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SUPPLEMENTARY INFORMATION

Cretaceous Eutherians and Laurasian Origin for Placental Mammals near K-T Boundary

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Part I. Full diagnosis for *Maelestes gobiensis* gen. et sp. nov.

Upper dentition: I?, C1, P5, M3. Lower dentition: i3, c1, p5, m3. No replacement teeth hidden in upper or lower jaws based on CT scanning. Upper incisors unknown and only part of upper canine alveolus preserved. P1 one root with one cusp. P2 two roots, larger than P1, crown broken. P3 smaller than P1, one root, crown broken. P4 three roots, tall, trenchant with one primary cusp (paracone) and lingual bulge (protocone). P5 three roots, molariform with one primary labial cusp (paracone), well-developed parastylar and metastylar lobes, protocone lower than paracone, and weak pre- and postcingulum. M1 much wider than long, narrow stylar shelf with parastylar lobe lingual to metastylar lobe and weak cusps A and B, metacone much lower than paracone but higher than narrow, procumbent protocone, metacone and paracone bases adjoined, paraconule and metaconule weak and nearer para- and metacone respectively, preparacingulum continuous between stylar margin and paraconule, postprotocrista does not extend labial to metacone, pre- and postcingulum but not extending labial to conules. M2 similar to M1 but with deeper ectoflexus and preparacingulum interrupted between stylar margin and paraconule. M3 without metastylar lobe, metacone relatively smaller than on M1 and M2, and pre- and postcingulum weaker than on M1 and M2. i1, i2, i3 subequal, procumbent, crowns broken with preserved tooth oval, roots closed and extend only to canine root. c1 large, still erupting with one open root. p1 one root, tiny, procumbent, peg-like. p2 two roots with primary cusp and small, unbasined heel with one cusp. p3 one root, larger than p1, crown broken. p4 with primary cusp, small, unbasined heel with one cusp, and nearly imperceptible anterior accessory cusp. p5 subequal in length to p4, with primary cusp, higher unbasined heel with one cusp, and nearly imperceptible anterior accessory cusp. m1 with anteroposteriorly compressed trigonid, protoconid lower than metaconid, protocristid transverse, paraconid anterolabial to metaconid and much lower, mesio-buccal cingular cuspule (f) with a distinct posteroventrally-directed shelf, talonid longer than trigonid but slightly narrower, cristid obliqua attaching at notch in protocristid, entoconid higher than hypoconid and connected to hypoconulid by high, nearly transverse crest. m2 similar to m1 but paraconid damaged, narrower talonid, cristid obliqua attaching lingual to notch in protocristid. m3 similar to m1 and m2 but narrower talonid, tall hypoconulid, more anterior entoconid not connected to hypoconulid by high crest.

Maelestes gobiensis differs from other Mongolian Djadokhta Formation eutherians - the asioryctitheres *Kennalestes* and *Asioryctes* (Kielan-Jaworowska, 1981), and *Ukhaatherium* (Novacek et al., 1997), and the zalambdalestids *Zalambdalestes* and *Barunlestes* (Kielan-Jaworowska and Trofimov, 1980, 1981; Kielan-Jaworowska, 1984a; Wible et al., 2004) - in having five upper and lower premolars, three subequal, procumbent lower incisors, a palatal vacuity between the maxilla and palatine, a postglenoid foramen behind the postglenoid process, a transpromontorial internal carotid artery, and a small prootic canal; differs from Central Asian Late Cretaceous

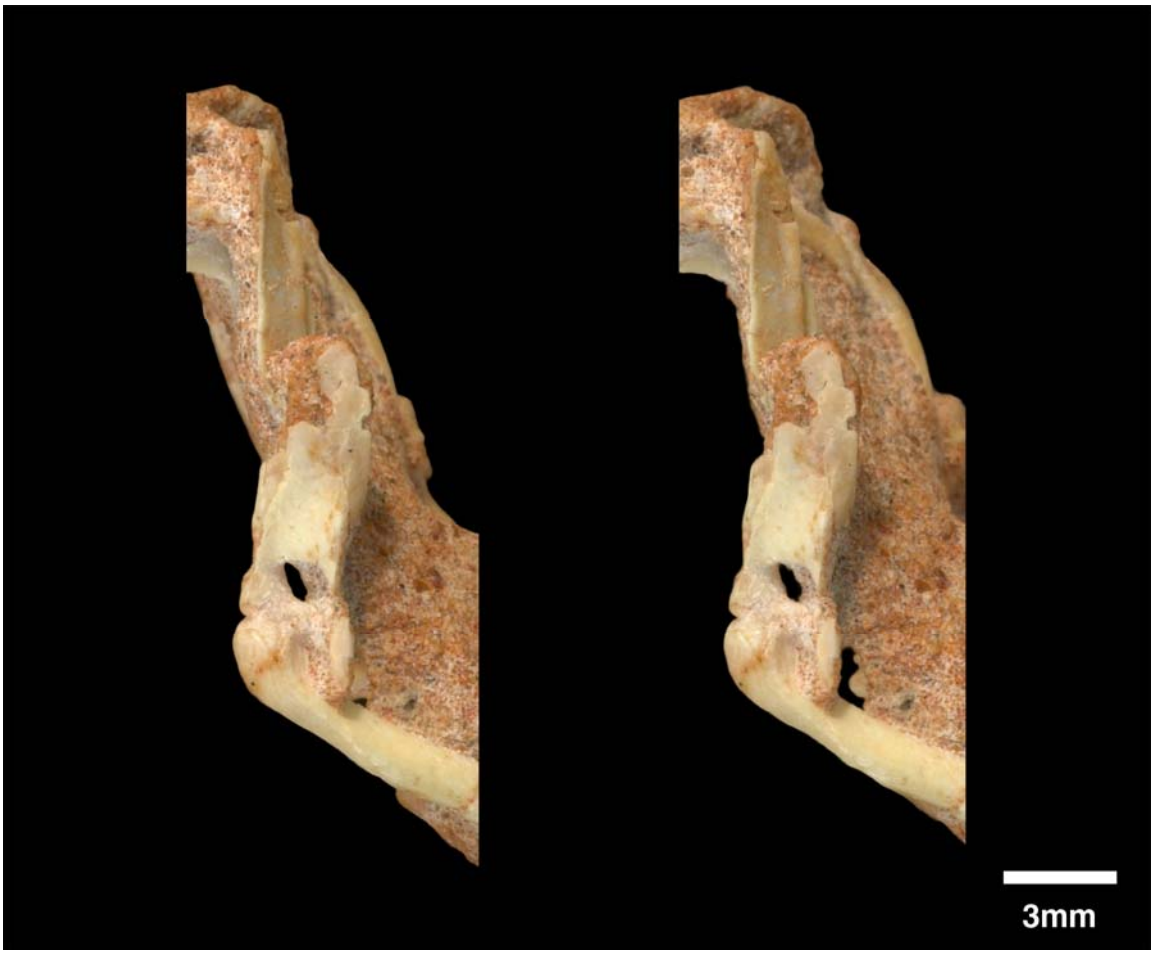
asioryctitheres *Bulaklestes*, *Daulestes*, and *Uchkudukodon* (Archibald and Averianov, 2006) in having five upper and lower premolars, single-rooted lower canine, penultimate upper premolar with three roots, upper molars much wider than long with narrower stylar shelves, and lower molars with protoconid subequal to metaconid; differs from Central Asian Late Cretaceous "zhelestids" – *Sheikhdzheilia* and *Eozhelestes* (Averianov and Archibald, 2005), *Aspanlestes*, *Zhelestes*, and *Parazhelestes* (Nessov et al., 1998; Archibald and Averianov, 2005) – and from North American and Central Asian Late Cretaceous *Paranyctoides* (Fox, 1979, 1984; Archibald and Averianov, 2001) in having upper molars with weak conules, metacone much smaller than paracone, and metacone and paracone with adjoined base, and lower molars with narrower talonids and no labial postcingulid; resembles North American Late Cretaceous cimolestids (Kielan-Jaworwoska et al., 2004) *Cimolestes* (Lillegraven, 1969; Clemens, 1973) and *Batodon* (Lillegraven, 1969; Clemens, 1973; Wood and Clemens, 2001) in having lower canine and first lower premolar single-rooted; resembles *Cimolestes* (Lillegraven, 1969) in having subequal procumbent lower incisors (two preserved in *C. propalaeoryctes*); resembles *Batodon* (Lillegraven, 1969; Clemens, 1973; Wood and Clemens, 2001) in having upper molars with narrow stylar shelves and pre- and postcingula, and lower molars with a transverse protocristid and entoconid approximating hypoconulid; and differs from *Cimolestes* (Lillegraven, 1969; Clemens, 1973) and *Batodon* (Lillegraven, 1969; Clemens, 1973; Wood and Clemens, 2001) in having five upper and lower premolars, upper molars with weak conules, and lower molars with more compressed trigonids and protoconid subequal to metaconid.

Part II. Additional Images of Maelestes

Supplementary Figure 1. *Maelestes gobiensis* PSS-MAE 607, stereophotograph of incomplete skull in ventral views. The palatine processes of the premaxillae are missing. On the left side of the mesocranium, matrix has been left to buttress the fragile entopterygoid process. The right ear region preserves part of the anterior crus of the ectotympanic.

Supplementary Figure 2. *Maelestes gobiensis* PSS-MAE 607, stereophotographs of the left lower jaw in labial and lingual views.

Supplementary Figure 3. *Maelestes gobiensis* PSS-MAE 607, stereophotograph of part of the main poscranial block showing on the left side of each pair the bodies of 12 thoracic vertebrae and several partial ribs, and on the bottom right of each pair part of the left clavicle and the proximal left ulna.



Supplementary Figure 4. *Maelestes gobiensis* PSS-MAE 607, stereophotograph of the broken left scapula and proximal humerus. Missing is the dorsal end of the supraspinous fossa, and the acromion and coracoid process are damaged. Matrix has not been removed from the ventral area of the infraspinous fossa to buttress the thin bone.

Supplementary Figure 5. *Maelestes gobiensis* PSS-MAE 607, stereophotograph of the nearly complete left humerus in anterior view. Distally, the lateral epicondyle and the capitulum are broken and preserved as an isolated piece (not shown) attached to the head and proximal body of the radius.

Part III. Character list

Following most character descriptions is an appropriate reference to a phylogenetic analysis that employed that character, with the number after the colon representing the character number used in the reference. A character number with an asterisk denotes some modification to the cited source for the character. The character state for *Maelestes* is provided for each entry; numbers refer to the character state; "?" and "–" are unknown and non-applicable respectively; "/" is either/or and "+" is and.

Dentition – General

1. Teeth (Asher et al., 2003: 94*) – present (0) or absent (1).
Maelestes (0).
Tamandua is the only taxon in the current matrix that completely lacks true teeth.

2. Teeth – differentiated into morphological types (incisors, canines, premolars, and molars) with enamel (0) or simple peg-like teeth without enamel (1).
Maelestes (0).
Chaetophractus, *Bradypus*, and *Orycteropus* have simple peg-like teeth without enamel. However, the Eocene armadillo *Utaetus* has enamel on some teeth (Simpson, 1932).

3. Number of postcanine tooth loci (Rougier et al., 1998: 7*) – eight or more (0), seven (1), six (2), or five or less (3).
Maelestes (0).

4. Upper diastema – small, between incisors and canine (0), small, between canine and premolars (1), enlarged (2), or absent (3).
Maelestes (0/3): diastema is absent between canine alveolus and first premolar, but the condition anterior to the canine is unknown.

5. Lower diastema behind incisors (Meng et al., 2003: 84) – absent or small (0) or enlarged (1).
Maelestes (0).

Dentition – Incisors

6. Incisor shape (Asher et al., 2005: 3) – root and crown are straight and continuous in length (0) or form a continuous curve (1).
Maelestes (0).

7. Number of upper incisors (Luo and Wible, 2005: 136*) – five (0), four (1), three (2), two (3), one (4), or none (5).
Maelestes (?).

8. Number of lower incisors (Luo and Wible, 2005: 135*) – four (0), three (1), two, anterior positions (2), one (3), or none or posterior position(s) only (4).
Maelestes (1).

9. Anteriormost upper incisor alveoli – approximating (0) or separated by a broad gap (1).
Maelestes (?).

10. Anteriormost upper incisor size (Meng et al., 2003: 10*) – small, subequal to subsequent (0), enlarged (1), or smaller than subsequent (2).
Maelestes (?).

11. Anteriormost upper incisor shape – conical (0), mediolaterally compressed (1), anteroposteriorly compressed (2), cuspate (one major and one minor) (3), or spatulate (4).
Maelestes (?).

12. Anteriormost upper incisor growth (Asher et al., 2005: 52*) – rooted (0), open rooted, in premaxilla only (1), or open rooted, extending into maxilla (2).
Maelestes (?).

13. Anteriormost upper incisor enamel (Asher et al., 2005: 49) – surrounds tooth (0) or discontinous posteriorly (1).
Maelestes (?).

14. Ultimate upper incisor – in premaxilla (0), between maxilla and premaxilla (1), or in maxilla (2).
Maelestes (?).

15. Anteriormost lower incisor size (Archibald et al., 2001: 28*) – small, subequal to subsequent incisors (0), greatly enlarged (1), or tiny, smaller than subsequent (2).
Maelestes (0).
Wible et al. (2004: 121) wrote: "Several authors have questioned the homologies of the enlarged lower incisors shared by *Zalambdalestes* and lagomorphs (and rodents). Both Luckett (1985) and Meng and Wyss (2001) have noted that the tooth in question in lagomorphs (and rodents) is the retained deciduous second incisor (Moss-Salentijn, 1978; Ooè, 1980; Luckett, 1985), whereas these authors scored the tooth in *Zalambdalestes* as the first incisor. The recent report of four lower incisors in [the zalambdalestid] *Kulbeckia* (Archibald et al., 2001; Archibald and Averianov, 2003) supports the latter interpretation. The primitive eutherian formula included four lower incisors (Rougier et al., 1998; Ji et al., 2002), the condition found in Early Cretaceous *Prokennalestes* (Sigogneau-Russell et al., 1992; personal obs.) and *Eomaia* (Ji et al., 2002) and in Late Cretaceous *Asioryctes* (Kielan-Jaworowska, 1975a) and *Ukhaatherium* (Novacek et al., 1997). *Zalambdalestes* (and *Barunlestes*) with a lower incisor count of three has lost one from the ancestral formula, but it is uncertain from which position. Consequently, the enlarged incisor in *Zalambdalestes* (and *Barunlestes*) could be either the first or second from the ancestral eutherian formula of four. However, *Kulbeckia* with four lower

incisors, with the enlarged one the first, supports that the enlarged tooth in *Zalambdalestes* (and *Barunlestes*) as [*sic*] the i1." Despite this, we choose here to make no *a priori* assumptions regarding the homologies of the anteriormost lower incisor and code all mesialmost incisors for this character (and for characters 16-20).

16. Anteriormost lower incisor shape - conical (0), mediolaterally compressed (1), anteroposteriorly compressed (2), cuspate (one major and one minor) (3) or spatulate (4).
Maelestes (?).

17. Procumbent anteriormost lower incisor (Archibald et al., 2001: 29) – absent (0) or present (1).
Maelestes (1).

18. Anteriormost lower incisor root (Asher et al., 2001: 32) – closed (0) or open (1).
Maelestes (0).

19. Anteriormost lower incisor root length (Archibald et al., 2001: 32*) – not extended posteriorly below p1 (0), extending posteriorly below p1 (1), extending posteriorly below penultimate or ultimate premolar (2), extending posteriorly below molars (3).
Maelestes (0).

20. Anteriormost lower incisor enamel (Archibald et al., 2001: 30) – covers the whole incisor (0) or discontinous posteriorly (1).
Maelestes (?).

21. Procumbent posterior lower incisor(s) – absent (0) or present (1).
Maelestes (1).

22. Staggered lower incisor (Rougier et al., 1998: 43) – absent (0) or present (1).
Maelestes (?).

Dentition – Canine

23. Upper canine (Meng et al., 2003: 23) – present, large (0), present, small (1), or absent (2).
Maelestes (0): based on the size of the alveolus.

24. Number of upper canine roots (Rougier et al., 1998: 10) – two (0) or one (1).
Maelestes (0/1).

25. Lower canine (Meng et al., 2003: 25) – present, large (0), present, small (1), or absent (2).
Maelestes (0).

26. Number of lower canine roots (Rougier et al., 1998: 44) – two (0) or one (1).
Maelestes (1).

27. Procumbent lower canine – absent (0) or present (1).
Maelestes (0).

28. Deciduous canine (Rougier et al., 1998: 65) – present (0) or absent (1).
Maelestes (?).

Dentition – Premolars

29. Number of premolars (Luo and Wible, 2005: 145) – five or more (0), four (1), three (2), or two (3).
Maelestes (0).
This character is a simple count of premolar number and does not assume homology of tooth position. Several subsequent characters, however, assume homology of premolar tooth position. Our basis for assigning homologies follows:
It is now generally accepted (e.g., Novacek, 1986b; Cifelli, 2000; Archibald et al., 2001) that the primitive premolar count in eutherians is five. Among Early Cretaceous eutherians, five upper and lower premolars occur in *Eomaia*, at 125 million years the oldest eutherian (Ji et al., 2003), and five lowers are known for *Prokennalestes* (Kielan-Jaworowska and Dashzeveg, 1989; Sigogneau-Russell et al., 1992) and *Bobolestes* (Averianov and Archibald, 2005). Among Late Cretaceous eutherians, five upper and lowers are known for *Zhelestes* and *Aspanlestes*, although not in association (Nessov et al., 1998; Archibald et al., 2001; Archibald, pers. comm.), and five lowers are known for *Paranyctoides* (Archibald and Averianov, 2001), *Eozhelestes* (Averianov and Archibald, 2005), *Parazhelestes* (Archibald et al., 2001; Archibald, pers. comm.), *Zhangolestes* (Zan et al., 2005), and some *Gypsonictops* (Lillegraven, 1969; Clemens, 1973; Fox, 1979) with the small middle tooth missing in some mandibles. In addition, five upper premolars occur in a juvenile *Kennalestes*, but not in the adult (Kielan-Jaworowska, 1981) with the middle one missing.
In the Late Cretaceous taxa with five premolar loci, the usual pattern is to have the middle one the smallest and the first the next smallest. Because of this and the lost middle tooth in *Gypsonictops* and *Kennalestes*, it is generally held (e.g., Luckett, 1993; Archibald et al., 2001) that eutherians with four premolars have lost the middle one of the ancestral five. We follow that model of reduction here. In taxa with five, we identify the teeth as P1, P2, P3, P4, P5 for the uppers and p1, p2, p3, p4, p5 for lowers. In taxa with four, we identify the teeth as P1, P2, P4, P5 and p1, p2, p4, p5.
Because the first premolar of five is the next smallest and is usually the smallest in eutherians with four, we follow that model of reduction, i.e., the loss of the first, for most eutherians with three, identifying the teeth as P2, P4, P5 and p2, p4, p5. However, within zalambdalestids, the p2 is lost in *Barunlestes* and some *Zalambdalestes*, whereas the p1 is retained (Kielan-Jaworowska, 1975b; Wible et al., 2004).

The metatherians scored in our analysis, and nearly all metatherians, have three premolars and four molars. Reconciling this formula with the five premolars and three molars of Cretaceous eutherians is problematic, especially because deciduous dentitions are not known for the vast majority of fossils (Luckett, 1993). A possible transitional form from the Early Cretaceous with four upper premolars and three lowers, *Sinodelphys*, has been described (Luo et al., 2003), but the specimen was not available to us for study. Until we have the opportunity to study that form with regards to the homologies of postcanine loci, we have not attempted to homologize the metatherian and eutherian postcanine dentitions.

30. Replacement of dP1/dp1 and dP2/dp2 (Rougier et al., 1998: 66) – present (0) or absent (1).
Maelestes (?).

31. Tall, trenchant premolar (Rougier et al., 1998: 3) – ultimate premolar (0), penultimate premolar (1), or absent (2). [Upper dentition considered when possible]
Maelestes (1).

32. Procumbent first upper premolar (Luo and Wible, 2005: 151*) – absent (0) or present (1).
Maelestes (0).

33. First upper premolar roots – two (0), one (1), or three (2).
Maelestes (1).

34. Diastema posterior to first upper premolar (Luo and Wible, 2005: 43) – absent (0) or present (1).
Maelestes (0).

35. Third upper premolar roots (only scored for taxa with five upper premolars) – two (0) or one (1).
Maelestes (1).

36. Penultimate upper premolar protocone (Rougier et al., 1998: 12) – absent (0), small lingual bulge (1), or with an enlarged basin (2).
Maelestes (1).

37. Penultimate upper premolar metacone – absent (0), swelling (1), or large (2).
Maelestes (0).

38. Penultimate upper premolar parastylar lobe – absent or small (0) or well developed (1).
Maelestes (0).

39. Penultimate upper premolar roots (Rougier et al., 1998: 13*) – two (0), three (1), one (2), or four (3).
Maelestes (1).

40. Ultimate upper premolar protocone (Rougier et al., 1998: 14*) – absent or narrow cingulum (0), shorter than paracone (1), or approaches paracone in height (2).
Maelestes (1).

41. Ultimate upper premolar metacone (Luo and Wible, 2005: 39) – absent (0), swelling (1), or large (2).
Maelestes (0).

42. Ultimate upper premolar para- and metastylar lobes – absent or insignificant (0), subequal (1), parastylar lobe larger (2), or metastylar lobe larger (3).
Maelestes (2).

43. Ultimate upper premolar precingulum – absent (0) or present (1).
Maelestes (1).

44. Ultimate upper premolar postcingulum – absent (0), present, lower than protocone (1), or present, level with protocone (2).
Maelestes (1).

45. Ultimate upper premolar conules – weak or absent (0) or prominent (1).
Maelestes (0).

46. Ultimate upper premolar size (occlusal surface) relative to first upper molar (Meng et al., 2003: 41) – smaller or subequal (0) or larger (1).
Maelestes (0).

47. First lower premolar orientation (Rougier et al., 1998: 45) – in line with jaw axis (0) or oblique (1).
Maelestes (0).

48. First lower premolar roots – two (0) or one (1).
Maelestes (1).

49. Diastema separating first and second lower premolars (Luo and Wible, 2005: 152*) – absent (gap less than one tooth root for whichever is smaller of adjacent teeth) (0) or present, subequal to one tooth-root diameter or more (1).
Maelestes (1).

50. Third lower premolar size to second (only scored for taxa with five lower premolars) – longer (0) or shorter (1).
Maelestes (1).

