

Earliest modern bandicoot and bilby (Marsupialia, Peramelidae and Thylacomyidae) from the  
Miocene of the Riversleigh World Heritage Area, northwestern Queensland, Australia

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SUPPLEMENTARY DATA 2

Nexus-formatted character matrix for the 42 taxa included in our phylogenetic analyses.  
Outgroup taxa were *Djarthia murgonensis*, *Barinya wangala*, *Mutpuracinus archibaldi*,  
*Dasyurus hallucatus*, *Dasyuroides byrnei*, *Phascogale tapoatafa*, *Antechinus stuartii*,  
*Sminthopsis macroura*. ? = missing data; - = inapplicable.

#NEXUS

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BEGIN TAXA;
  DIMENSIONS NTAX=42;
  TAXLABELS
    'D. murgonensis'
    'M. archibaldi'
    'B. wangala'
    'D. hallucatus'
    'D. byrnei'
    'P. tapoatafa'
    'A. stuartii'
    'S. macroura'
    'C. ecaudatus'
    'M. lagotis'
    'M. leucura'
    'I. australis'
    'P. broadbenti'
    'P. raffrayana'
    'M. longicauda'
    'M. papuensis'
    'R. prattorum'
    'E. clara'
    'E. davidi'
    'E. kalubu'
    'E. rufescens'
    'cf. P. tedfordi'
    'cf. P. sp.'
    'I. auratus'
    'I. obesulus'
    'I. macrourus'
    'P. nasuta'
    'P. bougainville'
    'P. gunnii'
    'P. eremiana'
    'P. sobbei'
    'P. bowensis'
    'P. allinghamensis'
    'Y. burchfieldi'
    'Y. kida'
    'G. speciosus'
    'G. grandis'
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        'G. amplus'
        'G. adversus'
        'B. palara'
        'L. dayi'
        'C. bandicoot'
    ;
ENDBLOCK;
BEGIN CHARACTERS;
    DIMENSIONS NCHAR=156;
    FORMAT DATATYPE=STANDARD MISSING=? GAP=- SYMBOLS="01234";
    CHARLABELS
        [1] 'Upper incisor number'
        [2] 'Diastema between I4 and I5'
        [3] 'I5 morphology'
        [4] 'Degree of development of lingual shelf on P3'
        [5] 'P3 major cusp development'
        [6] 'Stylar crest on M1'
        [7] 'Anterior cingulum of M1'
        [8] 'Anterior cingulum of M3'
        [9] 'Direction of preparacrista of M1'
        [10] 'Posterior cingulum of M3'
        [11] 'Morphology of the centrocrista on M1 and M2'
        [12] 'Morphology of Centrocrista on M3'
        [13] 'Lobation of i3'
        [14] 'Length of p3'
        [15] 'Presence of preentocristid'
        [16] 'Direction of preentocristid of m1-3'
        [17] 'Cusp within the hypoflexid region, between the talonid
and trigonid on the buccal side'
        [18] 'Distinction between lower molar crowns and roots'
        [19] 'Hypoconulid posterior to entoconid'
        [20] 'Size of talonid on m4'
        [21] 'Snout length and premaxilla size'
        [22] 'Width of nasals'
        [23] 'Position of nasal-frontal suture/maximum posterior
extension of nasals'
        [24] 'Infraorbital canal length'
        [25] 'Jugal-maxilla contact'
        [26] 'Lacrimal orbital rim'
        [27] 'Antorbital fossa'
        [28] Orbitosphenoid
        [29] Alisphenoid
        [30] 'Sphenorbital fissure and foramen rotundum'
        [31] 'Presence of Accessory fenestrae'
        [32] 'Presence of dividing septa in maxillopalatine
fenestrae'
        [33] 'Postglenoid foramen'
        [34] 'Morphology of the primary foramen ovale'
        [35] 'Morphology of the secondary foramen ovale'
        [36] 'Morphology of the ectotympanic'
        [37] 'Degree of inflation of the alisphenoid tympanic
process'
        [38] 'Alisphenoid tympanic process shape'
        [39] 'Morphology of the rostral tympanic proccess of the
petrosal'
        [40] 'Epitympanic recess'
        [41] 'Squamosal epitympanic sinus'
        [42] 'Supraoccipital shape'

