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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Journal of Vertebrate Paleontology

SUPPLEMENTARY DATA 1

List and description of 156 characters and states used in our phylogenetic analyses. Ordered characters are indicated with an asterisk (*).

1. Upper incisor number
    (0) five incisors present
    (1) four incisors present (I5 lost)
2. Diastema between I4 and I5
    (0) absent
    (1) present
3. I5 morphology
    (0) I5 similar in morphology to I1-4
    (1) I5 pointed and strongly canine-like
    (2) I5 premolar like
4. *Degree of development of lingual shelf on P3
    (0) no shelf
    (1) small/weakly developed shelf
    (2) well-developed lingual shelf
    (3) well-developed lingual shelf that extends to the buccal side of P3
5. *P3 major cusp development
    (0) P3 major cusp laterally compressed
    (1) P3 major cusp laterally enlarged but not conical
    (2) P3 major cusp large and conical, but P3 is narrower than M1
    (3) P3 major cusp large and conical, and P3 is wider than M1
6. *Stylar crest on M1
    (0) stylar crest present on stylar cusp D connects to metastylar tip
    (1) stylar cusp D is a conical cusp not connected to the stylar crest running to the metastylar tip
    (2) stylar cusp D is a conical cusp and no stylar crest present
7. *Anterior cingulum of M1
    (0) no anterior cingulum
    (1) small anterior cingulum lingual to anterior tip of tooth, no connection to talon
    (2) Anterior cingulum enlarged and connects to talon as small shelf
8. *Anterior cingulum of M3
    (0) no anterior cingulum
    (1) small anterior cingulum lingual to anterior tip of tooth
    (2) small anterior cingulum connected to protocone shelf by a small shelf

(3) large anterior cingulum expanded further up to the protocone

9. *Direction of preparacrista of M1
   (0) preparacrista anterobuccally orientated to connect to anteriorly positioned St B.
   (1) preparacrista buccally orientated (perpendicular to tooth row) then posterobuccally orientated
   (2) preparacrista posterobuccally orientated to connect to posteriorly located St B
   (3) preparacrista posterobuccally orientated to connect to St B and then reconnects with postparacrista posteriorly
10. *Posterior cingulum of M3
   (0) absent
   (1) present
   (2) present and wide
11. *Morphology of the centrocrista on M1 and M2
   (0) postparacrista and premetacrista contact each other, forming a complete centrocrista that connects the paracone and metacone (more lingually).
   (1) postparacrista and premetacrista contact each other, forming a complete centrocrista that connects the paracone and metacone (more buccally)
   (2) postparacrista does not connect to the premetacrista and ends at the base of St B, premetacrista ends at base of St D
12. *Morphology of centrocrista on M3
   (0) postparacrista and premetacrista contact each other, forming a complete centrocrista that connects the paracone and metacone (more lingually)
   (1) postparacrista and premetacrista contact each other, forming a complete centrocrista that connects the paracone and metacone (more buccally)
   (2) postparacrista does not connect to the premetacrista and ends at the base of St B, premetacrista ends at base of St D
13. *Lobation of i3
   (0) i3 is unicuspid
   (1) i3 posterior cusp present but small
   (2) I3 posterior cusp present and large
14. Length of p3
   (0) p3 longer or equal in length to p2
   (1) p3 shorter than p2
15. Presence of preentocristid
   (0) present
   (1) absent
16. Direction of preentocristid of m1-3
   (0) anteroposterior
   (1) oblique
17. Cusp within the hypoflexid region, between the talonid and trigonid on the buccal side
   (0) no median buccal cusp present
   (1) median buccal cusp present
18. Distinction between lower molar crowns and roots

(0) crown distinct from roots
(1) crown and root indistinct (other than for limit of enamel)

19. Hypoconulid posterior to entoconid
(0) hypoconulid positioned posterobuccal to the entoconid
(1) hypoconulid positioned almost directly posterior to the entoconid

20. *Size of talonid on m4
(0) entoconid and hypoconid large, talonid relatively wide, crests clearly identifiable
(1) entoconid and hypoconid smaller than in state 0, talonid smaller
(2) further reduction of entoconid and hypoconid, talonid very small, crest poorly defined

21. Snout length and premaxilla size
(0) premaxilla taller than it is long; maxilla-nasal contact longer than premaxilla-nasal contact (usually correlated with a relatively short snout)
(1) premaxilla longer than it is tall; premaxilla-nasal contact longer than maxilla-nasal contact (usually correlated with a relatively elongate snout)