51. Third lower premolar roots (only scored for taxa with five lower premolars) – two (0) or one (1).
Maelestes (1).

52. Penultimate lower premolar paraconid (Luo and Wible, 2005: 52) – indistinctive or absent (0) or present and distinctive (1).
Maelestes (0).

53. Penultimate lower premolar metaconid – absent (0), swelling (1), or separate from protoconid (2).
Maelestes (0).

54. Penultimate lower premolar talonid cusps – one (0), two (1), or three (2).
Maelestes (0).

55. Ultimate lower premolar paraconid (Luo and Wible, 2005: 45) – indistinctive or absent (0), distinctive but low (1), or distinctive and high (2).
Maelestes (0).

56. Ultimate lower premolar metaconid – absent (0), swelling (1), or large (2).
Maelestes (0).

57. Ultimate lower premolar talonid (Archibald and Averianov, 2006: 25) – narrower than anterior portion of crown (0) or as wide as anterior portion of crown (1).
Maelestes (0).

58. Ultimate lower premolar talonid cusps – one (0), two (1), or three (2).
Maelestes (0).

59. Length of ultimate lower premolar to penultimate (Archibald and Averianov, 2006: 24) – longer (0) or equal to or less (1).
Maelestes (1).

60. Ultimate lower premolar anterolingual cingulid – absent (0) or present (1).
Maelestes (0).

Dentition – Molars

Unless noted in the character description, molar features are scored for the penultimate molar when available.

61. Number of molars (Rougier et al., 1998: 4*) – four or more (0), three (1), or two (2).
Maelestes (1).

62. Size of molar series (Rougier et al., 1998: 6*) – subequal (0), posterior increase (1), or posterior decrease (1). [All molars considered in lower jaw, and all but the last considered in upper jaw]
Maelestes (0).

63. Molar cusp form (Rougier et al., 1998: 5*) – sharp, gracile (0), inflated, robust (1), or crest-like (2).
Maelestes (0).

64. Upper molar shape (Rougier et al., 1998: 15*) – as long as wide, or longer (0), wider than long (length more than 75% but less than 99% of width) (1), or much wider than long (length less than 75% of width) (2).
Maelestes (2).

65. Size (labiolingual width) of upper molar labial stylar shelf at maximum – 50% or more of total transverse width (0), less than 50% but more than 25% (1), less than 25% (2), or absent (3).
Maelestes (2).

66. Labial extent of parastylar and metastylar lobes (Archibald and Averianov, 2006: 8*) – parastylar lobe more labial (0), subequal (1), metastylar lobe more labial (2), or lobes absent (3).
Maelestes (2).

67. M1 parastylar lobe relative to paracone (Archibald and Averianov, 2006: 7) – parastylar lobe is anterolabial to paracone (0) or parastylar lobe is anterior to paracone (1). [Taxa scored with lobes absent on character 66 are scored inapplicable here.]
Maelestes (1).

68. Length of parastylar lobe (measured to stylocone or stylocone position) relative to total length on penultimate molar – more than 30% (0), less than 30% but more than 20% (1), or 20% or less (2).
Maelestes (0).

69. Preparastyle (Rougier et al., 1998: 21) – absent (0) or present (1).
Maelestes (0).

70. Stylar cusp A (Rougier et al., 1998: 20*) – subequal to larger than B (0), distinct, but smaller than B (1), or vestigial to absent (2).
Maelestes (2).

71. Stylar cusp B relative to paracone (Rougier et al., 1998: 22) – smaller but distinctive (0), vestigial to absent (1), or subequal (2).
Maelestes (1).

72. Stylar cusp C, mesostyle (Rougier et al., 1998: 23) – absent (0) or present (1).
Maelestes (0).

73. Stylar cusp D (Rougier et al., 1998: 24) – absent (0), smaller or subequal to B (1), or larger than B (2).
Maelestes (0).

74. Stylar cusp E (Rougier et al., 1998: 25) – directly lingual to D or D-position (0), distal to D (1), or small to indistinct (2).
Maelestes (2).

75. Preparacingulum (Rougier et al., 1998: 26*) – absent (0), interrupted between stylar margin and paraconule or paraconule position (1), or continuous (2).
Maelestes (1).

76. Deep ectoflexus (Rougier et al., 1998: 19) – present only on penultimate molar (0), on penultimate and preceding molars (1), or strongly reduced or absent (2).
Maelestes (0).

77. Metacone size relative to paracone (Rougier et al., 1998: 27*) – noticeably smaller (0), slightly smaller (1), subequal or larger (2), or absent or merged with paracone.
Maelestes (0).

78. Metacone position relative to paracone (Rougier et al., 1998: 28) – labial (0), approximately at same level (1), or lingual (2).
Maelestes (1).

79. Metacone and paracone bases (Rougier et al., 1998: 30) – adjoined (0) or separated (1).
Maelestes (0).

80. Preparacrista – strong, from side of paracone to stylocone (0) or weak, from base of paracone, or absent (1).
Maelestes (1).

81. Cuspate preparacrista – present (0) or absent (1).
Maelestes (1).

82. Centrocrista (Rougier et al., 1998: 31*) – straight (0), V-shaped (1), or absent (2).
Maelestes (0).

83. Postmetacrista (Luo and Wible, 2005: 118*) – prominent, from side of metacone to metastyle (0), salient (1), or weak, from base of metacone, or absent (2).

Maelestes (0).

84. Cuspate postmetacrista – present (0) or absent (1).
Maelestes (1).

85. Preprotocrista (Rougier et al., 1998: 33*) – does not (0), does (1) extend labially passed base of paracone (double rank prevallum/postvallid shearing), or absent (2).
Maelestes (0).

86. Postprotocrista – extends to mid-lingual surface of metacone (0), extends distal to metacone (1), or absent (2).
Maelestes (1).

87. Development of postvallum shear (Luo and Wible, 2005: 57*) - present but only by the first rank: postmetacrista (0), present, with the addition of a second rank (postprotocrista below postmetacrista) but the second rank does not reach labially below the base of the metacone (1), present, with second rank extending to metastylar lobe: metacingulum (2), or absent (3).
Maelestes (1).

88. Paraconule – weak or absent (0), prominent, closer to protocone (1), or prominent, midway or closer to paracone (2).
Maelestes (0).

89. Metaconule – weak or absent (0), prominent, closer to protocone (1), or prominent, midway or closer to metacone (2).
Maelestes (0).

90. Internal conular cristae (Luo and Wible, 2005: 107) – indistinct (0) or distinctive and wing-like (1). [Taxa without prominent conules are scored inapplicable.]
Maelestes (-).

91. Anteroposterior width of conular region (with or without conules) (Luo and Wible, 2005: 104) – narrow (anteroposterior distance less than 0.30 of total tooth length) (0), moderate development (distance = 0.31–0.50 of total tooth length) (1), or wide (distance greater than 0.51 of total tooth length) (2).
Maelestes (1).

92. Protocone (Rougier et al., 1998: 36*) – lacking (0), small, without trigon basin (1), or with distinct trigon basin (2).
Maelestes (2).

93. Protocone antero-posterior expansion (Archibald et al., 2001: 23*) – none, subequal to paracone (0) or expanded, larger than paracone (1).

Maelestes (0).

94. Protocone procumbency (Rougier et al., 1998: 37) – absent (0) or present (1).
Maelestes (1).

95. Degree of labial shift of protocone (distance from protocone apex to lingual border vs. total tooth width, in %) (Luo and Wible, 2005: 97*) – no labial shift (10%-20%) (0), moderate labial shift (21%-30%) (1), or substantial labial shift (≥ 31%) (2).
Maelestes (0).

96. Protocone height (Rougier et al., 1998: 38*) – low (0), tall, approaching paracone and metacone (1), or subequal (2).
Maelestes (0).

97. Precingulum – absent or weak (0), present (1), or present, reaching labially passed the paraconule or paraconule position (2).
Maelestes (1).

98. Postcingulum (Luo and Wible, 2005: 58*) – absent or weak (0), present, lingual to metaconule or metaconule position (1), present, reaching labially passed metaconule or metaconule position (2), or present, extending to labial margin (3).
Maelestes (1).

99. Hypocone on postcingulum – absent (0), present, lower than protocone (1), or present, subequal to protocone (2).
Maelestes (0).

100. Pre- and postcingulum – separated (0) or continuous lingually (1).
[Taxa without pre- and postcingulum are scored inapplicable.]
Maelestes (0).

101. Number of roots – three (0), four (1), or more (2).
Maelestes (0).

102. Number of roots on ultimate molar – three (0), two (1), one (2), or four or more (3).
Maelestes (0).

103. Lingual root position on upper molars (Rougier et al., 1998: 40) – supporting paracone (0) or supporting trigon (1).
Maelestes (1).

104. Ultimate upper molar width relative to penultimate molar (Rougier et al., 1998: 41) – subequal (0) or smaller (1).

Maelestes (0).

105. Metastylar lobe on ultimate molar – absent (0) or present (1).
Maelestes (0).

106. Paraconid (Meng et al., 2003: 77*) – present (0) or absent (1).
Maelestes (0).

107. Paraconid height relative to metaconid (Rougier et al., 1998: 60) – shorter (0), subequal (1), or taller (2).
Maelestes (0).

108. Paraconid on lingual margin (Luo and Wible, 2005: 89*) – absent (0) or present (1).
Maelestes (0).

109. Mesiolingual vertical crest of paraconid (Luo and Wible, 2005: 77) – rounded (0) or keeled (1).
Maelestes (0).

110. Paracristid – notched (0) or continuous curve without notch (1).
Maelestes (0).

111. Trigonid configuration (Rougier et al., 1998: 48*) – open, with paraconid anteromedial, paracristid-protocristid angle more than 50° (0), more acute, with paraconid more posteriorly placed, paracristid-protocristid angle between 36 and 49° (1), or anteroposteriorly compressed, paracristid-protocristid angle 35° or less (2). [Taxa lacking a paraconid are scored inapplicable.]
Maelestes (2).

112. Protoconid height (Rougier et al., 1998: 59*) – tallest cusp on trigonid (0), subequal to para- and/or metaconid (1), or smaller than para- and/or metaconid (2).
Maelestes (1).

113. Protocristid orientation (Rougier et al., 1998: 57*) – oblique (0) or transverse (1).
Maelestes (1).

114. Anterior and labial (mesio-buccal) cingular cuspule (f) (Luo and Wible, 2005: 67*) – present (0), present with a distinct cingular shelf posteroventrally directed from it (1), present with shelf continuing along buccal border (2), or absent (3).
Maelestes (1).

115. Talonid (Rougier et al., 1998: 49) – small heel (0) or multicusped basin (1).

Maelestes (1).

116. Cristid obliqua (Rougier et al., 1998: 51*) – incomplete, with distal metacristid present (0), complete, attaching lingual to notch in protocristid (1), complete, attaching labial to notch in protocristid (2), complete, attaching below middle posterior of protoconid (3), or complete, labially placed (4).
Maelestes (1).

117. Trigonid height relative to talonid height (Archibald and Averianov, 2006: 28*) – twice or more (0), less than twice (1), or subequal (2).
Maelestes (0).

118. Anteroposterior shortening at base of trigonid relative to talonid (Luo and Wible, 2005: 78) – trigonid long (more than 75% of tooth length) (0), some shortening (50-75% of tooth length) (1), or anteroposterior compression of trigonid (less than 50% of tooth length) (2).
Maelestes (2).

119. Talonid width relative to trigonid (Rougier et al., 1998: 50) – very narrow, subequal to base of metaconid (0), narrower (1), or subequal to wider (2).
Maelestes (1).

120. Hypoconulid (Rougier et al., 1998: 52*) – absent (0), in posteromedial position (near the mid-point of transverse talonid width (1), lingually placed with slight approximation to entoconid (2), or close approximation to entoconid (3).
Maelestes (2).

121. Hypoconulid of ultimate molar (Rougier et al., 1998: 53*) – short and erect (0), tall and sharply recurved (1), posteriorly procumbent (2), or absent (3).
Maelestes (1).

122. Entoconid (Rougier et al., 1998: 54) – absent (0), smaller than (1), or subequal to larger than hypoconid and/or hypoconulid (2).
Maelestes (2).

123. Postcristid (between entoconid and hypoconulid) taller than hypoconulid and nearly transverse – absent (0) or present (1).
Maelestes (1).

124. Mesoconid (Meng et al., 2003: 79) – absent (0) or present (1).
Maelestes (0).

125. Hypolophid (Meng et al., 2003: 82) – absent (0) or present (1).
Maelestes (0).

126. Labial postcingulid (Rougier et al., 1998: 55) – absent (0) or present (1).

Maelestes (0).

127. Ultimate lower molar size relative to penultimate lower molar (Rougier et al., 1998: 61) – subequal or larger (0) or smaller (1).
Maelestes (0).

Mandible

128. Number of mental foramina (Meng et al., 2003: 87) – two or more (0) or one (1).
Maelestes (0).

129. Anteriormost mental foramen (Archibald et al., 2001: 58*) – below incisors (or anteriormost mandible) (0), below p1 (1), below p2 (2), or more posterior (3).
Maelestes (2).

130. Posteriormost mental foramen (Luo and Wible, 2005: 25*) – in canine and anterior premolar (premolariform) region (in saddle behind canine eminence of mandible) (0), below penultimate premolar (under anterior end of functional postcanine row) (1), below ultimate premolar (2), or at ultimate premolar and first molar junction or more posterior (3). [Taxa with only one mental foramen are scored inapplicable]
Maelestes (3).

131. Depth of mandibular body (Meng et al., 2003: 86) – slender and long (0) or deep and short (1).
Maelestes (0).

132. Space between ultimate molar and coronoid process – absent (0) or present (1).
Maelestes (1).

133. Coronoid process height – higher than condyle (0) or even with condyle (1).
Maelestes (0).

134. Coronoid process width – broad, roughly two molar lengths (0), narrow, subequal to or less than one molar length (1).
Maelestes (0).

135. Tilting of coronoid process (measured as angle between anterior border of coronoid process and horizontal alveolar line of all molars) (Luo and Wible, 2005: 32) – strongly reclined and angle obtuse ($\geq 150^{o}$) (0), less reclined (135^{o}-145^{o}) (1), less than vertical (110^{o}-125^{o}) (2), near vertical (95^{o} to 105^{o}) (3), or tilted anteriorly (4).
Maelestes (2).

136. Coronoid crest (Luo and Wible, 2005: 21*) – absent or weakly developed (0) or present and laterally flaring (1).
Maelestes (0).

137. Ventral border of masseteric fossa (Luo and Wible, 2005: 20*) – absent (0), present as a low and broad crest (more than half the height of mandibular ramus) (1), or present as a well-defined and thin crest (less than half the height of the mandibular ramus) (2).
Maelestes (2).

138. Anteroventral extension of masseteric fossa (Luo and Wible, 2005: 22*) – absent (0) or extending anteriorly onto mandibular body (1).
Maelestes (0).

139. Labial mandibular foramen (Rougier et al., 1998: 70) – absent (0) or present (1).
Maelestes (1).

140. Condyloid crest – absent (0) or present (1).
Maelestes (1).

141. Posterior shelf of masseteric fossa (Rougier et al., 1998: 68) – absent (0) or present (1).
Maelestes (0).

142. Angular process – process on posterior aspect of mandibular ramus (0) or shelf along ventral border of mandibular ramus (1).
Maelestes (0).

143. Angular process orientation (Rougier et al., 1998: 73*) – posteriorly directed (0), medially inflected (1), posteroventrally directed (2), or posterodorsally directed (3).
Maelestes (2).

144. Angular process length – less than mandibular ramus length (0) or equal or greater than mandibular ramus length (1).
Maelestes (0).

145. Angular process shape – tapers, base wider than tip (0) or rounded, base as wide as tip (1).
Maelestes (0).

146. Angular process vertical position (Luo and Wible, 2005: 9) – at posteroventral border of mandible (0) or posterodorsal, at or near the alveolar border (1).
Maelestes (0).

147. Root of angular process relative to condylar process (Luo and Wible, 2005: 8*) – level with or posterior to (0) or anterior to (1).
Maelestes (0).

148. Condylar process – with posteriorly directed peduncle (0) or not (1).
Maelestes (1).

149. Condyle shape (Rougier et al., 1998: 71*) – ovoid (0), cylindrical (1), or anteroposteriorly elongate (2).
Maelestes (0).

150. Condyle position relative to tooth row (Luo and Wible, 2005: 31*) – at about same level (0), slightly above (1), or above by more than molar length (2).
Maelestes (2).

151. Mandibular symphysis shape (Meng et al., 2003: 86) – tapered (0) or deep (1).
Maelestes (0).

152. Mandibular symphysis posterior extent – p1 or more anterior (0), p2 (1), or p3 or more posterior (2).
Maelestes (0).

153. Mandibular symphysis (Luo and Wible, 2005: 36) – mobile (0) or fused (1).
Maelestes (0).

154. "Meckelian" groove (Rougier et al., 1998: 75) – present (0) or absent (1).
Maelestes (1).

155. Curvature of "Meckelian" groove (under tooth row) (applicable only to taxa with "Meckelian" groove) (Luo and Wible, 2005: 5) – parallel to (0) or convergent on ventral border of mandible (1).
Maelestes (-).

156. "Coronoid" facet (Rougier et al., 1998: 76) – present (0) or absent (1).
Maelestes (1).

157. Vertical position of mandibular foramen – anteriorly placed, near back of dentition (0), near ventral margin, at root of angle (1), recessed dorsally from ventral margin, but below alveolar plane (2), or recessed dorsally from ventral margin, at or above alveolar plane (3).
Maelestes (?).

158. Mandibular foramen dorsal to prominent longitudinal ridge – present (0) or absent (1).

Maelestes (?).

Skull – Rostrum

159. Septomaxilla (Rougier et al., 1998: 78) – present (0) or absent (1).
Maelestes (?).

160. Premaxilla, facial process dorsal extent (Rougier et al., 1998: 80) – does not (0) or does reach nasal (1).
Maelestes (1).

161. Premaxilla, facial process posterior extent (Luo and Wible, 2005: 406) – does not extend beyond canine (0), extends beyond canine but does not contact frontal (1), or extends beyond canine and contacts frontal (2).
Maelestes (1).

162. Premaxilla, facial process with distinct finger-like posterodorsal process – present (0) or absent (1).
Maelestes (0).

163. Lateral margin of paracanine fossa (Rougier et al., 1998: 81) – formed by maxilla (0) or maxilla and premaxilla (1).
Maelestes (0).

164. Exit(s) of infraorbital canal (Rougier et al., 1998: 82*) – multiple (0), single (1), or canal absent (2).
Maelestes (1).

165. Infraorbital foramen position (Geisler, 2001: 65*) – dorsal to ultimate premolar (0), to penultimate premolar or more anterior (1), or to first molar or more posterior (2). [Taxa without an infraorbital canal are scored inapplicable.]
Maelestes (1).

166. Infraorbital canal length (Asher et al., 2005: 95*) – long (more than one molar length) (0) or short (less than one molar length (1). [Taxa without an infraorbital canal are scored inapplicable.]
Maelestes (0).

167. Flaring of cheeks behind infraorbital foramen, as seen in ventral view (Rougier et al., 1998: 83) – present (0) or absent (1).
Maelestes (0).

168. Nasal (Asher et al., 2005: 110*) – widest posteriorly (0), sides sub-parallel (1), or widest anteriorly (2).
Maelestes (?).

169. Nasal overhangs external nasal aperture – present (0) or absent (1).
Maelestes (?).

170. Naso-frontal suture with medial process of frontals wedged between nasals (Rougier et al., 1998: 84) – present (0) or absent (1).
Maelestes (0).

171. Naso-frontal suture position (Geisler, 2001: 67*) – posterior to or even with (0) or anterior to anterior orbital rim (1).
Maelestes (0).

172. Nasal foramina (Rougier et al., 1998: 85) – present (0) or absent (1).
Maelestes (?).

173. Frontal-maxillary contact on rostrum (Rougier et al., 1998: 86) – absent (0) or present (1).
Maelestes (?).

174. Maxillary process of frontal (anterior projection of frontal) (Asher et al., 2005: 109*) – weak or absent (0) or elongate and thin (1).
Maelestes (?).

175. Preorbital length relative to postorbital (Rougier et al., 1998: 90*) – less than one third total length (0) or more than one third (1).
Maelestes (1).

176. Lacrimal (Asher et al., 2005: 103) – present (0) or absent (1).
Maelestes (0).

177. Facial process of lacrimal (Asher et al., 2005: 105) – large, triangular and pointed anteriorly (0) or small, rectangular or crescentic (1). [Taxa without lacrimal are scored inapplicable.]
Maelestes (?).

178. Lacrimal tubercle (Rougier et al., 1998: 87) – present (0) or absent (1). [Taxa without lacrimal scored are inapplicable.]
Maelestes (?).

179. Lacrimal foramen exposed on face (Rougier et al., 1998: 88) – present (0) or absent (1).
Maelestes (1).

180. Lacrimal foramen number (Rougier et al., 1998: 89) – two (0) or one (1).
Maelestes (0).

181. Lacrimal foramen within lacrimal (Asher et al., 2003: 100*) – present (0) or absent, with maxillary contribution (1), or absent, with jugal contribution (2).
Maelestes (0).

182. Translacrimal canal – absent (0) or present (1). [Taxa without lacrimal are scored inapplicable.]
Maelestes (0).

Skull – Palate

183. Premaxilla, palatal process (Rougier et al., 1998: 79) – does not (0) or does reach nearly or to canine alveolus (1).
Maelestes (?).

184. Premaxillary-maxillary suture on palate – transverse (0), wedge-shaped, pointing anteriorly (1), or wedge-shaped, pointing posteriorly (2).
Maelestes (?).

185. Incisive foramina (Luo and Wible, 2005: 409) – small, length of 1 or 2 incisors (0), intermediate, length of 3 or 4 incisors (1), or elongate, more than half the palate length (2).
Maelestes (?).

186. Incisive foramina composition – between premaxilla and maxilla (0) or within premaxilla (1).
Maelestes (?).

187. Palatal vacuities (Rougier et al., 1998: 93) – absent (0) or present (1).
Maelestes (1).

188. Major palatine foramen – within palatine (0), between palatine and maxilla (1), within maxilla (2), multiple small foramina (3), or absent (4).
Maelestes (1).

189. Anterior extent of palatine on palate (Wible et al., 2005: 55*) – to level of first molar (0), more posterior (1), or more anterior (2).
Maelestes (0).

190. Palatal expansion with regard to ultimate molar (Rougier et al., 1998: 94*) – even with (0), posterior (1), or anterior (2).
Maelestes (2).