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[43] 'Postorbital processes'  
[44] 'Left and right parietal suture'  
[45] 'Sagital crest'  
[46] 'Interparietal'  
[47] 'Lambdoid sesamoids'  
[48] 'Number of mental foramen'  
[49] 'Shape of I1'  
[50] 'Upper canine alveolus'  
[51] 'Relative height of P2 and P3'  
[52] 'Posterior crest of P3'  
[53] 'Relative height of p2 and p3'  
[54] 'Hypoconulid notch'  
[55] 'Relative position of hypoconid to protoconid on m3'  
[56] 'Posterior cingulid'  
[57] 'Shape of narial flange of premaxilla'  
[58] 'Position of lacrimal foramen'  
[59] 'Supraoccipital contribution to foramen magnum'  
[60] 'Shape of I2-4'  
[61] 'Shape of upper canine'  
[62] 'Lower molar crown height'  
[63] 'Position of the metacone'  
[64] 'Size of I3'  
[65] 'Lingual cusp presence on lower incisors'  
[66] 'Diastema between i3 and canine'  
[67] 'Shape of lower canine'  
[68] 'Size of upper or lower canine'  
[69] 'Diastema between C1 and P1'  
[70] 'Length of P1'  
[71] 'Anterior cusp of P1 and/or P2'  
[72] 'Diastema between P1 and P2'  
[73] 'Morphology of the central cusp of P1 and P2'  
[74] 'Relative length of P2 and P3'  
[75] 'Diastema between canine and p1'  
[76] 'Length of p1'  
[77] 'Anterior cusp of p1'  
[78] 'Anterior cusp of p2'  
[79] 'Diastema between p1 and p2'  
[80] 'Relative length of p2 and p3'  
[81] 'Anterior cusp of p3'  
[82] 'p3 major cusp development'  
[83] 'Reclining of p3'  
[84] 'Size of stylar cusp A on M1'  
[85] 'Morphology of stylar cusp B/C on M1'  
[86] 'Relative size of stylar cusp B and C on M1'  
[87] 'Connection of St B and D on M1'  
[88] 'Posterior cingulum of M1'  
[89] 'Termination of postprotocrista on M1'  
[90] 'Position of metaconule on M1'  
[91] 'St cusp D1 on M1'  
[92] 'St cusp E on M1'  
[93] 'Anterior cingulum of M2'  
[94] 'Size of stylar cusp A on M2'  
[95] 'Morphology of stylar cusp B on M2'  
[96] 'Connection of St B and D on M2'  
[97] 'Direction of preparacrista of M2'  
[98] 'Stylar crest on M2'  
[99] 'Posterior cingulum of M2'  
[100] 'Termination of postprotocrista on M2'

[101] 'Position of metaconule on M2'  
 [102] 'St cusp C on M2'  
 [103] 'St cusp D1 on M2'  
 [104] 'St cusp E on M2'  
 [105] 'Size of stylar cusp A on M3'  
 [106] 'Morphology of stylar cusp B on M3'  
 [107] 'Connection of St B and D on M3'  
 [108] 'Direction of preparacrista of M3'  
 [109] 'Stylar crest on M3'  
 [110] 'Termination of postprotocrista/posthypocrista on M3'  
 [111] 'Position of metaconule on M3'  
 [112] 'St cusp C on M3'  
 [113] 'St cusp D1 on M3'  
 [114] 'St cusp E on M3'  
 [115] 'Anterior cingulum of M4'  
 [116] 'Stylar cusp B on M4'  
 [117] 'Connection of St A and B on M4'  
 [118] 'Direction of preparacrista of M4'  
 [119] 'Postparacrista of M4'  
 [120] 'Termination of postprotocrista on M4'  
 [121] 'Metacone on M4'  
 [122] 'St cusp C/D on M4'  
 [123] 'Presence of protocone on M4'  
 [124] 'Anterior cingulid on m1'  
 [125] 'Hypoflexid on m1'  
 [126] 'Shape of trigonid on m1'  
 [127] 'Position of paraconid on m1'  
 [128] 'Shape of unworn entoconid on m1-3'  
 [129] 'Cristid obliqua termination on m1'  
 [130] 'Posthypocristid direction on m1'  
 [131] 'Connection of posthypocristid on m1'  
 [132] 'Size of Hypoconulid on m1'  
 [133] 'Shape of trigonid on m2'  
 [134] 'Cristid obliqua termination on m2'  
 [135] 'Posthypocristid direction on m2'  
 [136] 'Connection of posthypocristid on m2'  
 [137] 'Size of Hypoconulid on m2'  
 [138] 'Shape of trigonid on m3'  
 [139] 'Cristid obliqua termination on m3'  
 [140] 'Posthypocristid direction on m3'  
 [141] 'Connection of posthypocristid on m3'  
 [142] 'Size of Hypoconulid on m3'  
 [143] 'Shape of trigonid on m4'  
 [144] 'Preentocristid on m4'  
 [145] 'Preentocristid orientation on m4'  
 [146] 'Postentocristid on m4'  
 [147] 'Postentocristid orientation on m4'  
 [148] 'Cristid obliqua termination on m4'  
 [149] 'Posthypocristid direction on m4'  
 [150] 'Size of entoconid'  
 [151] 'Size of Hypoconulid on m4'  
 [152] 'Buccal shelf on m4'  
 [153] 'Presence of P3'  
 [154] 'Presence of p3'  
 [155] 'Presence of palatine fenestrae'  
 [156] 'Presence of maxillary fenestrae'

