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Fossil Avian Assemblage of Pitfall Origin from Holocene Sediments in Amphitheatre Cave (G-2), South-western Victoria, Australia

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ABSTRACT. The fossil avian assemblage from Amphitheatre Cave (6 km north of the township of Nelson, Victoria, Australia) consists of 27 species of birds. Three dominate the assemblage with 63% of the total minimum number of individuals (i.e., *Gallinula mortierii*, *Dasyornis broadbenti* and *Dasyornis brachypterus*). Most of the material originated from a pitfall accumulation, based upon the large percentage of individuals belonging to terrestrial species with elements lacking the damage characteristic of vertebrate accumulators. Geographic range extensions are noted for three species (i.e., *Gallinula mortierii*, *D. brachypterus* and *Ptilonorhynchus violaceus)*. Assuming the assemblage is intra-contemporaneous, the reconstruction of vegetation at the time of deposition would include; wetlands with some areas of short cropped grass, bordered by wet heathland, which subsequently gave way to *Eucalyptus* open forest formation away from the water source and *Eucalyptus* tall open forest formation in the gullies. The age of the deposit (4,670 ± 90 y.B.P.: NZA 700) is based upon a single radiocarbon date on bone.

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Amphitheatre Cave (G-2: Matthews, 1985) is located approximately 6 km north of the township of Nelson, south-western Victoria (38°03'S 141°01'E) and occurs in the central part of an easterly facing cliff, approximately 15 m above the Glenelg River.

The exact location of the cave from which this material came, was unknown for a number of years, and it was therefore referred to by the name of the collector of the fossil material, F.S. Colliver (i.e., Colliver's Cave: Rich & Baird, 1986; Baird, 1986). Recently a foray was organised, through the help of the Department of Conservation Forests and Lands, where the author was able to view cave entrances from the river. At this time the cave was confirmed as being the southern entrance of Amphitheatre Cave (G-2), matching a photo of the cave entrance provided in Colliver's (1938) article on

the deposit (see Fig.1). Note that the entrance to the cave is actually below that indicated by Colliver, and that the area he indicated is only shadow produced by a small overhang.

"Cave has three entrances to high bifurcating joint controlled passage 80 m long, 18 m deep. Main chamber has large aven. Two entrances are joint enlargements in cliff face 15 m above river level, third entrance is enlarged solution tube 30 m deep x 1.5 m diameter." (Davey & White, 1986).

See Figure 2 for a plan view and position of excavation within the cave.

The excavation was started by F.S. Colliver on April 20 and 21, 1935 (Easter weekend), and completed over three subsequent trips (Colliver, 1938). The material was collected by bringing "...handfuls of the flour [sediment within the cave] at a time and spread it on the surface within a daylight area, and picked out any small bones, jaws or individual teeth that appeared. The bigger bones were felt within the flour and gently eased out" (Colliver, personal communication).

The cave occurs on the Follett Coastal Plain (Land Conservation Council, 1981) of south-western Victoria. This region is characterised by a dissected coastal plain with a variation in elevation between 0 to 60 m. Subparallel consolidated limestone ridges trend north-west to west-north-west, with inter-dune corridors between 2 to 11 km wide. These are thought to mark former Pleistocene shorelines. Sandsheets of orange siliceous sand are widespread.

The local climate consists of rainfall with a winter maximum of 112 mm and a summer minimum of 28 mm (average rainfall) and temperature ranges from 3.6 to 13.7°C (range of mean monthly temperatures) in June to 10.8 to 25.2°C in January, based upon the rainfall and temperature curves of the nearest weather station in Rennick, Victoria (approximately 19.5 km north of Amphitheatre Cave). Westerly winds predominate.

The local vegetation consists largely of woodland or open forest, composed of brown stringybark (*Eucalyptus baxteri*), messmate (*E. obliqua*), manna gum (*E. viminalis*), shining peppermint (*E. nitida*) and swamp gum (*E. ovata*), with extensive heaths as understorey. In the immediate vicinity of the cave the vegetation is a mixture of open scrub, heathland and open forest (Land Conservation Council, 1981). For a history of vegetation changes in the area refer to Baird (1985).

Material and Methods

The material reported on herein was gleaned from several drawers of material in the Museum of Victoria, Department of Vertebrate Fossils, labelled as collected by F.S. Colliver from Amphitheatre Cave, Glenelg River region (see Introduction). To the best of my knowledge all of the avian material available has been studied, though for some taxa, only higher taxonomic level determinations are presented. Modern comparative material used in the identifications was provided by the Department of Ornithology, Museum of Victoria and Department of Ornithology, South Australian Museum.

All of the fossil material discussed will be deposited in the Museum of Victoria, Department of Vertebrate Fossils. Museum of Victoria catalogue numbers can be found in the Materials section of each species account. A prefix 'P' should accompany each number but has been omitted for conservation of space.

The Scientific names used in each account follow Condon (1975) and Schodde (1975). Taxa previously unknown from sub-fossil and fossil deposits are noted (unpublished records in the faunal lists of Rich & van Tets (1982) are not considered formally confirmed

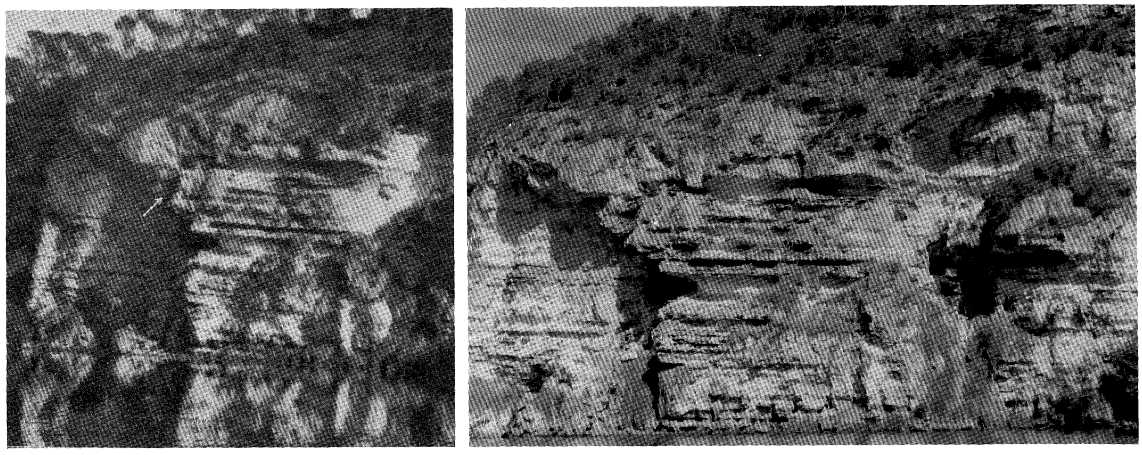

Fig.1. Photographs of the entrance to Amphitheatre Cave, including the original from Colliver (1938) and a more recent one taken by the author. Note that in the original photo the arrow only points to a small overhang, in the new photo both the south and the north entrances can be discerned. The south entrance is 15 m above the water level.

records as no full diagnoses are provided). Minimum numbers of individuals were determined by the standard method of counting the most abundant element from a particular side.

Geographical ranges for each species are here assumed to be the same as the current range, unless otherwise noted. The current range of each species is assumed to include the area surrounding the amphitheatre section of the Glenelg River, unless mentioned otherwise.

Anatomical terminology follows Baumel *et al.* (1979).

All measurements in the text are in millimetres. Standard measurements in the text are indicated in brackets and follow the guidelines in von den Driesch (1976) unless stated otherwise. All measurements were taken with vernier callipers accurate to 0.05 mm and were rounded to the nearest 0.1 mm.

Species determination is based upon mensural criteria in every species account except where otherwise stated. Botanical nomenclature follows the guidelines of Specht (1981).

All tables referred to throughout the paper are included in Appendix I. Abbreviations used in the text, figures and appendices are listed in Appendix II.

Material identified as juvenile is based upon the criteria of having a "...pitted appearance of the surface of the bone and incomplete ossification of the articular facets..." (Campbell, 1979: 17).

Morphological characters for determinations higher than species level are included in Appendix III, unless only one element is considered, in which case they are included in each species account. Characteristics include those separating the species from closest relatives and other families which may have similar appearance to the elements in question. This is not supposed to be an exhaustive account of characters separating the species, families and orders in question but only a guide to the characters used to identify the elements in question from all other Australian taxa with similar appearance. All bird species currently recorded from the Australian continent and Tasmania were included in the comparisons unless noted otherwise (in the Characters section of the species accounts).

Unless otherwise stated, actualism or methodological uniformitarianism is assumed to be valid (see Simpson, 1970 and Gould, 1965, 1985, respectively). This implies that if a species is restricted to a particular set of environmental parameters currently, the species was also restricted to those parameters in the past. Although there are several examples of modern species, now restricted to specific habitats, that are found in deposits whose faunal composition suggests that those species inhabited a wider range of habitats in the past than is presently displayed, I have not presumed wider ecological tolerances for species unless the fauna, as a whole, or

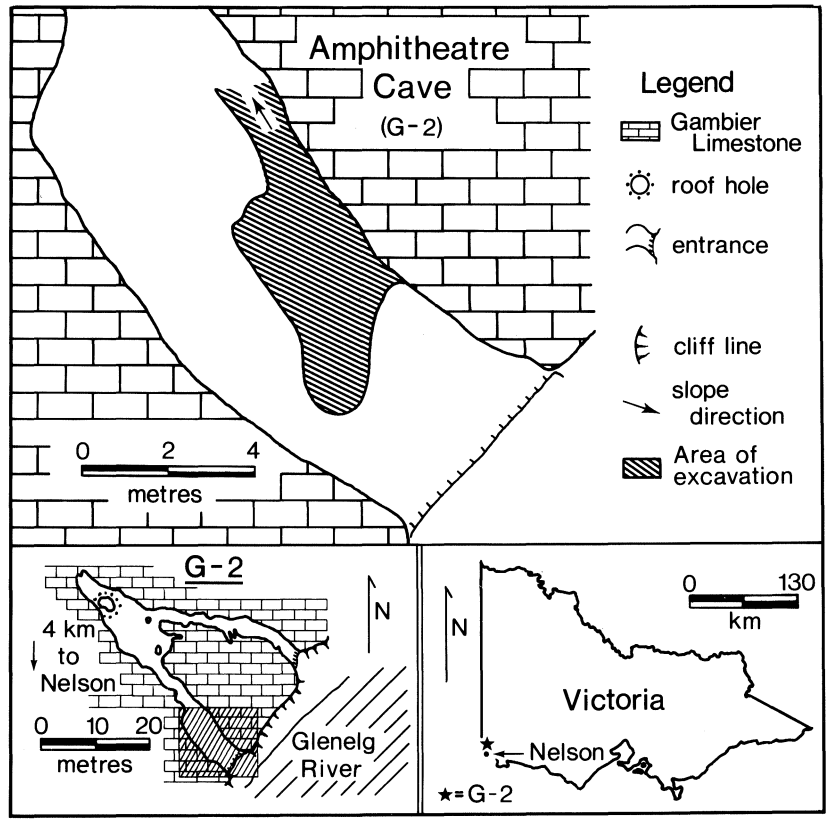

Fig.2. Plan view of Amphitheatre Cave demonstrating the position within the feature from which the fossil material was excavated.

palaeobotanical information suggests otherwise. Information provided in the environmental reconstructions is based on species habitat preferences from modern analogues (see Baird, 1989).

SYSTEMATIC PALAEONTOLOGY

Aves

Sphenisciformes

Spheniscidae

Eudyptula minor

Material. prox. frag. pel. (178677), com. right fem. (178678), com. left fem. (178679), incom. left tbt. (178680), incom. left tmt. (178681).

Characters. *Eudyptula minor* is the smallest extant penguin in the world, and the fossil material conforms to the range of variation exhibited by this species.

Remarks. The condition of the material referred to this species differs from that of most of the material from this cave in that it is bleached white with sand grains adhering to their surfaces. Elements with similar preservation are those referred to *Pachyptila* sp., *Phalacrocorax* sp. and *Larus novaehollandiae* (see Taphonomy section for more details). This species is largely pelagic, but is known to have colonies along most of the southern coastline of Australia (Serventy *et al.*, 1971) and beach washed specimens are frequent in the south-east of South Australia (Parker & Reid, 1983).

Procellariiformes

Procellariidae

Pachyptila sp.

Material. incom. right ulna (178682).

Characters. The two characters on the ulna considered diagnostic for the family Procellariidae, include: Ulna (whole), 1. shaft markedly straight and angular, 2. *cot. ventralis* and *cot. dorsalis* proximally facing.

The element is referred to the genus *Pachyptila* based on its diminutive size.