191. Postpalatine torus (Rougier et al., 1998: 95) – absent (0) or present (1).
Maelestes (1).

192. Posterior nasal spine – weak or absent (0) or prominent (1).
Maelestes (0).

193. Minor palatine foramen (Rougier et al., 1998: 97*) – small (0), large, with thin, posterior bony bridge (1), multiple small foramina (2), or absent (3).
Maelestes (1).

194. Minor palatine foramen composition – palatine or maxilla-palatine (0) or palatine-pterygoid (1).
Maelestes (1).

195. Maxilla with large shelf-like expansion posterior to ultimate molar – absent (0) or present (1).
Maelestes (0).

Skull – Zygoma

196. Posterior edge of anterior zygomatic root (Meng et al., 2003: 123*) – aligned with last molar (0), with anterior molars (1), or with premolars (2).
Maelestes (0).

197. Zygomatic process of maxilla – present (0) or vestigial (1).
Maelestes (1).
Most therians have a large zygomatic process of the maxilla that forms the ventral part of the anterior zygoma root, with the jugal forming the dorsal part. In a few forms considered here, including *Maelestes*, the zygomatic process of the maxilla is insignificant and the jugal forms the bulk of the anterior zygoma root or the anterior zygoma root is absent.

198. Jugal – present (0) or absent (1).
Maelestes (0).

199. Jugal (Wible et al., 2005: 58*) – contributes to anteroventral orbit and zygoma (0) or contributes to zygoma (1). [Taxa without jugal are scored inapplicable.]
Maelestes (0).

200. Maxillary-jugal contact bifurcated (Rougier et al., 1998: 91) – absent (0) or present (1).
Maelestes (0). [Taxa without jugal are scored inapplicable.]

201. Jugal-lacrimal contact (Meng et al., 2003: 137) – present (0) or absent (1).
Maelestes (0). [Taxa without jugal and/or lacrimal are scored inapplicable.]

202. Zygomatic arch (Rougier et al., 1998: 92*) – stout (0), delicate (1), or incomplete (2).
Maelestes (1).

Skull – Orbit

203. Roots of molars exposed in orbit floor (Asher et al., 2005: 126) – absent (0) or present (1).
Maelestes (1).
Because the derived state is present in some recent forms (e.g., *Solenodon*) and is not artifactual, we consider the occurrence of similar openings in fossils to be real.

204. Palatine reaches infraorbital canal (Rougier et al., 1998: 98) – present (0) or absent (1).
Maelestes (1).

205. Lacrimal contributes to maxillary foramen (Luo and Wible, 2005: 376*) – present (0) or absent (1). [Taxa without lacrimal are scored inapplicable.]
Maelestes (0).

206. Groove connects maxillary and sphenopalatine foramina (Asher et al., 2005: 97*) – absent (0) or present (1).
Maelestes (1).

207. Sphenopalatine foramen (Asher et al., 2005: 133*) – within palatine (0), between palatine and maxilla (1), between palatine, maxilla, and frontal (2), or within maxilla (3).
Maelestes (1).

208. Sphenopalatine foramen proximal to maxillary foramen – absent (0) or present (1).
Maelestes (0).

209. Maxilla excluded from medial orbital wall – present (0) or absent (1).
Maelestes (0).

210. Frontal and maxilla contact in medial orbital wall (Geisler, 2001: 52) – absent (0) or present (1).
Maelestes (0).

211. Orbital process of palatine (Asher et al., 2005: 127*) – present (0) or absent or with thin sliver in ventromedial wall of orbit (1).
Maelestes (0).

212. Ethmoid exposure in medial orbital wall – absent (0) or present (1).
Maelestes (0).

213. Ethmoid foramen – between frontal and orbitosphenoid (0) or within frontal (1).
Maelestes (0).

214. Foramen for frontal diploic vein – absent (0) or present (1).
Maelestes (1).

215. Frontal foramen on skull roof (Thewissen et al., 2001: 41) – absent (0) or present (1).
Maelestes (?).

216. Postorbital process (Meng et al., 2003: 145*) – present, prominent (0), present, weak (1), or absent (2).
Maelestes (0/1): the base of the postorbital process is preserved, but the size is unknown.

217. Postorbital process composition (Wible et al., 2005: 67*) – frontal (0) or parietal (1).

Maelestes (0).

218. Postorbital bar (Meng et al., 2003: 145*) – absent (0) or present (1).
Maelestes (0).

219. Dorsal process of jugal (Meng et al., 2003: 142*) – weak or absent (0) or strong (1).
Maelestes (0).

220. Optic foramen (Rougier et al., 1998: 102) – absent (0) or present (1).
Maelestes (?).

221. Optic foramen position – narrowly (0) or broadly (1) separated from sphenorbital fissure, or not visible in lateral view (2). [Taxa without optic foramen are scored inapplicable.]
Maelestes (?).

222. Orbitosphenoid – expanded anteriorly from optic foramen (or with anterior process for forms without optic foramen) (0), expanded dorsally from optic foramen (or with dorsal process for forms without optic foramen) (1), or not expanded anteriorly or dorsally (2).
Maelestes (?).

223. Suboptic foramen – absent (0) or present (1).
Maelestes (?).

224. Orbitotemporal canal (Rougier et al., 1998: 103) – present (0) or absent (1).
Maelestes (0).

225. Frontal/alisphenoid contact (Luo and Wible, 2005: 382) – dorsal plate of the alisphenoid contacting frontal at anterior corner (0), with more extensive contact with frontal (~50% of its dorsal border) (1), or absent (2).
Maelestes (?).

Skull – Braincase

226. Frontal length on midline – subequal to slightly smaller than parietal (0), less than half that of parietal (1), or more than 50% longer than parietal (2).
Maelestes (1).

227. Frontoparietal suture – transverse (0), with anterior process of parietal off the midline (1), or with anterior process of parietal on the midline (2).
Maelestes (1).

228. Temporal lines meet on midline to form sagittal crest (Geisler, 2001: 33*) – present (0) or absent (1).
Maelestes (?).

229. Interparietal (Rougier et al., 1998: 155) – absent (0) or present (1).
Maelestes (?).

230. Nuchal crest – level with or anterior to foramen magnum (0) or posterior to foramen magnum (1).
Maelestes (?).

231. Anterior lamina exposure on lateral braincase wall (Rougier et al., 1998: 108*) – present (0) or absent (1).
Maelestes (1).

232. Squama of squamosal (Rougier et al., 1998: 113) – absent (0) or present (1).
Maelestes (1).

233. Foramina for temporal rami (Rougier et al., 1998: 143) – on petrosal (0), on parietal and/or squama of squamosal (1), or absent (2).
Maelestes (1).

Skull – Mesocranium

234. Choanae – as wide as posterior palate (0) or narrower (1).
Maelestes (1).

235. Vomer contacts pterygoid – absent (0) or present (1).
Maelestes (?).

236. Pterygoids contact on midline (Rougier et al., 1998: 99) – present (0) or absent (1).
Maelestes (0).

237. Pterygopalatine crests (Rougier et al., 1998: 100) – present (0) or absent (1).
Maelestes (?).

238. Midline crest in basipharyngeal canal – absent (0) or present (1).
Maelestes (1).

239. Entopterygoid process – absent (0), ends at anterior basisphenoid (1), or approaches ear region (2).
Maelestes (2).

240. Midline rod-shaped eminence on basisphenoid – absent (0) or present (1).
Maelestes (1).

241. Ectopterygoid process of alisphenoid (Rougier et al., 1998: 101*) – absent (0), ends at anterior basisphenoid (1), or approaches ear region (2).
Maelestes (2).

242. Ectopterygoid process of alisphenoid extent – long crest (0) or narrow process (1). [Taxa without ectopterygoid process are scored inapplicable.]
Maelestes (0).

243. Transverse canal foramen (Rougier et al., 1998: 104) – absent (0) or present (1).
Maelestes (?).

244. Exit for maxillary nerve relative to alisphenoid (Rougier et al., 1998: 110) – behind (0), within (2), or in front (2).
Maelestes (?).

245. Number of exit(s) for the mandibular branch of the trigeminal nerve (Luo and Wible, 2005: 317) – two (0) or one (1).
Maelestes (?).

246. Foramen ovale composition (Rougier et al., 1998: 111*) – in petrosal (anterior lamina) (0), between petrosal and alisphenoid (1), in alisphenoid (2), or between alisphenoid and squamosal (3).
Maelestes (2/3): foramen ovale is not in the petrosal or between the petrosal and alisphenoid.

247. Foramen ovale position (Rougier et al., 1998: 112) – on lateral wall of braincase (0) or on ventral surface of skull (1).
Maelestes (?).

248. Alisphenoid canal (Rougier et al., 1998: 107) – absent (0) or present (1).
Maelestes (?).

249. Posterior opening of alisphenoid canal – separated from foramen ovale (0) or in common depression with foramen ovale (1). [Taxa without alisphenoid canal are scored inapplicable.]
Maelestes (?).

Skull – Basicranium

250. Position of jaw articulation relative to fenestra vestibuli (Rougier et al., 1998: 114) – at same level (0) or in front (1).
Maelestes (1).

251. Glenoid fossa position – on zygoma (0) or partially on braincase (1).
Maelestes (1).

252. Glenoid fossa shape (Rougier et al., 1998: 115*; Archibald et al., 2001: 137*) – concave, open anteriorly (0), trough-like (1), anteroposteriorly elongate (2), anteroposteriorly short (3), or convex, open anteriorly (4).
Maelestes (0).

253. Glenoid fossa position relative to sphenoid on midline skull base – even with (0) or higher (1).
Maelestes (0).

254. Glenoid process of jugal (Rougier et al., 1998: 116) – present, with articular facet (0), present, without facet (1), or absent (2). [Taxa without jugal are scored inapplicable.]
Maelestes (?).

255. Glenoid process of alisphenoid (Rougier et al., 1998: 117) – absent (0) or present (1).
Maelestes (0).

256. Postglenoid process (Rougier et al., 1998: 118) – absent (0) or present (1).
Maelestes (1).

257. Postglenoid foramen – absent (0) or present (1).
Maelestes (1).

258. Postglenoid foramen position (Rougier et al., 1998: 120*) – behind postglenoid process (0), medial or anterior to postglenoid process (1), or on lateral aspect of braincase (2). [Taxa without postglenoid foramen are scored inapplicable.]
Maelestes (0).

259. Postglenoid foramen composition – within squamosal (0) or behind squamosal (1).
Maelestes (0). [Taxa without postglenoid foramen are scored inapplicable.]

260. Suprameatal foramen – absent (0) or present (1).
Maelestes (1).

261. Entoglenoid process of squamosal (Luo and Wible, 2005: 284) – absent (0), present, separate from postglenoid process (1), or present, continuous with postglenoid process (2).
Maelestes (0).

262. Posttympanic crest of squamosal (see Wible et al., 2004) – absent (0) or present (1).
Maelestes (0).

263. Carotid foramen (Rougier et al., 1998: 105*) – within basisphenoid (0), between basisphenoid and petrosal (1), or absent (2).
Maelestes (0).

264. Cavum epiptericum (Rougier et al., 1998: 109*) – floored by petrosal (0), petrosal and alisphenoid (1), primarily or exclusively squamosal (2), or primarily open as piriform fenestra (3).
Maelestes (3).

265. Alisphenoid tympanic process (Rougier et al., 1998: 121*) – absent (0) or present (1).
Maelestes (0).

266. Basisphenoid tympanic process – absent (0) or present (1).
Maelestes (0).

267. Basicochlear fissure (Thewissen et al., 2001: 59*) – closed (0) or patent (1).
Maelestes (0).

268. Epitympanic wing medial to promontorium (Rougier et al., 1998: 122*) – absent (0), flat (1), or thickened (2).
Maelestes (1).

269. Rostral tympanic process of petrosal, on posteromedial aspect of promontorium (Rougier et al., 1998: 130*) – absent or low ridge (0), moderate ridge, contributing to posterodorsomedial bulla (1), or tall ridge, contributing to ventral bulla (2).
Maelestes (0).

270. Course of internal carotid artery – lateral (transpromontorial) (0), medial (perbullar or extrabullar) (1), or absent (2).
Maelestes (0).

271. Intratympanic vascular canal (for transpromontorial internal carotid) – absent (0) or present (1).
Maelestes (0).

272. Deep groove for internal carotid artery excavated on anterior pole of promontorium (Rougier et al., 1998: 148) – absent (0) or present (1).
Maelestes (0).

273. Perbullar carotid canal (for medial internal carotid) – absent (0) or present (1).
Maelestes (-): inapplicable because the artery is transpromontorial and not medial.

274. Stapedial artery on promontorium (Asher et al., 2005: 161) – sulcus (0), canal (1), or absent (2).
Maelestes (0).

275. Stapedial ratio (Rougier et al., 1998: 127) – rounded, less than 1.8 (0) or elliptical, more than 1.8 (1).
Maelestes (1).

276. Coiling of cochlea (Rougier et al., 1998: 129) – less than 360° (0) or 360° or greater (1).
Maelestes (1).

277. Pars cochlearis length – more than 13% of skull length (0) or less than 10% of skull length (1).
Maelestes (1).

278. Promontorium shape – flat (0) or globose (1).
Maelestes (1).

279. Promontorium depth relative to basioccipital – even with or ventral to (0) or dorsal to (1).
Maelestes (0).

280. Intratympanic course of facial nerve (Meng et al., 2003: 169*) – open in sulcus (0), open anteriorly, canal posteriorly (1), or in canal (2).
Maelestes (0).

281. Tympanic aperture of hiatus Fallopii (Rougier et al., 1998: 123*) – in roof through petrosal (0), at anterior edge of petrosal (1), absent (2), or via fenestra semilunaris (3).
Maelestes (2).

282. Prootic canal (Rougier et al., 1998: 124*) – present (0) or absent (1).
Maelestes (0).

283. Prootic canal length and orientation (Rougier et al., 1998: 124*) – long and vertical (0), short and vertical (1), or short and horizontal (2). [Taxa without prootic canal are scored inapplicable.]
Maelestes (2).

284. Lateral flange (Rougier et al., 1998: 126*) – parallels length of promontorium (0) or greatly reduced or absent (1).
Maelestes (1).

285. Length of bony shelf lateral to promonotorium (lateral trough or tegmen tympani) – extended anteriorly as far as promontorium (0), confined posterolaterally (1), or prolonged anterior to promontorium (2).
Maelestes (1).

286. Width of bony shelf lateral to promonotorium (lateral trough or tegmen tympani) – uniform (0) or expanded anteriorly (1).
Maelestes (0).

287. Inflation of bony shelf lateral to promontorium (lateral trough or tegmen tympani) (Thewissen et al., 2001: 52*) – absent (0) or present (1).
Maelestes (0).

288. Stapedial canal on bony shelf lateral to promontorium (lateral trough or tegmen tympani) – absent (0) or present (1).
Maelestes (0).

289. Tensor tympani fossa (Geisler, 2001: 14*) – shallow (0) or deep circular pit (1).
Maelestes (0).

290. Medial process of squamosal in tympanic cavity (Rougier et al., 1998: 141) – absent (0) or present (1).
Maelestes (0).

291. Hypotympanic sinus (Rougier et al., 1998: 140*) – absent (0), formed by squamosal, petrosal, and alisphenoid (1), formed by alisphenoid and petrosal (2), or formed by petrosal (3).
Maelestes (0).

292. Epitympanic recess/fossa incudis size – subequal (0), epitympanic recess larger (1), or no visible depression for epitympanic recess (2).
Maelestes (0).

293. Epitympanic recess lateral wall (Rougier et al., 1998: 138*) – with small contribution to posterolateral wall by squamosal (0), with extensive contribution to lateral wall by squamosal (1), or with no squamosal contribution (2).
Maelestes (1).

294. Fossa incudis (Rougier et al., 1998: 137) – continuous with (0) or separated from epitympanic recess (1).
Maelestes (0).

295. Floor ventral to fossa incudis – absent (0), formed by squamosal (1), or formed by ectotympanic (2).
Maelestes (0).

296. Fossa incudis position relative to fenestra vestibuli – lateral (0) or anterior (1).
Maelestes (1).

297. Foramen for ramus superior of stapedial artery (Rougier et al., 1998: 145) – on petrosal (0), on petrosal-squamosal suture (1), or absent (2).
Maelestes (1/2): unclear if foramen is absent or in piriform fenestra.

298. Position of ramus superior foramen relative to fenestra vestibuli (Luo and Wible, 2005: 326) – posterior or lateral (0) or anterior (1). [Taxa without ramus superior are scored inapplicable.]
Maelestes (?).

299. Ascending canal (Rougier et al., 1998: 152) – intramural (0), intracranial (1), or absent (2).
Maelestes (1/2): canal is either absent or intracranial.

300. Stapedius fossa (Rougier et al., 1998: 139) – twice the size of fenestra vestibuli (0) or small and shallow (1).
Maelestes (0).

301. Cochlear canaliculus visible canal in middle ear space – absent (0) or present (1).
Maelestes (0).

302. Cochlear fossula – weak or absent (0) or distinct pit behind fenestra cochleae (1).
Maelestes (1).

303. Fenestra cochleae position to fenestra vestibuli – posteromedial (0) or posterior (1).
Maelestes (0).

304. Posterior septum shields fenestra cochleae – absent (0) or present (1).
Maelestes (0).

305. Paroccipital process (sensu Wible and Hopson, 1993) (Rougier et al., 1998: 131) – vertical (0), slanted, projecting anteroventrally as flange towards back of promontorium (1), or indistinct to absent (2).
Maelestes (0).

306. Caudal tympanic process of petrosal notched (Rougier et al., 1998: 132*) – absent (0) or present (1).
Maelestes (1).

307. Crista interfenestralis and caudal tympanic process of the petrosal connected by curved ridge (Rougier et al., 1998: 133) – absent (0) or present (1).
Maelestes (1).

308. "Tympanic process" (Rougier et al., 1998: 134) – absent (0), present, low (1), or present, high.
Maelestes (1).

309. "Tympanic process" composition – petrosal (0) or petrosal and exoccipital (1). [Taxa without "tympanic process" are scored inapplicable.]
Maelestes (1).

310. Rear margin of auditory region (Rougier et al., 1998: 136) – marked by steep wall (0) or extended onto a flat surface (1).
Maelestes (1).

311. Inferior petrosal sinus (Rougier et al., 1998: 151) – intrapetrosal (0), between petrosal, basisphenoid, and basioccipital (1), or endocranial (2).
Maelestes (1/2): intrapetrosal course can be excluded because no appropriate foramina are present.

312. Jugular foramen size relative to fenestra cochleae (Rougier et al., 1998: 149) – subequal (0) or larger (1).
Maelestes (0).

313. Jugular foramen (Rougier et al., 1998: 150) – confluent with (0) or separated from opening for inferior petrosal sinus (1).

Maelestes (0).

314. Hypoglossal foramen (Luo and Wible, 2005: 349) – two or more (0) or one (1).
Maelestes (0+1): right side has three and the left side one.

315. Hypoglossal foramen housed in opening larger than jugular foramen – absent (0) or present (1).
Maelestes (1).

316. Paracondylar ("paroccipital") process of exoccipital (sensu Evans and Christensen, 1979) (Rougier et al., 1998: 135*) – weak or absent (0), prominent, vertical (1), or prominent, posteriorly directed (2).
Maelestes (0).

317. Ectotympanic – phaneric or visible in ventral view (0) or aphaneric or hidden by auditory bulla (1).
Maelestes (0).

318. Ectotympanic shape (Rougier et al., 1998: 142) – ring-like (0), fusiform (1), or expanded (2).
Maelestes (?): the ectotympanic is insufficiently preserved to evaluate.

319. Anterior crus of ectotympanic broadly contacts facet on squamosal – absent (0) or present (1).
Maelestes (0).

320. Elongate ossified external acoustic canal – absent (0) or present (1).
Maelestes (?).

321. Roof of external acoustic meatus – petrosal (0) or squamosal (1).
Maelestes (0).

322. Entotympanic (Luo and Wible, 2005: 363) – absent (0) or present (1).
Maelestes (0).

323. Pit on ectotympanic for hyoid – absent (0) or present (1).
Maelestes (?): the ectotympanic is insufficiently preserved to evaluate.

324. Hyoid arch contributes to bulla – absent (0) or present (1).
Maelestes (?).

325. Dorsum sellae (Rougier et al., 1998: 106) – tall (0) or low (1).
Maelestes (1).

326. Posterior clinoid process contacts anterior pole of promontorium (see Wible et al., 2004) – absent (0) or present (1).

Maelestes (0).

327. Position of sulcus for anterior distributary of transverse sinus relative to subarcuate fossa (Rougier et al., 1998: 125) – anterolateral (0) or posterolateral (1).
Maelestes (0).

328. Wall separating cavum supracochleare from cavum epiptericum (Rougier et al., 1998: 128*) – absent (0), incomplete, with fenestra semilunaris (1), or complete (2).
Maelestes (2).

329. Crista petrosa – vestigial or absent (0) or tall, thin crest (1).
Maelestes (1).

330. Subarcuate fossa aperture – not constricted (0), constricted (1), or fossa absent (2).
Maelestes (1).

331. Anterior semicircular canal – does (0) or does not form lateral wall of subarcuate fossa aperture (1).
Maelestes (1).

332. Internal acoustic meatus (Rougier et al., 1998: 153) – deep, with thick prefacial commissure (0) or shallow, with thin prefacial commissure (1).
Maelestes (1).

Skull – Occiput

333. Posttemporal canal (Rougier et al., 1998: 144) – large (0), small (1), or absent (2).
Maelestes (1).

334. Posttemporal canal composition – between petrosal and squamosal (0) or within petrosal (1).
Maelestes (1).

335. Posttemporal canal position – on occiput (0) or dorsal to external acoustic meatus (1).
Maelestes (0).

336. Mastoid foramen (Meng et al., 2003: 114*) – absent (0), two in mastoid (1), one in mastoid (2), or between mastoid and supraoccipital (3).
Maelestes (0/3): foramen is either absent or between mastoid and supraoccipital.

337. Amastoidy or lack of occipital exposure of mastoid (Geisler, 2001: 38) – absent (0) or present (1).
Maelestes (0).

338. Dorsal margin of foramen magnum (Rougier et al., 1998: 156) – formed by exoccipitals (0) or by exoccipitals and supraoccipital (1).
Maelestes (?).