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STATELABELS

1 'five incisors present'  
'four incisors present (I5 lost)',

2 absent  
present,

3 'I5 similar in morphology to I1-4 '  
'I5 pointed and strongly canine-like '  
'I5 is premolar like',

4 'no shelf'  
'small/weakly developed shelf'  
'well-developed lingual shelf'  
'well-developed lingual shelf that extends to the  
buccal side of P3',

5 'P3 major cusp laterally compressed'  
'P3 major cusp laterally enlarged but not conical'  
'P3 major cusp large and conical, but P3 is narrower  
than M1'  
'P3 Major cusp large and conical, and P3 is wider than  
M1',

6 'stylar crest present on stylar cusp D connects to  
metastylar tip'  
'stylar cusp D is a conical cusp not connected to the  
stylar crest running to the metastylar tip '  
'stylar cusp D is a conical cusp and no stylar crest  
present',

7 'no anterior cingulum'  
'small anterior cingulum lingual to anterior tip of  
tooth, no connection to talon'  
'Anterior cingulum enlarged and connects to talon as  
small shelf',

8 'no anterior cingulum'  
'small anterior cingulum lingual to anterior tip of  
tooth'  
'small anterior cingulum connected to protocone shelf  
by a small shelf'  
'large anterior cingulum expanded further up to the  
protocone',

9 'preparacrista anterobuccally orientated to connect to  
anteriorly positioned St B.'  
'preparacrista buccally orientated (perpendicular to  
tooth row) then posterobuccally orientated'  
'preparacrista posterobuccally orientated to connect  
to posteriorly located St B'  
'preparacrista posterobuccally orientated to connect  
to St B and then reconnects with postparacrista posteriorly',

10 Absent  
Present  
'Present and wide',

11

'postparacrista and premetacrista contact each other,  
forming a complete centrocrista that connects the paracone and metacone  
(more lingually).'

'postparacrista and premetacrista contact each other,  
forming a complete centrocrista that connects the paracone and metacone  
(more buccally)'

'postparacrista does not connect to the premetacrista  
and ends at the base of St B, premetacrista ends at base of St D ',

12

'postparacrista and premetacrista contact each other,  
forming a complete centrocrista that connects the paracone and metacone  
(more lingually).'

'postparacrista and premetacrista contact each other,  
forming a complete centrocrista that connects the paracone and metacone  
(more buccally)'

'postparacrista does not connect to the premetacrista  
and ends at the base of St B, premetacrista ends at base of St D ',

13

'i3 is unicuspid'

'i3 posterior cusp present but small'

'I3 posterior cusp present and large',

14

'p3 longer or equal in length to p2 '

'p3 shorter than p2 ',

15

present

absent,

16

anteroposterior

oblique,

17

'no median buccal cusp present '

'median buccal cusp present ',

18

'crown distinct from roots '

'crown and root indistinct (other than for limit of

enamel) ',

19

'hypoconulid positioned posterobuccal to the entoconid

,

'hypoconulid positioned almost directly posterior to

the entoconid ',

20

'entoconid and hypoconid large, talonid relatively  
wide, crests clearly identifiable.'