Due to the amount of mensural overlap, the extant species of *Pachyptila* cannot be separated by mensural criteria of the ulna; therefore, the determination is *Pachyptila* sp. (see Olson, 1985 for a discussion and figure of *Pachyptila* ulnae).

Remarks. See Remarks section for *Eudyptula minor*.

Pelecaniformes

Phalacrocoracidae

Phalacrocorax sp.

Material. 2 incom. pel. (178683, 178684).

Characters. The suite of characters on the synsacrum considered diagnostic for the family Phalacrocoracidae, include: Synsacrum, 1. *cta ventralis* markedly expanded ventrally, 2. long and gracile throughout, 3. no opening for proximodorsal canal, distally, 4. tubercles present just dorsal to the *antitrochanter*.

The Australian species of *Phalacrocorax* can be separated into three size groups. The fossil material agrees in size with the medium-size group, which includes both *P. fuscescens* and *P. varius*. Due to extensive mensural overlap within this a group species-determination cannot be finalised.

Remarks. For colouration and other surficial characters see that under *Eudyptula minor*. Habitats include marine, coastal, subcoastal lakes, and inland waters (Parker & Reid, 1983).

Anseriformes

Anatidae

small species

Material. incom. right ccd. (178685), incom. right tbt. (178609).

Characters. Generic and specific determinations are not considered possible due to the small amount of comparative material currently available.

Accipitriformes

Accipitridae

Accipiter fasciatus

Material. com. left tmt. (167068).

Characters. The suite of characters considered diagnostic for the genus *Accipiter* includes: Tarsometatarsus, (proximal end), 1. *cta medialis* and *lateralis* completely separate with a small groove on the lateral edge of *cta lateralis*, 2. *imp. retinaculi extensorii* are positioned on the medial edge of the dorsal surface close to *cot. medialis* and *lateralis*; (distal end), 1. laterally compressed shaft, 2. laterally compressed *troc. metatarsi terti*, 3. dorsal surface of *troc. metatarsi secundi* slopes gently medially, viewed distally, 4. *troc. metatarsi* nearly equal in length, 5. *fora. vascularia* distale further proximal than most other accipitrids; 6. *troc. metatarsi secundi* and *terti* does not extend as far ventrally.

Species determination is based upon size where *Accipiter fasciatus* is consistently less robust than *A. novaehollandiae*, and the dimensions of the fossil specimen (e.g., G.L. = 77.9, B.p. = 9.3) fall within the range of variation exhibited by *A. fasciatus* (see Fig.3).

Remarks. According to Blakers *et al.* (1985) *Accipiter fasciatus* "...lives wherever there are groves of trees but is most abundant in forest and woodland".

Falconidae

cf. *Falco cenchroides*

Material. incom. right ulna (167255).

Characters. The suite of characters diagnostic for the genus *Falco*, include: Ulna, (proximal end), 1. *cot. ventralis* dorsoventrally flattened, 2. *olecranon* dorsoventrally flattened, 3. *dep. M. brachialis* prominent and extends distally, 4. distinct ridge leading to *olecranon* proximally (viewed posteriorly); (shaft), 1. curved (convex posterior); (distal end), 1. *labrum condyli* extends proximally, 2. *tub. carpale* large and curved ventrally.

Species determination is based on overall size, precise measurements are not considered reliable due to damage of the terminal ends.

Remarks. *Falco cenchroides* occurs throughout Australia and is capable of surviving in all terrestrial habitats.

Galliformes

Phasianidae

Coturnix sp.

Material. incom. rost. (178686), incom. right hum. (167251), com. left hum. (167246), dist. end left hum. (167248), 2 com. right ulna (167219, 167257), com. left ulna (178687), 2 com. right ccd. (178383, 178386), com. left ccd. (178509), huml. end left scap. (178381), incom. right tmt. (167294), incom. right tmt. (juv.)(178619), com. left tmt. (167237).

Characters. The larger species of *Coturnix* cannot be separated by size or morphology (see Baird, 1986).

Remarks. Of the two species considered to be biogeographically likely for this material, *C. australis* and *C. pectoralis* are both irruptive. They disperse when

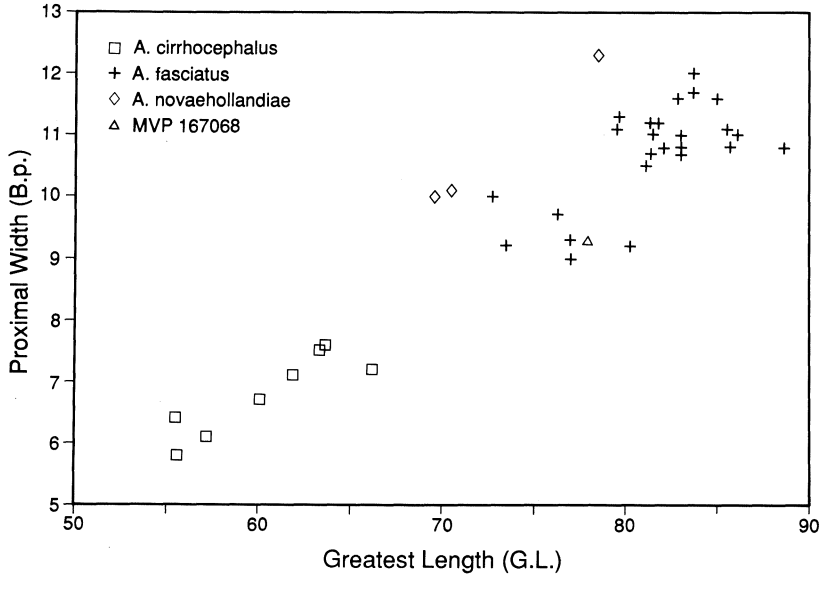

Fig.3. Plot of tarsometatarsi measurements of modern comparative specimens from the three species of *Accipiter* occurring in Australia, as compared with the fossil specimen from Amphitheatre Cave (167068), demonstrating the affinity of the specimen with *A. fasciatus*.

food becomes scarce, and *C. pectoralis* will invade inland areas after substantial rains (Frith *et al.*, 1977; Frith & Waterman, 1977); therefore, the range of habitats covered by these species is large and includes EOFF, EWF, HF, MOSF and ATSF.

Gruiformes

Turnicidae

Turnix varia

Material. 3 com. right hum. (178365-178367), 2 incom. left hum. (178615, 178616), incom. right ulna (178514), com. right ccd. (167074), com. right ccd. [juv.] (178363), com. left ccd. (178362), incom. left ccd. (178614), com. furc. (178508), stm. spin. proc. frag. (178364), incom. stm. [juv.] (167071), com. right fem. (178688), prox. end right fem., (167271), incom. left fem. (178689), com. right tbt. (167233), com. right tbt. [juv.] (178368), prox. end right tbt. (178618), com. left tbt. (178617), incom. left tmt. (178368).

Characters. *Turnix varia* is larger than all other species of *Turnix* in south-eastern Australia (see Table 1). Comparative material included only *T. melanogaster*, *T. varia*, *T. velox* and *T. pyrrhothorax* since no other Australian turnicids are represented in skeletal collections.

Remarks. The range of habitats frequented by this species includes "...eucalypt forest [EOFF], woodland [EWF], and heath [HF] where there is a layer of leaf and twig litter..." (Blakers *et al.*, 1984). In the south-east of South Australia, this species occurs in inland HF and EWF (Bourne, 1982; Parker & Reid, 1983).

Rallidae

Rallus philippensis

Material. incom. rost. (178504), com. left hum. (178592), com. right rad. (167183), com. right cmc. (167230), com. right scap. (167083), com. syn. (167182), com. right fem. (167167), com. left fem. (167103), com. right tbt. (167102), com. left tbt. (178658), com. right tmt. (167295), com. left tmt. (178452).

Characters. *Rallus philippensis* is the largest of the small rallids in Australia and the fossil specimens fall within the range of variation exhibited by this species (see Baird, 1986).

Remarks. All of the elements probably came from a single individual, as there are no duplicates of elements and measurements for each pair of postcranial elements are identical.

The habitat requirements of *R. philippensis* include wet tussock grassland (Parker & Reid, 1984), "...rank vegetation in swamps and along creeks or in paperbark woodlands..." (Blakers *et al.*, 1984), mangroves and wet sclerophyll forest [ETOFF] (Morris *et al.*, 1984).

Gallinula mortierii

Material. See Appendix IV.

Characters. Postcranial elements of *G. mortierii* are larger and more robust than those of all other species of rail in Australia (see Olson, 1975; Baird, 1984).

Remarks. The Tasmanian Native-hen, currently restricted to the island of Tasmania, is a secondary grazer and most frequently encountered in areas near permanent or temporary water, including arable land and cultivated pastures. It is dependent on short lush pasture for feeding and permanent water for breeding (Ridpath, 1972).

The mid-Holocene radiocarbon date on the *Gallinula mortierii* element from Amphitheatre Cave prompted a review of the hypotheses for its extinction from the mainland of Australia (Baird, 1991b) in which Baird argued that it is possible that both the dingo (*Canis familiaris dingoensis*) and the environment may have been important to this extinction.

Because of the abundance of *G. mortierii* in this deposit measurements for most of the postcranial elements have been provided in Appendix V to facilitate comparison with material from other fossil deposits.

Charadriiformes

Laridae

Larus novaehollandiae

Material. incom. right hum. (178690).

Characters. The suite of characters diagnostic for the family Laridae include: Humerus, (distal end), 1. long *proc. supracondylaris dorsalis*, not incurved, 2. deep *fossa M. brachialis.*

The suite of characters considered diagnostic for the genus *Larus* include: Humerus, (proximal end), 1. *caput humeri* low, 2. second *fossa pneumotricipitalis* relatively shallow, 3. *cta pectoralis* proximally located; (distal end), 1. *proc. supracondylaris dorsalis* distally located.

Larus novaehollandiae is the smallest species of

Larus in Australia and the fossil material agrees with comparative modern specimens of that species.

Remarks. For condition of preservation see that under *Eudyptula minor*.

Larus novaehollandiae is found throughout Australia, and seems only to require the presence of open water, be it fresh, brackish or salt (Blakers *et al.*, 1984).

Columbiformes

Columbidae

Phaps chalcoptera

Material. incom. right ccd. (167240).

Characters. The suite of characters considered diagnostic for the family Columbidae, include: Coracoid, (humeral end), 1. *proc. acrocoracoideus* ends, distally, very abruptly, 2. distance between *proc. acrocoracoideus* and *cot. scap.* relatively large, 3. *cot. scap.* broad and extends sternally down shaft, 4. lacks pneumatic fenestrae at interface of *sul. M. supracoracoidei* and *fac. art. clavicularis*; (sternal end), 1. *angulus medialis* attaches broadly to main body of coracoid, 2. *proc. lateralis* extends beyond *fac. art. sternalis*.

The suite of characters considered diagnostic for the genus *Phaps*, include: Coracoid, (humeral end), 1. internal edge of *imp. lig. acrocoracohumeralis* medially elongate (from an internal view, *imp. lig. acrocoracohumeralis* mainly obscured by this edge), 2. *imp. lig. acrocoracohumeralis* rectangular in outline (in humeral view), 3. *fac. art. clavicularis* medially located.

Of the three members of this genus *P. chalcoptera* is the largest, and the specimen falls within the range of variation demonstrated by that species (see Table 2).

Remarks. *Phaps chalcoptera* is the most wide-ranging species of large columbiform in Australia. This species can be found "...in all, except the most dense and wet wooded habitats" (Frith, 1982). Although it currently frequents coastal heathlands, Frith (1982) considered that this is largely the result of the clearing of eucalypt forests, whereas the heaths are usually left untouched. This, according to Frith, causes the members of this species to expand into what might be considered sub-optimal habitat.

Phaps elegans

Material. incom. left ccd. (167207).

Characters. See that under *Phaps chalcoptera* for the suites of characters considered diagnostic for the family Columbidae and the genus *Phaps*.

Of the three members of this genus *P. elegans* is the smallest, and the fossil specimen falls within the range of variation demonstrated by that species (see Table 2).

Remarks. "Throughout its [*Phaps elegans*] range, it maintains this preference for heathland and other vegetation with a heath-like structure" (Frith, 1982). This is particularly true around swamps and in coastal and sub-coastal country. Although this species is not exclusively dependant upon heaths, where it is sympatric with *P. chalcoptera*, it seems to have a strong preference for this type of habitat.

Species previously unrecorded in the fossil record.

Psittaciformes

Loriidae

Glossopsitta concinna

Material. incom. right ulna (167224), incom. left cmc. (178601).

Characters. Both generic and specific determination of based on mensural criteria. Postcranial elements of the three species of *Glossopsitta* are smaller than any of the member in the genus *Trichoglossus*. Of the three species in the genus *Glossopsitta*, *G. concinna* is the largest and the elements referred to this species fall within the range of variation for this species.