22. Width of nasals
(0) broad nasals
(1) slender nasals, not markedly expanded posteriorly

23. *Position of nasal-frontal suture/maximum posterior extension of nasals
(0) posterior to the anterior rim of the orbit when viewed laterally
(1) nasals terminate just anterior to the orbit when viewed laterally (associated with a wide maxilla-frontal suture)
(2) nasals terminate well anterior to the anterior margin of the orbit

24. Infraorbital canal length
(0) long infraorbital canal (longer than half the molar row)
(1) short infraorbital canal (shorter or equal to half the molar row)

25. Jugal-maxilla contact
(0) jugal invades the maxilla and extends onto the facial region of the skull (not bifid)
(1) maxilla invades the zygomatic arch so that the jugal has two thin wings around the posterior maxillary flange (bifid)

26. *Lacrimal orbital rim
(0) lacrimal crest absent
(1) partially developed lacrimal crest
(2) fully developed lachrimal crest

27. *Antorbital fossa
(0) antorbital fossa absent
(1) weak or partial fossa development
(2) very deep antorbital fossa

28. *Orbitosphenoid
(0) orbitosphenoid identifiable in lateral view as a large ossification

(1) orbitosphenoid identifiable in lateral view as a small ossification
(2) orbitosphenoid is very small or absent and not obvious in lateral view

29. Alisphenoid
(0) alisphenoid-parietal contact
(1) squamosal-frontal contact

30. *Sphenorbital fissure and foramen rotundum
(0) sphenorbital fissure slightly larger than foramen rotundum. Both canals are tube-like in shape, especially the foramen rotundum
(1) sphenorbital fissure is enlarged and more widely open, and there is a reduction in the length of the tube leading to the foramen rotundum
(2) sphenorbital fissure is further enlarged and open, and there is no tube leading to the foramen rotundum, which instead appears

31. Presence of Accessory fenestrae
(0) absent
(1) present

32. Presence of dividing septa in maxillopalatine fenestrae
(0) septum present in maxillopalatine fenestrae
(1) septum absent in maxillopalatine fenestrae

33. Postglenoid foramen
(0) foramen bound by squamosal or squamosal and alisphenoid
(1) foramen bounded medially by the petrosal

34. Morphology of the primary foramen ovale
(0) primary foramen ovale is between alisphenoid and petrosal
(1) primary foramen ovale is entirely within the alisphenoid

35. *Morphology of the secondary foramen ovale
(0) secondary foramen ovale absent
(1) secondary foramen ovale defined by a complete strut or bridge formed by the alisphenoid, but the primary foramen ovale is still visible
(2) secondary foramen ovale present, and extensive ossification of the alisphenoid means that the primary foramen ovale is no longer visible in intact skulls

36. *Morphology of the ectotympanic
(0) thin
(1) somewhat thickened
(2) further thickened
(3) heavily thickened

37. *Degree of inflation of the alisphenoid tympanic process
(0) alisphenoid tympanic process small, lateral and medial walls open.
(1) alisphenoid tympanic process largely open but medial wall enclosed greater than in state 0, and hypotympanic sinus is also enlarged relative to state 0
(2) alisphenoid tympanic process and hypotympanic sinus further enlarged.relative to state 1; hypotympanic sinus walled posteriorly by the alisphenoid

(3) alisphenoid tympanic process and hypotympanic sinus greatly hypertrophied

38. Alisphenoid tympanic process shape
    (0) flattened
    (1) ventrally rounded, anterior boundary rounded does not extend as far as the transverse foramen or foramen ovale
    (2) ventrally rounded, anterior boundary pointed and extends as far as the transverse foramen
    (3) ventrally angular, anterior boundary pointed and terminates anterior to the transverse foramen
39. *Morphology of the rostral tympanic proccess of the petrosal
    (0) rostral tympanic process of the petrosal absent or very small
    (1) rostral tympanic process of the petrosal forms a distinct projecting process that partially walls the posteromedial margin of the hypotympanic sinus
    (2) rostral tympanic process of the petrosal further enlarged, forming elongate crest-like process that extends the length of the promontorium and forms posteromedial wall of the hypotympanic sinus; medial margin of petrosal overlaps basioccipital
    (3) 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
    (4) 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. Epitympanic recess
    (0) poorly defined and shallow
    (1) wider and deeper than the plesiomorphic state but still relatively poorly defined
    (2) deep sinus with enclosing walls that is well distinguished from remainder of auditory cavity
    (3) wide and deep sinus that extends posterolaterally
41. Squamosal epitympanic sinus
    (0) absent
    (1) present, poorly defined
    (2) wide with high posterior wall
    (3) deep and round
42. Supraoccipital shape
    (0) supraoccipital about as tall as it is wide
    (1) supraoccipital taller than it is wide
43. Postorbital processes
    (0) absent or indistinct
    (1) present
44. Left and right parietal suture
    (0) median suture present
    (1) partially or completely co-ossified suture
45. *Sagittal crest
    (0) no sagittal crest