'entoconid and hypoconid smaller than in state 0,  
talonid smaller'

'Further reduction of entoconid and hypoconid, talonid  
very small, crest poorly defined ',

21

'premaxilla taller than it is long; maxilla-nasal  
contact longer than premaxilla-nasal contact (usually correlated with a  
relatively short snout) '

'premaxilla longer than it is tall; premaxilla-nasal  
contact longer than maxilla-nasal contact (usually correlated with a  
relatively elongate snout) ',

22

'broad nasals'

23 'slender nasals, not markedly expanded posteriorly ',  
 viewed laterally 'posterior to the anterior rim of the orbit when  
 viewed laterally 'nasals terminate just anterior to the orbit when  
 (associated with a wide maxilla-frontal suture) '  
 'nasals terminate well anterior to the anterior margin  
 of the orbit',  
 24 'long infraorbital canal (longer than half the molar  
 row).'  
 'short infraorbital canal (shorter or equal to half  
 the molar row).',  
 25 'jugal invades the maxilla and extends onto the facial  
 region of the skull (not bifid)'  
 'maxilla invades the zygomatic arch so that the jugal  
 has two thin wings around the posterior maxillary flange (bifid)',  
 26 'lacrimal crest absent'  
 'Partially developed lacrimal crest'  
 'Fully developed lachrimal crest',  
 27 'antorbital fossa absent '  
 'weak or partial fossa development '  
 'very deep antorbital fossa',  
 28 'orbitosphenoid identifiable in lateral view as a  
 large ossification '  
 'orbitosphenoid identifiable in lateral view as a  
 small ossification '  
 'orbitosphenoid is very small or absent and not  
 obvious in lateral view',  
 29 'alisphenoid-parietal contact '  
 'squamosal-frontal contact ',  
 30 'sphenorbital fissure slightly larger than foramen  
 rotundum. Both canals are tubelike in shape, especially the foramen  
 rotundum'  
 'sphenorbital fissure is enlarged and more widely  
 open, and there is a reduction in the length of the ''tube'' leading to  
 the foramen rotundum'  
 'sphenorbital fissure is further enlarged and open,  
 and there is no ''tube'' leading to the foramen rotundum, which instead  
 appears',  
 31 Absent  
 Present,  
 32 'Septum present in maxillopalatine fenestrae'  
 'Septum absent in maxillopalatine fenestrae',  
 33 'foramen bound by squamosal or squamosal and  
 alisphenoid '  
 ' foramen bounded medially by the petrosal',  
 34

petrosal ' 'primary foramen ovale is between alisphenoid and  
 alisphenoid',  
 35 'secondary foramen ovale absent'  
 'secondary foramen ovale defined by a complete strut  
 or bridge formed by the alisphenoid, but the primary foramen ovale is  
 still visible'  
 'secondary foramen ovale present, and extensive  
 ossification of the alisphenoid means that the primary foramen ovale is  
 no longer visible in intact skulls',  
 36  
 'thin'  
 'somewhat thickened '  
 'further thickened'  
 'heavily thickened',  
 37  
 'alisphenoid tympanic process small, lateral and  
 medial walls open. '  
 'alisphenoid tympanic process largely open but medial  
 wall enclosed greater than in state 0, and hypotympanic sinus is also  
 enlarged relative to state 0 '  
 'alisphenoid tympanic process and hypotympanic sinus  
 further enlarged.relative to state 1; hypotympanic sinus walled  
 posteriorly by the alisphenoid'  
 'alisphenoid tympanic process and hypotympanic sinus  
 greatly hypertrophied',  
 38  
 'flattened '  
 'ventrally rounded, anterior boundary rounded does not  
 extend as far as the transverse foramen or foramen ovale '  
 'ventrally rounded, anterior boundary pointed and  
 extends as far as the transverse foramen'  
 'ventrally angular, anterior boundary pointed and  
 terminates anterior to the transverse foramen',  
 39  
 'rostral tympanic process of the petrosal absent or  
 very small '  
 'rostral tympanic process of the petrosal forms a  
 distinct projecting process that partially walls the posteromedial  
 margin of the hypotympanic sinus . '  
 'rostral tympanic process of the petrosal further  
 enlarged, forming elongate crestlike process that extends the length of  
 the promontorium and forms posteromedial wall of the hypotympanic  
 sinus; medial margin of petrosal overlaps basioccipital.'  
 'ventral margin of the rostral tympanic process of the  
 petrosal extends laterally and slightly dorsally, resulting in the  
 formation of a distinct hypotympanic sinus within the rostral tympanic  
 process itself'  
 'further dorsal extension of the ventral margin of the  
 rostral tympanic process relative to state 3, resulting in lateral wall  
 to the hypotympanic sinus within the process ',  
 40  
 'poorly defined and shallow '  
 'wider and deeper than the plesiomorphic state but  
 still relatively poorly defined '