Remarks. *Glossopsitta concinna* inhabits most types of forested or wooded country (Morris *et al.*, 1981; Blakers *et al.*, 1984) and will frequent any area where "...there are flowering or fruit bearing trees or shrubs..." (Forshaw, 1969).

Cacatuidae

Cacatua tenuirostris

Material. incom. right hum. (178657).

Characters. The element conforms to all those morphological characters for *C. tenuirostris* defined in Baird (1985), including: 1. presence of a small posterior groove on anterior face of *cta pectoralis*, 2. a deep *fossa pneumotricipitalis*, and 3. a greater angle between *inc. capitis* and shaft axis. Mensurally, the total length [GL = 71.6] falls just above the mean for the modern comparative material [GL = 71.3] and well below the

mean of the fossil population of this species in Green Waterhole Cave (GL = 74.6; Baird, 1985).

Remarks. Emison & Beardsell (1985) define the habitat of *C. tenuirostris* as EWF, especially those composed of River Red Gum (*Eucalyptus camaldulensis*) woodland alliance (85%) with an additional small percentage of sightings (15%) in South Australian Blue Gum (*E. bicostata*)/Pink Gum (*E. fasciculosa*) woodland alliance.

cf. *Cacatua roseicapilla*

Material. incom. right ulna (178338), incom. left cmc. (167258).

Characters. These elements are of typical cacatuid form and are closest to those of *Cacatua roseicapilla* (see Baird, 1985).

Platycercidae

Platycercus elegans

Material. incom. rost. (1783), com. right hum. (167250), prox. end right hum. (167252), incom. left hum. (167247), com. right ulna (167256), com. right rad. (167260), incom. left ccd. (178570), huml. end right scap. (167261).

Characters. *Platycercus elegans* is the largest member of this genus in Victoria (Baird, 1985) and the fossil material agrees in mensural criteria to those of this species.

Remarks. *Platycercus elegans* "...is a bird of humid and semi-humid forests [ETOFF & EOFF], from sealevel to the highest mountains..." but "...post breeding flocks of immatures regularly come into open woodland [EWF], heathlands [HF] and partly cleared farmlands" (Forshaw, 1969). Currently recorded from EOFF and EWF in the south-east of South Australia (Parker & Reid, 1983).

Species previously unrecorded in the fossil record.

Neophema sp.

Material. incom. right ulna (167220), 1 incom. right fem. (178752).

Characters. These specimens could not be identified to species level since, for those elements, there is considerable overlap in size among the six species in the genus.

Psittaciformes

Family Indeterminate

Material. spinus proc. frag. (178507), incom. right fem. (178433).

Characters. Referred to the order Psittaciformes for being bifurcate (although not extreme) with little or no dorsal 'carina' on the spinus process (as in certain Passeriformes); the anterior section of the carina rounded; the whole *spinus proc.* largely dorsomedially extending.

Passeriformes

Hirundinidae

gen. et sp. indet.

Material. prox. end right hum. (167217), incom. left hum. (juv.) (167215), 2 incom. right ulna (178402, 178599), incom. left ulna (178408), incom. right tbt. (167235), dist. end left tbt. (juv.) (178446).

Characters. It is not considered possible to separate the various genera of Hirundinidae currently inhabiting continental Australia (see Baird, 1985).

Remarks. Presence of juvenile material suggests this species was nesting in the cave; therefore, it is regarded as autochthonous in origin.

Orthonychidae

Cinclosoma punctatum

Material. dist. end cran. (178370), right mand. art. (178377), com. right hum. (178387), com. left hum. (178511), incom. left ccd. (167243), com. right fem. (178438), com. left fem. (178423), dist. end right tmt. (178464), incom. left tmt. (juv.) (178457).

Characters. The postcranial elements of *C. punctatum* are larger than those of any other species in the genus *Cinclosoma*. All the abovementioned elements agreed in mensural criteria with comparable elements in a modern series of *C. punctatum* (see Baird, 1986).

Remarks. Most of the elements are completely ossified, except the proximal end of the tarsometatarsus (178457). I assume that they all came from the same individual and that, among the elements represented, the proximal end of the tarsometatarsus is the last to become fully ossified (based upon gross times of post

cranial bone ossification; see Latimer, 1927; Fujioka, 1955).

Cinclosoma punctatum occurs in most types of dry sclerophyll forest (EOFF: Frith, 1969; Morris *et al.*, 1981), and both Loyn (1985c) and Smith (1984) regard this species as occurring most frequently on dry ridges. Loyn (1980) describes its habitat as EOFF, "...specially where [the] understorey is sparse and there is a lot of plant litter, logs, and *Poa* spp."

Species previously unrecorded in the fossil record.

cf. *Cinclosoma punctatum*

Material. incom. stm. (juv.) (178346).

Characters. *Cinclosoma* can be identified by its proportionately anteriorly elongate *spina externa*, by its short more laterally projecting *proc. craniolateralis*, by the more arcuate nature of its *carina sterni* and its proportionately large *inc. lateralis*.

Acanthizidae

Dasyornis brachypterus

Material. 2 com. left hum. (178399, 167213), incom. left hum. (167163), prox. frag. left hum. (178401), com. right ulna (178409), com. left ulna (178407), 2 com. right fem. (178517, 178518), 4 com. left fem. (178427, 178428, 178431, 178602), 2 incom. left fem. (178429, 178430), com. right tbt. (167172), 4 incom. right tbt. (167171, 167231, 167232, 178448), prox. frag. right tbt. (178451), dist. end right tbt. (178449), incom. left tbt. (178528), 2 com. right tmt. (178463, 178613), 2 com. left tmt. (178453, 178454), dist. end left tmt. (178538).

Characters. *Dasyornis brachypterus* is intermediate in size between the other two species of *Dasyornis*. These mensural criteria are based on measurements from skins, the fossil material of *D. brachypterus* from Buchan, Victoria, and the fossil material of Western Bristlebird (*D. longirostris*) from the Cape Leeuwin/ Cape Naturaliste area of Western Australia (see Table 3). At present there are no modern comparative specimens of *D. brachypterus* and only one juvenile skeletal specimen of *D. longirostris*. The fossil material and the modern material fall into three distinct mensural groups (see Table 3); therefore, I am confident in the species-determination of this material as *D. brachypterus* (see Appendix VI and Fig.4).

Remarks. *Dasyornis brachypterus* is largely restricted to HF, especially that associated with watercourses, and rank vegetation, either bordering sub-coastal watercourses or along the coast (Morris *et al.*, 1981; Blakers *et al.*, 1984). McNamara (1946) in discussing the habitat preferences of *D. brachypterus* stated: "...it has been recorded from areas right on the seacoast and also from the tops of coastal ranges up to more than 2,000 feet above sealevel, there being a wide range in climatic conditions, though a high rainfall is common to both areas as is necessary to promote the growth of vegetation of the type they inhabit".

Species previously unrecorded in the fossil record. This is the only record for fossil *D. brachypterus* west of Buchan, Victoria, a range extension of approximately 780 km (see Fig.5; Baird, 1986).

Dasyornis broadbenti

Material. See Appendix IV.

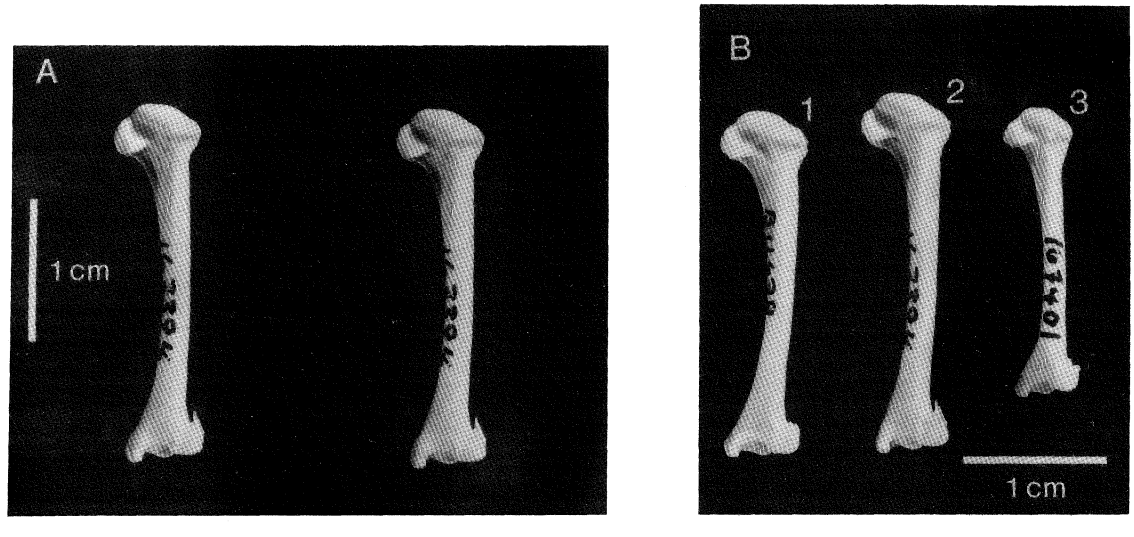

Fig.4. Stereo pair of a fossil right humerus (167394) referred to *Dasyornis broadbenti* (A), and a set of three right humeri (B) including (1) *Dasyornis broadbenti* (modern, MV B11638), (2) *D. broadbenti* (fossil from Amphitheatre Cave, 167394), and (3) *D. brachypterus* (fossil from Amphitheatre Cave, 167401).

Characters. Of the three species of *Dasyornis* in Australia, *D. broadbenti* is the largest. The referred fossil material is indistinguishable from comparable modern material of *D. broadbenti* (see Table 3 and Appendix VI).

Remarks. *Dasyornis broadbenti* is largely restricted to the coastal and subcoastal HF of the western coast of Victoria, but does occur in dense vegetation bordering streams in the Otway Ranges (see Fig.5; Blakers *et al.*, 1984).

Meliphagidae

cf. *Anthochaera carunculata*

Material. dist. end right hum. (167253), prox. end left hum. (178595), incom. right ccd. (167241), incom. left ccd. (167244), incom. right tbt. [juv.] (178533), incom. left tbt. (178478), incom. left tbt. [juv.] (178445), prox. end left tbt. [juv.] (167279), dist. end left tbt. [juv.] (167281).

Characters. Although morphological characters for the genera within the family Meliphagidae have not been worked out the material agrees in size with *Anthochaera carunculata.*

Remarks. *Anthochaera carunculata* "...lives...in eucalypt forest, woodland, mallee..." (Blakers *et al.*, 1985).

cf. *Anthochaera chrysoptera*

Material. incom. right ulna [juv.] (178513).

Characters. Although morphological characters for the genera within the family Meliphagidae have not been worked out the material agrees in size with *Anthochaera chrysoptera.*

Remarks. *Anthocharea chrysoptera* "...lives in eucalypt forest, heath and gardens mostly at low altitude in coastal and sub-coastal districts..." (Blakers *et al.*, 1985).

Paradiaseidae

Ptilonorhynchus violaceus

Material. left mand. art. (178378), com. right ulna (178339), incom. left ulna [juv.] (178340), incom. right ccd. (juv.) (178382), incom. left ccd. [juv.] (167242), incom. right fem. [juv.] (167266).

Characters. The fossil material conforms in all respects to those of modern comparative samples of the monotypic genus *P. violaceus.*

Remarks. *Ptilonorhynchus violaceus* ranges throughout a number of different habitats including EOFF, ETOFF and CFF, but its distribution seems to be centred on moist habitats including CFF and ETOFF (Morris *et al.*, 1981; Blakers *et al.*, 1984). The wide range of habitats comes from dispersal from summer breeding grounds during winter, for as Frith (1969) points out, "...locally it is abundant in the wet sclerophyll forests and moist gullies in the ranges and winter in the surrounding open country...".

Family previously unrecorded in the fossil record. This material constitutes a range extension of approximately 240 km west (Blakers *et al.*, 1984).

