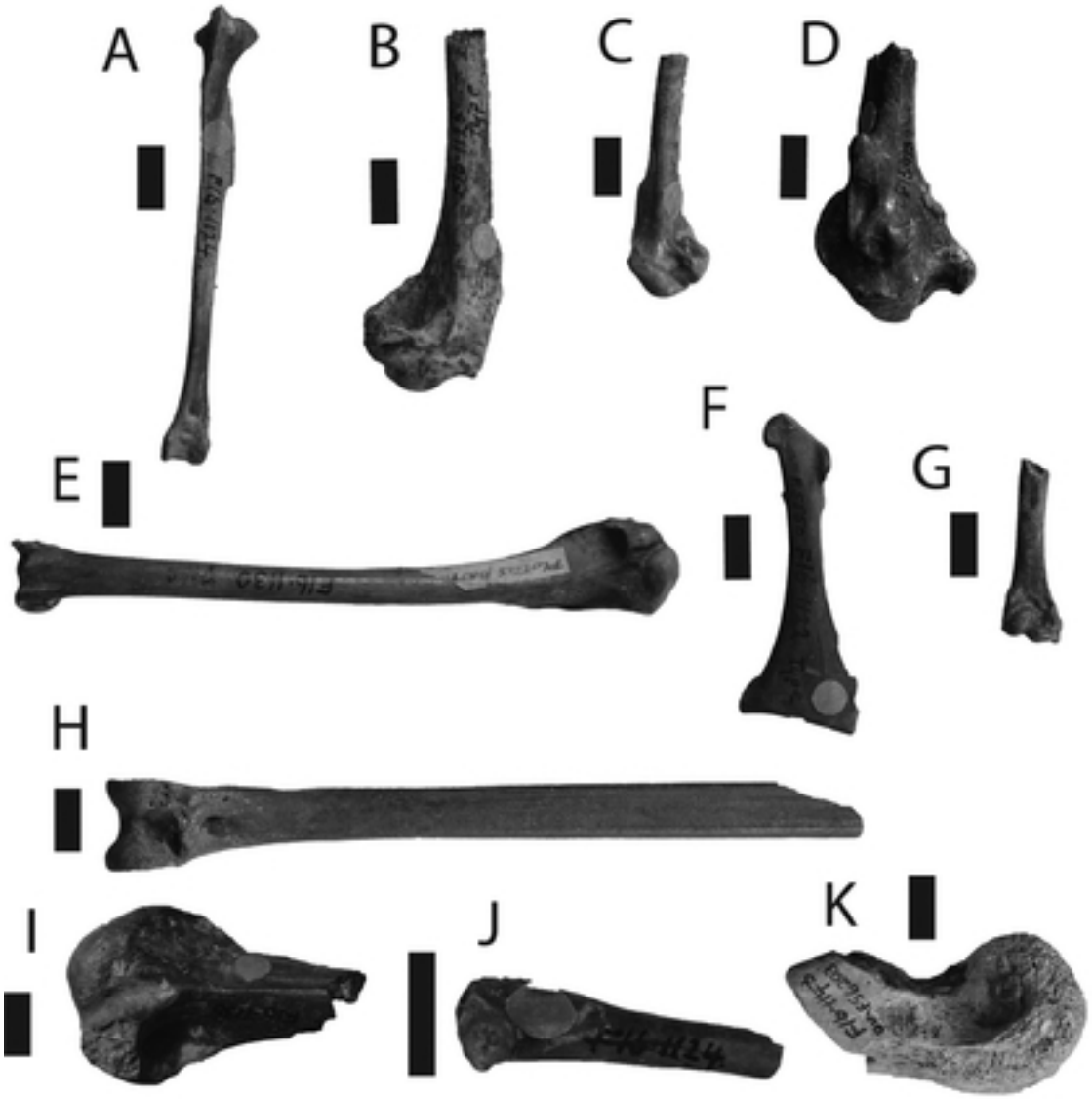

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Figure 6

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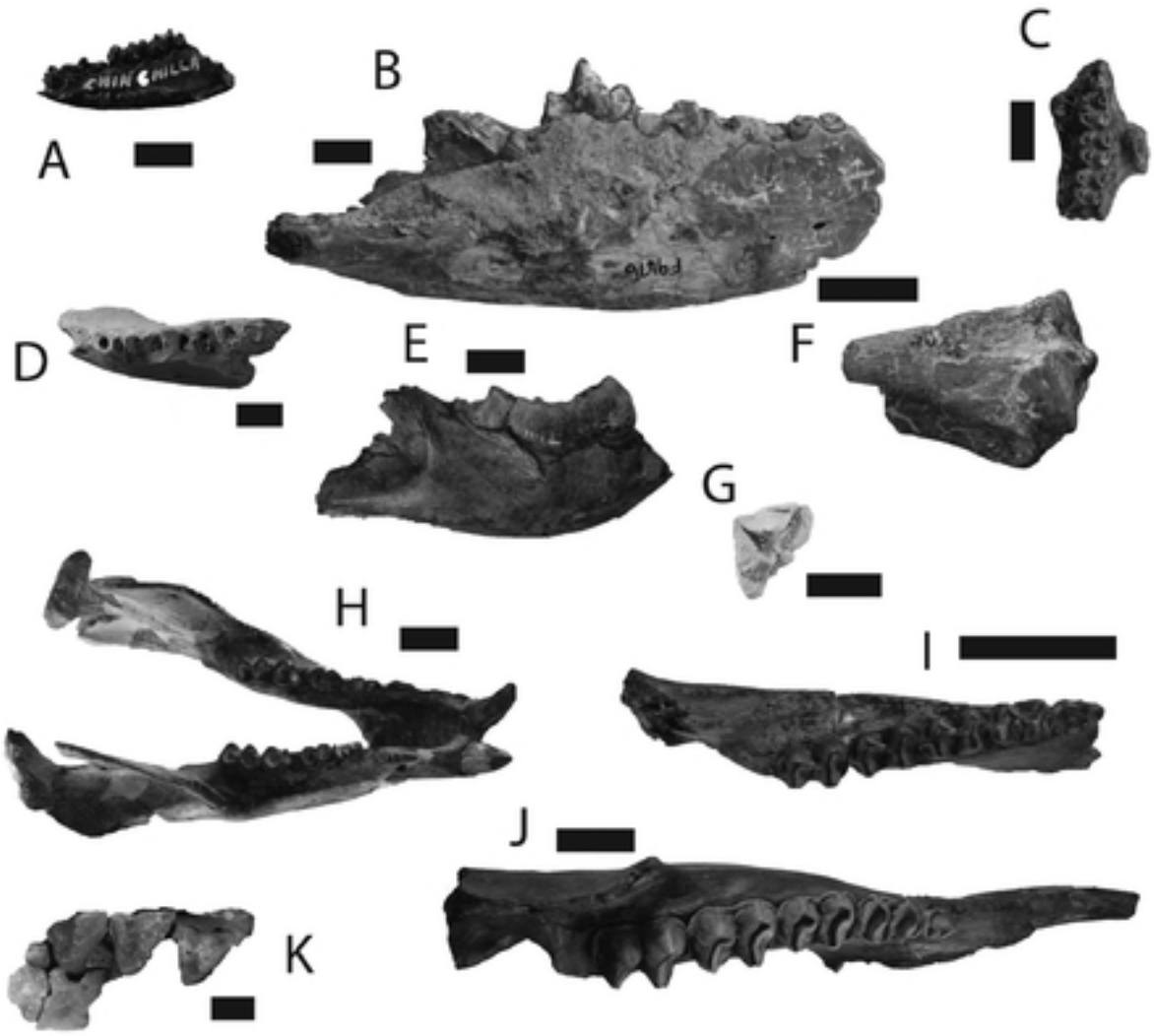

FIGURE 6. Non-macropodid marsupials. A, Dasyurus dunmalli QM F6579, ; left mandibular ramus; B, Thylacinus cynocephalus QM F9476, right mandibular fragment; C, Koobor notabilis QM F691, left maxillary fragment; D Phascolarctidae gen. et sp. indet. QM F52287, left dentary fragment; Scale bar equals 1 cm; E, Thylacoleo crassidentatus QM F3565, right mandibular ramus; F, Vombatus ursinus QM F743, proximal right tibia; Scale bar equals 2 cm; G, Phascolarctos ?stirtoni QM F52289, isolated RM1, 2 or 3 fragment; Scale bar equals 5 mm; H, Euowenia grata QM F519, mandible; I, Palorchestes parvus QM F783, left mandibular fragment; J, Euryzygoma dunense QM F376, left mandible; Scale bar equals 5 cm; K, Archerium chinchillaensis QM F39847, left maxillary fragment; Scale bar equals 2cm. [planned for page width]