Postcranium – Vertebrae

339. Atlantal foramen (Horovitz and Sánchez-Villagra, 2003: 1*) – present (0) or absent (1).
Maelestes (1).

340. Atlas neural hemiarches fused – absent (0) or present (1).
Maelestes (0).

341. Atlas neural arch and intercentrum fused (Luo and Wible, 2005: 167) – absent (0) or present (1).
Maelestes (0).

342. Axis (Luo and Wible, 2005: 169*) – with (0) or without suture between atlantal and axial parts (1).
Maelestes (0).

343. Axis with extra pair of transverse processes on ventral surface of body (Horovitz and Sánchez-Villagra, 2003: 11*) – present (0) or absent (1).
Maelestes (1).

344. Axis anterior facets (prezygopophyses) and dens connection (Horovitz and Sánchez-Villagra, 2003: 12*) – not linked (0), linked (1), or facets extend ventral to dens (2).
Maelestes (0).

345. Inferior lamellae on posterior cervical vertebrae – present (0) or absent (1).
Maelestes (?).

346. C7 transverse foramen (Horovitz and Sánchez-Villagra, 2003: 21*) – present (0) or absent (1).
Maelestes (?).

347. Number of thoracic vertebrae (Luo and Wible, 2005: 172) – 13 or fewer (0) or 15 or more (1).
Maelestes (?).
After submission of our paper, Sánchez-Villagra et al. (2007) reviewed the number of thoracolumbar vertebrae across a broad spectrum of mammals and reported that an increase from the plesiomorphic condition of 19 represents a synapomorphy of Afrotheria. In our analysis, we did not consider thoracolumbar vertebrae as a single unit, but retained separate characters for the number of thoracic versus lumbar vertebrae.

348. Number of lumbar vertebrae – 6 or more (0) or 5 or fewer (1).
Maelestes (?).

349. Xenarthrous articulations on lumbar vertebrae (Luo and Wible, 2005: 176) – absent (0) or present (1).
Maelestes (?).

350. Number of sacral vertebrae (Geisler, 2001: 131*) – 2 (0), 3 (1), or 4 or more (2).

351. Sacral vertebrae fused to pelvis – absent (0) or present (1).
Maelestes (?).

Postcranium – Pectoral Girdle and Forelimb

352. Infraspinous fossa position to supraspinous fossa (Rougier, 1993: 13*) – different planes (in part, medial to) (0) or coplanar (1).
Maelestes (0).

353. Suprascapular incisure (Luo and Wible, 2005: 196) – absent (0) or present (1).
Maelestes (0).

354. Acromion (Asher et al., 2005: 174*) – reaches distal to glenoid articulation (0), is proximal (1), or absent (2).
Maelestes (0).

355. Metacromion – weak or absent (0) or well-developed process (1).
Maelestes (?).

356. Greater tubercle of humerus (Asher et al., 1998: 175) – ventral to (0) or even with or dorsal to humeral head (1).
Maelestes (1).

357. Extension of deltopectoral crest (Horovitz and Sánchez-Villagra, 2003: 50) – limited to proximal half of humerus (0) or reaches distal half (1).
Maelestes (0).

358. Sigmoidal shelf for supinator ridge extending proximally from ectepicondyle (Luo and Wible, 2005: 206) – weak or absent (0) or present (1).
Maelestes (0).

359. Medial epicondyle (Geisler, 2001: 134) – robust (0) or weak (1).
Maelestes (0).

360. Entepicondylar foramen (Geisler, 2001: 135 – present (0) or absent (1).

Maelestes (0).

361. Supratrochlear foramen (Asher et al., 1998: 178) – absent (0) or present (1).
Maelestes (1).

362. Ulnar articulation on humerus (Luo and Wible, 2005: 203*) – cylindrical trochlea in posterior view with a vestigial ulnar condyle in anterior view (0) or cylindrical trochlea without an ulnar condyle (cylindrical trochlea extending to the anterior/ventral side) (1).
Maelestes (1).

363. Radial articulation on humerus (Luo and Wible, 2005: 204*) – rounded radial condyle anteriorly but cylindrical posteriorly (0) or capitulum (forming a continuous synovial surface with the ulnar trochlea; cylindrical in both anterior and posterior aspects) (1).
Maelestes (1).

364. Humeral articulation on radius (Geisler, 2001: 141*) – single fossa (0) or two fossae (1).
Maelestes (0).

365. Central process of radial head (Asher et al., 2005: 181) – small or absent (0) or present (1).
Maelestes (0).

366. Radius and ulna distal fusion (Thewissen et al., 2001: 81) – absent (0) or present (1).
Maelestes (?).

367. Radial articulation with carpals (Thewissen et al., 2001: 80) – single fossa (0) or two fossae (1).
Maelestes (?).

368. Scaphoid and lunate (Asher et al., 2005: 183) – separate (0) or fused (1).
Maelestes (?).

369. Os centrale (Asher et al, 2005: 184) – present (0) or absent (1).
Maelestes (?).

Postcranium – Pelvic Girdle and Hindlimb

370. Pubic symphysis (Meng et al., 2003: 22*) – extensive (0) or narrow (1).
Maelestes (?).

371. Epipubic bone (Luo and Wible, 2005: 218) – present (0) or absent (1).
Maelestes (?).

372. Articular surface of femoral head (Asher et al., 2005: 186) – extended posterolaterally (0) or limited to sphere of head (1).
Maelestes (?).

373. Fovea for ligamentum teres (MacPhee, 1994: 27) – does not (0), or does (1) interrupt margin of articular surface of femoral head, or absent (2).
Maelestes (?).

374. Greater trochanter to femoral head (Horovitz and Sánchez-Villagra, 2003: 79) – lower (0) or higher (1).
Maelestes (?).

375. Size of lesser trochanter of femur (Luo and Wible, 2005: 228) – large (0) or small (1).
Maelestes (?).

376. Third trochanter of femur (Asher et al., 2005: 188) – absent (0) or present (1).
Maelestes (?).

377. Pectineal tubercle (see Lessertisseur and Saban, 1967b) – absent or vestigial (0) or distinct (1).
Maelestes (?).

378. Distal femur (Asher et al., 2005: 189) – similar in size in anteroposterior and mediolateral dimensions (0) or longer anteroposteriorly (1).
Maelestes (?).

379. Patellar facet ('groove') of femur (Luo and Wible, 2005: 230*) – weakly developed (0), broad and shallow (1), or narrow and elevated (2).
Maelestes (?).

380. Ossified patella (Luo and Wible, 2005: 273) – absent (0) or present (1).
Maelestes (?).

381. Articulation between femur and fibula (Horovitz and Sánchez-Villagra, 2003: 84) – absent (0) or present (1).
Maelestes (?).

382. Tibia and fibula proximal fusion (Asher et al., 2005: 190) – absent (0) or present (1).
Maelestes (?).

383. Tibia and fibula distal fusion (Horovitz and Sánchez-Villagra, 2003: 87) – absent (0) or present (1).

Maelestes (?).

384. Depth of trochlear groove (Zack et al., 2005: 40*) – shallow (0) or moderately deep (U-shaped) (1).
Maelestes (0).

385. Astragalus, angle between medial and lateral facets for tibia (Horovitz and Sánchez-Villagra, 2003: 94*) – 180° (0), intermediate (1), or 90° (2).
Maelestes (1).

386. Astragalus, angle between facet for fibula and lateral facet for tibia (Horovitz and Sánchez-Villagra, 2003: 99) – 180° (0), intermediate (1), or 90° (2).
Maelestes (1).

387. Radius of curvature of lateral trochlear ridge (Zack et al., 2005: 41) – greater than (0) or subequal to medial trochlear ridge (1).
Maelestes (0).

388. Cotylar fossa (Zack et al., 2005: 44*) – absent (0) or present (1).
Maelestes (0).

389. Sustentacular and navicular facets of astragalus contact (Asher et al., 2005: 204) – absent (0) or present (1).
Maelestes (?).

390. Astragalar sustentacular facet medial extent (Horovitz and Sánchez-Villagra, 2003: 102) – does not (0) or does reach medial edge of neck (1).
Maelestes (?).

391. Astragalar medial planar tuberosity (ampt) (Horovitz and Sánchez-Villagra, 2003: 98*) – weak or absent (0) or protruding (1).
Maelestes (?).

392. Astragalar neck (Horovitz and Sánchez-Villagra, 2003: 100) – absent (0), present, shorter than body width (1), or present, similar in length to body width (2).
Maelestes (1).

393. Convex astragalar head (Thewissen et al., 2001: 92*) – absent (0) or present (1).
Maelestes (1).

394. Facet on astragalus for cuboid (Asher et al., 2005: 208) – absent (0) or present (1).
Maelestes (?).

395. Astragalar canal (Horovitz and Sánchez-Villagra, 2003: 104*) – present (0), dorsal foramen only (1), or absent (2).
Maelestes (?).

396. Posterior trochlear shelf of astragalus (Asher et al., 2005: 198) – weak or absent (0) or strong (1).
Maelestes (0).

397. Calcaneal width (Asher et al., 2005: 210) – broad with sustentacular and ectal facets extending from body (0) or narrow with sustentacular and ectal facets in line with long axis (1).
Maelestes (?).

398. Ectal (or posterior calcaneoastragalar facet) longest dimension (Horovitz and Sánchez-Villagra, 2003: 113) – anteromedial to posterolateral (0), straight (1), or posteromedial to anterolateral (2).
Maelestes (?).

399. Anteroposterior overlap between calcaneal ectal and sustentacular facets (Zack et al., 2005: 32*) – no overlap (0), partial overlap (1), or nearly complete overlap (2).
Maelestes (?).

400. Calcaneal sustentacular facet mesiolateral orientation (Horovitz and Sánchez-Villagra, 2003: 118) – medial (0) or dorsal (1).
Maelestes (?).

401. Calcaneal sustentacular facet expanded onto body – absent (0) or present (1).
Maelestes (?).

402. Calcaneal anterior peroneal tubercle position (Horovitz and Sánchez-Villagra, 2003: 117) – protruding anteriorly beyond calcaneocuboid facet (0), anterior, non-protruding (1), or at a distance from anterior end of calcaneum (2).
Maelestes (?).

403. Calcaneal plantar tubercle (Horovitz and Sánchez-Villagra, 2003: 122*) – absent (0), present, at distal margin (1), or present, more proximal (2).
Maelestes (?).

404. Tuber calcis ventral curvature (Horovitz, 2000: 3*) – present (0) or absent (1).
Maelestes (?).

405. Calcaneal facet for fibula (Horovitz and Sánchez-Villagra, 2003: 125*) – present (0) or absent (1).

Maelestes (?).

406. Orientation of ML axis of cuboid facet on calcaneum relative to long axis of calcaneum (Zack et al., 2005: 37) – ~90° (0), ~70-80° (1), or less than ~70° (2).
Maelestes (?).

407. Proportions of cuboid facet on calcaneum (Zack et al., 2005: 38) – facet much deeper (dorsoventral) than wide (mediolateral) (0), facet depth and width subequal (1), or facet much wider (mediolateral) than deep (dorsoventral) (2).
Maelestes (?).

408. Deep groove for tendon of flexor fibularis on calcaneum – absent (0) or present (1).
Maelestes (?).

Part IV. List of Taxa and Sources

Nanolestes drescherae, *N. krusati* – Martin (2002)
Peramus tenuirostris – Simpson (1928); Mills (1964); Clemens and Mills (1971); Rougier et al. (1998); Sigogneau-Russell (1999); Butler and Clemens (2001)
Vincelestes neuquenianus – Rougier et al. (1992, 1998); Rougier (1993); Horovitz (2000); Horovitz and Sánchez-Villagra (2003)
Kielantherium gobiensis – Crompton and Kielan-Jaworowska (1978); Kielan-Jaworowska and Dashzeveg (1984); Lopatin and Averianov (2006)
Deltatheridium pretrituberculare – Kielan-Jaworowska (1975c); Rougier et al. (1998, 2004); Horovitz (2000); Horovitz and Sánchez-Villagra (2003)
Mayulestes ferox – Muizon (1998); Rougier et al. (1998); Horovitz (2000); Argot (2002); Horovitz and Sánchez-Villagra (2003)
Pucadelphys andinus – Marshall et al. (1995); Rougier et al. (1998); Horovitz (2000); Argot (2002); Horovitz and Sánchez-Villagra (2003)
Eomaia scansoria– Ji et al. (2002)
Prokennalestes trofimovi, *P. minor* – Kielan-Jaworowska and Dashzeveg (1989); Sigogneau-Russell et al. (1992); Rougier et al. (1998); Wible et al. (2001)
Murtoilestes abramovi – Averianov and Skutschas (2000, 2001)
Bobolestes zenge – Nessov et al. (1994); Averianov and Archibald (2005)
Montanalestes keebleri – Cifelli (1999); OMNH 60793
Sheikhdzheilia rezvyii – Averianov and Archibald (2005)
Alostera saskathchewanensis – Fox (1989); Storer (1991)
Lainodon orueetxebarriai – Gheerbrant and Astibia (1994, 1999)
Avitotherium utahensis – Cifelli (1990, pers. comm.)
Gallolestes pachymandibularis, *G. agujaensis* – Lillegraven (1972, 1976); Clemens (1980); Butler (1990); Cifelli (1994)
Parazhelestes robustus, *P. mynbulakensis* – Nessov et al. (1998); Archibald et al. (2001); Ekdale et al. (2004); Archibald and Averianov (2005); Archibald (pers. comm.)
Aspanlestes aptap – Nessov et al. (1994, 1998); Archibald et al. (2001); Averianov and Archibald (2003); Ekdale et al. (2004); Archibald (pers. comm.)
Zhelestes temirkaysk – Nessov et al. (1994, 1998); Archibald et al. (2001); Ekdale et al. (2004); Archibald and Averianov (2005); Archibald (pers. comm.)
Paranyctoides sternbergi, *P. maleficus*, *P. megakeros*, *P. aralensis*, *P.* spp. – Fox (1979, 1984); Lillegraven and McKenna (1986); Cifelli (1990); Archibald and Averianov (2001); Archibald et al. (2001)
Eozhelestes mangit – Averianov and Archibald (2005)
Cimolestes incisus, *C. simpsoni*, *C. propalaeoryctes*, *C. stirtoni*, *C. magnus* – Reynolds (1936); Clemens and Russell (1965); Van Valen (1966); Lillegraven (1969); Clemens (1973)
Maelestes gobiensis – this report
Batodon tenuis – Lillegraven (1969); Clemens (1973); Storer (1991); Wood and Clemens (2001)
Bulaklestes kezbe – Archibald and Averianov (2006)
Daulestes kulbeckensis, *D. inobservabilis* – Nessov et al. (1994); Archibald and Averianov (2006)

Uchkudukodon nessovi – McKenna et al. (2000); Archibald and Averianov (2006); Archibald (pers. comm.)
Kennalestes gobiensis – Kielan-Jaworowska (1969, 1977, 1981); Crompton and Kielan-Jaworowska (1978); Rougier et al. (1998)
Asioryctes nemegtensis – Kielan-Jaworowska (1975b, 1977, 1981); Rougier et al. (1998); Horovitz (2000); Horovitz and Sánchez-Villagra (2003)
Ukhaatherium nessovi – Novacek et al. (1997); Horovitz (2000, 2003); Rougier et al. (1998); Horovitz and Sánchez-Villagra (2003)
Deccanolestes hislop, *D. robustus* – Prasad and Sahni (1988); Godinot and Prasad (1994); Prasad and Godinot (1994); Prasad et al. (1994); Rana and Wilson (2003)
Kulbeckia kulbecke – Archibald and Averianov (2003); Ekdale et al. (2004)
Zhangolestes jiliensis – Zan et al. (2006)
Alymlestes kielanae – Averianov and Nessov (1995)
Zalambdalestes lechei – Kielan-Jaworowska (1978, 1984a); Kielan-Jaworowska and Trofimov (1981); Novacek et al. (1997); Fostowicz-Frelik and Kielan-Jaworowska (2002); Wible et al. (2004); Archibald and Averianov (2006)
Barunlestes butleri – Kielan-Jaworowska (1975a, 1975b, 1978); Kielan-Jaworowska and Trofimov (1980); Fostowicz-Frelik and Kielan-Jaworowska (2002); Wible et al. (2004); Archibald and Averianov (2006)
Gypsonictops hypoconus, *G. illuminatus*, *G. lewisi* – Lillegraven (1969); Sahni (1972); Clemens (1973); Crompton and Kielan-Jaworowska (1978); Fox (1979)
Leptictis spp. – Lillegraven (1969); Novacek (1986a); Cavigelli (1997); Rougier et al. (1998); Rose (1999, in press); Asher et al. (2005)
Purgatorius unio, *P. janisae* – Van Valen and Sloan (1965); Clemens (1974, 2004); Van Valen (1994)
Protungulatum donnae, *P. mckeeveri*, *P. gorgon* – Sloan and Van Valen (1965); MacIntyre (1972); Szalay and Decker (1974); Kielan-Jaworowska et al. (1979); Archibald (1982, 1998); Luo (1991); Lofgren (1995)
Oxyprimus erikseni – Archibald (1982); Luo (1991); Lofgren (1995)
Vulpavus profectus, *V. ovatus*, *V. canavus* – Matthew (1909, 1915); Cifelli (1982); Gingerich (1983); Wang and Tedford (1994); Heinrich and Rose (1997); Geisler (2001); AMNH 11498 cast of skull
Miacis parvivorus, *M. sylvestris* – Matthew (1909); AMNH 129284
Gujaratia pakistanensis – Thewissen et al. (1983, 2001); Russell et al. (1983); Geisler and Luo (1998); Thewissen and Hussain (1990); Geisler (2001); Bajpai et al. (2005)
Hyopsodus spp. – Gazin (1968); West (1979); Cifelli (1982); Geisler (2001); Thewissen et al. (2001); Asher et al. (2005); Zack et al. (2005)
Phenacodus spp. – Osborn (1898); Kitts (1956); Radinsky (1966); Cifelli (1982); Thewissen (1990); Geisler (2001); Thewissen et al. (2001)
Meniscotherium spp. – Gazin (1965); Cifelli (1982); Williamson and Lucas (1992); MacPhee (1994); Geisler (2001); Thewissen et al. (2001)
Ptilocercus lowii – Le Gros Clark (1926); Szalay and Drawhorn (1980); Butler (1980); Sargis (2001, 2002a, b, c); USNM 483068, 488052, 488058
Plesiadapis tricuspidens, *P. gidleyi* – Simpson (1935); Russell (1964); Szalay and Decker (1974); Szalay et al. (1975); Gingerich (1976)

Notharctus osborni, *N. venticolus*, *N. tenebrosus*, *N. robustior*, *N. crassus* – Gregory (1920); Gazin (1958); Decker and Szalay (1974)
Adapis parisiensis, *A. magnus* – Stehlin (1912); Gregory (1920); Decker and Szalay (1974); Gingerich (1981); Gingerich and Martin (1981); MacPhee and Cartmill (1986)
Tribosphenomys minutus, *T. secundus* – Meng and Wyss (2001); Lopatin and Averianov (2004)
Paramys delicatus, *P. copei*, *P. taurus* – Matthew (1910); Wood (1962); Wahlert (1974, 2000); Rose and Chinnery (2004)
Rhombomylus turpanensis – Meng et al. (2003)
Gomphos elkema – Meng et al. (2004); Asher et al. (2005)
Mimotona wana – Li and Ting (1993); Asher et al. (2005)
Blarina brevicauda – CM 261, 24287, 50523, 102792; Gaughran (1954)
Erinaceus europaeus – CM 1692, 89002, 92138, 107856, 107857; Gould (1995, 2001)
Solenodon paradoxus – AMNH 185012, 212912
Eoryctes melanus – Thewissen and Gingerich (1989)
Potamogale velox – CM 3931, 6129, 9501, 16034, 40781, 42297, 42298; AMNH 34881, 51344
Orycteropus afer – CM 1758, 20920, 57994; Le Gros Clark and Sonntag (1926); Colbert (1941); Lessertisseur and Saban (1967a, 1967b); MacPhee (1994)
Rhynchocyon cirnei – CM 86641, 86642, 86643, 86644, 86645 *R. petersi* CM 18067; Evans (1942)
Procavia capensis – CM 47320, 48676, 48677, 51880, 51881, 51882; Lessertisseur and Saban (1967a, 1967b); Cifelli (1982)
Moeritherium trigodon – Andrews (1906); Tassy (1981); Court (1994)
Chaetophractus villosus – CM 2369
Bradypus variegatus, *Bradypus* sp. – CM 1365, 2180, 21006, 22556; Wible and Gaudin (2004)
Tamandua tetradactyla, *T. mexicana* – CM 683, 649, 91944; Patterson et al. (1992); Wible and Gaudin (2004)

Part V. Taxon-Character Matrix

The taxon-character matrix is presented in two forms. The first is in reader friendly format, facilitating comparisons; the second is in a format facilitating importation to a parsimony computer program, such as TNT (Goloboff et al., 2003) or PAUP (Swofford, 2002).