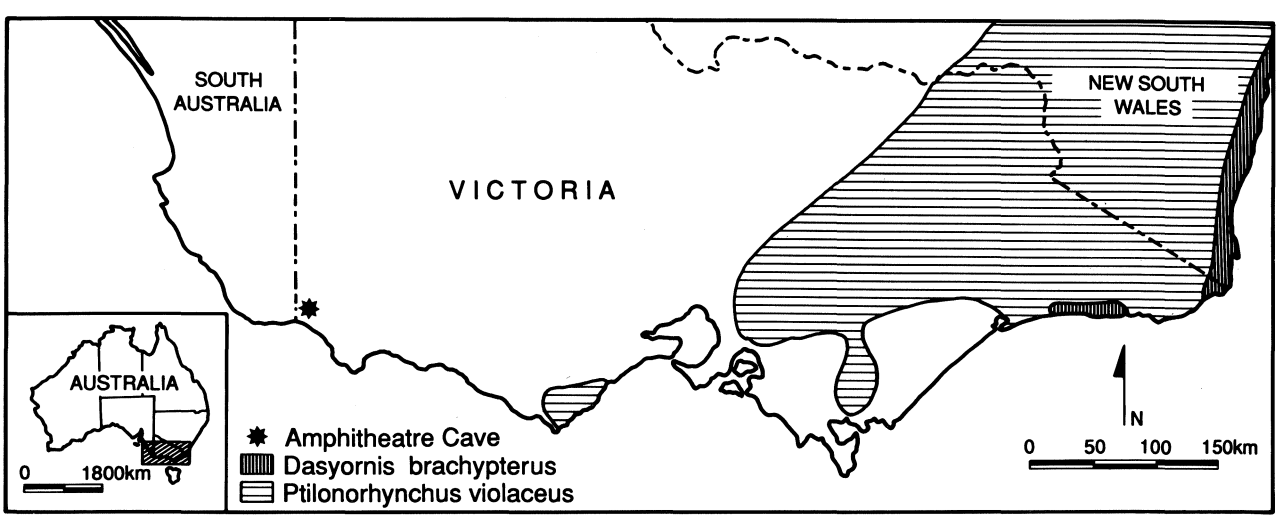

Fig.5. Distribution of *Dasyornis brachypterus* and *Ptilonorhynchus violaceus* in south-eastern Australia, including the fossil locality and current distributions.

Cracticidae

Indeterminate

Material. incom. right hum. (178660).

Characters. Species determination is not considered possible, for this element, because its length falls [L = 51.8] within the area of mensural overlap between *Gymnorhina tibicen* and *Strepera graculina.*

Corvidae

Corvus sp.

Material. prox. end right hum. (178343), dist. end right hum. (178342), incom. left cmc. (178659), incom. left tmt. (178341).

Characters. Species-determination not considered possible (see Baird, 1985).

Aves

Order Indeterminate

Material. huml. end left scap. (167184), incom. left fem. [juv.] (178527), shaft frag. right tbt. (178537), phal. dig. maj. (178516).

Passeriformes

Family Indeterminate

Material. 2 left ram. mand. (178376, 178588) spinus proc. frag. (178379), com. right ccd. (178466), stnl. end right ccd. (178383), com. left ccd. (178385), incom. left ccd. (178384), incom. right scap. (178380).

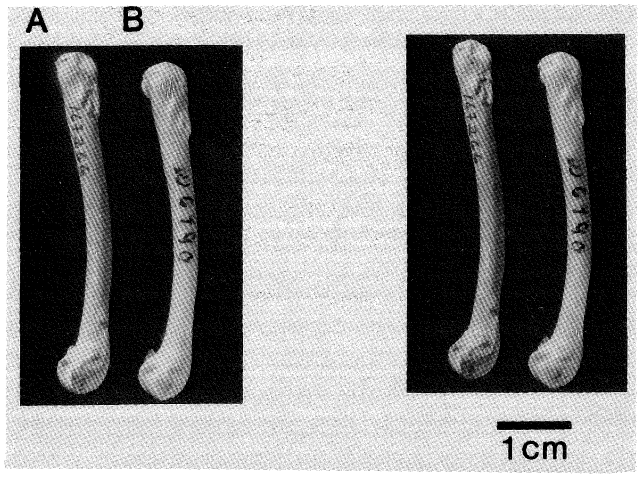

Fig.6. Stereoviews of *Ptilonorhynchus violaceus* femora, including (A) fossil specimen from Amphitheatre Cave (167266) and (B) modern specimen (MV W6490).

non-Passeriformes

Family Indeterminate

Material. incom. right ccd. [juv.] (178589), huml. end left scap. (178591).

Results and Discussion

The fossil avian assemblage from Amphitheatre Cave is composed of at least 27 species (MNI = 81), of which three species dominate the assemblage with 63% of the total MNI's (i.e., *Gallinula mortierii*, *Dasyornis brachypterus* and *D. broadbenti*; see Table 4). Out of these 27 species at least four are of questionable origin (see the Taphonomy section, below, for details).

Range extensions are noted for three species (i.e., *Gallinula mortierii*, *Dasyornis brachypterus* and *Ptilonorhynchus violaceus*), each of which is an indicator of a wetter climate than currently occurs in the area today (Fig.5).

Although previous dating of the deposit, based on faunal analysis, suggested a latest date of 12,000 y.B.P. by the presence of *G. mortierii* (Baird, 1984). A radiocarbon date of 4,670 ± 90 y.B.P. (NZA 700) has been obtained on a tibiotarsus identified as *Gallinula mortierii*. The date was made on the organic fraction of the bone (d13C: -23.42 per mille). Therefore *G. mortierii* is no longer considered reliable as an indicator of pre-Holocene deposits.

Taphonomy

Based on the condition of the elements, the avian assemblage from Amphitheatre Cave can be divided into two fractions. The first comprises bleached white elements with grains adhering to their surfaces and lack any carnivore damage. The second comprises elements whose coloration varies but is usually chamois (Munsell Notation, 1.7 Y 8.0/6.0; Smithe, 1975), whose surfaces are powdered with very minute gypsum crystals in the topographic depressions (J. Bodard, personal communication) and in many cases have very characteristic surficial weathering patterns. The taxa included in the first fraction are either pelagic or aquatic (i.e., *Eudyptula minor*, *Pachyptila* sp., *Phalacrocorax* sp., *Larus novaehollandiae*), and those in the second are largely terrestrial. I suggest that the material from the first fraction should not be included in a discussion of the taphonomic history of the cave assemblage, proper, for it is possible that it comprises beach washed specimens picked up either on the shore

line below the entrance of the cave by people who presumed them to have come from the cave itself, or at some undesignated point and included in the cave material by accident. The Glenelg River is tidal, at least to the Amphitheatre section, which would facilitate the transport of the pelagic species. The colouration, presence of sand grains, and habits of those members of this fraction would be compatible with such a scenario.

The material collected from the cave proper is characterised by the following: (i) it is composed of a wide variety (of which three predominate, numerically) of species, (ii) the range of body sizes for the species involved is great, with no centre of abundance at towards any end of the scale (see Fig.7), (iii) most (86%) of the individuals are terrestrial (see Fig.8), and (iv) elements are largely intact, with few acute or obtuse fractures (some right angle breaks are present). The hirundinid material was ignored in this analysis, as it is considered to be autochthonous/habitual cave-dweller in origin (see Baird, 1991a). The above-mentioned characters would be compatible with an autochthonous/pitfall/death trap origin for the bulk of the Amphitheatre Cave assemblage (Table 5; Baird, 1991a).

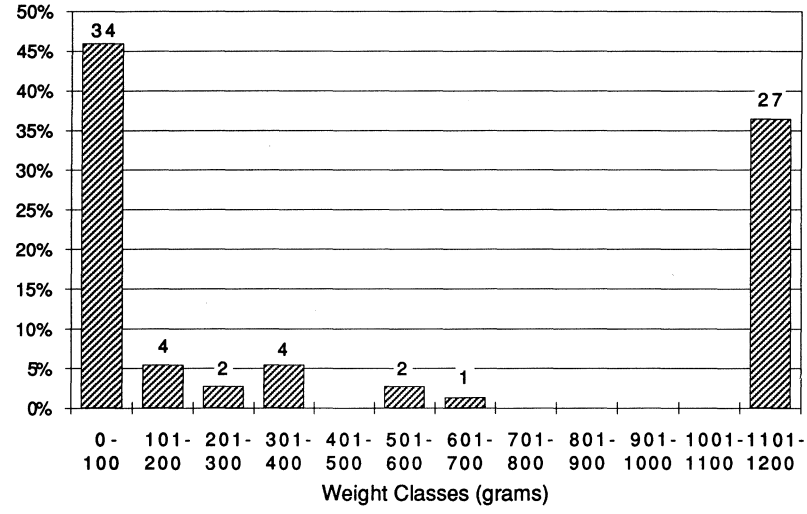

Fig.7. Percentage contribution of weight classes for bird species making up the Amphitheatre Cave avian assemblage showing no centre of distribution at either end of the weight scale. Numbers above the columns represent MNI from a total of 74. N = MNI from a total of 74. Not including *Eudyptula minor*, *Pachyptila* sp., *Phalacrocorax* sp., *Larus novaehollandiae* and Hirundinidae for reasons set out in the text.

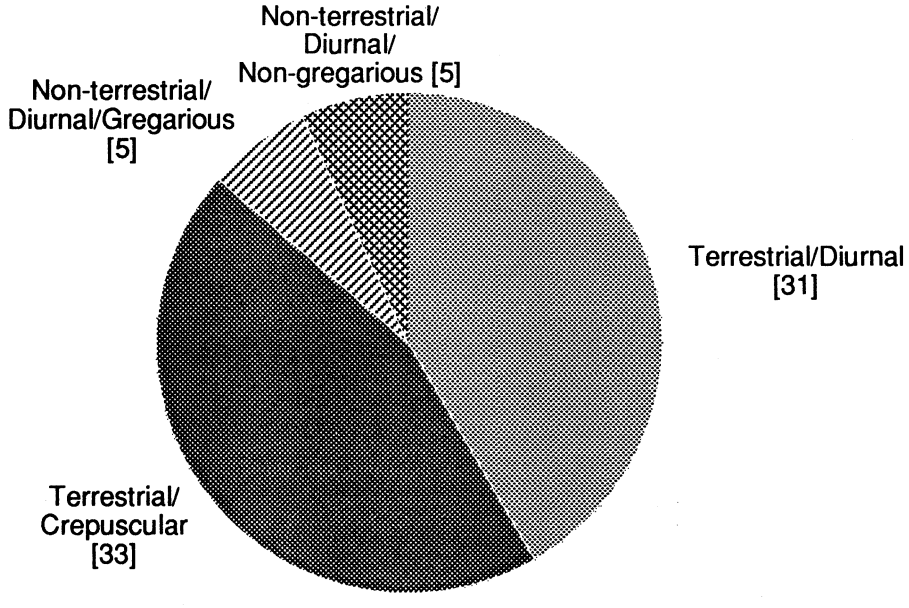

Fig.8. Percentages from total fauna (based on MNI = 74) of various avian behavioural groups from the Amphitheatre Cave avian assemblage demonstrating the large percentage of terrestrial individuals (figures in brackets are the MNIs for each group). Not including *Eudyptula minor*, *Pachyptila* sp., *Phalacrocorax* sp., *Larus novaehollandiae* and Hirundinidae for reasons set out in the text.

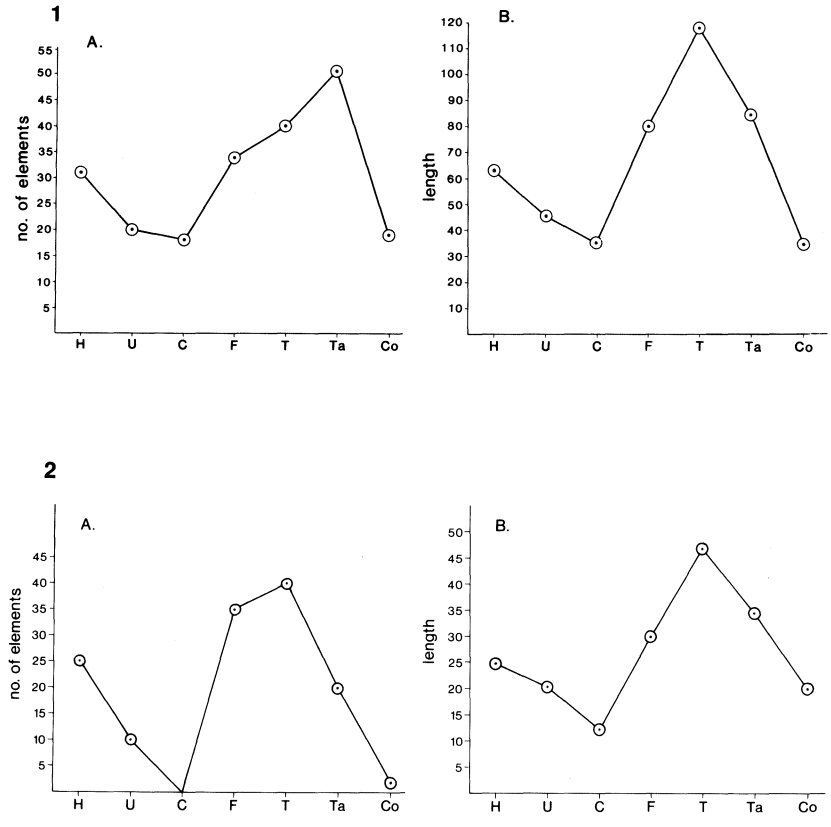

Fig.9. Graphic distribution of postcranial elements of *Gallinula mortierii* (Top) and *Dasyornis broadbenti* (Bottom) from Amphitheatre Cave demonstrating the bias for long bones by the collecting method of sieving with hands [A = element abundances and B = element total lengths]. H = humeri, U = ulnae, C = carpometacarpi, F = femora, T = tibiotarsi, Ta = tarsometatarsi and Co = coracoids.