distinguished from remainder of auditory cavity'  
 'wide and deep sinus that extends posterolaterally',  
 41 'absent '  
 'present, poorly defined '  
 'wide with high posterior wall'  
 'deep and round',  
 42 'supraoccipital about as tall as it is wide '  
 'supraoccipital taller than it is wide ',  
 43 'absent or indistinct'  
 present,  
 44 'median suture present'  
 'partially or completely co-ossified suture',  
 45 'no sagittal crest'  
 'sagittal crest small, not extending to frontals'  
 'sagittal crest large and extending to frontals',  
 46 absent  
 present,  
 47 absent  
 present,  
 48 'one mental foramen'  
 'two mental foramina'  
 'three or more mental foramina',  
 49 'Styliform or chisel-like'  
 'mesiodistally expanded and flat-crowned',  
 50 'occupies premaxillary-maxillary suture'  
 'entirely contained within maxillary',  
 51 'P2 taller than P3'  
 'P2 and P3 subequal in height'  
 'P3 taller than P2',  
 52 'well-developed posterior cutting edge'  
 'lacking posterior cutting edge',  
 53 'p2 taller than p3'  
 'p2 and p3 subequal in height'  
 'p3 taller than p2',  
 54 'present in anterior cingulum of m2-4'  
 absent,  
 55 buccally salient to protoconid'  
 'subequal to protoconid'  
 'lingual to salient protoconid',  
 56 absent  
 present,

57 'no distinct process'  
 ''wing-like'' narial processes present',

58 'within lacrimal'  
 'within lacrimal-maxillary suture',

59 'contributes to superior margin of foramen magnum'  
 'exoccipitals contact each other medially, excluding  
 the supraoccipital from the foramen magnum ',

60 'rhomboidal crowns'  
 'mesiodistally expanded and flat-crowned',

61 'single-rooted unicuspid upper canine'  
 'accessory cusps are present on either side of the  
 major cusp of C1',

62 'Lower molars are as high on the buccal side as they  
 are on the lingual side'  
 'Lower molar height is significantly higher on buccal  
 side than lingual side',

63 'Metacone is directly posterior to the paracone'  
 'Metacone is shifted lingually in relation to the  
 paracone',

64 'I2-4 are the same size'  
 'I3 is larger than I2 and I4',

65 Present  
 Absent,

66 'no diastema'  
 'Diastema present',

67 'single-rooted unicuspid lower canine'  
 'accessory cusps are present on either side of the  
 major cusp of c1',

68 'Large, raised above premolars'  
 'Small, about as high as premolars',

69 'no diastema'  
 'short, less than the length of P1'  
 'long, more than the length of P1',

70 'P1 is shorter than P2'  
 'P1 is as long as P2'  
 'P1 is longer than P2',

71 'tall distinct cusp'  
 'small remnant or no cusp',

72 'No diastema'  
 'short, less than the length of p1'  
 'long, more than the length of p1',