Each of the 69 taxa in Part II are scored for the 408 characters in Part I. Numbers (0-5) refer to states of those characters. "?" and "–" are unknown and non-applicable respectively. Letters are explained below: "/" is either/or and "+" is and, both of which are treated as either/or in the phylogenetic analysis; true polymorphisms are noted here for the sake of completeness.

```
A = 0/1
B = 0+1
C = 0/2
D = 0+2
E = 0/3
F = 0+3
G = 0/1/2
H = 0+1+2
J = 0/1/3
K = 1/2
L = 1+2
M = 1/3
N = 1+3
P = 1/2/3
R = 1+2+3
S = 2/3
T = 2+3
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Nanolestes

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000?0 ??0?? ????0 ?1?0? 00000 0??00 000?0 00000 01000 ?0000
00000 00010 0?000 0?010 20110 A0000 0000- -000- -0--- -----
0?0?? 00000 00010 00010 ?0--- 0?002 0?000 1???? 00200 00?1?
02000 ?00?? ????? ????? ????? ????? ????? ????? ????? ?????
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Peramus

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000E0 ??G?? ????? ???0? 00010 1??0? 10000 00000 01000 00000
00001 10001 10000 00002 00000 10100 0000- -000- -0--- -----
0?00? 00000 00010 00001 00--- 0002L 01011 110?1 00200 010?1
01000 01??? ????? 0???? ????? ????? ????? ????? ????? ?????
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Vincelestes
00300 01100 00000 00000 00000 10?30 0---- 00000 00000 1----
-0000 0--00 10100 00102 00100 22101 10010 0000- 01000 000--
02110 01000 00030 01001 00--- 01032 11001 12011 00001 01101
0201- 01100 0000B 00000 000-0 00010 00000 00000 00000 00000
00000 00000 00000 00000 –0000 00000 00000 001-0 0-000 000-0
00000 00--0 00000 00000 00-00 00000 00000 00000 00000 00000
00000 000-0 00000 0??0? 00000 00100 00000 00000 0?020 0?000
0000? 00000 00000 00000 00000 00?00 ?0000 0-000 00000 00000
01000 000

Kielantherium
000?? ????? ????? ???0? ????? ???1? ????? ????? ????? ?000-
-???? ???0? 00011 10112 00022 A1100 00011 1100- 02000 000--
0?1?? 02000 00011 00101 00--- 01A?1 01??? ??01? ????? ?????
???01 0???? ????? ????? ????? ????? ????? ????? ????? ?????
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Deltatheridium
00100 01100 00000 00?0? 01010 10121 0010- 00000 00000 0101-
-0000 00000 01011 10100 00022 11100 10101 11220 12000 000--
01110 02100 00011 00101 110-0 01013 01001 11000 01100 01011
0001- 11111 00001 000?0 010-0 01000 00100 ?0000 001?0 10000
00000 0??10 ????? ???01 ????? ????? 1121? ????? ????? ?????
?1?A0 1100? ???1? ??10C -0-20 111?0 20211 0000? 0??00 02-20
00001 000-0 101?? ????? 1?0?? 012?? ?01?0 ?0??? ????? ?????
????? ????? ????? ????? ????? ????? ????? ????? ????? ??000
0??00 ??0

Mayulestes
00100 00000 00000 00000 01010 10?2? 0100- 00000 00000 0100-
-?000 00000 01011 10100 20122 12210 10111 11220 12110 000—-
00110 00110 10111 30113 11000 10013 01?0? ??0?? ????? ?????
00011 ??111 10111 00001 010-0 01000 00101 00011 10100 00000
00000 ?0000 00?00 10-00 -?0?1 10000 11110 01010 0-011 110-1
01001 1100? 00010 00101 -1-20 11100 11-10 00001 11000 02-21
00001 000-0 11100 0??0? 1000? 0???? ????? 20110 0100? ?????
?1100 11100 01100 00??? 10001 10010 ?0000 0–010 0110? 00100
01100 000

Pucadelphys
00100 00000 00000 00000 01010 10?2? 0100- 00000 00000 0101-
-0000 00000 01011 10100 20121 12210 11011 11220 22110 100--
00110 00010 11111 30123 12000 10013 01002 11000 11100 01111
0001- 11111 00011 00000 01100 01000 00101 0???1 11100 00000
00000 00000 00010 10-00 -2011 000?0 1120? ?1?10 0-111 110-1
01001 11001 00010 00101 -1-20 11100 10210 00001 01000 02-21
00000 000-0 11100 0??0? 1000? 0120? 01??? 20110 00000 100??
?1100 10100 01100 0???0 00001 10000 ?0000 ?-0?0 ?1100 00100

01100 000

Eomaia
00010 00000 000?0 00?00 00010 10?0? 10010 10001 01??? ??010
01001 0?00? 100C1 0?1?0 ?002? A0100 ?00?? 11110 12??0 0?0--
001?1 010?0 10?01 ?02?? 01?00 00021 01011 12011 00200 01001
02001 01011 00011 ??0?? 010-1 00?1? ?0??? ????? ????? 0?000
01??? ????? ????? ????? ????? 0?0?0 ????? ????? ????? ?????
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0?00? ???

Prokennalestes
000?0 0?0?? ????? ???0? 0???0 0??0? 1???? 10001 B1000 00000
0B00B 000B0 100L1 00110 00102 00100 00001 11110 12000 000--
00100 00000 10011 00211 11000 00011 01011 12011 00200 010?1
00001 010?? ??011 ?1??? ????? ????? ????? ????? ????? ??0?0
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Murtoilestes
00??? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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Bobolestes
000?0 0?0?? ????0 ???0? 0???1 1??0? 1???? ????? ????? ?0000
00001 20000 10011 0?200 10022 A1100 10011 11221 12010 100—-
00100 00000 10011 10211 11000 0002L 01??0 1?01? ????? ?????
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Montanalestes
00A?? ??G?? ????? ????? ????? ???A? 1???? ????? ????? ?????
?1001 10001 110?? ????? ????? ????? ????? ????? ????? ?????
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0C01- 021?? ????? ????? ????? ????? ????? ????? ????? ?????
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Sheikhdzheilia
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0?1?? 000?0 10011 K1223 ?2000 0?A?2 0???? ????? ????? ?????
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Alostera
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Lainodon
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Avitotherium
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Gallolestes
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Parazhelestes
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00100 21?0? 10012 21212 10022 22111 10211 11221 22111 22200
00100 00000 21111 21223 02000 10012 01??? 1201? ????? ?????
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0000? 000-? K???? ????? ??00? ?020? 111?0 ?0??? ????? ?????
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Aspanlestes
000?0 ??G?? ????? ????? ????? ???0? 1?1?0 1??01 11110 01000
00100 21001 10022 21212 10022 02111 10211 11221 22110 22200
001?? 000?0 11111 21223 02000 100L1 01??1 1201? ????? ?????
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0000? 000-? K???? ????? ??00? ?020? 111?0 ?0??? ????? ?????
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Zhelestes
00010 ????? ????? ????? ??010 10?0? 1?101 10001 1111? 01001
00100 21??? 10022 21212 1002K 22111 1021A 11??? 22110 KK200
00100 00000 11111 21223 02000 10012 0?0?1 120?1 00200 01001
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0000? 000-? K???? ????? ??00? ?020? 111?0 ?0??? ????? ?????
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Paranyctoides
000?0 ????? ????? ???0? ????1 1??0? 1???? 1A001 L2000 ?0001
01000 0B001 10011 10110 10D22 A1111 10011 11121 12111 11100
0?1?? 00000 10011 31221 12000 100N2 01??1 1?0?? ????? ?????
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Eozhelestes
000?? ??0?? ????? ???0? ????1 1??0? ????? ????? ????? ?000B
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Cimolestes
001E0 0?1?? ????0 21?00 10010 10?1? 1?10- 10012 BB000 0010-
-0000 00000 10011 00102 10022 00101 10011 11221 12010 1BB00
00100 00000 00011 10211 120B0 0001L 01001 12001 0???? 000?0
0B01- 121?? ??11B ?10?? 0???? 01?11 0???? ???20 10??0 1????
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Maelestes
000E0 0?1?? ????0 ?100? 1?0A0 10?0? 10101 10011 02110 00111
10000 00010 10022 21202 10021 00101 10010 1100- 12010 11100
00100 00000 21111 10212 12100 00023 01002 12011 00200 00102
0001- 1???1 10011 00??? 0???1 0??10 00??? ?1102 10110 01000
01110 11000 0001? A000? ???0? 11??? 1111? 01121 20??? S???1
100?0 11001 00030 00100 00-01 11100 20211 00000 00100 1K?K0
01000 11111 K00B1 00?0? 00??1 00211 11110 E0110 0010? ?????
?000? 10000 11100 ????? ????? ????? ???01 100?? ?11?? 0????
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Batodon
001?? ????? ????? ???0? ????0 1??1? 1???? 100?1 12000 ?010-
-0001 10001 10022 1?102 10021 21101 10011 11221 12010 11100
00100 00000 10111 K0212 1K000 00022 ?1??? ????? ????? ?????
0001- ????? ????? ????? ????? ????? ????? ????? ????? ?????
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Bulaklestes
001?? ????? ????? ???0? 0???0 0??1? 1???? 1000? ????? ?000-
-0001 00001 10011 21112 10022 CA101 10011 11121 12001 100--
001?0 000?0 10011 10211 21000 00002 ?1??? ???1? ????? ?????
0001- ?21?? ????? ????? ????? ????? ????? ????? ????? ?????
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Daulestes
001?? ????? ????? ???0? ????0 0??1? 1???- 10001 12000 0000-
-0001 01011 10011 1B100 00022 00101 10011 11121 12000 1BB00
0?1?? 000?0 20011 10211 ?1000 0?0?2 ????? ???1? ????? ?????
???1- ????? ???1? ????? ????? ????? ????? ????? ????? ?????

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Uchkudukodon
001E0 0?A?? ????A ???0? 000?0 00010 1???- 10001 02000 0??0-
-000? 0101? 10011 01110 00022 00101 10011 11121 12000 1BB00
0?100 00000 20011 10211 21000 0001T 01011 12011 00200 01001
0201- 121?? 0?011 000?1 110-1 00111 000?? ?0A02 10110 ?1000
01100 1J?00 000?0 2--01 0?002 10??? 1111? ??1?0 0-021 S00-1
?00?0 11101 2?1?0 00100 00000 11100 ?1-1? 0000? ????? 1????
??00? ????? ????? ?00?0 ?000? ????? ????? ?0?10 0???? ?????
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Kennalestes
00100 0G1?0 00010 00?0? 00000 00010 1000- 10011 12110 0001-
-0000 01010 10021 20212 00022 00101 10011 11121 12001 11200
00100 00000 10111 10211 11000 00012 01002 12001 00200 00??1
0001- 12111 00011 010?0 ?10-1 01111 000?? ?0000 10110 0?000
0110? 10000 000?? 2--?1 0100? ??000 1111? 01?2? 20?11 300-1
000?0 11101 21?30 00101 -0001 11100 ?1-10 00000 0?1?1 1??A0
01002 11101 10011 0?1?0 0000? 00211 112-- 20?11 0???? ?????
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Asioryctes
00100 00000 00010 00?00 00000 00?1? 1000- 20011 22000 0001-
-1001 01010 10021 00102 10022 00101 10011 111D1 12001 100--
00100 00000 20111 10211 11000 00001 01002 12001 00200 01001
0001- 12111 00011 010?0 010-1 00111 00000 00??0 10110 00001
0110? 10000 000?? 2--01 0100C 10000 1111? 01110 20011 300-1
00010 11101 21?30 00101 -0001 11100 01-10 00000 0?111 1??A0
01002 11101 10011 001?0 0000? 0???? ??2-- 10111 00110 1????
????? ????? ????? 000?? ????? ????? ??001 1?0?1 1111? 00??1
00000 0?0

Ukhaatherium
00100 00000 00010 00000 00010 10?1? 1001- 20011 22000 0001-
-1001 01010 10021 00102 10022 00101 10011 11101 12001 100--
00100 00000 20?11 10211 11000 00002 01002 12001 00200 01001
0001- ?2111 00011 01000 010-1 01111 00000 00??0 10110 00001
011?0 1?0?? 00??0 2--01 010?? 1?000 1111? 01110 200?1 ?00-1
00010 11101 21030 00101 -0001 11100 ?1-10 00000 0?1?1 1A1A0
01002 111?1 10001 00110 ?0001 002?? ?12-- 2011? ????? ?????
?1000 10000 011?0 0?0?0 0??01 ?00?1 1?001 10011 12100 00101
0200? 220

Deccanolestes
00??? ????? ????? ???0? ????0 1??1? 1???? 1011? ????? ?001-
-000? 2100? ??021 10102 10022 A2111 10011 11220 12011 200-0
001?0 001?0 10011 112L1 11000 0?012 ????? ????? ????? ?????

000?? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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00111 100

Kulbeckia
00110 0G0?? ???21 ?1?11 10000 0??1? 1000- 2?111 02000 0000-
-?001 211?1 10022 00202 10022 21111 10211 11121 22001 200--
001?0 00000 22111 L1222 11000 000L1 01??? 1210? ????? ?????
0001- 12111 00011 0000? 0?0-? 00??? ?101? ??G?? ????0 01000
0???? ????? ????1? 10-?? ????? ????? 1???? ????? ????? ?????
????? ????? ????? ??10K -0?0B 1?1?0 11-11 0000? ???1? 011A0
0100? 111?1 1???? ????? ??00? ??2?? ?11?0 ?0??? ????? ?????
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Zhangolestes
000?0 0?1?? ????1 ?1?21 1???1 11?0? ????? ????? ????? ?0001
1???1 21??0 100?? ????? ????? ????? ????? ????? ????? ?????
????? 00000 1?011 31222 ??000 0?A?1 01??? ????? ????? ?????
0?0?? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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Alymlestes
00??? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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????? 00100 22101 31223 ???00 0???? ????? ????? ????? ?????
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Zalambdalestes
00LB0 0T111 10?21 21121 10001 11?L? 1000- 21111 12000 1000-
-0001 21000 10022 00202 10021 21111 10210 1100- 22001 200--
00110 00100 22111 31223 12100 00011 01011 120A1 00200 00101
0001- 12111 00011 00000 110-1 00010 01010 00200 A0110 10000
01110 12001 10100 00001 01001 01B00 11110 01111 20011 300-1
000K0 11101 21030 00101 -0001 11100 11-10 00000 00101 111A0
01002 11111 K0000 00110 1000? 102?? ?1100 101?? ?00?1 1????
?11?? 100?0 ????0 ????? 01??? 100?? 0??K2 200?1 ?110K 01201
?3011 2?0

Barunlestes
002B0 0?1?? ????1 21121 10111 11?2? 1---- 20111 1200? 000--
-0??1 21000 10022 00202 10021 21111 10210 1100- 22001 200--

00110 00100 22111 31223 12100 001-1 01011 12001 00200 00101
0101- 121?? ?0?11 000?? ??0-1 00?11 0?0?? ?0220 10100 1?00?
???1? 1M011 00??0 ????1 0?0?? ????0 11?1? ?1111 20011 30??1
000?0 11101 21030 00101 -0?01 11100 11-10 00000 0?1?1 1???0
01002 11111 ?0000 0???? 1?0?? 1???? ????? ?0111 00?0? ??0?0
?1??? 10000 1110? 00100 01211 1001? 0???? ????? ????? ?????
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Gypsonictops
00B?0 0?G?? ????? ???0? 0???0 10?B? 1???? 2B112 22111 00001
0B1L1 21101 10022 10102 10022 21111 10011 11221 22011 22200
00100 00000 2L111 312L1 12000 00022 01??? 1200? ?0200 00???
???1- 121?? ???11 ????? ????? ????? ????? ????? ????? ?????
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Leptictis
00130 03110 00000 00000 00011 10?10 1001- 11112 22111 0010-
-0001 21201 10022 00202 10022 21111 10211 11221 12011 21200
00110 00000 2L111 31221 12000 00012 01011 12001 00200 00112
0?01- 12111 00112 11101 11101 01011 00100 00020 11100 00001
01011 00000 00010 2--01 10001 00100 11111 11020 10121 20101
10020 11001 10011 00100 00001 11100 11-10 00000 1?100 01?10
01002 100-1 11110 00010 11001 00211 012-- 301?1 11??? ?0002
01111 00000 1110? 00010 10011 1002? 00102 20001 02102 00201
01111 210

Purgatorius
001?0 0?1?? 300?0 ?1?0? 0???0 1??1? ????- ????2 K1000 0010-
-0002 00101 10022 K0202 10022 22K11 10211 11121 12112 22200
0?1?? 001?0 11011 11221 11000 00032 00??? ????? ????? ?????
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Protungulatum
001?? 0???? ????0 ?0?00 0?010 10?1? 2???- 10112 B1110 0010-
-1001 10001 11022 10202 10022 22211 10211 12110 22102 22200
00110 00B00 11011 11L13 12000 100LL 01002 12001 00201 00102
0001- 121?? ????? ????? ????? ????? ????? ????? ????? ?????
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????? ????? ????? ??000 00?01 1?1?0 01-10 ???0? ?211? 0K?K0
01002 10101 1???? ????? 1?00? ?0201 112-- ?0??? ????? ?????
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01110 120

Oxyprimus
001?? ????? ????? ????? ????? ???1? ????- ????? ????? ????-

-1001 20001 11022 10202 10022 22211 10211 12110 22102 22200
001?0 00000 11011 11L12 12000 10A?1 01002 12001 00??? 00??2
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Vulpavus
00L00 02100 00000 00000 00010 10?L? 0111- 00011 23000 0011-
-0000 0000? 12022 00202 10022 22111 10211 1100- 22101 111B1
00110 01100 21011 11221 31000 010LL 0?001 1?00? 00000 01112
??01- 1??11 B0110 01L01 01100 01111 001?0 ?01D? ????0 1?001
0A?0? ????? ????0 00011 0?01? 01001 111?? 110?0 ???21 20111
000?0 1100? 01130 00000 00-0? 11010 ?1-12 00010 2A1A0 010A0
00000 100-1 K1010 2???0 1?00? ????? ????? ?0??? ????? ??00?
?1?00 1??00 01100 00B?? ?1011 1001? ??002 20001 02101 00201
02011 100

Miacis
00100 02100 00000 00000 0?010 10?1? 0111- 00001 23000 101?-
-0001 00000 12022 00202 10022 21011 10211 1100- 22100 1DB01
00110 01100 10011 11102 31000 01A?1 0100? 10000 ?0??? ?1111
???1- 1P1?? ???10 012?1 0?10? ????? ????? ????2 0???0 ?????
??10? 10000 00110 000?1 0?010 010?1 11111 ?1010 11?21 T0111
000?0 11000 111N0 00000 00-01 11010 ?1-12 00011 11100 0???0
00000 10101 K1000 2???0 1?00? ????? ????? ?0??? ????? ??001
0???? 10?00 0???? 0?00? ????? 1???? ?000? ????? ??1?1 ?0???
????1 ???

Gujaratia
00100 021?0 000?0 40000 00011 10?1? 2001- 20012 00110 0011-
-0002 01001 11112 00202 10022 22111 10211 11221 22102 22300
00100 000?0 21011 12222 12000 1002L 01001 10000 00300 001A2
000?? ???11 10111 010?0 01101 01011 00??? ????1 103-0 30000
00??0 02001 00111 00001 00000 00001 1111? ?1?10 10021 200-1
00010 1100? ??130 00000 00-?? ?1?1? ?1-?? 0?01? ????? ?????
???02 ????1 ?11A0 102?0 1000? ????? ??2-- 30??? ????1 ???01
0???? 10011 ??11? 01010 1??11 1?121 00012 21001 02012 01101
01210 110

Hyopsodus
00130 02101 00000 00000 00111 10?10 2110- 10012 00110 0010-
-0B12 21100 11112 00202 10022 22111 10211 20220 22101 2232B
00110 B0000 21011 12222 21000 100H2 01011 10100 00C01 00111
0?01- 12111 10111 00001 11100 01011 ?0120 00G00 103-0 00000
0000? ?00?0 00??0 2--01 1?0?1 11001 11101 11010 10021 201-1
00020 11000 10110 01000 00-0? 11010 11-10 01010 02A?0 02-?0
01002 00101 K101? 10??? 1?00? 00201 ?11?? ?0??? 111?0 ?1?02
00101 11000 11111 01010 1100? 10021 00001 21001 02112 00201
01110 100

Meniscotherium

00110 02100 40000 40000 00111 10?10 2001- 20012 20111 0011-
-0002 21100 11212 00201 11022 22111 11212 20201 22101 22321
00110 00000 11011 12220 31-00 00002 11012 10000 00001 00112
0011- 12111 1011L 0100B 01100 01011 00121 ?0A02 00000 0?000
0001? 00010 00??0 00001 100?2 10001 1110? ?1010 10?K1 20111
00?20 11000 10130 01000 00-01 11010 11-10 01000 01100 02-??
0?002 10101 K0?11 1???? 1?00? 0???1 ??1?? ?0?01 11101 11002
01111 10010 11111 01010 11111 10021 00001 20000 02100 00201
01111 120

Phenacodus
00100 02110 40000 40000 00011 10?1? 2010- 210?2 20111 0?11-
-0H02 21L00 1B112 00201 11022 22211 11212 20220 22102 22321
00110 00100 21011 12222 11000 10002 0100B 1000? 00001 00112
0?0?? ???11 1011L 0000? 01100 01011 00121 00220 ?03-0 0000B
0000? 00000 00101 2--01 1?002 1??01 1110? ???10 10?21 20111
00?20 11000 10130 0100? -002K 11010 11-10 01000 0?1?? 02-?1
0?002 100-1 2100A 10??? 1?00? 0???? ??100 F0?01 111?? ?1002
0111? 10010 11111 01010 10111 10121 00002 2?001 021?0 00201
01?11 2?0

Ptilocercus
00200 03110 00002 11000 10101 10020 0000- 10011 02010 0----
-0002 21001 10012 20202 10022 12211 10011 0100- 22111 12201
00100 00010 11021 31223 12000 10031 01001 12000 00200 00102
0001- 13111 20010 11200 01110 01101 00100 00000 11300 10001
11111 10010 00110 00111 01002 01110 11101 11010 10021 20101
00000 11001 10110 00000 10-11 11102 11-12 10100 21110 0A111
00002 000-1 20110 01010 11001 00211 112-- 30101 111?1 1A101
01111 00100 01100 00001 11000 10011 00002 21011 02102 00101
12111 100

Plesiadapis
00TB1 03101 30001 01020 -0L12 -0?T- 20B0- 2B012 L011B 0----
-0000 B1L00 11122 B0202 1B022 22L11 10211 01220 22102 22320
001B0 01000 21021 31221 02000 10032 10002 12000 00200 01102
1101- 13111 20112 00201 11101 00101 00000 00000 113-0 10000
00010 ?0011 001?0 2--01 0?01? 12000 1111? 1112? 20011 200-1
10020 11000 10110 00020 00-21 11100 11-12 10000 31??C 02-21
11112 00201 K1110 01101 1000? ????? ??2-- 30?11 1???1 ??001
01??? 00000 01100 00??? 110B0 1?01? ??002 20011 01100 10201
12111 101

Northarctus
00100 03200 40000 40000 00010 10010 2011- 20002 L0110 0010-
-0B02 21100 11122 10202 10022 22111 10211 01221 22101 22320
00110 1---- -1021 22222 02000 10012 1B00L 12000 00200 00102
1B11- 13111 10110 00111 01100 01101 10100 00000 013-0 00000
1001? 000?? 0???0 00111 0?0?A 12000 1110? 11110 200?1 200-1
100?0 11000 00110 00020 10-11 11102 11-12 10100 3111? 0A11?
11112 00201 K1110 01001 1000? ????1 1?2-- 30?11 111?? ?0001
0??0? 00100 01100 0010? 10?00 10021 00002 21010 0210? 11101
12211 221

Adapis
00130 03200 40000 40000 00B11 10010 2010- L0002 20110 0010-
-0002 21100 11122 B0202 10022 22L11 10211 01200 22101 22320
00100 1---- -1021 22220 02-00 10012 10001 10000 00300 10102
1B11- 13111 101BB 00211 01100 01101 10100 00010 113-0 0000B
00011 00011 011?0 00111 0?010 12000 1110? 11010 20011 210-1
10010 11000 00110 00020 10-11 11102 11-12 10100 311?? 0A11?
11112 00201 K1110 01001 10001 0??0? ??2-- 30??? ????? ?????
????? ???0? ??10? 00??? 1???? ???2? ???02 21010 02101 11101
12211 121

Tribosphenomys
00321 14301 221-1 21131 -02-2 --?3- 2---- 0002? ????? ?----
--??0 210-0 10122 00202 10022 22211 122-1 01220 22102 2031-
00111 1---- -2131 31221 02010 001-2 100?1 02100 ?02?? 0???1
0101- 131?1 ??-11 10??? ????? ????? ??-?? ????? ????? 10???
??1?? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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????? ????? ????? ????? ????? ????? ?0002 21001 01102 00201
01111 1?0

Paramys
00321 14301 221-1 21131 -02-2 --?T- 2---- 00022 20111 0----
----0 211-0 101B3 3---- -1--2 22211 -22-2 2-220 22102 22320
00111 1---- -2131 32221 01010 00B32 10011 02100 00C?? 01022
0101- 13111 20-11 10200 01100 01111 10-01 00002 113-0 20000
0001? ?3011 001?0 2--01 01000 01000 11101 11020 20020 20111
02120 01200 00130 00100 00-01 11100 01-10 10000 01200 00111
01002 100-1 11110 20?00 1000? 0???? ??2-- ?0?01 1110? ?0001
0??0? 0000B 011?1 0?00? 11211 10021 00002 20001 01102 00201
01111 210

Rhombomylus
00321 14301 221-1 21131 -02-2 --?3- 2---- 2B0?2 B1020 0----
-0112 20200 11123 3---- -0--0 21201 -22-2 0100- 22102 2032-
1?111 1---- -1101 31211 12000 0003L 10001 12100 00210 00002
0101- 12111 20-11 10200 01100 01111 10-01 00002 003-0 10000
10111 01011 00100 00011 01012 12000 11111 11120 20021 20A01
02120 01100 002M0 00102 ---21 1110L 11-12 10010 31202 02-2?
01002 000-1 210B0 20211 10000 00201 012-- 201?? ?1??1 ??0?1
?1?01 10000 11101 0???? 11011 10121 00002 21001 01102 00211
01110 120

Gomphos
00T21 13201 21101 21131 102-2 --?T- 2---- 210?2 10000 0----
-0220 21200 10123 3---- -1--0 22211 -22-2 01020 22102 2032-
0?111 1---- -1131 31221 02010 00032 10001 12100 00210 01002
0101- 12111 20-11 10100 01?01 ??111 10-?1 00?02 003?0 10000
1011? 010?? 00??0 2--01 ??0?? 0???0 1111? 11010 10??1 201?1
03110 01200 00210 ?0002 ---?? ?1??? ????? ????? ????? ?????
????? ????? ?1??0 ?0210 1000? ????? ????? 30??1 11??? ???00
0110? 001?0 11??? ????? 10?11 1?1?1 00002 20001 02102 01111
01111 100

Mimotona
00T21 13201 21101 21131 102-2 --?T- 2---- 20002 00000 0----
-0000 21000 10123 3---- -B--0 22211 -22-2 0100- 22102 2032-
0?101 1---- -11?1 31221 02000 0003? 1???? ??10? ????? ?????
01??? ???11 K0-11 10??? ??1?? 01?1? ??-?1 ????? ????? 00000
0?1?? ????? ????? ????? ????? ????? ????? ????? ????? ?????
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Blarina
00T30 02S11 201A1 11031 0011K ?1?T? 0---- 10021 20020 1----
-0002 22-00 10011 00200 11020 22211 11010 0100- 12110 1022-
11110 00110 11121 31123 32000 011-3 01002 00000 00000 10111
0101- 13111 10112 01111 01111 01101 ?0??0 ?0201 10100 011--
-21?0 0?1?? ???10 2---1 2?00? 10000 11111 11010 10021 S00-1
100-? 10-?? 11130 00010 00-01 11100 31-12 00000 01101 00010
00002 11201 21010 00100 10010 0?101 012-- 00?01 11100 1A000
01001 10000 01100 00011 10010 10011 00102 20001 12100 00201
01110 1?1

Erinaceus
00T00 02211 000B1 01000 10101 110T0 0---- B00B1 00010 0----
-0002 20000 10012 00202 10002 22211 -0210 0100- 22010 22320
11110 00100 21121 31220 32-00 11B3T 01012 10000 00300 10102
0101- 13111 20010 01111 11111 1?-01 10120 01001 11100 10010
1111- 01011 10B00 2--01 00100 02000 11111 11010 10021 200-1
04020 111?1 10011 10010 00-01 11100 11-10 10100 21000 00110
01000 11101 21010 20100 B0001 00201 ?1110 T0101 11110 11001
01101 10011 01100 00111 10201 10011 00102 21011 01112 01201
01010 110

Solenodon
00230 02101 30012 00000 00101 10?2? 1000- 10011 02010 0----
-0001 20000 10020 00202 00122 13--1 12011 1100- 12010 0011-
00100 00000 20100 10000 30-00 00013 01002 11000 00301 11101
0101- 13111 1011D 11111 11111 01111 00120 00011 11100 001--
-2111 01011 10000 2---1 00000 00001 11110 11010 0-021 20111
100-0 110?1 21130 00000 00-01 11100 11-11 00000 01100 01110
01002 11201 21100 00110 10011 0???? ??2-- 30101 11010 11102
01101 01000 01101 01001 10010 10011 00002 21001 0211? 00201
01010 211

Eoryctes
002?0 0?S?? ????? ???0? ????0 1??2? 1???? 10011 22000 1----
-0001 000?0 10022 00202 10022 A0101 10211 2000- 120?0 100--
0?100 000?0 20001 10203 ?2000 0?0T2 ????? ????? ????? ?????
010?? ????? ???10 01??? 0?10? 11?11 0???? ?0?22 10100 ?0???
?2??? ????0 0?0?? 2--?1 0?00? 00?00 1111? 11??0 ???21 20111
100?0 110?1 K0111 101?0 10-1? 1110? ???12 10100 21100 0A110
01000 11101 ?1000 ?01?0 1???? ????? ????? ?0??? ????? ?????
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Potamogale
00230 02101 20002 30000 10101 10020 2000- 20012 21000 0----
-1101 20011 10021 10202 21022 12001 10011 1100- 22000 100--
00100 00000 21111 10200 32-00 00013 01002 00000 00000 00101
0201- 13111 10112 10111 01111 1--11 1-100 00321 00000 001--
-210- 00100 00100 2---1 00110 11010 11110 11010 0-021 20111
100-0 110?0 21121 11010 00-01 11000 11-11 00001 11101 01110
01000 10201 21010 00110 10011 00201 11100 00101 11110 11100
01010 11011 01100 00011 11001 0?021 00101 200?1 11102 01??1
?0010 2?0

Orycteropus
01T-- -54-- ----- ----- --2-2 --?T? 2---- ---0- ----- 0----
----- ---0- 10-0- ----- ----- ----- ----- ----- ----- -----
----- ----- ----- ----- ----- -100R 01011 00100 00300 10102
0201- 13110 01-B2 01011 11101 00101 20-20 00401 10101 00000
01000 00100 00010 00001 01000 00000 11100 11010 0-021 200-1
04120 10--0 20110 00200 00-01 11010 11-10 00000 01110 01101
01002 100-1 11110 00110 10001 02202 -12-- R01?1 1110? ?0002
01101 11100 11100 01010 10111 1102? 11012 20101 11100 002?1
01?11 2??

Rhynchocyon
00210 051-- ---10 31000 11001 00010 2001- 12011 22020 1001-
-11B2 21200 22203 3---- -0--0 21211 -02-1 0100- 22101 100--
0-1-- 00001 11031 22220 -2-00 0-012 01110 00000 00300 10102
0201- 13111 00110 01101 11101 00111 00120 00021 01001 00001
01000 00100 00010 01001 01110 20000 11210 11010 11021 200-1
04020 01010 10111 10?10 10-11 11000 31-10 10100 11202 ?011?
0???1 0?201 K?100 00111 11011 00211 112-- 20101 11110 10001
01111 11010 11100 01010 10011 10121 11112 21101 12112 01221
01010 201

Procavia
00121 B4201 221-0 31000 102-2 --?1? 2020- 22032 20120 0000-
-1212 21100 10203 3---- -1--0 21211 -12-1 2300- 22101 12320
23101 00001 01111 11220 32-01 00001 11112 00100 00301 10102
0211- 12111 11-11 10001 11100 01011 00-20 00B0B B1001 B0000
00011 01011 000B0 01011 01012 00010 11211 11010 11021 21101
04100 10--0 20110 01001 -0021 11100 11-10 00000 01200 02-21
00002 000-0 21010 10211 11001 02100 112-- 01101 11100 11002
01120 10011 11110 01010 10111 1B121 01102 20111 11012 01221
03010 220

Moeritherium
00211 B2202 00010 21000 10112 --?2? 2---- 22012 20110 0----
-1212 21110 11103 3---- -0--0 22211 -02-0 2300- 22101 22321
00101 1---- -1121 42221 02001 001-1 10113 10101 00001 00102
0011- 1??11 10111 ?0100 01100 1--?? ?-000 001B1 10000 20010
10?1- 1?001 10100 2--01 0?010 00100 11100 11010 00011 ?1101
04000 00-?0 001?0 0???? ????? ??01? ????? ????? ????? ?????
0??02 ????? ?102- 0???0 1?0?? ?0?12 -0??? ?1?01 11100 ?1102
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01120 11011 011?? ????? ?0011 0001? ????? ????? ????? ?????
????? ???

Chaetophractus
01130 054-- ---0- ----- --111 1-?-- ----- ----- ----- -----
----- ----- ----- ----- ----- ----- ----- ----- ----- -----
----- ----- ----- ----- ----- --000 00012 00101 00300 10112
0201- 13111 0111- 10100 10101 01001 00100 103-1 00200 -0000
00011 01011 00110 2--01 02001 20100 11111 11020 0-121 200-1
03120 11111 20110 00101 -0121 11101 21-11 00000 12210 02-20
01002 000-1 10111 00211 11001 00200 01010 00101 11101 11112
11100 10100 01100 01011 10110 10021 01102 20000 01102 00201
01110 010

Bradypus
0133- -54-- ----- ----- --112 --?-- ----- ----- ----- -----
----- ----- ----- ----- ----- ----- ----- ----- ----- -----
----- ----- ----- ----- ----- --003 10012 00101 00000 00102
1211- 13110 0102- -011B 01100 01101 00020 003-0 00200 -0000
02011 00011 00110 2--01 02010 00100 11201 11020 0-021 T00-1
10020 10--0 00110 00001 -0120 11100 21-11 00001 11210 02-20
01002 000-1 200B0 00210 11101 00102 -1101 00101 11101 01112
11010 00001 01100 00011 11201 00021 00003 20001 01002 01121
01001 000

Tamandua
1---- ----- ----- ----- ----- ----- ----- ----- ----- -----
----- ----- ----- ----- ----- ----- ----- ----- ----- -----
----- ----- ----- ----- ----- --1-0 0-0-0 00-01 00000 11102
0201- 13111 -1-1- 01101 11101 0110B 00-20 003-1 0020- -0010
02-00 00000 00010 2--01 02010 20100 1120? 11120 0-021 200-1
10020 10--0 10010 00000 00-21 1110? ?1-1? 0000? ????? ?2-2?
0?002 000-1 21011 00210 11001 00201 01L01 00?01 11100 11112
11000 00100 01100 01011 11001 00021 00002 20011 01002 00221
01011 000