Abundances of post-cranial elements are of no use in this case because the method of collection (i.e., through sieving with one's hands; Colliver, 1938) was biased towards long elements and against the short elements (see Fig.9).

Several species (e.g., *Cacatua tenuirostris*, *C. roseicapilla*, etc.) are of unknown taphonomic origin and may have been brought to the deposit from some distance by mammalian accumulators of bone, like the Tasmanian Devil [*Sarcophilus harrisii*] or Marsupial Wolf [*Thylacinus cynocephalus*], both of which occur in the deposit (Colliver, 1938).

Palaeoenvironmental Interpretation

Assuming that the assemblage from within the cave is contemporaneous, then it would be compatible with a reconstruction of the vegetation at the time of deposition that would have included; wetlands with some areas of short cropped grass, bordered by wet heathland, that subsequently gave way to EOFF away from the water source and ETOFF in the gullies (see Table 6). All of the vegetative formations would have been within the immediate area of the cave entrance at the time of deposition, because of the nature of the avian assemblage (i.e., autochthonous/pitfall; see Baird, 1991a).

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References

Baird, R.F., 1984. The Pleistocene distribution of the Tasmanian Native-hen, *Gallinula m. mortierii*. The Emu 84: 119-123.

Baird, R.F., 1985. Avian fossils from Quaternary deposits in 'Green Waterhole Cave', south-eastern South Australia. Records of the Australian Museum 37: 353-370.

Baird, R.F., 1986. The Avian Portions of the Quaternary Cave Deposits of Southern Australia and their Biogeographical and Palaeoenvironmental Interpretations. Unpublished PhD Thesis, Monash University, Clayton, Victoria.

Baird, R.F., 1989. Fossil bird assemblages from Australian caves: precise indicators of late Quaternary palaeoenvironments? Palaeogeography, Palaeoclimatology, Palaeoecology 69: 241-244.

Baird, R.F., 1991a. The taphonomy of late Quaternary cave localities yielding vertebrate remains in Australia. Pp. 267-309. **In** P.V Rich, J. Monaghan, R.F. Baird & T.H. Rich (eds). Vertebrate Palaeontology of Australasia. Pioneer Design Studio, Lilydale, 1437 pp.

Baird, R.F., 1991b. The dingo as a possible factor in the disappearance of *Gallinula mortierii* from the Australian mainland. The Emu.

Baumel, J.J., A.S. King, A.M. Lucus, J.E. Breazile & H.E. Evans, 1979. Nomina Anatomica Avium. Academic Press, London, xxv + 637 p.

Blakers, M., S.J.J.F. Davies & P.N. Reilly, 1984. The Atlas of Australian Birds. Melbourne University Press, Melbourne, 738 pp.

Bourne, J.M., 1982. Remarks on the status of the Painted, Little and Red-chested Button-quails in the southeast of South Australia. South Australian Ornithologist 29: 5-6.

Campbell, K.E, Jr., 1979. The non-passerine Pleistocene avifauna of the Talara Tar Seeps, northwestern Peru. Life Sciences Contributions (Royal Ontario Museum) 118: 1-203.

Colliver, F.S., 1938. Cave hunting in Victoria. Victorian Naturalist 54: 152-155.

Condon, H.T., 1975. Checklist of the Birds of Australia, I. Non-Passerines. Royal Australasian Ornithologists Union, Melbourne, xx + 311 pp.

Davey, A.G. & S. White, 1986. Preliminary management classification & catalogue of Victorian caves and karst. Department of Conservation, Forests & Lands, Melbourne.

Emison, W.B. & C.M. Beardsell, 1985. Distribution of the Long-billed Corella in South Australia. South Australian Ornithologist 29: 197-205.

Forshaw, J.M., 1969. Australian Parrots. Lansdowne Press, Melbourne, 33 pp.

Frith, H.J., 1982. Pigeons and Doves of Australia. Rigby Publishers, Adelaide, 304 pp.

Frith, H.J. & M.H. Waterman, 1977. Movements of Stubble Quail *Coturnix pectoralis* from South Australian grainfields. Australian Wildlife Research 4: 85-90.

Frith, H.J., B.K. Brown & A.K. Morris, 1977. Food habits of the Stubble Quail *Coturnix pectoralis* in south-eastern Australia. CSIRO Wildlife Research Technical Papers 32: 1-70.

Fujioka, T., 1955. Time and order of appearance of ossification centres in the chicken skeleton. Acta anatatomica Nipponensis 30: 140-150.

Gould, S.J., 1968. Is uniformitarianism necessary? American Journal Science 263: 223-228.

Gould, S.J., 1984. Toward the vindication of punctuational change. Pp. 9-34. **In** W.A. Berggren & J.A. Van Couvering (eds). Catastrophies and Earth History - the New Uniformitarianism. Princeton University, Princeton.

Hope, J.H. & H.E. Wilkinson, 1982. *Warenjia wakefieldi*, a new genus of wombat (Marsupialia, Vombatidae) from Pleistocene sediments in McEacherns Cave, Western Victoria. Memoirs of the National Museum of Victoria 43: 109-120.

Land Conservation Council, 1981. South-western Area, District 1 - Review. Land Conservation Council, Melbourne, x + 137 pp.

Latimer, H.B., 1927. Postnatal growth of the chicken skeleton. American Journal of Anatomy 40: 1-57.

Loyn, R.H., 1980. Bird populations in a mixed eucalypt forest used for production of wood in Gippsland, Victoria. The Emu 80: 145-156.

Loyn, R.H., 1985. Ecology, distribution and density of birds in Victorian forests. Pp. 33-46. **In** A. Keast, H.F. Recher, H. Ford & D. Saunders (eds). Birds of Eucalypt Forests and Woodlands : Ecology, Conservation, Management. Surrey Beatty & Sons Ltd, Chipping Norton.

Matthews, P.G., 1985. Australian Karst Index. Australian Speleological Federation Inc., Melbourne.

McNamara, E., 1946. Field notes on the Eastern Bristle-bird. The Emu 45: 260-265.

Morris, A.K., A.R. McGill & G. Holmes, 1981. Handlist of Birds in New South Wales. Field Ornithology Club, Sydney, 80 pp.

Olson, S.L., 1975. The fossil rails of C.W. DeVis, being mainly an extinct form of *Tribonyx mortierii* from Queensland. The Emu 75: 49-54.

Olson, S.L., 1985. Early Pliocene Procellariiformes (Aves) from Langebaanweg, south-western Cape Province, South Africa. Annals of the South African Museum 95: 123-145.

Parker, S.A. & N.C.H. Reid, 1983. Birds. Pp. 135-150. **In** M.J. Tyler (ed.). Natural History of the South East. Royal Society of South Australia, Adelaide.

Rich, P.V. & R.F. Baird, 1986. History of the Australian avifauna. Current Ornithologist 4: 97-139.

Rich, P.V. & J. Van Tets, 1982. Fossil birds of Australia and New Guinea: their biogeographic, phylogenetic and biostratigraphic input. Pp. 235-384. **In** P.V. Rich & E.M. Thompson (eds). The Fossil Vertebrate Record of Australasia. Monash University Offset Printing Unit, Clayton.

Ridpath, M.G., 1972. The Tasmanian Native-hen, *Tribonyx mortierii* III Ecology. CSIRO Wildlife Research 15: 91-118.

Schodde, R., 1975. Interim List of Australian Songbirds. passerines. Royal Australasian Ornithologists Union, Melbourne, vi + 46 pp.

Serventy, D.L., V. Serventy & J. Warham, 1971. The Handbook of Australian Sea-birds. A.H. & A.W. Reed, Melbourne, 254 pp.

Simpson, G.G., 1970. Uniformitarianism. An inquiry into principle, theory and method in geohistory and biohistory. Pp. 43-96. **In** M.K. Hecht & W.C. Steere (eds). Essays in Evolution and Genetics in Honour of Theodosius Dobzhansky. Appleton-Century-Crofts, New York.

Smith, P., 1984. The forest avifauna near Bega, New South Wales I. Differences between forest types. The Emu 84: 200-210.

Smithe, F.B., 1975. Naturalist's Color Guide. American Museum of Natural History, New York.
Specht, R.L., 1981. Major vegetation formations in Australia. Pp. 165-297. **In** A. Keast (ed.). Ecological Biogeography of Australia. Dr W. Junk, The Hague.
von den Driesch, A., 1976. A Guide to the Measurement of Animal Bones from Archaeological Sites. Peabody Museum (Harvard University) Bulletin 1, 135 pp.

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APPENDIX I

Table 1. Length measurements of the humeri [GL] for all of the *Turnix* spp. currently inhabiting south-eastern Australia demonstrating the affinities of the material from Amphitheatre Cave (G-2).

	μ	s-1	OR	N
T. varia	34.1	1.0	32.5 - 35.2	5
T. varia (G-2)	33.9	1.2	32.2 - 35.2	5
T. velox	24.6	1.3	23.3 - 26.7	5
T. pyrrhothorax	25.6	1.3	24.0 - 27.4	8

Table 2. Length measurements [La] of coracoids from the three species currently included in the genus *Phaps* demonstrating the affinities of the two specimens from Amphitheatre Cave (G-2).

	μ	s-1	OR	N
P. chalcoptera	34.6	1.1	33.0 - 36.0	10
P. chalcoptera (G-2)	34.0	-	-	1
P. histrionica	31.7	0.8	31.1 - 32.2	2
P. elegans	29.9	0.7	29.0 - 31.0	10
P. elegans (G-2)	30.8	-	-	1

Table 3. Greatest length of humeri [GL] for the three species of *Dasyornis*. Including samples from Mabel Cave (EB-1), Clogg's Cave (EB-2), Amphitheatre Cave (G-2), Skull Cave (AU-8), and Devil's Lair (WI-61E: see Rich & Baird, 1986) (unpublished data from Baird, 1986). M = modern comparative material.

		μ	s-1	OR	N
D. broadbenti	M	24.8	0.6	24.1 - 25.7	8
	G-2	25.5	0.8	24.3 - 27.0	22
D. brachypterus	EB-1	20.7	0.5	20.0 - 21.4	5
	EB-2	20.8	0.4	20.6 - 21.1	10
	G-2	20.6	0.8	19.8 - 21.5	4
D. longirostris	M	19.3	-	-	1
	AU-8 + WI-61E	19.1	0.1	19.0 - 19.2	3

Table 4. List of avian species recorded in the deposits from Amphitheatre Cave (G-2).

	MNI	N		MNI	N
Spheniscidae			**Loriidae**		
Eudyptula minor	1	5	*Glossopsitta concinna*	1	2
Procellariidae			**Cacatuidae**		
Pachyptila sp.	1	1	*Cacatua tenuirostris*	1	1
Phalacrocoracidae			cf. *C. roseicapilla*	1	2
Phalacrocorax sp.	2	2	**Platycercidae**		
Anatidae			*Platycercus elegans*	1	8
small species	1	2	*Neophema* sp.	1	2
Accipitridae			**Hirundinidae**		
Accipiter fasciatus	1	1	indeterminate	2	8
Falconidae			**Orthonychidae**		
cf. *Falco cenchroides*	1	1	*Cinclosoma punctatum*	1	9
Phasianidae			cf. *Cinclosoma punctatum*	1	1
Coturnix sp.	2	14	**Acanthizidae**		
Turnicidae			*Dasyornis brachypterus*	6	27
Turnix varia	3	21	*D. broadbenti*	18	88
Rallidae			**Meliphagidae**		
Rallus philippensis	1	12	cf. *Anthochaera carunculata*	2	9
Gallinula mortierii	27	297	cf. *Anthochaera chrysoptera*	1	1
Laridae			**Paradisaeidae**		
Larus novaehollandiae	1	1	*Ptilonorhynchus violaceus*	1	6
Columbidae			**Cracticidae**		
Phaps chalcoptera	1	1	Indeterminate	1	1
P. elegans	1	1	**Corvidae**		
			Corvus sp.	1	4

Table 5. Avian taxa from excavations of Amphitheatre Cave and their proposed respective taphonomic accumulators (groupings).