Figure 7

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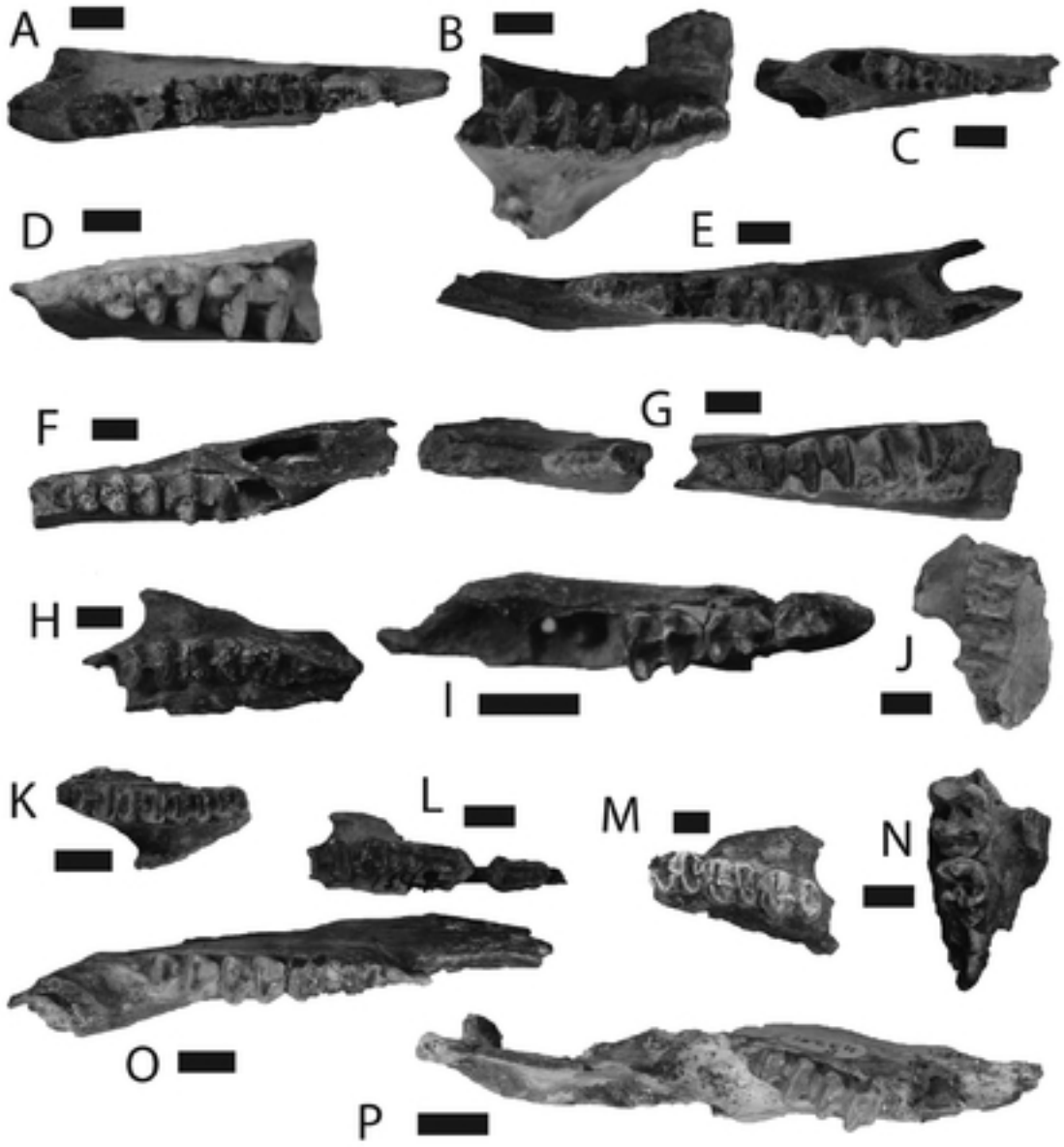