```
*****
#NEXUS

BEGIN DATA;
      DIMENSIONS  NCHAR=408 NTAX=69;
      FORMAT SYMBOLS= " 0 1 2 3 4 5" MISSING=? GAP=- ;
      CHARSTATELABELS
            1  Teeth / present absent,
   2  Teeth_types /
'differentiated_into_morphological_types_(incisors,_canines,_premolars,
_molars)_with_enamel'
'simple_peg-like_teeth',
   3  Postcanine_loci / 8_or_more 7 6 5_or_less,
   4  Upper_diastema / 'narrow,_between_I/C' 'narrow,_between_C/P'
enlarged absent,
   5  'Lower diastema behind i''s' / absent_or_narrow enlarged,
   6  Incisor_shape /
root_and_crown_are_straight_and_continous_in_length
root_and_crown_form_a_continous_curve,
   7  Upper_incisors / 5 4 3 '2_(anterior)' '1_(anterior)'
'none_or_1-2_small_posterior',
   8  Lower_incisors / 4 3 2 1 none_or_small_posterior,
   9  Upper_anteriormost_incisors_aveoli / approximating
separated_by_broad_gap,
   10  Anteriormost_upper_incisor_size / subequal_to_subsequent
greatly_enlarged smaller_than_subsequent,
   11  Anteriormost_upper_incisor / conical 'medio-
laterally_compressed'
'antero-posteriorly_compressed' 'cuspate_(one_major_and_one_minor)'
spatulate,
   12  Upper_anteriormost_incisor_root / rooted
'hypsodont,_in_premaxilla' 'hypsodont,_in_maxilla',
   13  Enamel_distribution_on_upper_anterior_dentition /
surrounds_tooth
discontinuous_posteriorly,
   14  Ultimate_upper_incisor / in_premaxilla
between_premaxilla_and_maxilla in_maxilla,
   15  Lower_anteriormost_incisor_size /
'small,_subequal_to_subsequent'
greatly_enlarged 'tiny,_smaller_than_subsequent',
   16  Anteriormost_lower_incisor_shape / conical
mediolaterally_compressed anteroposteriorly_compressed
'cuspate_(subequal_cusps)' spatulate,
   17  Lower_anteriormost_incisor_procumbency / absent present,
   18  Lower_anteriormost_incisor_growth / determinate_ 'ever-
growing_',
   19  Lower_anteriormost_incisor_root_length /
not_extended_posteriorly_below_p1 extending_posteriorly_below_p1_
extending_posteriorly_below_penultimate_or_ultimate_premolar
extending_posteriorly_below_molars,
   20  Lower_anteriormost_incisor_enamel / covers_the_tooth_
discontinuous_posteriorly,
   21  Lower_post._incisors_procumbency / absent present,
   22  Staggered_lower_incisor / absent_ present_,
   23  Upper_canine / present_and_enlarged_ present_and_small_ absent,
   24  Upper_canine_roots / two_ one_,
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   25  Lower_canine / present_and_enlarged_ present_and_small_ absent,
   26  Lower_canine_roots / two_ one_,
   27  Lower_canine_procumbency / absent present,
   28  Deciduous_canine / present absent,
   29  Premolars / five_ four_ three two_or_less,
   30  P1p1_P2p2_replacement / present absent,
   31  'Tall, trenchant premolar' / in_ultimate_premolar_position
in_penultimate_premolar_position absent,
   32  P1_procumbency / absent present,
   33  P1_roots / double single three,
   34  P1_posterior_diastema / absent present,
   35  'P c roots (only for taxa with five)' / two one,
   36  Penult_upper_premolar_protocone / absent 'small,_lingual_bulge'
with_enlarged_basin,
   37  Penult_upper_premolar_metacone / absent swelling large,
   38  'Penult upper premolar para/metastyle' / absent_or_weak
well_developed,
   39  Penult_upper_premolar_roots / two three one four,
   40  Ult_upper_premolar_protocone / absent_or_narrow_cingulum
smaller_than_paracone approaches_paracone_in_height,
   41  Ult_upper_premolar_metacone / absent swelling large,
   42  'Ult upper premolar para/metastylar lobe' / absent_or_vestigial
subequal parastylar_larger metastylar_larger,
   43  Ult_upper_premolar_precingulum / absent present,
   44  Ult_upper_premolar_postcingulum / absent
'present,_but_lower_than_protocone' forming_hypoconal_shelf,
   45  Ult_upper_premolar_conules / weak_or_absent prominent,
   46  Ult_upper_premolar_size_to_M1 / smaller_or_subequal larger,
   47  p1_orientation / in_line_with_jaw_axis oblique,
   48  First_lower_premolar_roots / two one,
   49  'p1-p2 diastema' / absent_
'present,_subequal_to_one_tooth_root_diameter',
   50  'p c size (only for taxa with 5 premolars)' / longer_than_p2
shorter_than_p2,
   51  'p c roots (only for taxa with 5)' / two one,
   52  Penult_lower_premolar_paraconid / vestigial_or_absent_
distinctive_,
   53  Penult_lower_premolar_metaconid / absent swelling separate,
   54  'Penult lower premolar "talonid" cusps' / one two three,
   55  Ult_lower_premolar_paraconid / vestigial_or_absent
distinctive_and_low distinctive_and_high,
   56  Ult_lower_prem_metaconid / absent swelling separate,
   57  Ultimate_lower_premolar_talonid / narrower_than_anterior_crown
as_wide_as_anterior_crown absent,
   58  Ult_lower_premolar_talonid_cusps / one two three,
   59  Length_of_ultimate_lower_premolar / longer_than_penutlimate
equal_or_less_than_penultimate,
   60  Ultimate_lower_premolar_anterolingual_cingulid / absent present,
   61  Molars / four_or_more_ three_ two,
   62  Molar_size_increasing_posteriorly / absent
moderate_posterior_increase marked_posterior_decrease,
   63  Molar_cusp_form / 'sharp,_gracile' 'inflated,_robust' 'crest-
like',
   64  Upper_molar_shape / as_long_as_wide
'wider_than_long_(length_more_than_75_and_less_than_99%_width)'
'wider_than_long_(length_less_than_75%_width)',
   65  Upper_molar_stylar_shelf / 50%_or_more_of_width_
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less_than_50%_but_more_than_25%_ less_than_25% absent,
   66  Metastylar_and_parastylar_lobe_labial_extent /
parastylar_more_labial subequal metastylar_more_labial lobes_absent,
   67  Upper_first_molar_parastylar_lobe_position_to_paracone /
anterolabial anterior,
   68  Parastylar_lobe_width / more_than_30%_total_width
less_than_30_but_more_than_20 20_or_less,
   69  Preparastyle / absent present,
   70  Stylar_cusp_A / subequal_to_larger_than_B
'distinct,_but_smaller_than_B' vestigial_to_absent,
   71  Stylar_cusp_B_to_paracone / smaller_but_distinctive
vestigial_to_absent subequal,
   72  'Stylar cusp C (mesostyle)' / absent present,
   73  Stylar_cusp_D / absent smaller_or_subequal_to_B larger_than_B,
   74  Stylar_cusp_E / 'directly_lingual_to_D_or_D-position'
distal_to_D
small_to_indistinct,
   75  Preparacingulum / absent
interrupted_between_stylar_margin_and_paraconule
continuous_with_preprotocrista,
   76  Deep_ectoflexus / present_only_on_penultimate_molar
on_penultimate_and_succeding_molars strongly_reduced_or_absent,
   77  Metacone_size_to_paracone / noticeably_smaller slightly_smaller
subequal_or_larger absent,
   78  Metacone_position_to_paracone / labial
approximately_at_same_level lingual,
   79  Paracone_and_metacone_bases / adjoined separate,
   80  Preparacrista / strong weak_or_absent,
   81  Preparacrista / cuspate not_cuspate,
   82  Centrocrista / straight 'V-shaped' absent,
   83  Postmetacrista / extends_from_side_of_metacone_to_metastyle
salient 'weak,_from_base_of_metacone,_or_absent',
   84  Postmetacrista / cuspate not_cuspate,
   85  Preprotocrista / does_not_ does_extend_labially_beyond_paracone
absent,
   86  Postprotocrista / 'extends_to_mid-lingual_surface_of_metacone'
extends_to_distal_surface_of_metacone absent,
   87  Postvallum_wear /
'Present_but_only_by_the_first_rank:_postmetacrista'
'second_rank,_does_not_extend_labially_passed_metacone'
extends_to_metastyle absent,
   88  Paraconule / weak_or_absent 'prominent,_closer_to_protocone'
'prominent,_midway_or_closer_to_paracone',
   89  Metaconule / weak_or_absent 'prominent,_closer_to_protocone'
'prominent,_midway_or_closer_to_metacone',
   90  Internal_conular_cristae / indistinctive 'distinctive_and_wing-
like',
   91  Conular_region_width / 'narrow_(less_than_.3_total_tooth_width)'
'moderate_(.31-.50_total_tooth_width)'
'wide_(more_than_.51_total_tooth_width)',
   92  Protocone / lacking 'small,_without_trigon_basin'
'small,_with_distinct_trigon_basin' somewhat_expanded_anteroposteriorly
posterior_portion_expanded,
   93  'Protocone antero-posterior expansion' / subequal_to_paracone
larger_than_paracone,
   94  Procumbent_protocone / absent present,
   95  Protocone_labial_shift / 'no_shift_(10-20%)'
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'moderate_shift_(21-30%)' 'substantial_labial_shift_(more_than_31%)',
   96  Protocone_height / low 'tall,_approaching_paracone_and_metacone'
subequal,
   97  Precingulum_on_upper_molars / absent present
present_and_reaching_labially_passed_paraconule,
   98  Postcingulum_on_upper_molars / absent present
present_and_reaching_labially_passed_metaconule
extends_to_labial_margin,
   99  Hypocone_on_postcingulum / absent
'present,_lower_than_protocone'
'present,_subequal_to_protocone',
   100  'Pre- and postcingulum' / separated continuous,
   101  Upper_molar_roots / three four more,
   102  Last_upper_molar_roots / three two one four_or_more,
   103  Lingual_root_on_upper_molars / supporting_paracone
supporting_trigon,
   104  Last_upper_molar_width_to_penultimate / subequal smaller,
   105  Last_upper_molar_metastylar_lobe / absent present,
   106  Paraconid / distinctive vestigial_or_absent,
   107  Paraconid_height_to_metaconid / shorter subequal taller,
   108  Paraconid_on_lingual_margin / absent present,
   109  Mesiolingual_vertical_crest_of_paraconid / rounded
forming_a_keel,
   110  Paracristid / notched continous_curve,
   111  Trigonid_configuration /
'open,_paracristid-protocristid_angle_more_than_50_degrees'
'more_acute,_angle_between_36_and_49_degrees'
'anteroposteriorly_compressed,_angle_less_than_35' paraconid_absent,
   112  Protoconid_height / tallest_cusp_on_trigonid
'subequal_to_paraconid_and/or_metaconid' smaller_than,
   113  Protocristid_orientation / oblique transverse,
   114  Mesiobuccal_cingular_cusp_f / present
'present,_with_distinct_posteroventrally_directed_cingular_shelf'
'present,_with_shelf_continuing_along_buccal_border' absent,
   115  Talonid / small_heel multicuspidated_basin,
   116  Cristid_obliqua / 'incomplete,_with_distal_metacristid_present'
'complete,_attaching_lingual_to_notch_in_protocristid'
'complete,_attaching_at_or_labial_to_notch_in_protocristid'
'complete,_attaching_below_middle_posterior_of_protoconid'
'complete,_labially_placed' absent,
   117  Trigonid_height / twice_or_more_the_height_of_talonid
less_than_twice_the_height_of_talonid subequal_to_trigonid,
   118  Trigonid_to_talonid_length /
'long_(more_than_75%_of_total_length)'
'some_shortening_(51-75%_of_total_length)'
'anteroposterior_compression_of_trigonid_(50_%_or_less__of_total_length
)',
   119  Talonid_width_to_trigonid /
'very_narrow,_subequal_to_base_of_metaconid' narrower
subequal_to_wider,
   120  Hypoconulid / absent in_posteromedial_position
lingually_placed_with_slight_approximation_to_entoconid
close_approximation_to_entoconid,
   121  Hypoconulid_of_last_molar / short_and_erect
tall_and_sharply_recurved posteriorly_procumbent absent,
   122  Entoconid / absent smaller_than
'subequal_to_larger_than_hypoconid_and/or_hypoconulid',
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   123  'Postcristid (between entoconid and hypoconulid) taller than
hypoconulid and nearly transverse' / absent present,
   124  Mesoconid / absent present,
   125  Hypolophid / absent present,
   126  Labial_postcingulid / absent present,
   127  Last_lower_molar_size_to_penultimate / subequal_or_larger
smaller,
   128  Number_of_mental_foramina / two_or_more one,
   129  Anteriormost_mental_foramen /
'below_incisors_(or_anteriormost_mandible)' below_p1 below_p2
more_posterior,
   130  Posteriormost_mental_foramen /
in_canine_and_anterior_premolar_region below_penultimate_premolar
below_ultimate_premolar
at_ultimate_premolar_and_first_molar_junction_or_more_posterior,
   131  Depth_of_mandibular_body / shallow_and_long deep_and_short,
   132  Space_between_ultimate_molar_and_coronoid_process / absent
present,
   133  Coronoid_process_height / higher_than_condyle
even_with_condyle,
   134  Coronoid_process_width / 'broad_(roughly_2_molar_lengths)'
'narrow_(subequal_to_or_less_than_molar_length)',
   135  Tilting_of_coronoid_process / '135-145' '110-125' 95_to_105
tilted_anteriorly,
   136  Coronoid_crest / absent_or_weakly_developed
present_and_laterally_flaring,
   137  Ventral_border_of_masseteric_fossa / absent_or_weakly_developed
'present_as_low,_broad_crest_more_than_half_the_height_of_the_body'
'present_as_well_defined_crest,_less_than_half_the_height_of_the_body',
   138  Anteroventral_extension_of_masseteric_fossa / absent
extending_anteriorly_onto_body below_ultimate_premolar,
   139  Labial_mandibular_foramen / absent present,
   140  Condyloid_crest / absent present,
   141  Posterior_shelf_of_masseteric_fossa / absent present,
   142  Lower_jaw_angle / process_on_posterior_ramus
medially_inflected_shelf_on_ventral_ramus,
   143  Lower_jaw_angle / posteriorly_directed medially_inflected
posteroventrally_directed posterodorsally_directed,
   144  Lower_jaw_angle_length / length_less_than_ramus_length
equal_or_greater_than_ramus_length,
   145  Lower_jaw_angle_shape / 'tapers,_base_wider_than_tip'
'rounded,_base_as_wide_as_tip',
   146  Angular_process_vertical_position / posteroventral_border
'posterodorsal,_near_or_above_alveolar_plane',
   147  Angular_process_to_condylar_process /
level_with_or_posterior_to
anterior,
   148  Condylar_process / peduncle_posteriorly_directed_ absent_,
   149  Condyle_shape / ovoid cylindrical anteroposteriorly_elongate,
   150  Condyle_position_to_tooth_row / at_about_same_level
slightly_above above_by_more_than_molar_length,
   151  Mandibular_symphysis / tapered deep,
   152  Mandibular_symphysis_posterior_extent / p2_
p3_or_more_posterior
p1_or_more_anterior,
   153  Mandibular_symphysis_fused / absent present,
   154  '"Meckel''s" sulcus' / present absent,
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   155  'Curvature of "Meckel''s" sulcus' / parallel_to
convergent_on_ventral_border_of_body,
   156  '"Coronoid" facet' / present absent,
   157  Mandibular_foramen /
'anteriorly_placed,_near_back_of_dentition'
'near_ventral_margin,_at_root_of_angle'
recessed_dorsally_from_ventral_margin near_or_above_alveolar_plane,
   158  'Mandibular foramen dorsal to prominent, oblique subpterygoid
ridge' / present absent,
   159  Septomaxilla / present absent,
   160  'Premaxilla, posterodorsal process dorsal extent' / does_not
does_reach_nasal,
   161  'Premaxilla, posterodorsal process posterior extent' /
does_not_extend_beyond_canine extends_beyond_canine
contacts_frontal_posteriorly absent,
   162  'Posterodorsal process of premaxilla with distinct finger-like
extension' / present absent,
   163  Lateral_margin_of_paracanine_fossa / formed__by_maxilla
maxilla_and_premaxilla,
   164  'Exit(s) of infraorbital canal' / multiple single canal_absent,
   165  Infraorbital_foramen / dorsal_to_ult_premolar
to_penult_premolar_or_more_anterior to_first_molar_or_more_posterior,
   166  Infraorbital_canal_length / 'long_(more_than_one_molar_length)'
'short_(subequal_or_less_than_one_molar_length)',
   167  Flaring_of_cheeks_behind_infraorbital_foramen / present absent,
   168  Nasal / widest_posteriorly 'sides_sub-parallel'
widest_anteriorly,
   169  Nasal_overhangs_external_nasal_aperture / present absent,
   170  'Naso-frontal suture with medial process of frontals wedged
between nasals' / present absent,
   171  Nasofrontal_suture_position /
posterior_to_or_even_with_anterior_orbital_rim anterior_to_orbital_rim,
   172  Nasal_foramina / present absent,
   173  'Fronto-maxillary contact on rostrum' / absent present,
   174  Maxillary_process_of_frontal / vestigial_or_absent
elongate_and_thin,
   175  Preorbital_length_relative_to_postorbital_length /
'less_then_one-third' 'more_than_one-third',
   176  Lacrimal / present absent,
   177  Facial_process_of_lacrimal /
'large,_triangular_and_pointed_anteriorly'
'small,_rectangular_or_crescentic',
   178  Lacrimal_tubercle / present absent,
   179  Lacrimal_foramen_exposed_on_face / present absent,
   180  Lacrimal_foramen_number / two one,
   181  Lacrimal_foramen_within_lacrimal / yes
'no,_with_maxillary_contribution' 'no,_with_jugal_contribution',
   182  Translacrimal_canal / absent present,
   183  'Premaxilla, palatal process' / does_not
does_reach_nearly_to_canine_alveolus,
   184  'Premaxillary-maxillary suture on palate' / transverse
'wedge-shaped,_pointing_anteriorly' 'wedge-
shaped,_pointing_posteriorly',
   185  Incisive_foramen / 'small,_length_of_1_or_2_incisors'
'intermediate,_length_of_3_or_4_incisors'
'elongate,_more_than_half_the_palate_length',
   186  Incisive_foramen_composition / between_maxilla_and_premaxilla
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within_premaxilla,
   187  Palatal_vacuities / absent present_,
   188  Major_palatine_foramen / within_palatine_
between_palatine_and_maxilla_ within_maxilla multiple_small_foramina
absent,
   189  Anterior_extent_of_palatine_on_palate / first_molar_
more_posterior_ more_anterior,
   190  Palatal_expansion_to_last_molar / even posterior anterior,
   191  Postpalatine_torus / absent_ present_,
   192  Posterior_nasal_spine / weak_or_absent prominent,
   193  Minor_palatine_foramen / small_
'large,_with_thin,_posterior_bony_bridge_' multiple_small_foramina
absent,
   194  Minor_palatine_foramen_composition /
'palatine_(or_palatine-maxilla)' palatine_and_pterygoid,