(1) sagittal crest small, not extending to frontals
(2) sagittal crest large and extending to frontals

46. Interparietal
(0) absent
(1) present

47. Lambdoid sesamoids
(0) absent
(1) present

48. *Number of mental foramen
(0) one mental foramen
(1) two mental foramina
(2) three or more mental foramina

49. Shape of I1
(0) styliform or chisel-like
(1) mesiodistally expanded and flat-crowned

50. Upper canine alveolus
(0) occupies premaxillary-maxillary suture
(1) entirely contained within maxillary

51. *Relative height of P2 and P3
(0) P2 taller than P3
(1) P2 and P3 subequal in height
(2) P3 taller than P2

52. Posterior crest of P3
(0) well-developed posterior cutting edge
(1) lacking posterior cutting edge

53. *Relative height of p2 and p3
(0) p2 taller than p3
(1) p2 and p3 subequal in height
(2) p3 taller than p2

54. Hypoconulid notch
(0) present in anterior cingulum of m2-4
(1) absent

55. *Relative position of hypoconid to protoconid on m3
(0) buccally salient to protoconid
(1) subequal to protoconid
(2) lingual to salient protoconid

56. Posterior cingulid
(0) absent
(1) present

57. Shape of narial flange of premaxilla
(0) no distinct process
(1) wing-like narial processes present

58. Position of lacrimal foramen
(0) within lacrimal
(1) within lacrimal-maxillary suture

59. Supraoccipital contribution to foramen magnum
(0) contributes to superior margin of foramen magnum
(1) exoccipitals contact each other medially, excluding the supraoccipital from the foramen magnum

60. Shape of I2-4

(0) rhomboidal crowns
(1) mesiodistally expanded and flat-crowned

61. Shape of upper canine
(0) single-rooted unicuspid upper canine
(1) accessory cusps are present on either side of the major cusp of C1

62. Lower molar crown height
(0) lower molars are as high on the buccal side as they are on the lingual side
(1) lower molar height is significantly higher on buccal side than lingual side

63. Position of the metacone
(0) metacone is directly posterior to the paracone
(1) metacone is shifted lingually in relation to the paracone

64. Size of I3
(0) I2-4 are the same size
(1) I3 is larger than I2 and I4

65. Lingual cusp presence on lower incisors
(0) present
(1) absent

66. Diastema between i3 and canine
(0) no diastema
(1) diastema present

67. Shape of lower canine
(0) single-rooted unicuspid lower canine
(1) accessory cusps are present on either side of the major cusp of c1

68. Size of upper or lower canine
(0) large, raised above premolars
(1) small, about as high as premolars

69. *Diastema between C1 and P1
(0) no diastema
(1) short, less than the length of P1
(2) long, more than the length of P1

70. *Length of P1
(0) P1 is shorter than P2
(1) P1 is as long as P2
(2) P1 is longer than P2

71. Anterior cusp of P1 and/or P2
(0) tall distinct cusp
(1) small remnant or no cusp

72. *Diastema between P1 and P2
(0) no diastema
(1) short, less than the length of p1
(2) long, more than the length of p1

73. Morphology of the central cusp of P1 and P2
(0) central cusp is not inflated
(1) central cusp is inflated widening the tooth anteriorly

74. *Relative length of P2 and P3
(0) P3 almost twice as long as P2

(1) P2 shorter than P3
(2) P2 and P3 subequal length
(3) P2 longer than P3
(4) P2 twice as long as P3

75. *Diastema between canine and p1
(0) no diastemata
(1) short, less than the length of p1
(2) long, more than the length of p1

76. Length of p1
(0) p1 is shorter than either p2 or p3
(1) p1 is as long as p2 or p3

77. Anterior cusp of p1
(0) tall distinct cusp
(1) none or small remnant

78. Anterior cusp of p2
(0) tall distinct cusp
(1) none or small remnant

79. *Diastema between p1 and p2
(0) no diastemata
(1) short, less than the length of p1
(2) long, more than the length of p1