Taphonomic group	Taphonomic agent	Species associated
Autochthonous	Pitfall/deathtrap	Anatidae small sp. *Coturnix* sp. *Turnix varia* *Rallus philippensis* *Gallinula mortierii* *Phaps chalcoptera* *P. elegans* *Cinclosoma punctatum* *Dasyornis brachypterus* *D. broadbenti* *Ptilonorhynchus violaceus* Cracticidae indet. *Corvus* sp.
Autochthonous/speleophiles	Natural Attrition	Hirundinidae indet.
Unknown	*Accipiter fasciatus*	cf. *Falco cenchroides* *Cacatua tenuirostris* *Glossopsitta concinna* *C. roseicapilla* *Platycercus elegans* cf. *Anthochaera carunculata* cf. *A. chrysoptera*

Table 6. Groups of taxa from the Amphitheatre Cave avian assemblage based on their usefulness in palaeoenvironmental interpretation (habitat specificity (exact/wide ranging) habitat distribution (patchy/ regional)).

Wide ranging/Patchy	Wetlands	*Rallus philippensis* *Gallinula mortierii* Anatidae small sp.
	HF	*Phaps elegans* *Dasyornis broadbenti*
Wide ranging/Regional	EOFF	*Accipiter fasciatus* *Coturnix* sp. *Turnix varia* *Phaps chalcoptera* *Glossopsitta concinna* *Platycercus elegans* *Cinclosoma punctatum*
	EWF	*Cacatua tenuirostris* *C. roseicapilla*
Exact/Regional	Wet HF	*Dasyornis brachypterus*
	ETOFF	*Ptilonorhynchus violaceus*

APPENDIX II

List of abbreviations used in text, figures and appendices.

acet.	*acetabulum*
art.	*articularis*
a.p.s.l.	above present sea-level
ATSF	*Acacia* tall scrub formation
b.p.s.l.	below present sea level
cta	*crista*
ccd.	coracoid
CFF	Closed Forest Formation
cmc.	carpometacarpus
com.	complete
cond.	*condylus*
cot.	*cotyla*
cran.	cranium
dist.	distal
EOFF	*Eucalyptus* open forest formation
ETOFF	*Eucalyptus* tall open forest formation
EWF	*Eucalyptus* woodland formation
fac.	*facies*
fem.	femur
for.	*foramen/foramina*
frag.	fragment
furc.	furcula
HF	heathland formation
hum.	humerus
huml.	humeral
imp.	*impressio*
inc.	*incisura*
incom.	incomplete
juv.	juvenile
lig.	*ligamenta*
M.	*musculus*
mand.	mandible
M.N.I.	minimum number of individuals
MOSF	Mallee open scrub formation
N	number of elements in the statistical population
OR	observed range
osc.	*os coxae*
pel.	pelvis
proc.	*processus*
prox.	proximal
rad.	radius
ram.	*ramus*
rost.	rostrum
scap.	scapula
s	standard deviation
spin.	*spinus*
stm.	sternum
stnl.	sternal
sul.	*sulcus*
symph.	*symphysis*
syn.	synsacrum
tbt.	tibiotarsus
tmt.	tarsometatarsus
troc.	*trochlea*
tub.	*tuberculum*
μ	mean
y.B.P.	years Before Present

APPENDIX III

Suites of characters considered diagnostic for those taxa included in this study. Only those elements for which representatives occur in the cave deposit are included. The sequence of elements is standardised for ease of reference and includes the following: rostrum, cranium, mandible, humerus, ulna, carpometacarpus, coracoid, scapula, furcula, sternum, pelvis, synsacrum, femur, tibiotarsus and tarsometatarsus. For each of the long bones separate sections are provided for the proximal end, shaft and distal end (except for the coracoid which is divided into humeral end, shaft and sternal end) and each character is numbered. Not included in the analysis were the vertebrae, costal elements and phalanges.

SPHENISCIFORMES

Spheniscidae

The suites of characters considered diagnostic for the family Spheniscidae include: Synsacrum, (overall), 1. *cta ventralis* expanded ventrally (proximally), 2. short and stout: Femur, (proximal end), 1. *caput femori* projects proximomedially, 2. *fac. ventralis* excavated, 3. *cta trochanteris* merges gradually with shaft distally, 4. *fac. lateralis* flattened (with little topography); (shaft), 1. straight (not anteroposteriorly curved); (distal end), 1. laterally narrow, 2. *cond. medialis* and *cond. lateralis* pronounced dorsally, 3. *sul. patellaris* narrow: Tibiotarsus, (proximal end), 1. *cta cnemialis cranialis* short and stout, 2. *cta cnemialis* lateralis not expanded laterally and very stout, 3. *sul. interctalis* with numerous proximodistally running ridges; (shaft), 1. lateral edge rounded, 2. stout; (distal end), 1. offset from shaft to a small degree, 2. laterally flattened, 3. *inc. intercondylaris* shallow, 4. *cond. medialis* and *cond. lateralis* project distally an equal amount: Tarsometatarsus, (overall), 1. very laterally broad, 2. metatarsals incompletely fused.

ANSERIFORMES

Anatidae

The suites of characters considered diagnostic for the family Anatidae include: Coracoid, (humeral end), 1. axis of *proc. acrocoracoid* in line with that of shaft, 2. *cot. scapularis* large and deep, 3. *proc. procoracoid* broad and medially extending, 4. *sul. M. supracoracoidei* not bulbous or greatly expanded; (sternal end), 1. *imp. M. sternocoracoidei* very shallow, 2. *fac. art. sternalis* indistinct with a very faint bordering ridge (in dorsal view), 3. *fac. art. sternalis* only apparent along the mediosternal edge (in ventral view); Tibiotarsus, (proximal end), 1. *cta cnemialis cranialis* not markedly expanded proximally, 2. *cta cnemialis lateralis* markedly expanded laterally; (shaft), 1. ventral surface flattened, adjacent to *cta fibularis*; (distal end), 1. offset laterally, 2. *sul. extensorius* centered on shaft, 3. *cond. lateralis* extends further distally than *cond. medialis*.

GALLIFORMES

Phasianidae

Coturnix: The following suites of characters are considered diagnostic for the genus *Coturnix*: Rostrum, 1. anteroposteriorly short, 2. *os premaxilla* broad and rounded anteriorly (viewed dorsally), 3. nasal opercula anteroposteriorly short and rounded on all sides, 4. os nasale dorsal arm gracile; Humerus, (proximal end), 1. double *fossa pneumotricipitalis*, distinctly separated by *margo caudalis* (not *crus dorsale fossa* as in passerines), 2. *caput humeri* with small dome, 3. *cta pectoralis* with very small apical overhanging prominence; (shaft), 1. shaft laterally flattened; (distal end), 1. *fossa M. brachialis* relatively small and posteriorly projecting, 2. *cond. dorsalis* anteroposteriorly aligned, 3. *cond. ventralis* with angular posterior margin, 4. *proc. supracondylaris dorsalis* very small and rounded: Ulna, (proximal end), 1. olecranon acute proximally and dorsoventrally flattened, 2. *tub. lig. collateralis ventralis* not prominent, 3. dorsal margin of *cot. dorsalis* rounded; (shaft), 1. dorsoventrally flattened (width greater than depth): Coracoid, (humeral end), 1. *proc. procoracoid* very reduced; (shaft and sternal end), 1. *imp. M. sternocoracoidei* shallow and limited to sternal end, 2. *proc. lateralis* pronounced but relatively small: Tarsometatarsus, (proximal end), 1. medial *fora. vascularia proximalia* further proximal than lateral *fora. vascularia proximalia*, 2. a single tendinal canal along medial side of *hypotarsus*, 3. one major open *sul. hypotarsi*, 4. base of *hypotarsus* excavated; (distal end), 1. ventral extension of *troc. metatarsi II* rounded and solid, 2. *fossa metatarsi I* present.

GRUIFORMES

Turnicidae

Turnix. The following suites of characters are considered diagnostic for the genus *Turnix*: Humerus, (proximal end), 1. single large *fossa pneumotricipitalis*, 2. deep, proximodistally elongate groove on palmar face of *tub. dorsale*, 3. *caput humeri* highly domed, 4. *cta pectoralis* with large tuberosity, 5. *tub.* present of proximal-most point of *margo caudalis*; (distal end), 1. *fossa M. brachialis* relatively large and anteriorly projecting, 2. main axis of *cond. dorsalis* laterally aligned, 3. *cond. ventralis* with rounded posterior margin, 4. *proc.* supracondylaris dorsalis relatively large and distally acute: Ulna; (proximal end), 1. *olecranon* acute proximally and not laterally flattened, 2. *tub. lig. collateralis* ventralis forms a prominent shelf, 3. dorsal margin of *cot. dorsalis* angular; (shaft), 1. not dorsoventrally flattened (width and depth subequal): Carpometacarpus, (proximal end), 1. *cta dorsalis* of *troc. carpalis* extends distally, 2. *cta ventralis* of *troc. carpalis* with an even, rounded margin, 3. *proc. piciformis* acute distally; (shaft), 1. *os metacarpus majus* with no *proc. intermetacarpale*, 2. *os metacarpus minus* with a smooth distal margin: Coracoid, (humeral end), 1. *proc. procoracoid* closes on *fac. art. clavicularis* of *proc. acrocoracoid* forming a definite canal between them, 2. whole coracohumeral surface well developed and nearly at right angles to shaft, humerally; (shaft and distal end), 1. *imp. M. sternocoracoidei* deep and humerosternally extensive, 2. *proc. lateralis* pronounced: Sternum, 1. *carina sterni* anteriorly projecting and deep: Femur, (proximal end), 1. *cta trochanteris* extends distally very briefly, 2. one prominent muscular insertion proximally

and one very small muscular insertion distally, 3. distal muscular insertion is the continuation of *linea intermuscularis caudalis*; (distal end), 1. *cond. medialis* slopes gradually to shaft, proximally, 2. *imp. ansae M. iliofibularis* in contact with *troc. fibularis* but also extends proximally: Tibiotarsus, (proximal end), 1. *caput tibiotarsi* not laterally compressed, 2. *cta cnemialis* lateralis extends laterally and points distally but does so gradual manner, 3. *cta cnemialis cranialis* large; (shaft), 1. *cta fibularis* markedly delineated on both proximal and distal ends, and does not approach *cta cnemialis lateralis*, 2. shaft not dorsoventrally flattened; (distal end), 1. *inc. intercondylaris* small, 2. *cond. medialis* distally foreshortened with a pronounced lateral extension on dorsal lip: Tarsometatarsus, (proximal end), 1. medial *fora. vascularia proximalia* further distal than lateral *fora. vascularia proximalia*, 2. single tendinal canal almost centred in *hypotarsus*, 3. two nearly closed *sulci hypotarsi*, 4. base of *hypotarsus* swollen; (distal end), 1. ventral extension of *troc. metatarsi II* anteroposteriorly elongate and laterally flattened, 2. no *fossa metatarsi I.*

Rallidae

Rallinae

The following suite of characters are considered diagnostic for the subfamily Rallinae: Rostrum, 1. anteroposteriorly elongate, 2. nasal operculum anteroposteriorly elongate and rounded on all sides, 3. *os nasale* dorsal arm robust: Humerus, (proximal end), 1. main axis of *inc. capitis* approaches that of shaft, 2. single *fossa pneumotricipitalis*, 3. main axis of *caput humeri* parallel to that of *inc. capitis*; (distal end), 1. *proc. supracondylaris* dorsalis small and rounded, 2. distal end narrow, 3. *proc. flexorius* extends as far or farther than *cond. ventralis*: Ulna, (proximal end), 1. *sul. M. brachialis* small, 2. *cot. ventralis* completely enclosed, 3. *cot. ventralis* does not extend upon *olecranon*: Radius, (shaft), 1. *corpus radii* short, straight and stout; (distal end), 1. *sul. ligimenta* shallow: Carpometacarpus, (proximal end), 1. *proc. extensorius* tends proximolaterally, 2. *troc. carpalis* extends proximally and acute at its proximal most point, 3. *os metacarpus minus* and *majus* subparallel: Sternum, 1. single notched, 2. *rostrum sterni* small: Pelvis, 1. laterally flattened, 2. *cta iliaca dorsalis* fuse to *cta dorsalis* of synsacrum, proximally, 3. *tub. preacetabulare* pronounced, 4. pelvis deep in lateral view, 5. strong *cta iliaca dorsolateralis*: Coracoid, (proximal end), 1. *proc. procoracoid* pronounced and extends further medially than *proc. acrocoracoid*, 2. *cot. scapularis* large and deep, 3. *fac. art. humeralis* flares strongly laterally; (distally), 1. *imp. M. sternocoracoidius* deep: Femur, (proximal end), 1. *cta trochanteris* extends dorsally not proximally, 2. *sul. M. iliotrochantericus caudalis* restricted to extreme proximal end of *trochanter*; (shaft), 1. pronounced curve, (in lateral view), 2.strong ridge extending from ventral portion of *cta trochanteris* distally, and in some case extends to distal end: Tibiotarsus, (proximal end), 1. proximodistally flattened *cta cnemialis lateralis*; (shaft), 1. broad, flat area adjacent to *cta fibularis*, viewed ventrally; (distal end), 1. area below *sul. extensorius* expanded distally, increasing depth of *inc. intercondylaris*, 2. *fac. lateralis* of epicondyle lateralis rounded: Tarsometatarsus, (proximal end), 1. *caput carpalis* tapers gradually to shaft, distally (in dorsal view), 2. *cta lateralis hypotarsi* extended distally; (shaft), 1. dorsal surface flat (not concave); (distal end), 1. *troc. metatarsi III* strongly rotated positioned almost completely below shaft.