   195  Maxilla_expanded_posterior_to_last_molar / absent present,
   196  Posterior_edge_of_anterior_zygomatic_root /
aligned_with_last_molar_ with_anterior_molars_ with_premolars
posterior_to_last_molar,
   197  Zygomatic_process_of_maxilla / present_ vestigial_,
   198  Jugal / present absent,
   199  Jugal / contributes_to_anteroventral_orbit_and_zygoma
contributes_to_zygoma,
   200  'Maxillary-jugal contact bifurcated' / absent present,
   201  'Jugal-lacrimal contact' / present absent,
   202  Zygomatic_arch / stout delicate incomplete,
   203  Molar_roots_exposed_in_orbit_floor / absent present,
   204  Palatine_reaches_infraorbital_canal / present absent,
   205  Lacrimal_contributes_to_maxillary_foramen / present absent,
   206  Groove_connects_maxillary_and_sphenopalatine_foramina / absent
present,
   207  Sphenopalatine_foramen / within_palatine
between_palatine_and_maxilla 'between_palatine,_maxilla,_and_frontal'
within_maxilla,
   208  Sphenopalatine_foramen_proximal_to_maxillary_foramen / absent
present,
   209  Maxilla_excluded_from_medial_orbital_wall / present absent,
   210  Frontal_and_maxilla_contact_in_medial_orbital_wall / absent
present,
   211  Orbital_process_of_palatine / present
'absent_(palatine_excluded_from_medial_wall)_or_thin_sliver_in_ventrome
dial_wall',
   212  Ethmoid_exposure_in_orbit / absent present,
   213  Ethmoid_foramen / between_frontal_and_orbitosphenoid
within_frontal,
   214  Foramen_for_frontal_diploic_vein / absent present,
   215  'Frontal foramen (on skull roof)' / absent present,
   216  Postorbital_process / 'present,_prominent' 'present,_weak'
absent,
   217  Postorbital_process_composition / frontal parietal,
   218  Postorbital_bar / absent present,
   219  Dorsal_process_of_jugal / weak_or_absent strong,
   220  Optic_foramen / absent present,
   221  Optic_foramen_position /
narrowly_separated_from_sphenorbital_fissure
broadly_separated_from_sphenorbital_fissure
not_visible_in_lateral_view,
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   222  Orbitosphenoid / expanded_anteriorly expanded_dorsally
confined_to_optic_foramen_and_vicinity,
   223  Suboptic_foramen / absent present,
   224  Orbitotemporal_canal / present absent,
   225  'Frontal/alisphenoid contact' /
alisphenoid_contacting_frontal_at_anterior_corner
'with_more_extensive_contact_(50%_of_dorsal_border)' absent,
   226  Frontal_length_on_midline_skull_roof /
subequal_to_slightly_smaller_than_parietal less_than_half_parietal
more_than_.5_longer_than_parietal,
   227  Frontoparietal_suture / transverse
with_anterior_process_of_parietal_off_the_midline
with_anterior_process_of_parietal_on_the_midline,
   228  Temporal_lines_meet_to_form_sagittal_crest / present absent,
   229  Interparietal / absent present,
   230  Nuchal_crest / level_with_or_anterior_to_foramen_magnum
extends_posteriorly,
   231  Anterior_lamina_on_side_wall / present absent,
   232  Squama_of_squamosal / absent_ present_,
   233  Foramina_for_temporal_rami / on_petrosal_
on_parietal_and_or_squamosal_ absent,
   234  Choanae / as_wide_as_posterior_palate narrower,
   235  Vomer_contacts_pterygoid / present absent,
   236  Pterygoids_contact_on_midline_in_roof_of_basipharyngeal_canal /
present_ absent_,
   237  Pterygopalatine_crests / present_ absent_,
   238  Midline_crest_in_basipharyngeal_canal / absent_ present_,
   239  Entopterygoid_process / absent ends_at_anterior_basisphenoid
approaches_ear_region,
   240  Midline_cordiform_eminence_on_basisphenoid / absent_ present_,
   241  Ectopterygoid_process_of_alisphenoid / absent_
ends_at_anterior_basisphenoid approaches_ear_region,
   242  Ectopterygoid_process / Long_crest small_process,
   243  Transverse_canal_foramen / absent_ present_,
   244  Exit_for_maxillary_nerve_to_alisphenoid / behind_ within_
in_front,
   245  Number_of_mandibular_nerve_exits / two_or_more one_,
   246  Foramen_ovale_composition / in_petrosal
between_petrosal_and_alisphenoid in_alisphenoid
between_alisphenoid_and_squamosal,
   247  Foramen_ovale_position / on_lateral_wall_of_braincase
on_ventral_surface_of_skull,
   248  Alisphenoid_canal / absent present,
   249  Posterior_opening_of_alisphenoid_canal /
separated_from_foramen_ovale in_common_depression_with_foramen_ovale,
   250  Position_of_jaw_articulation_to_fenestra_vestibuli /
at_same_level in_front,
   251  Glenoid_fossa / on_zygoma partially_on_braincase,
   252  Glenoid_fossa_shape / 'concave,_open_anteriorly' 'trough-like'
'anteroposteriorly_elongate,_concave' anteroposteriorly_short
'convex,_open_anteriorly',
   253  Glenoid_fossa_vertical_position / even_with_central_stem
significantly_higher,
   254  Glenoid_process_of_jugal / 'present,_with_articular_facet'
'present,_without_facet' absent,
   255  Glenoid_process_of_alisphenoid / absent present,
   256  Postglenoid_process / absent present,
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   257  Postglenoid_foramen / absent_or_vestigial present,
   258  Postglenoid_foramen_position /
'present,_behind_postglenoid_process'
'present,_medial_to_postglenoid_process,_within_glenoid_fossa'
on_lateral_aspect_of_braincase,
   259  Postglenoid_foramen_composition / within_squamosal
behind_squamosal,
   260  Suprameatal_foramen / absent present,
   261  Entoglenoid_process_of_squamosal / absent
'present,_separate_from_postglenoid_process'
'present,_continuous_with_postglenoid_process',
   262  Posttympanic_crest_of_squamosal / absent present,
   263  Carotid_foramen / within_basisphenoid_
between_basisphenoid_and_petrosal_ absent,
   264  Cavum_epiptericum / floored_by_petrosal_
petrosal_and_alisphenoid_ primarily_or_exclusively_squamosal
open_as_piriform_fenestra,
   265  Alisphenoid_tympanic_process / absent_ 'present,_low',
   266  Basisphenoid_tympanic_process / vestigial_or_absent
'present,_contributing_to_anteromedial_bulla',
   267  Basicochlear_fissure / closed patent,
   268  Epitympanic_wing_medial_to_promontorium / absent_ flat_
thickened,
   269  RTPP / vestigial_or_absent
'low_ridge,_contributing_to_posteromedial_bulla'
'tall_ridge,_contributing_to_ventral_bulla',
   270  Course_of_internal_carotid_artery /
'lateral_(transpromontorial)' 'medial_(perbullar_or_extrabullar)'
artery_absent,
   271  'Intratympanic vascular canal for internal carotid (in lateral
position)' / absent present,
   272  Deep_groove_for_internal_carotid_on_anterior_pole / absent_
present_,
   273  'Perbullar carotid canal (for medial course)' / absent present,
   274  Stapedial_artery / sulcus canal_ absent,
   275  Stapedial_ratio / 'rounded,_less_than_1.8_'
'ellipital,_more_than_1.8_',
   276  Coiling_of_cochlea / less_than_360_ 360_or_greater_,
   277  Pars_cochlearis_length / greater_than_13%_skull_length
less_than_10_%_skull_length,
   278  Promontorium_shape / flat globose,
   279  Promontorium_depth / even_with_or_lower_than_basioccipital
higher_than_basioccipital,
   280  Facial_nerve_intratympanic_course / open_in_sulcus
'open_anteriorly,_in_canal_posteriorly' in_canal,
   281  Tympanic_aperture_of_hiatus_Fallopii /
in_roof_through_petrosal_
at_anterior_edge_of_petrosal_ absent semilunar_hiatus,
   282  Prootic_canal / present absent,
   283  Prootic_canal / long_and_vertical_ short_and_vertical_
short_and_horizontal,
   284  Lateral_flange / parallels_length_of_promontorium_
greatly_reduced_or_absent,
   285  Bony_shelf_lateral_to_promontorium / extended_anteriorly
confined_posterolaterally prolonged_anterior_to_promonotorium,
   286  Tegmen_tympani_width / uniform expanded_anteriorly,
   287  tegmen_tympani_inflation / absent present,
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   288  Stapedial_canal_on_tegmen_tympani / absent present,
   289  Tensor_tympani_fossa / shallow_or_vestigial circular_pit,
   290  Medial_process_of_squamosal_in_tympanic_cavity / absent_
present_,
   291  Hypotympanic_sinus / absent_
'formed_by_squamosal,_petrosal,_and_alisphenoid_'
formed_by_alisphenoid_and_petrosal formed_by_petrosal,
   292  'Epitympanic recess/fossa incudis size' / subequal
epitympanic_recess_larger no_visible_depression_for_epitympanic_recess,
   293  Epitympanic_recess /
with_small_contribution_to_posterolateral_wall_by_squamosal_
with_extensive_contribution_to_lateral_wall_by_squamosal_
with_no_squamosal_contribution,
   294  Fossa_incudis / continuous_with_
separated_from_epitympanic_recess_,
   295  Fossa_incudis / open_ventrally floored_by_squamosal
floored_by_ectotympanic,
   296  Fossa_incudis_position_relative_to_fenestra_vestibuli / lateral
anterior,
   297  Foramen_for_ramus_superior / on_petrosal_
'on_petrosal-squamosal_suture_' absent,
   298  Foramen_for_ramus_superior_to_f._vestibuli /
posterior_or_lateral_ anterior_,
   299  Ascending_canal / intramural_ intracranial_ absent,
   300  Stapedius_fossa / twice_size_of_fenestra_vestibuli_
small_and_shallow_,
   301  Cochlear_canaliculus_visible_canal_in_middle_ear / absent
present,
   302  Cochlear_fossula / vestigial_or_absent
distinct_pit_behind_fenestra_cochleae,
   303  Fenestra_cochleae / posteromedial_to_fenestra_vestibuli
posterior_to_fenestra_vestibuli,
   304  Posterior_septum_shields_fenestra_cochleae / absent present,
   305  Paroccipital_process_orientation / vertical_
'slanted,_towards_back_of_promontorium_' indistinct_to_absent,
   306  CTPP_notched / absent present,
   307  Crista_interfenestralis_and_CTPP_connected_by_curved_ridge /
absent_ present_,
   308  '"Tympanic process"' / absent_ 'present,_low'
inflated_into_bulla_wall,
   309  '"Tympanic process" composition' / petrosal
petrosal_and_exoccipital,
   310  Rear_margin_of_auditory_region / marked_by_steep_wall_
extended_onto_flat_surface_,
   311  Inferior_petrosal_sinus / intrapetrosal_
'between_petrosal,_basisphenoid,_and_basioccipital_' endocranial,
   312  Jugular_foramen_size_to_f._cochleae / subequal_ larger_,
   313  Jugular_foramen / confluent_with_
separated_from_opening_for_inferior_petrosal_sinus_,
   314  Hypoglossal_foramen / two_or_more_ one_ absent,
   315  Hypoglossal_foramen_size / smaller_than_jugular_foramen
housed_in_large_opening_subequal_to_larger_than_jugular_foramen,
   316  Paracondylar_process / weak_or_absent_ 'prominent,_vertical'
'prominent,_posteriorly_directed',
   317  Ectotympanic / phaneric aphaneric,
   318  Ectotympanic_shape / 'ring-like_' fusiform_
'expanded,_contributing_to_bullar_floor',
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   319  Ant_crus_ectotympanic_broadly_contacts_squamosal / absent_
present_,
   320  Elongate_ossified_external_acoustic_meatus / absent present,
   321  Roof_of_external_acoustic_meatus / petrosal squamosal,
   322  Entotympanic / absent_ present_,
   323  Hyoid_pit / absent present,
   324  Hyoid_contributes_to_bullar_floor / absent present,
   325  Dorsum_sellae / tall_ low_,
   326  Post_clinoid_process_contacts_promontorium / absent_ present_,
   327  Position_of_ant_distrib_of_transverse_sinus_to_subarcuate_fossa
/ anterolateral_ posterolateral_ absent,
   328  Wall_separating_cavum_supracochleare_and_epiptericum / absent_
incomplete complete,
   329  Crista_petrosa / vestigial_or_absent 'tall,_thin_crest',
   330  Subarcuate_fossa_aperture / not_constricted constricted absent,
   331  Anterior_semicircular_canal / does_
does_not_form_lateral_wall_of_subarcuate_fossa,
   332  Internal_acoustic_meatus /
'deep,_with_thick_prefacial_commissure_'
'shallow,_with_thin_prefacial_commissure_',
   333  Posttemporal_canal / large small absent,
   334  Posttemporal_canal_composition /
posterior_opening_between_petrosal_and_squamosal within_petrosal,
   335  Posttemporal_canal_position / on_occiput
dorsal_to_external_acoustic_meatus,
   336  Mastoid_foramen / absent_ two_in_mastoid_ one_in_mastoid
between_mastoid_and_supraoccipital,
   337  Amastoidy / absent present,
   338  Dorsal_margin_of_foramen_magnum / formed_by_exoccipitals_
by_exoccipitals_and_supraoccipital_,
   339  Atlantal_foramen / present_ absent_,
   340  Atlas_neural_arch_fused / absent_ present_,
   341  Atlas_neural_arch_and_intercentrum_fused / absent_ present_,
   342  Axis / with_suture_between_atlantal_and_axial_parts
without_suture,
   343  Axis_with_extra_pair_of_transverse_processes_on_ventral_surface
/ present_ absent_,
   344  Axis_anterior_facets_and_dens_connection / not_linked_ linked_
facets_extend_ventral_to_dens,
   345  Cervical_inferior_lamellae / present absent,
   346  'C7 (or last)  transverse foramen' / present_ absent_,
   347  Thoracic_vertebrae / 13_or_fewer 15_or_more,
   348  Number_of_lumbars / six_or_more five_or_fewer,
   349  'Xenarthrous articulation in addition to the pre- and
post-zygapophyses of lumbar vertebrae' / absent present,
   350  Sacral_vertebrae / two three four_or_more,
   351  Sacral_vertebra_fused_to_pelvis / absent present,
   352  Infraspinous_fossa_position_and_size_to_supraspinous /
different_planes_and_larger_ coplanar_and_subequal_,
   353  Suprascapular_incisure / absent_ present_,
   354  Acromion / reaches_distal_to_glenoid_articulation_with_humerus
remains_proximal absent,
   355  Metacromion / weak_or_absent distinct_process,
   356  Greater_tubercle_of_humerus / ventral_to_humeral_head
even_or_dorsal_to_humeral_head,
   357  Deltopectoral_crest / proximal_half_of_humerus_
distal_half_of_humerus_,
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   358  Supinator_ridge / weak_or_absent_ 'shelf-like',
   359  Medial_epicondyle / robust weak,
   360  Entepicondylar_foramen / present absent,
   361  Supratrochlear_foramen / absent_ present_,
   362  Ulnar_articulation_on_humerus / spherical_ cylindrical_,
   363  Radial_articulation_on_humerus /
rounded_radial_condyle_anteriorly_but_cylindrical_posteriorly
capitulum,
   364  Radius_articulation_with_distal_humerus / single_fossa
two_fossae,
   365  Central_process_of_radial_head / small_or_absent present,
   366  Radius_and_ulna_distal_fusion / absent present,
   367  Radius_articulation_with_carpals / single_fossa two_fossae,
   368  Scaphoid_and_lunate / separate fused,
   369  Centrale / present absent,
   370  Pubic_symphysis / extensive narrow,
   371  Epipubic_bone / present_ absent_,
   372  Articular_surface_of_femoral_head / extended_posterolaterally
limited_to_sphere_of_femoral_head,
   373  Fovea_for_ligamentum_teres /
does_not_interrupt_margin_of_articular_surface does absent,
   374  Greater_trochanter_to_femoral_head / lower higher,
   375  Size_of_lesser_trochanter_of_femur / large_ small_,
   376  Third_trochanter / absent present,
   377  Pectineal_tubercle / absent_or_vestigial distinct,
   378  Distal_femur /
similarly_sized_in_anteroposterior_and_mediolateral_dimensions
longer_anteroposteriorly_than_mediolaterally,
   379  Patellar_facet_of_femur / 'shallow,_weakly_developed_'
broad_and_shallow narrow_and_elevated,
   380  Ossified_patella / absent_ present_,
   381  Articulation_betw_femur_and_fibula / absent_ present_,
   382  Tibia_and_fibula_proximal_fusion / absent present,
   383  Tibia_and_fibula_distal_fusion / absent present,
   384  Depth_of_trochlear_groove / absent_or_shallow
'moderately_deep_(U-shaped)' 'deep_(V-shaped)',
   385  'Astragalus, angle bet med and lat tib facets' / 180_
intermediate_ 90 lateral_tibial_facet_absent,
   386  'Astragalus, angle betw fib facet and lat tib facet' / 180
intermediate_ 90,
   387  Radius_of_curvature_of_lateral_trochlear_ridge /
greater_than_medial subequal,
   388  Cotylar_fossa / absent present,
   389  Sustentacular_and_navicular_facets_of_astragalus_contact /
absent present,
   390  Astragalar_sustentacular_facet_medial_extent / does_not__
does_reach_medial_edge_of_neck_,
   391  'Astragalar medial plantar tubercle (ampt)' /
vestigial_or_absent protruding,
   392  Astragalar_neck / absent_ present_ present_long,
   393  Astragalar_head_convexity / absent present,
   394  Facet_on_astragalus_for_cuboid / absent present,
   395  Astragalar_canal / present dorsal_foramen_only absent,
   396  Posterior_trochlear_shelf_of_astragalus / reduced strong,
   397  Calcaneal_width /
'broad,_with_sustentacular_and_ectal_facets_extending_away_from_body'
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'narrow,_with_sustentacular_and_ectal_facets_in_line_with_long_axis_of_
body',
   398  'Ectal (post calcaneoastragalar facet) longest dimension' /
anteromedial_to_posterolateral_ straight_
posteromedial_to_anterolateral,
   399  Overlap_between_ectal_and_sustentacular_facets /
partial_overlap
complete_overlap absent,
   400  Calcaneal_sustentacular_facet_mesiolateral_orientation /
medial_
dorsal_,
   401  Calcaneal_sustentacular_facet_expanded_onto_body / absent
present,
   402  Calcaneal_anterior_peroneal_tubercle_position /
protruding_anteriorly_beyond_calcaneocuboid_facet_
'anterior,_non-protruding_'
at_a_distance_from_anterior_end_of_calcaneum
absent,
   403  Calcaneal_plantar_tubercle / absent_ at_distal_margin
more_proximal,
   404  Tuber_calcis_ventral_curvature / present_ absent_,
   405  Calcaneal_facet_for_fibula / present absent,
   406
Orientation_of_ML_axis_of_cuboid_facet_relative_to_long_axis_of_calcane
um
/ less_than_70_degrees 70_to_80_degrees approximately_90_degrees,
   407  Proportions_of_cuboid_facet / depth_and_width_subequal
deeper_than_wide wider_than_deep,
   408  Deep_groove_for_tendon_of_flexor_fibularis / absent present
            ;