80. *Relative length of p2 and p3
(0) p3 almost twice as long as p2
(1) p2 shorter than p3
(2) p2 and p3 subequal length
(3) p2 longer than P3

81. Anterior cusp of p3
(0) tall distinct cusp
(1) none or small remnant

82. p3 major cusp development
(0) p3 major cusp laterally compressed
(1) p3 major cusp very large

83. Reclining of p3
(0) the anterior and posterior roots of p3 are level
(1) the anterior root of p3 is more exposed than the posterior root, reclining p3 toward m1

84. *Size of stylar cusp A on M1
(0) stylar cusp A is large, with a long crest running anteroposteriorly
(1) stylar cusp A is small, with a short or no crest running anteroposteriorly
(2) stylar cusp A remnant or no stylar cusp A

85. Morphology of stylar cusp B/C on M1
(0) no stylar cusp B or C
(1) stylar cusp B and C are distinct cusps
(2) stylar cusp B and C are fused and oval in shape connected by a stylar crest but clearly identifiable as separate cusp
(3) stylar cusp B and C are fused and oval in shape connected by a stylar crest but difficult to clearly identify each cusp

86. *Relative size of stylar cusp B and C on M1

(0) stylar cusp B larger than stylar cusp C
(1) stylar cusp B subequal to stylar cusp C
(2) stylar cusp C larger than stylar cusp B

87. Connection of stylar cusp B and D on M1
(0) stylar cusp B/C and D are connected by a series of crests
(1) stylar cusp B/C and D are not connected by any crests

88. *Posterior cingulum of M1
(0) absent
(1) present
(2) present and wide

89. *Termination of postprotocrista on M1
(0) postprotocrista ends on anterior flank of metacone
(1) postprotocrista ends on lingual flank of metacone
(2) postprotocrista ends on posterolingual flank of metacone
(3) postprotocrista joins with the posterior cingulum and ends posteriorly to the midpoint of the postmetacrista
(4) postprotocrista joins with the posterior cingulum and ends at the lingual flank of the metastylar tip

90. *Position of metaconule on M1
(0) metaconule is directly positioning at the base of the metacone
(1) a small shelf is between the base of the metacone and the metaconule
(2) a larger shelf is between the base of the metacone and the metaconule

91. Stylar cusp D1 on M1
(0) present
(1) absent

92. *Stylar cusp E on M1
(0) stylar cusp E present as a distinct cusp
(1) remnant of stylar cusp E as a stylar crest or small cusp
(2) no stylar cusp E (no stylar crest),

93. *Anterior cingulum of M2
(0) no anterior cingulum
(1) small anterior cingulum lingual to anterior tip of tooth
(2) small anterior cingulum connected to protocone shelf by a small shelf
(3) large anterior cingulum expanded further up to the protocone

94. *Size of stylar cusp A on M2
(0) stylar cusp A is large, with a long crest running anteroposteriorly
(1) stylar cusp A is small, with a short or no crest running anteroposteriorly
(2) no stylar cusp A

95. Morphology of stylar cusp B on M2
(0) stylar cusp B is oval with a stylar crest running through it
(1) stylar cusp B is conical with no stylar crest connection

96. Connection of stylar cusp B and D on M2
(0) stylar cusp B and D are connected by a series of crests
(1) stylar cusp B and D are not connected by any crests

97. *Direction of preparacrista of M2

(0) preparacrista terminates at base of stylar cusp B (no crest connection).
(1) preparacrista terminates at the tip stylar cusp B.
(2) preparacrista connects to stylar cusp B with a weak connection to stylar cusp A
(3) preparacrista connects to parastylar tip/stylar cusp A

98. *Stylar crest on M2
(0) stylar crest present on stylar cusp D connects to metastylar tip
(1) stylar cusp D is a conical cusp not connected to the stylar crest running to the metastylar tip
(2) stylar cusp D is a conical cusp and no stylar crest present

99. *Posterior cingulum of M2
(0) absent
(1) present
(2) present and wide

100. *Termination of postprotocrista on M2
(0) postprotocrista ends on anterior flank of metacone
(1) postprotocrista ends on lingual flank of metacone
(2) postprotocrista ends on posterolingual flank of metacone
(3) postprotocrista joins with the posterior cingulum and ends posteriorly to the midpoint of the postmetacrista
(4) postprotocrista joins with the posterior cingulum and ends at the lingual flank of the metastylar tip