73

'Central cusp is not inflated'  
 'Central cusp is inflated widening the tooth  
 anteriorly',  
 74  
 'P3 almost twice as long as P2'  
 'P2 shorter than P3'  
 'P2 and P3 subequal length'  
 'P2 longer than P3'  
 'P2 twice as long as P3',  
 75  
 'no diastemata'  
 'short, less than the length of p1'  
 'long, more than the length of p1',  
 76  
 'p1 is shorter than either p2 or p3'  
 'p1 is as long as p2 or p3',  
 77  
 'tall distinct cusp'  
 'none or small remnant',  
 78  
 'tall distinct cusp'  
 'none or small remnant',  
 79  
 'no diastemata'  
 'short, less than the length of p1'  
 'long, more than the length of p1',  
 80  
 'p3 almost twice as long as p2'  
 'p2 shorter than p3'  
 'p2 and p3 subequal length'  
 'p2 longer than P3',  
 81  
 'tall distinct cusp'  
 'none or small remnant',  
 82  
 'p3 major cusp laterally compressed'  
 'p3 major cusp very large',  
 83  
 'the anterior and posterior roots of p3 are level'  
 'the anterior root of p3 is more exposed than the  
 posterior root, reclining p3 toward m1',  
 84  
 'Stylar cusp A is large, with a long crest running  
 anteroposteriorly'  
 'Stylar cusp A is small, with a short or no crest  
 running anteroposteriorly'  
 'st A remnant or no St A',  
 85  
 'No st C or B'  
 'stylar cusp B and C are distinct cusps'  
 'Stylar cusp B and C are fused and oval in shape  
 connected by a stylar crest but clearly identifiable as separate cusp'  
 'Stylar cusp B and C are fused and oval in shape  
 connected by a stylar crest but difficult to clearly identify each  
 cusp',  
 86  
 ' Stylar cusp B larger than stylar cusp C'  
 'Stylar cusp B subequal to st C'

87 'Stylar cusp C larger than st B',  
 'St B/C and D are connected by a series of crests'  
 'St B/C and D are not connected by any crests',  
 88 absent  
 present  
 'present and wide',  
 89 'postprotocrista ends on anterior flank of metacone'  
 'postprotocrista ends on lingual flank of metacone'  
 'postprotocrista ends on posterolingual flank of  
 metacone '  
 'postprotocrista joins with the posterior cingulum and  
 ends posteriorly to the midpoint of the postmetacrasta'  
 'postprotocrista joins with the posterior cingulum and  
 ends at the lingual flank of the metastylar tip',  
 90 'metaconule is directly positioning at the base of the  
 metacone'  
 'a small shelf is between the base of the metacone and  
 the metaconule'  
 'a larger shelf is between the base of the metacone  
 and the metaconule',  
 91 present  
 absent,  
 92 'St E present as a distinct cusp'  
 'remnant of St E as a stylar crest or small cusp'  
 'No St E (no stylar crest)',  
 93 'no anterior cingulum'  
 'small anterior cingulum lingual to anterior tip of  
 tooth'  
 'small anterior cingulum connected to protocone shelf  
 by a small shelf'  
 'large anterior cingulum expanded further up to the  
 protocone',  
 94 'Stylar cusp A is large, with a long crest running  
 anteroposteriorly'  
 'Stylar cusp A is small, with a short or no crest  
 running anteroposteriorly'  
 'no St A',  
 95 'Stylar cusp B is oval with a stylar crest running  
 through it'  
 'Stylar cusp B is conical with no stylar crest  
 connection',  
 96 'St B and D are connected by a series of crests'  
 'St B and D are not connected by any crests',  
 97 'preparacrasta terminates at base of St B (no crest  
 connection).'  
 'preparacrasta terminates at the tip St B. '

to St A' 'preparacrista connects to st B with a weak connection  
 98 'preparacrista connects to parastylar tip/St A',  
 metastylar tip' 'stylar crest present on stylar cusp D connects to  
 'stylar cusp D is a conical cusp not connected to the  
 stylar crest running to the metastylar tip'  
 'stylar cusp D is a conical cusp and no stylar crest  
 present',  
 99 absent  
 present  
 'present and wide',  
 100 'postprotocrista ends on anterior flank of metacone'  
 'postprotocrista ends on lingual flank of metacone'  
 'postprotocrista ends on posterolingual flank of  
 metacone '  
 'postprotocrista joins with the posterior cingulum and  
 ends posteriorly to the midpoint of the postmetacrista'  
 'postprotocrista joins with the posterior cingulum and  
 ends at the lingual flank of the metastylar tip',  
 101 'metaconule is directly positioning at the base of the  
 metacone'  
 'a small shelf is between the base of the metacone and  
 the metaconule'  
 'a larger shelf is between the base of the metacone  
 and the metaconule',  
 102 'Present as tall cusp'  
 'small remnant present'  
 absent,  
 103 present  
 absent,  
 104 'St E present as a distinct cusp'  
 'remnant of St E as a stylar crest'  
 'No St E (no stylar crest)',  
 105 'Stylar cusp A is large, with a long crest running  
 anteroposteriorly'  
 'Stylar cusp A is small, with a short or no crest  
 running anteroposteriorly'  
 'no St A',  
 106 'Stylar cusp B is oval with a stylar crest running  
 through it'  
 'Stylar cusp B is conical with no stylar crest  
 connection (except by wear)',  
 107 'St B and D are connected by a series of crests'  
 'St B and D are not connected by any crests',  
 108 'preparacrista terminates at base of St B (no crest  
 connection).'