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Figure 8

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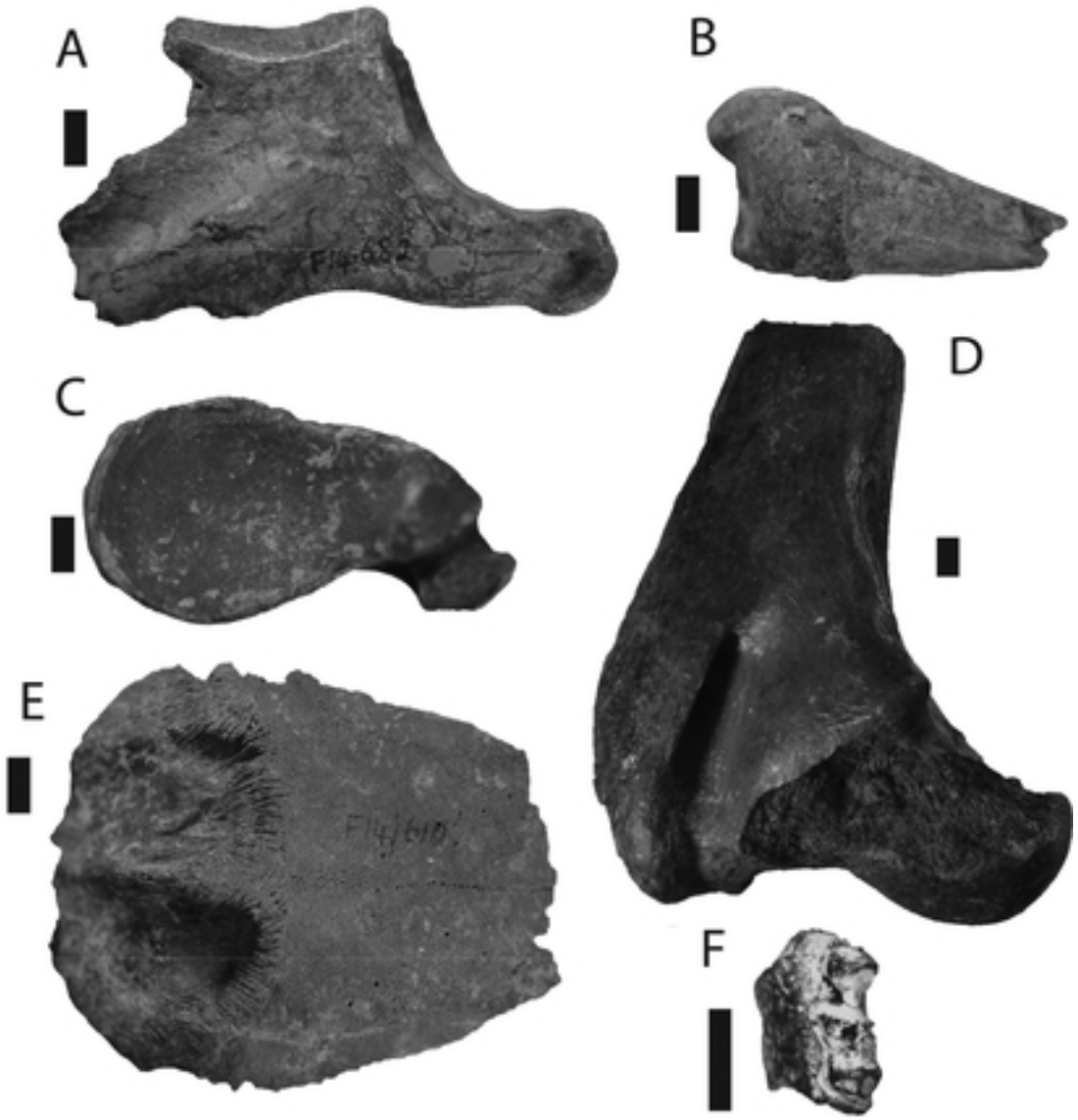

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