101. *Position of metaconule on M2
(0) metaconule is directly positioning at the base of the metacone
(1) a small shelf is between the base of the metacone and the metaconule
(2) a larger shelf is between the base of the metacone and the metaconule

102. *Stylar cusp C on M2
(0) Present as tall cusp
(1) small remnant present
(2) absent

103. Stylar cusp D1 on M2
(0) present
(1) absent

104. *Stylar cusp E on M2
(0) stylar cusp E present as a distinct cusp
(1) remnant of stylar cusp E as a stylar crest
(2) no stylar cusp E (no stylar crest)

105. *Size of stylar cusp A on M3
(0) stylar cusp A is large, with a long crest running anteroposteriorly
(1) stylar cusp A is small, with a short or no crest running anteroposteriorly
(2) no stylar cusp A

106. Morphology of stylar cusp B on M3
(0) stylar cusp B is oval with a stylar crest running through it
(1) stylar cusp B is conical with no stylar crest connection (except by wear)

107. Connection of stylar cusp B and D on M3
    (0) stylar cusp B and D are connected by a series of crests
    (1) stylar cusp B and D are not connected by any crests,
108. *Direction of preparacrista of M3
    (0) preparacrista terminates at base of stylar cusp B (no crest connection).
    (1) preparacrista terminates at the tip stylar cusp B.
    (2) preparacrista connects a crest linking stylar cusp A and stylar cusp B
    (3) preparacrista connects to parastylar tip/stylar cusp A
109. *Stylar crest on M3
    (0) stylar crest present on stylar cusp D connects to metastylar tip
    (1) stylar cusp D is a conical cusp not connected to the stylar crest running to the metastylar tip
    (2) stylar cusp D is a conical cusp and no stylar crest present
110. *Termination of postprotocrista/posthypocrista on M3
    (0) postprotocrista ends on anterior flank of metacone
    (1) postprotocrista ends on lingual flank of metacone
    (2) postprotocrista ends on posterolingual flank of metacone
    (3) postprotocrista joins with the posterior cingulum and ends posteriorly to the midpoint of the postmetacrista
    (4) postprotocrista joins with the posterior cingulum and ends at the lingual flank of the metastylar tip
111. *Position of metaconule on M3
    (0) metaconule is directly positioning at the base of the metacone
    (1) a small shelf is between the base of the metacone and the metaconule
    (2) a larger shelf is between the base of the metacone and the metaconule
112. *Stylar cusp C on M3
    (0) present as tall cusp
    (1) small remnant present
    (2) absent
113. Stylar cusp D1 on M3
    (0) present
    (1) absent
114. *Stylar cusp E on M3
    (0) stylar cusp E present as a distinct cusp
    (1) remnant of stylar cusp E as a stylar crest
    (2) no stylar cusp E (no stylar crest),
115. *Anterior cingulum of M4
    (0) no anterior cingulum
    (1) small anterior cingulum lingual to anterior tip of tooth
    (2) small anterior cingulum connected to protocone shelf by a small shelf
    (3) large anterior cingulum expanded further up to the protocone
116. *Stylar cusp B on M4
    (0) no stylar cusp B
    (1) small stylar cusp B
    (2) large stylar cusp B

117. Connection of stylart A and B on M4
    (0) no connection
    (1) crest connecting the two cusps
118. Direction of preparacrista of M4
    (0) preparacrista terminates stylar cusp A
    (1) preparacrista terminates at the anterior flank of stylar cusp B
119. Postparacrista of M4
    (0) postparacrista straight
    (1) postparacrista curves as a small centrocrista and ends just after the centrocrista
120. *Termination of postprotocrista on M4
    (0) postprotocrista ends anterior to the most posterior end of the postparacrista
    (1) postprotocrista ends level with the most posterior end of the postparacrista
    (2) postprotocrista ends posterior to the most posterior end of the postparacrista
121. *Metacone on M4
    (0) absent
    (1) small metacone raise above the postparacrista
    (2) large metacone expands the length of the tooth
122. Stylar cusp C/D on M4
    (0) absent
    (1) present
123. Presence of protocone on M4
    (0) present
    (1) absent
124. Anterior cingulid on m1
    (0) absent or small remnant
    (1) present
125. Hypoflexid on m1
    (0) absent
    (1) present
126. *Shape of trigonid on m1
    (0) paraconid-metaconid distance is longer than metaconid-protoconid distance
    (1) paraconid-metaconid distance is as long as metaconid-protoconid distance
    (2) paraconid-metaconid distance is shorter than metaconid-protoconid distance
    (3) paraconid highly reduced or absent
127. Position of paraconid on m1
    (0) paraconid anterior to metaconid
    (1) paraconid anterobuccal to metaconid
128. Shape of unworn entoconid on m1-3
    (0) oval
    (1) triangular (wider posteriorly than anteriorly)
    (2) conical
129. *Cristid obliqua termination on m1
    (0) cristid obliqua terminates buccal to level with the protocone