PSITTACIFORMES

The following suite of characters are considered diagnostic for the order Psittaciformes: Humerus, (proximal end), 1. *imp. M. coracobrachialis cranialis* prominent, 2. tub. dorsale deeply excavated and restricted, distally, to medial edge of *tub. ventrale*, 3. whole prox. head rotated counterclockwise (in distal view); (distal end), 1. *cond. ventralis* not prominent and extends distally as much as *proc. flexorius*, 2. *proc. supracondylaris dorsalis* insignificant and distal (i.e., closer to *epicondylus dorsalis*): Ulna, (proximal end), 1. lateral edge of *cot. ventralis* nearly round (viewed proximally), 2. *olecranon* short and blunt, 3. *tub. lig. collateralis ventralis* with little lateral extension; (shaft), 1. *papillae remigiales caudales* insignificant, 2. shaft width and depth subequal, 3. shaft curved; (distal end), 1. laterally flared, 2. *cond. ventralis* prominent and extends furthest distally, 3. *sul. radialis* deep with distinct borders: Radius, (shaft), 1. *corpus radii* stout,long and curved; (distal end), 1. *sul. ligimenta* not present, 2. *tub. aponeurosus* large, rounded and distally extending, 3. tub. on *facies ventralis* prominent and rounded: Carpometacarpus, (proximal end), 1. *proc. extensorius* elongate and tends laterally; (shaft and distal end), 1. no *proc.* intermetacarpalis (or insignificant), 2. ventral ridges of *os metacarpale majus* and *minus* extend to just distal to *proc. pisiformis* (in palmar view): Coracoid, (humeral end), 1. *proc. acrocoracoid.* extends and tapers to meld with *fac. art. humeralis*, 2. distance between *proc. acrocoracoid.* and *cot. scapul.* narrow, 3. *cot. scapularis* narrow and restricted to *proc. cot. scapularis*, 4. presence of pneumatic fenestrae at interface of *sul. M. supracoracoidei* and *fac. art. clavicularis*; (sternal end), 1. *angularis medialis* narrowly attaches to main body of coracoid, 2. *proc. lateralis* does not extend beyond lateral most extension of *fac. art. sternalis*: Femur, (proximal end), 1. *trochanter* with no proximal extension, 2. *cta trochanteris* rounded, stout and restricted to dorsal surface, 3. *cta obturator* produced not by ventral extension of *trochanter* but by presence of two large fossa just distal to *trochanter*, 4. *caput femoralis* relatively large with a stout neck; (shaft), 1. straight; (distal end), 1. *cond. medialis* expanded proximodistally.

Loriidae

Elements referred to the family Loriidae are based on the following characters: Ulna, (shaft), 1. stout, 2. large curvature; (whole), 1. medium to small size (this suite of characters also present in *Lathamus*); Carpometacarpus, 1. *os metacarpus majus* stout, 2. *proc. extensorius* anteriorly elongate, 3. *proc. extensorius* at greater angle to shaft, viewed laterally, 4. *proc. pisiformis* located further distally.

Glossopsitta

Elements are referred to the genus *Glossopsitta*, for the presence of the following suites of characters, including: Ulna, based upon mensural characters; Carpometacarpus, (proximal end), 1. facet for insertion of *lig. radiocarpometacarpale* more lateral on *troc. carpalis*, 2. more distally located *proc. pisiformis*, 3. T.L. less than 20 mm.

Platycercidae

Elements are referred to the family Platycercidae based on

the following characters: Humerus, (proximal end), 1. faint broad second *fossa pneumotricipitalis*, 2. narrow based *caput humeri*, 3. distal extension of *caput humeri* on palmar face, 4. *cta bicipitalis* expanded laterodistally and abruptly attaches to shaft distally (except in Pezoporinae): Ulna, (shaft), 1. shallow curvature, 2. gracile; (whole), 1. medium size (this suite of elements does not cover small *Psephotus* spp. and all *Neophema* spp.): Coracoid, (humeral end), 1. *proc. acrocoracoid* bulbous; (sternal end), 1. narrow *fac. art. lateralis*, 2. *proc. lateralis* attenuate laterally, 3. *imp. M. sternocoracoidei* deep: Femur, (proximal end), 1. *cta trochanteris* surpasses *caput femora* proximally.

Platycercus

Elements are referred to the genus *Platycercus* based on the following characters: Rostrum, 1. curved moderately, 2. external nares located further distally on rostrum, 3. *culmen* rounded laterally: Humerus, as for family: Ulna, as for family: Carpometacarpus; (proximal end), 1. facet for insertion of unknown lig. interrupts *cta dorsalis* of *troc. carpalis*, 2. *spatium intermetacarpale* of medium width, 3. *proc. extensorius* projects proximomedially, 4. not laterally narrow or broad, 5. head proximodistally shortened, 6. mensural characters, intermediate in size: Coracoid, (humeral end), 1. *proc. acrocoracoideus* rounded humerally, 2. *tub.* on internal face of *proc. acrocoracoid* not markedly raised above adjacent areas, 3. sternal end narrower than in *Barnardius* but identical to *Purpureicephalus*, 4. T.L. greater than 10 mm.

Neophema

Elements are referred to the genus *Neophema* based on the following characters: Ulna, (shaft), 1. moderate curvature, 2. gracile; (whole), 1. small elements (this suite of characters also pertains to small spp. of *Psephotus*); Femur, (whole), 1. very long and gracile; (distal end), 1. *cta dorsalis* of *cond. medialis* larger and more prominent than that of *cond. lateralis*, 2. very narrow, 3. twisted distolaterally (the same suite of characters can be seen in *Pezoporus* but are less pronounced in *Neophema*)

PASSERIFORMES

Hirundinidae

gen. et sp. indet.

Gen. et sp. indeterminate. Elements are referred to the family Hirundinidae based on the following characters: Humerus, (proximal end), 1. very strongly developed proximal edge of *cta pectoralis*, 2. shelf created by palmar expansion of *caput humeri* and proximal edge of *cta pectoralis*, 3. *cta pectoralis* well developed with palmar face concave, 4. single *fossa pneumotricipitalis*; (distal end), 1. long (lateral) axis of distal end rotated approximately 45 degrees from long (lateral) axis of proximal end, 2. well developed *proc. supracondylaris* dorsalis, 3. *cond. dorsalis* expanded distally, 4. *fossa M. brachialis* shallow: Ulna, (proximal end), 1. *cotyla dorsalis* proximodistally elongate, 2. *tub. lig. collateralis ventralis* prominent, 3. *olecranon* laterally compressed; (shaft), 1. short, stout and straight: Tibiotarsus, (distal end), 1. condyles positioned distally to the distal opening of the *canalis extensorius*.

Orthonychidae

Cinclosoma

Cinclosoma. Elements are referred to the genus *Cinclosoma* for the presence of the following characters: Humerus, (proximal end), 1. *crus dorsale fossa* very stout and extends past *tub. dorsale*, 2. *caput humeri* broad and flat with a prominence just proximal to *margo caudalis*, 3. *cta pectoralis* proximodistally short (not extending past *cta bicipitalis* distally) and ventrally swollen; (shaft) 1. stout; (distal end) 1. *proc. flexorius* broad and highly sculpted: Coracoid, (humeral end), 1. *proc. acrocoracoideus* laterally compressed, 2. *fac. art. clavicularis* with deep fossa: Femur, (proximal end), 1. no *fossa trochanteris*, 2. *cta trochanteris* not extended proximally, only weakly extended dorsally and junction of two sections forms a sharp point, 3. *cta ventralis* of *caput femoris* present with no excavation of *fac. ventralis*, 4. no distal extension of *cta trochanteris*, 5. *tub. M. iliofemoralis externus* and *tub. M. iliotrochanteris caudalis* concentrated on dorsoventral portion of *fac. lateralis*, 6. *tub. M. iliotrochanteris caudalis* angles abruptly distally, 7. *tub. M. ischiofemoralis* very small and proximodistally short; (shaft), 1. stout: Tarsometatarsus, (distally), 1. shaft gradually expands laterally to *troc. metatarsi* (smooth continuous curve), 2. all *troc. metatarsi* in same lateral plane, 3. *for. vasculare distale* minute or non-existent, 4. *troc. metatarsi II* laterally expanded with a very shallow sulcus, 5. *troc. metatarsi III* with definite but shallow sulcus, 6. *troc. metatarsi IV* laterally expanded but with no sulcus, 7. *inc. intertrochlearis* very shallow (anteroposteriorly).

Acanthizidae

Dasyornis

Dasyornis. Elements are referred to the genus *Dasyornis* based on the following characters: Humerus, (proximal end), see Baird, 1985: Ulna, (overall), markedly short and stout, and agrees in size with *Dasyornis*: Femur, (proximal end), 1. *cta trochanteris* expanded dorsally, not proximally, 2. *cta trochanteris* extends distally, 3. *fossa trochanteris* present along whole length of *cta trochanteris*, 4. *tub. M. iliotrochantericus cranialis* small and centrally located on *fac. lateralis*, 5. *fac. art. antitrochanteris* broad dorsally (in proximal view), 6. *fac. ventralis* excavated; (shaft), 1. markedly curved ventrally, distal to midpoint of shaft, 2. laterally flattened; (distal end), 1. *imp. ansae M. iliofibularis* pronounced, 2. *imp. ansae M. iliofibularis* not joined to *cta tibiofibularis lateralis*, 3. *epicondylus medialis* excavated and proximodistally elongate, 4. medioventral edge of *cond. medialis* expanded proximally: Tibiotarsus, (see Baird, 1985): Tarsometatarsus, (distal end), 1. all troc. metatarsi on distinct slope medially off of shaft axis, 2. lateral edge of *troc. metatarsi* IV expanded (over inner edge) and narrow, 3. medial edge of *troc. metatarsi* II very narrow with a definite shelf laterally.

Meliphagidae

The suite of characters considered diagnostic for the family Meliphagidae include: Humerus, (proximal end), 1. *cta bicipitalis* concave proximally, 2. single *fossa pneumotricipitalis*, 3. *cta pectoralis* extends past junction of *cta bicipitalis* and shaft,

distally, 4. *crus ventrale* fossa extends past *tub. ventrale* ventrally (in palmar aspect), 5. *cta pectoralis* ends abruptly distally, 6. *inc. capitis* proximodistally narrow and deep: Coracoid, (proximal end), 1. *proc. acrocoracoideus* laterally broad, 2. *fac. art. clavicularis* with deep fossa (similar to the Cracticidae): Tibiotarsus, (proximal end), 1. *cta cnemialis* lateralis expanded laterally, 2. *sulcus intercristalis* deep, 3. *tub. M. femorotibialis* interior distinct, 4. area between *tub. M. femorotibialis interior* and proximal-most point on *cta cnemialis cranialis* depressed; (shaft), 1. anteromedial edge of shaft expanded medially, viewed ventrally; (distal end), 1. laterally wide, 2. proximodistally elongate, 3. *inc. lig. intercondylaris* proximodistally elongate, 4. *pons supratendinosus* proximodistally elongate, 5. *cta intercondylaris* present in *sulcus cartilaginus tibialis.*

Paradisaeidae

Ptilonorhynchus and *Ailuroedus*

Ptilonorhynchus and *Ailuroedus*. The suite of characters considered diagnostic for the genera *Ptilonorhynchus* and *Ailuroedus* include; Ulna, (proximal end), 1. *olecranon* pointed proximally and not angles back so as to point more laterally, 2. dorsal surface of *cot. dorsalis* flattened, in proximal view, 3. *cot. dorsalis* proximodistally elongate: Coracoid, (humeral end), 1. *proc. acrocoracoid* not tilted medially, 2. *proc. acrocoracoideus* anteriorly extending and acute, 3. *sul. M. supracoracoidei* shallow, 4. *proc. procoracoideus* prominent, 5. *proc. acrocoracoideus* bulbous along its most humeral edge (ventral view); (distal end), 1. *proc. lateralis* with strong laterally tending *proc.* at its humeral most point, 2. *fac. art. sternalis* laterally broad: Femur, (proximal end), 1. long axis of *tub. M. iliotrochanteris caudalis* proximodistally aligned, 2. *tub. M. iliofemoralis externus* and *tub. iliotrochanteris caudalis* not attached or continuous, 3. *tub. M. ischiofemoralis* very proximodistally elongate and central on *fac. lateralis*, 4. *tub. M. iliotrochanteris cranialis* separate from *tub. M. ischiofemoralis* but forms part of main body of *cta trochanteris.*

Cractidae

The suite of characters considered diagnostic for the family Cracticidae include: Humerus (proximal end), 1. single *fossa pneumotricipitalis*, 2. cta *bicipitalis* convex distally, 3. *tub. ventrale* relatively small and elevated portion laterally restricted, 4. *cta pectoralis* does not extend as far down shaft distally, 5. *crus dorsale fossae* projects anconally, 6. *cta pectoralis* ends abruptly distally, 7. *tub. M. scapulohumeralis* anterior distinct, 8. transition from *caput humer*i to *cta pectoralis* smooth; (shaft), 1. smooth arc to ventral edge as far as *proc. flexorius* (in palmar view); (distal end), 1. *proc. flexorius* extends distolaterally.