'preparacrista terminates at the tip St B. '  
 'preparacrista connects a crest linking St A and St B'  
 'preparacrista connects to parastylar tip/St A',  
 109 'stylar crest present on stylar cusp D connects to  
 metastylar tip'  
 'stylar cusp D is a conical cusp not connected to the  
 stylar crest running to the metastylar tip'  
 'stylar cusp D is a conical cusp and no stylar crest  
 present',  
 110 'postprotocrista ends on anterior flank of metacone'  
 'postprotocrista ends on lingual flank of metacone'  
 'postprotocrista ends on posterolingual flank of  
 metacone '  
 'postprotocrista joins with the posterior cingulum and  
 ends posteriorly to the midpoint of the postmetacrista'  
 'postprotocrista joins with the posterior cingulum and  
 ends at the lingual flank of the metastylar tip',  
 111 'metaconule is directly positioning at the base of the  
 metacone'  
 'a small shelf is between the base of the metacone and  
 the metaconule'  
 'a larger shelf is between the base of the metacone  
 and the metaconule',  
 112 'present as tall cusp'  
 'small remnant present'  
 'absent',  
 113 present  
 absent,  
 114 'St E present as a distinct cusp'  
 'remnant of St E as a stylar crest'  
 'No St E (no stylar crest)',  
 115 'no anterior cingulum'  
 'small anterior cingulum lingual to anterior tip of  
 tooth'  
 'small anterior cingulum connected to protocone shelf  
 by a small shelf'  
 'large anterior cingulum expanded further up to the  
 protocone',  
 116 'no St B'  
 'small st B'  
 'Large St B',  
 117 'no connection'  
 'crest connecting the two cusps',  
 118 'preparacrista terminates St A'  
 'preparacrista terminates at the anterior flank of St  
 B',  
 119 'postparacrista straight '

'postparacrista curves as a small centrocrista and  
 ends just after the centrocrista',  
 120  
 'postprotocrista ends anterior to the most posterior  
 end of the postparacrista'  
 'postprotocrista ends level with the most posterior  
 end of the postparacrista'  
 'postprotocrista ends posterior to the most posterior  
 end of the postparacrista ',  
 121  
 Absent  
 'small metacone raise above the postparacrista'  
 'large metacone expands the length of the tooth',  
 122  
 Absent  
 Present,  
 123  
 present  
 absent,  
 124  
 'absent or small remnant'  
 present,  
 125  
 absent  
 present,  
 126  
 'Paraconid-metaconid distance is longer than  
 metaconid-protoconid distance'  
 'Paraconid-metaconid distance is as long as metaconid-  
 protoconid distance'  
 'Paraconid-metaconid distance is shorter than  
 metaconid-protoconid distance'  
 'Paraconid highly reduced or absent',  
 127  
 'Paraconid anterior to metaconid'  
 'Paraconid anterolabial to metaconid',  
 128  
 Oval  
 'Triangular (wider posteriorly than anteriorly)'  
 Conical,  
 129  
 'cristid obliqua terminates buccal to level with the  
 protocone'  
 'cristid obliqua terminates lingual to the protocone  
 to the midpoint to the tooth width'  
 'cristid obliqua terminates lingual to the midpoint of  
 the tooth width',  
 130  
 'oblique to the tooth row axis'  
 'perpendicular to the tooth row axis ',  
 131  
 'posthypocristid connects to hypoconulid'  
 'posthypocristid connects to base of entoconid when  
 the tooth is unworn, but as the tooth wears down, a crest connects the  
 tip of the entoconid to the posthypocristid.',  
 132  
 'Large distinct cusp'  
 'small cusp',

133 'Paraconid-metaconid distance is longer than  
metaconid-protoconid distance'  
'Paraconid-metaconid distance is as long as metaconid-  
protoconid distance'  
'Paraconid-metaconid distance is shorter than  
metaconid-protoconid distance'  
'Paraconid highly reduced or absent',