(1) cristid obliqua terminates lingual to the protocone to the midpoint to the tooth width
(2) cristid obliqua terminates lingual to the midpoint of the tooth width

130. Posthypocristid direction on m1
(0) oblique to the tooth row axis
(1) perpendicular to the tooth row axis

131. Connection of posthypocristid on m1
(0) posthypocristid connects to hypoconulid
(1) 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. Size of hypoconulid on m1
(0) large distinct cusp
(1) small cusp

133. *Shape of trigonid on m2
(0) paraconid-metaconid distance is longer than metaconid-protoconid distance
(1) paraconid-metaconid distance is as long as metaconid-protoconid distance
(2) paraconid-metaconid distance is shorter than metaconid-protoconid distance
(3) paraconid highly reduced or absent

134. *Cristid obliqua termination on m2
(0) cristid obliqua terminates buccal to the protocone
(1) cristid obliqua terminates lingual to the protocone about midpoint to the tooth width
(2) cristid obliqua terminates lingual to the midpoint of the tooth width

135. Posthypocristid direction on m2
(0) oblique to the tooth row axis
(1) perpendicular to the tooth row axis

136. Connection of posthypocristid on m2
(0) posthypocristid connects to hypoconulid
(1) posthypocristid connects to entoconid

137. *Size of hypoconulid on m2
(0) large distinct cusp
(1) small cusp
(2) hypoconulid absent

138. *Shape of trigonid on m3
(0) paraconid-metaconid distance is longer than metaconid-protoconid distance
(1) paraconid-metaconid distance is as longer as metaconid-protoconid distance
(2) paraconid-metaconid distance is shorter than metaconid-protoconid distance
(3) paraconid highly reduced or absent

139. *Cristid obliqua termination on m3
(0) cristid obliqua terminates buccal to the protocone

(1) cristid obliqua terminates lingual to the protocone about midpoint to the tooth width
(2) cristid obliqua terminates lingual to the midpoint of the tooth width

140. Posthypocristid direction on m3
(0) oblique to the tooth row axis
(1) perpendicular to the tooth row axis

141. Connection of posthypocristid on m3
(0) posthypocristid connects to hypoconulid
(1) posthypocristid connects to entoconid

142. *Size of hypoconulid on m3
(0) large distinct cusp
(1) small cusp
(2) hypoconulid absent

143. *Shape of trigonid on m4
(0) paraconid-metaconid distance is longer than metaconid-protoconid distance
(1) paraconid-metaconid distance is as longer as metaconid-protoconid distance
(2) paraconid-metaconid distance is shorter than metaconid-protoconid distance
(3) paraconid highly reduced or absent

144. Preentocristid on m4
(0) present
(1) absent

145. Preentocristid orientation on m4
(0) anteroposterior
(1) oblique

146. Postentocristid on m4
(0) absent
(1) present

147. Postentocristid orientation on m4
(0) anteroposterior
(1) oblique

148. Cristid obliqua termination on m4
(0) cristid obliqua terminates lingual to the protocone about midpoint to the tooth width
(1) cristid obliqua terminates lingual to the midpoint of the tooth width

149. *Posthypocristid direction on m4
(0) oblique to the tooth row axis
(1) perpendicular to the tooth row axis
(2) anteriorly oriented

150. *Size of entoconid
(0) large distinct cusp
(1) small cusp
(2) entoconid absent

151. *Size of hypoconulid on m4
(0) large distinct cusp
(1) small cusp

(2) hypoconulid absent

152. Buccal shelf on m4
(0) buccal shelf end at buccal side of hypoconid
(1) buccal shelf buccally reduced (hypoconid more buccal than shelf)

153. Presence of P3
(0) present
(1) absent

154. Presence of p3
(0) present
(1) absent

155. Presence of palatine fenestrae
(0) absent
(1) present

156. Presence of maxillary fenestrae
(0) absent
(1) present