Corvidae

The suite of characters considered diagnostic for the family Corvidae include: Humerus, (proximal end), 1. *crus dorsale fossa* projects distally to shaft, 2. *cta pectoralis* long and melds with shaft distally, 3. *cta bicipitalis* concave proximally, 4. tub. ventrale large and elevated portion not laterally restricted, 5. *tub. M. scapulohumeralis anterior* indistinct but has a distinct ridge extending distally from its base, 6. transition from *caput humeri* to *cta pectoralis* smooth, 7. single *fossa pneumotricipitalis;* (shaft), 1. smooth arc to ventral edge as far as *proc. flexorius* (in palmar view); (distal end), 1. *proc. flexorius* extends distolaterally: Carpometacarpus, 1. mensural characters, larger than all other Australian passerines: Tarsometatarsus, (overall), 1. TL greater than 45; (shaft), 1. mediodistal edge smooth and continuous to distal end (not broken by reinforcement for *fossa metatarsi I*); (distal end), 1. inc. intertrochlearis narrow proximally, 2. *troc. metatarsi II* expanded laterally, 3. *troc. metatarsi II* and *IV* lack sulci, 4. proximal edge of *troc. metatarsi IV* does extend as far proximally as that of *troc. metatarsi III*, 5. lateral and medial edges of *troc. metatarsi IV* parallel, 6. *cta medialis* of *troc. metatarsi III* only slightly expanded, distally and dorsally, over *cta lateralis*, 7. *troc. metatarsi III* and *IV* relatively broad, laterally.

APPENDIX IV

Rallidae

Gallinula mortierii

Material. 4 incom. cran. (167104-167106, 178345), incom. rost. (178749), 2 incom. rost. (178348, 178542), com. mand. (178750), 5 right ram. mand. (178350-178353, 178543), 2 left ram. mand. (178499, 178544), 2 dist. symph. mand. (167107, 178349), 8 com. right hum. (167005-167008, 167086-167088, 167124), 2 incom. right hum. (167125, 167126), 2 prox. end right hum. (178355, 178553), 9 com. left hum. (167001, 167004, 167061, 167084, 167085, 178477, 178551, 178620, 178621), 7 incom. left hum. (167002, 167003, 167118-167121, 178315), incom. left hum (juv.) (167038), 3 prox. end left hum. (167122, 178314, 178552), 2 dist. end left hum. (167037, 167123), 7 com. right ulna (167062, 167063, 167127, 167128, 167195, 178356, 178558), 3 incom. right ulna (167129, 167130, 178559), prox. end right ulna (167196), dist. end right ulna (178560), 4 com. left ulna (167191, 178316, 178554, 178557), 4 incom. left ulna (167192, 167193, 178555, 178556), incom. left ulna (juv.) (167254), prox. end left ulna (167194), com. right rad. (178357), 5 incom. right rad. (167131, 167197, 167198, 167259, 178563), 2 com. left rad. (178561, 178562), 5 com. right cmc. (167201, 178317, 178318, 178359, 178584), 3 incom. right cmc. (167202, 178319, 178358), incom. right cmc. (juv.) (178360), 6 com. left cmc. (167132, 167134, 167199, 167200, 178503, 178586), 3 incom. left cmc. (167133, 178585, 178622), 3 incom. stm. (167307, 178474, 178475), 3 stm. frag. (167116, 167117, 167181), 4 com. right scap. (167050, 167114, 178547, 178548), 4 incom. right scap. (167113 167115, 167190, 178546), 3 com. left scap. (178313, 178500, 178549), 3 incom. left scap. (167059, 178312, 178501), incom. left scap. (juv.) (167058), 8 com. right ccd. (167187-167189, 167308, 167309, 178310, 178476, 178545), 3 incom. right ccd. (167109-167111), 2 incom. right ccd. (juv.) (178337, 178589), huml.

end right ccd. (167112), 2 com. left ccd. (167056, 167057), 3 incom. left ccd. (167186, 178311, 178354), huml. end left ccd. (167108), 10 incom. pel. (167064, 167135, 167136, 167203, 167204, 178467-178471, 178478, 178623, 178624), 3 prox. end pel. (167135, 167136, 178471), 3 incom. syn. (178479, 178481, 178626), 3 prox. end syn (178473, 178497, 178627), 3 dist. end syn. (167065, 178344, 178480), 2 left os pelvis (178564, 178565), left os pelvis (juv.) (178472), 3 right acet. frag. (167138, 167139, 178361), 3 left acet. frag. (167137, 167140, 178566), 4 com. right fem. (178630, 178631, 178633, 178634), 8 incom. right fem. (#, 167013-167015, 167143, 167144, 178629, 178632), incom. right fem. (juv.) (178635), dist. end right fem. (167016), 4 com. left fem. (167010, 167090, 178637, 178638), 13 incom. left fem. (167011, 167012, 167040, 167041, 167066, 167089, 167091, 167092, 167141, 178482, 178567, 178636, 178639), 3 incom. left fem (juv.) (167009, 167039, 167142), prox. end left fem. (167093), 2 com. right tbt. (167098, 178486), 8 incom. right tbt. (167034, 167035, 167096, 167097, 167148, 178484, 178485, 178570), 2 incom. right tbt. (juv.) (167036, 178483), 2 prox. end right tbt. (167019, 167020), dist. end right tbt. (167147), dist. end right tbt. (juv.) (167021), 7 com. left tbt. (167026, 167028, 167029, 167145, 178488, 178568, 178644), 10 incom. left tbt. (167027, 167030, 167094, 167146, 178487, 178489, 178640-178643), 2 incom. left tbt. (juv.) (167032, 167033), 3 prox. end left tbt. (178748, 167160, 178490), 6 dist. end left tbt. (167017, 167018, 167031, 167095, 178569, 178645), dist. end left tbt. (juv.) (178320), 11 com. right tmt. (167048-167052, 167100, 167101, 178493, 178494, 178653-178655), 10 incom. right tmt. (167025, 167024, 167049, 167100, 167101, 167155, 167158, 178495, 178574), 2 incom. right tmt. (juv.) (167053, 178656), 2 dist. end right tmt. (juv.) (178322, 178324), 12 com. left tmt. (167022, 167023, 167044, 167149, 167150, 178491, 178496, 178646, 178648-178651), 8 incom. left tmt. (167042, 167043, 167099, 167151, 167152, 167156, 178647, 178652), 2 incom. left tmt. (juv.) (167046, 167153), 3 dist. end left tmt. (167045, 167067, 167154), dist. end left tmt. (juv.) (167047), 30 unspecified phalanges (167159, 167239, 167301-167306, 178325-178335, 178347, 178575-178583, 178587).

Acanthizidae

Dasyornis broadbenti

Material. incom. mand. (178372), dist. mand. symph. (178505), 2 right ram. mand. (167205, 167206), 4 left ram. mand. (178373-178375, 178506), 9 com. right hum. (167164, 167216, 167249, 178394-178397, 178596, 178598), 2 incom. right hum. (178398, 178597), dist. end right hum. (167165), 8 com. left hum. (167161, 167162, 167212, 167218, 178388, 178389, 178512, 178594), 3 incom. left hum. (167245, 178392, 178593), 2 prox. end left hum. (178390, 178391), prox. shaft frag. left hum. (178393), dist. end left hum. (167214), 6 com. right ulna (167221, 178403-178405, 178515, 178600), 3 com. left ulna (167226, 167227, 178406), incom. left ulna (178406), 2 incom. right ccd. (167211, 178510), 1 incom. stm. (167072), 3 incom. pel. (178411, 178412, 178415), 5 com. syn. (167073, 178410, 178413, 178414, 178416), 2 incom. syn. (178417, 178418), 3 pel. frag. (178419-178420), 13 com. right fem. (167075, 167168, 167169, 167267-167269, 178436-178439, 178519-178521, 178604), 4 incom. right fem. (167185, 167270, 178434, 178435), shaft frag. right fem. (178440), dist. frag. right fem. (167170), 10 com. left fem. (167166, 167262, 167264, 178422, 178424-178426, 178523-178525), 6 incom. left fem. (167076, 167263, 178432, 178522, 178603, 178751), prox. end left fem. (178526), dist. end left fem. (167265), com. right tbt. (178531), 12 incom. right tbt. (167077, 167078, 167173, 167175, 167176, 167282-167284, 167287, 178447, 178532, 178534), 5 prox. end right tbt. (167285, 167286, 167288, 167289, 178536), 2 shaft frag. right tbt. (167082, 178535), 4 dist. end right tbt. (167174, 167290, 178450, 178610), 4 com. left tbt. (167274, 178442, 178444, 178605), 11 incom. left tbt. (167080, 167084, 167177, 167272, 167273, 167276, 178441, 178443, 178529, 178530, 178606), 7 prox. end left tbt. (167178, 167275, 167277, 167278, 167280, 178607, 178608), 8 com. right tmt. (167179, 167297, 167298, 178459, 178460, 178540, 178611, 178612), 3 incom. right tmt. (167296, 178461, 178462), prox. end right tmt. (167299), shaft frag. right tmt. (178465), dist. end right tmt. (178541), 6 com. left tmt. (167180, 167291, 167292, 178455, 178456, 178539), incom. left tmt. (167293), shaft frag. left tmt. (178458).

APPENDIX V

Measurements of *Gallinula mortierii* from Amphitheatre Cave. The measurement for the proximal width of the tibiotarsus PW = the distance between the medial edge of the *fac. art. medialis* and the lateral edge of the *fac. art. lateralis.*

	μ	s-1	OR	N
HUMERI				
Greatest Length [GL]	63.6	2.2	60.0 - 67.9	21
Proximal Width [Bp]	13.7	0.6	12.7 - 14.8	22
Distal Width [Bd]	9.9	0.5	9.0 - 10.9	21
ULNAE				
Greatest Length [GL]	46.7	1.6	43.6 - 48.9	13
CARPOMETACARPI				
Greatest Length [GL]	35.7	1.2	33.3 - 37.6	16
FEMORA				
Length [Lm]	79.4	2.6	74.6 - 83.0	25
Proximal Width [Bp]	17.3	0.7	16.1 - 18.7	24
Distal Width [Bd]	16.4	0.5	15.6 - 17.5	24
TIBIOTARSI				
Length [La]	130.0	4.2	121.9 - 137.2	29
Proximal Width [PW]	14.5	0.6	13.4 - 16.0	26
Distal Width [Bd]	12.4	0.5	11.5 - 13.5	31
TARSOMETATARSI				
Greatest Length [GL]	85.7	3.7	78.4 - 90.5	37
Proximal Width [Bp]	13.3	0.4	12.5 - 14.7	32
Distal Width [Bd]	13.4	0.4	12.6 - 14.5	36
CORACOIDS				
Length [Lm]	35.7	1.2	33.6 - 37.9	13

APPENDIX VI

Length measurements of fossil *Dasyornis* postcranial material from Amphitheatre Cave. The measurement for humerus length, L, equals the distance between the *caput humeri* and the *cond. ventralis* (see Table 3 for the Greatest Length measurements).

	μ	s-1	OR	N
HUMERI				
Length [L]				
D. brachypterus	20.6	0.8	19.8 - 21.5	4
D. broadbenti	25.5	0.8	24.3 - 27.0	22
ULNAE				
Greatest Length [GL]				
D. brachypterus	17.1	0.7	16.6 - 17.6	2
D. broadbenti	21.7	0.6	20.7 - 22.4	8
FEMORA				
Greatest Length [GL]				
D. brachypterus	25.6	0.5	25.1 - 26.6	8
D. broadbenti	30.7	1.0	28.9 - 32.3	26
TIBIOTARSI				
Length [La]				
D. brachypterus	37.4	1.2	36.0 - 38.9	4
D. broadbenti	48.2	1.9	44.4 - 52.4	26
TARSOMETATARSI				
Greatest Length [GL]				
D. brachypterus	26.6	1.0	26.0 - 28.1	4
D. broadbenti	35.1	1.1	33.6 - 37.6	18