134 'cristid obliqua terminates buccal to the protocone'  
about midpoint to the tooth width'  
'cristid obliqua terminates lingual to the protocone  
the tooth width',  
'cristid obliqua terminates lingual to the midpoint of  
the tooth width',

135 'oblique to the tooth row axis'  
'perpendicular to the tooth row axis ',

136 'posthypocristid connects to hypoconulid'  
'posthypocristid connects to entoconid',

137 'Large distinct cusp'  
'small cusp'  
'hypoconulid absent',

138 'Paraconid-metaconid distance is longer than  
metaconid-protoconid distance'  
'Paraconid-metaconid distance is as longer as  
metaconid-protoconid distance'  
'Paraconid-metaconid distance is shorter than  
metaconid-protoconid distance'  
'Paraconid highly reduced or absent',

139 'cristid obliqua terminates buccal to the protocone'  
about midpoint to the tooth width'  
'cristid obliqua terminates lingual to the protocone  
the tooth width',  
'cristid obliqua terminates lingual to the midpoint of  
the tooth width',

140 'oblique to the tooth row axis'  
'perpendicular to the tooth row axis ',

141 'posthypocristid connects to hypoconulid'  
'posthypocristid connects to entoconid',

142 'Large distinct cusp'  
'small cusp'  
'hypoconulid absent',

143 'Paraconid-metaconid distance is longer than  
metaconid-protoconid distance'  
'Paraconid-metaconid distance is as longer as  
metaconid-protoconid distance'  
'Paraconid-metaconid distance is shorter than  
metaconid-protoconid distance'  
'Paraconid highly reduced or absent',

144 present



absent,  
145 anteroposterior  
oblique,  
146 absent  
present,  
147 anteroposterior  
oblique,  
148 'cristid obliqua terminates lingual to the protocone  
about midpoint to the tooth width'  
'cristid obliqua terminates lingual to the midpoint of  
the tooth width',  
149 'oblique to the tooth row axis'  
'perpendicular to the tooth row axis '  
'anteriorly oriented',  
150 'Large distinct cusp'  
'small cusp'  
'entoconid absent',  
151 'Large distinct cusp'  
'small cusp'  
'hypoconulid absent',  
152 'Buccal shelf end at buccal side of hypoconid'  
'Buccal shelf buccally reduced (hypoconid more buccal  
than shelf)',  
153 Present  
Absent,  
154 Present  
Absent,  
155 Absent  
Present,  
156 absent  
present,

;

# MATRIX

'D. murgonensis'            ???0002100 11?1000000 ??????????  
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'M. archibaldi'            1-?0102100 00?0000001 0001020?0?  
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'B. wangala'            1--0201100 00?1000000 0001020001  
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'D. hallucatus' 1----021-0 ?00-000002 0001020000  
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 'P. tapoatafa' 1--0002201 ?011000002 0000020002  
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 'A. stuartii' 1--0012201 ?011000001 0000020002  
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 'M. leucura' 0101220120 2221?0112 1111122010  
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 'I. australis' ?????????? ??????101? ??????????  
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 'P. raffrayana' 0112102130 22200000011 1110111210  
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 'M. longicauda' 0111000130 22200000012 1121111110  
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'E. rufescens' 1--1112230 2220000012 1111111210  
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'I. obesulus' 0112212312 2220011111 1111121111  
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'I. macrourus' 0113222322 2220(01)1111 1111121111  
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'P. nasuta' 0112112021 2220??1011 1120121212  
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'P. bougainville' 0111112020 2221??0012 1120122212  
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1100113102 2211011321 2210010010 1000110200 0021101211 0121-0-111  
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'P. gunnii' 0122222020 22211-0011 1120122212  
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'P. eremiana' 01?1112030 2221??0012 1120122212  
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        'G. grandis'            ?????02201 11?000011 ??????????
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        'G. adversus'           ?????02210 21????????? ???11?1???
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        'B. palara'             ???1001120 (12)221000011 ?1001?1000
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0021000211 (01)01000-010 200000

        'L. dayi'                ?????????? 2???01101? ??????????
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105 108 - 112 114 - 116 120 - 121 126 129 133 - 134 137 - 139 142 - 143
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