MATRIX
[                          10        20        30        40        50
      60        70        80        90       100       110       120
     130       140       150       160       170       180       190
     200       210       220       230       240       250       260
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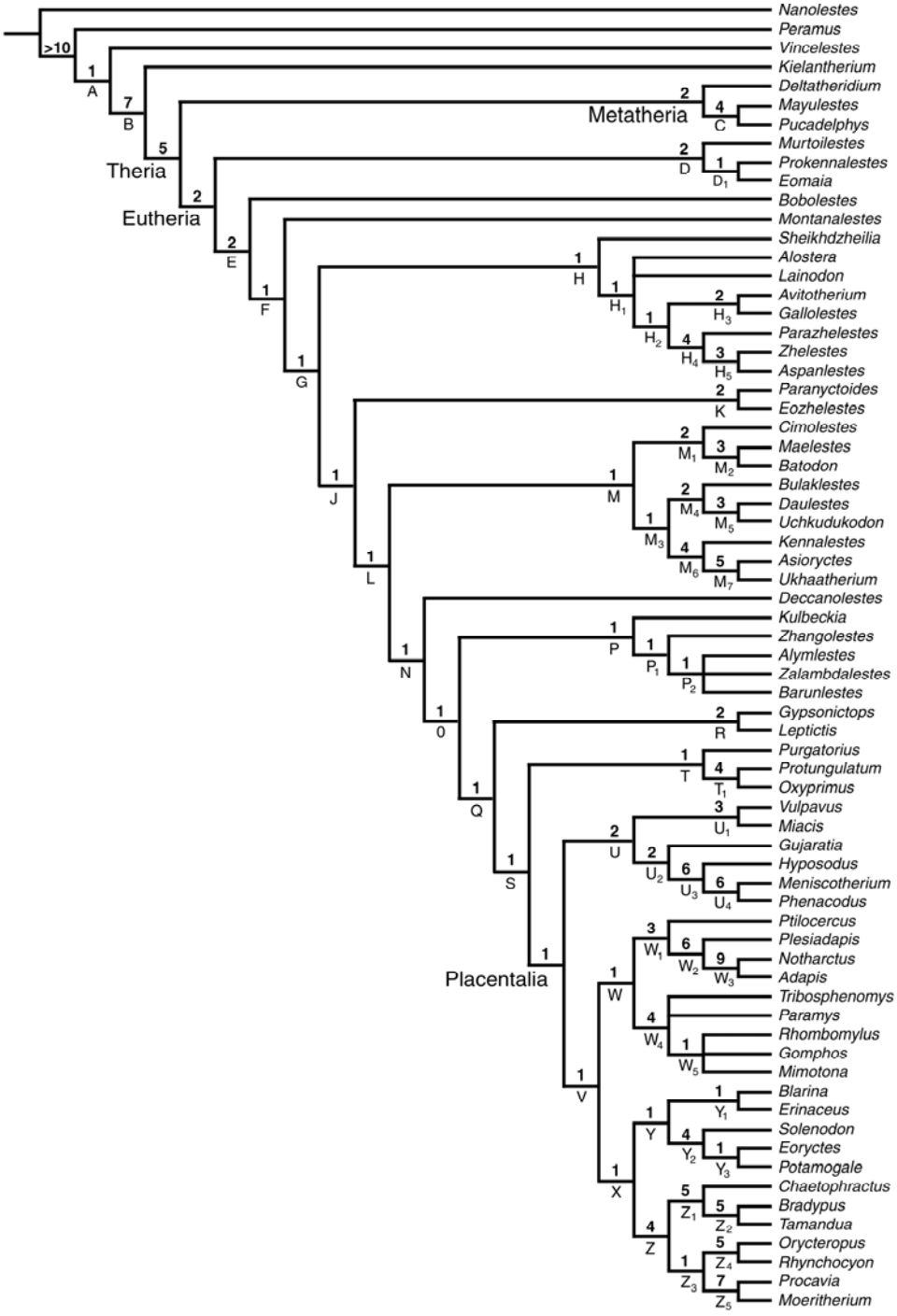
Part VI. TNT Analysis



Supplementary Figure 6. Heuristic searches of the taxon-character matrix in Part IV. with multistate characters unordered employing the program TNT (Goloboff et al., 2003) yielded three most parsimonious trees (tree length = 2296; Consistency Index = 0.261; Retention Index = 0.551). The strict consensus of these three trees is shown above.

Numbers above nodes indicate Bremer branch support, and letters below nodes refer to nodes in the diagnoses. Bremer supports are calculated from a pool of 50,000 suboptimal trees of up to 10 steps longer than the shortest trees obtained. To recover the same results in PAUP (Swofford, 2002), multistate taxa should be set to "uncertainty" and zero-length branches should be set to collapse if their minimum length is zero ("amb-").

Diagnoses of Nodes (characters in common on strict consensus tree)

Node A – *Vincelestes* + (*Kielantherium* + Theria)
68 (1) M2 parastylar lobe less than 30% but more than 20% of tooth length
84 (1) M2 postmetacrista non-cuspate
103 (1) lingual root on upper molars supporting trigon

Node B – *Kielantherium* + Theria
64 (1) M2 wider than long (length more than 75% but less than 99% of width)
65 (1) M2 stylar shelf less than 50% but more than 25% total tooth width
66 (1) M2 parastylar and metastylar lobes of similar labial extent
74 (2) M2 stylar cusp E small to indistinct
75 (2) M2 preparacingulum continuous between stylar margin and paraconule or paraconule position
87 (1) M2 postvallum shear with second rank that does not extend labial to metaconal base
115 (1) multicuspidate lower molar talonid
118 (1) m2 trigonid with some anteroposterior shortening relative to talonid (trigonid 50% to 75% of tooth length)

Theria
70 (0) M2 stylar cusp A subequal to larger than B
88 (2) M2 paraconule prominent, midway or closer to paracone
89 (2) M2 metaconule prominent, midway or closer to protocone
91 (1) M2 conular region moderate (0.31–0.50 total tooth length)
121 (1) hypoconulid of ultimate lower molar tall and sharply recurved
122 (1) m2 entoconid smaller than hypoconid and/or hypoconulid

Metatheria
3 (1) seven postcanine tooth families
22 (1) staggered lower incisor
29 (2) three premolars
47 (1) first lower premolar oblique
62 (1) molar size increasing posteriorly
130 (3) posteriormost mental foramen at ultimate premolar first molar junction or more posterior
139 (0) labial mandibular foramen absent
140 (0) condyloid crest absent
142 (1) angular process shelf along ventral border of mandible
143 (1) angular process medially directed

154 (1) "Meckelian" groove absent
156 (1) "coronoid" facet absent
179 (0) lacrimal foramen exposed on face
183 (1) palatal process of premaxilla reaches nearly or to canine alveolus
252 (1) glenoid fossa trough-like
270 (1) medial course of internal carotid artery
274 (2) stapedial artery absent
297 (2) foramen for ramus superior absent
299 (2) ascending canal absent
313 (1) opening for inferior petrosal sinus separate from jugular foramen
327 (1) sulcus for anterior distributary of transverse sinus posterolateral to subarcuate fossa

Node C – *Mayulestes* + *Pucadelphys*
32 (1) first upper premolar procumbent
71 (2) M2 stylar cusp B subequal to paracone
77(2) M2 metacone subequal or larger than paracone
78 (2) M2 metacone lingual relative to paracone
79 (1) M2 paracone and metacone bases separated
93 (1) M2 protocone anteroposteriorly expanded
94 (1) M2 protocone procumbent
109 (1) m2 mesiolingual vertical crest of paraconid keeled
113 (1) m2 protocristid transverse
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid
120 (3) m2 hypoconulid close approximation to entoconid
126 (1) m2 labial postcingulid present
185 (1) incisive foramen intermediate in length (length of 3 to 4 incisors)
190 (1) palatal expanded posterior to ultimate molar
255 (1) glenoid process of alisphenoid present
272 (1) deep groove for internal carotid artery on anterior pole of promontorium
300 (1) stapedius fossa small and shallow
312 (1) jugular foramen larger than fenestra cochleae

Eutheria
31 (1) tall, trenchant upper premolar in penultimate position
36 (1) penultimate upper premolar protocone small lingual bulge
40 (1) ultimate upper premolar protocone smaller than paracone
55 (1) ultimate lower premolar paraconid distinctive but low
118 (2) m2 trigonid anteroposteriorly compressed (less than 50% total length)
175 (1) preorbital length more than one-third skull length
202 (1) zygomatic arch delicate
293 (1) epitympanic recess lateral wall with extensive squamosal contribution
380 (1) ossified patella present
391 (1) astragalar medial plantar tuberosity protruding
400 (1) calcaneal sustentacular facet with dorsal mesiolateral orientation

Node D – *Murtoilestes* + (*Prokennalestes* + *Eomaia*)
69 (1) M2 preparastyle present
84 (0) M2 postmetacrista cuspate
88 (1) M2 paraconule prominent, closer to protocone

Node D_1 – *Prokennalestes* + *Eomaia*
66 (0) M2 parastylar lobe labial relative to metastylar lobe
77 (0) M2 metacone noticeably smaller than paracone
89 (1) M2 metaconule prominent, closer to protocone

Node E
71 (1) M2 stylar cusp B vestigial or absent
73 (0) M2 stylar cusp D absent
90 (1) M2 internal conular cristae distinctive and wing-like
94 (1) M2 protocone procumbent
96 (1) M2 protocone height approaching paracone and metacone
157 (2) mandibular foramen recessed dorsally from ventral margin, but below alveolar plane

Node F
60 (1) ultimate lower premolar anterolingual cingulid present
154 (1) "Meckelian" groove absent

Node G
57 (1) ultimate lower premolar talonid as wide as anterior portion of crown
119 (2) m2 talonid width subequal to wider than trigonid
122 (2) m2 entoconid larger than hypoconid and/or hypoconulid
156 (1) "coronoid" facet absent

Node H – Zhelestidae – defined here as the clade formed by *Sheikhdzheilia*, *Zhelestes*, and all their descendants
65 (2) M2 stylar shelf less than 25% total tooth width
83 (2) M2 postmetacrista weak or absent
91 (2) M2 conular region wide (greater than .51 total tooth length)
96 (2) M2 protocone height subequal to paracone and metacone
120 (3) m2 hypoconulid close approximation to entoconid

Node H_1
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid

Node H_2
126 (1) m2 labial postcingulid present

Node H_3 – *Avitotherium* + *Gallolestes*
97 (1) M2 precingulum present
114 (0) m2 anterior and labial (mesio-buccal) cingular cuspule (f) present

Node H_4 – *Parazhelestes* + (*Zhelestes* + *Aspanlestes*)
53 (1) penultimate lower premolar metaconid swelling
55 (0) ultimate lower premolar paraconid indistinctive
66 (2) M2 metastylar lobe labial relative to parastylar lobe
69 (1) M2 preparastyle present
113 (1) m2 protocristid transverse
116 (2) m2 cristid obliqua attaching labial to notch in protocristid
121 (0) hypoconulid of ultimate lower molar short and erect

Node H_5 – *Zhelestes* + *Aspanlestes*
43 (1) ultimate upper premolar precingulum present
44 (1) ultimate upper premolar postcingulum present
64 (2) M2 much wider than long (length less than 75% of width)

Node J
42 (2) Ultimate upper premolar parastylar lobe larger than metastylar
95 (1) moderate labial shift of M2 protocone

Node K – *Paranyctoides* + *Eozhelestes*
25 (1) lower canine small
52 (1) penultimate lower premolar paraconid distinctive
126 (1) m2 labial postcingulid present

Node L
3 (1) seven postcanine tooth families
8 (1) three lower incisors
29 (1) four premolars
39 (1) penultimate upper premolar three roots

Node M
77 (0) M2 metacone noticeably smaller than paracone
79 (0) M2 metacone and paracone bases adjoined
119 (1) m2 talonid width narrower than trigonid
194 (1) minor palatine foramen formed by palatine and pterygoid
226 (1) frontal length on midline less than half that of parietal
296 (1) fossa incudis anterior relative to fenestra vestibuli
315 (1) hypoglossal foramen size housed in opening larger than jugular foramen
321 (0) petrosal roof for external acoustic meatus

Node M_1 – Cimolestidae
17 (1) anteriormost lower incisor procumbent
21 (1) posterior lower incisor(s) procumbent
33 (1) first upper premolar one root
48 (1) first lower premolar one root
57 (0) ultimate lower premolar talonid narrower than anterior portion of crown

95 (0) no labial shift of M2 protocone

Node M_2 – *Maelestes* + *Batodon*
65 (2) M2 stylar shelf less than 25% total tooth width
75 (1) M2 preparacingulum interrupted between stylar margin and paraconule
113 (1) m2 protocristid transverse
120 (2) m2 hypoconulid lingually placed with slight approximation to entoconid
129 (2) anteriormost mental foramen below second premolar

Node M_3 – Asioryctitheria sensu Archibald and Averianov, 2006
26 (0) lower canine two roots
94 (0) M2 protocone not procumbent
122 (1) m2 entoconid smaller than hypoconid and/or hypoconulid
216 (2) postorbital process absent
258 (1) postglenoid foramen medial or anterior to postglenoid process

Node M_4 – *Bulaklestes* + (*Daulestes* + *Uchkudukodon*)
39 (0) penultimate upper premolar two roots
67 (1) M1 parastylar lobe anterior to paracone
121 (2) ultimate lower molar hypoconulid posteriorly procumbent

Node M_5 – *Daulestes* + *Uchkudukodon*
70 (0) M2 stylar cusp A subequal to larger than B
71 (0) M2 stylar cusp B distinctive
95 (0) no labial shift of M2 protocone
111 (2) m2 trigonid anteroposteriorly compressed

Node M_6 – *Kennalestes* + (*Asioryctes* + *Ukhaatherium*)
49 (1) diastema separating first and second lower premolars present
113 (1) m2 protocristid transverse
135 (2) tilting of coronoid process near vertical (95^o to 105^o)
270 (1) medial course of internal carotid artery
340 (1) atlas neural arch fused

Node M_7 – *Asioryctes* + *Ukhaatherium*
8 (0) four lower incisors
36 (2) penultimate upper premolar protocone with enlarged basin
41 (2) ultimate upper premolar metacone large
52 (1) penultimate lower premolar paraconid distinctive
111 (2) m2 trigonid anteroposteriorly compressed
129 (0) anteriormost mental foramen below incisors (or anteriormost mandible)
200 (1) maxillary-jugal contact bifurcated

Node N
38 (1) penultimate upper premolar parastylar lobe well developed
56 (2) ultimate lower premolar metaconid large

96 (2) M2 protocone height subequal to paracone and metacone
404 (1) tuber calcis ventral curvature absent
405 (1) calcaneal facet for fibula absent

Node O
65 (2) M2 stylar shelf less than 25% total tooth width
68 (2) M2 parastylar lobe 20% or less of tooth length
76 (2) upper molar deep ectoflexus strongly reduced or absent
83 (2) M2 postmetacrista weak or absent
91 (2) M2 conular region wide (greater than .51 total tooth length)
111 (2) m2 trigonid anteroposteriorly compressed
385 (2) astragalus, angle between medial and lateral facets for tibia 90°
395 (2) astragalar canal absent

Node P – Zalambdalestidae
14 (2) ultimate upper incisor in maxilla
15 (1) anteriormost lower incisor size greatly enlarged
17 (1) anteriormost lower incisor procumbent
20 (1) anteriormost lower incisor enamel discontinuous posteriorly
21 (1) posterior lower incisor(s) procumbent
120 (2) m2 hypoconulid lingually placed with slight approximation to entoconid
130 (1) posteriormost mental foramen below penultimate premolar
182 (1) translacrimal canal present
184 (1) premaxillary-maxillary suture on palate wedge-shaped, pointing anteriorly
270 (1) medial course of internal carotid artery

Node P_1 – *Zhangolestes* + (*Alymlestes* + *Zalambdalestes* + *Barunlestes*)
25 (1) lower canine small
60 (0) ultimate lower premolar anterolingual cingulid absent
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid

Node P_2 – *Alymlestes* + *Zalambdalestes* + *Barunlestes*
108 (1) m2 paraconid on lingual margin
120 (3) m2 hypoconulid close approximation to entoconid

Node Q
40 (2) ultimate upper premolar protocone approaches paracone in height
44 (1) ultimate upper premolar postcingulum present
97 (2) M2 precingulum present, reaching labially passed paraconule
98 (2) M2 postcingulum present, reaching labially passed metaconule
150 (2) condyle more than molar length above tooth row
163 (1) lateral margin of paracanine fossa formed by maxilla and premaxilla
170 (1) naso-frontal suture with no medial process of frontals wedged between nasals
173 (1) frontal-maxillary contact on rostrum
183 (1) palatal process of premaxilla reaches nearly or to canine alveolus

216 (2) postorbital process absent
235 (1) vomer contacts pterygoid
236 (1) pterygoids do not contact on midline
238 (0) midline crest in basipharyngeal canal absent
244 (2) exit for maxillary nerve in front of alisphenoid
246 (2) foramen ovale in alisphenoid
248 (1) alisphenoid canal present
312 (1) jugular foramen larger than fenestra cochleae
333 (2) posttemporal canal absent
341 (1) atlas neural arch and intercentrum fused
342 (1) axis without suture between atlantal and axial parts
371 (1) epipubic bones absent

Node R – *Gypsonictops* + *Leptictis*
43 (1) ultimate upper premolar precingulum present
45 (1) ultimate upper premolar conules prominent
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid

Node S
31 (2) tall, trenchant upper premolar absent
77 (2) M2 metacone subequal or larger than paracone
93 (1) M2 protocone anteroposteriorly expanded
268 (0) epitympanic wing medial promontorium absent

Node T – *Purgatorius* (*Protungulatum* + *Oxyprimus*)
57 (0) ultimate lower premolar talonid narrower than anterior portion of crown
95 (2) substantial labial shift of M2 protocone
111 (1) m2 trigonid more acute

Node T_1 – *Protungulatum* + *Oxyprimus*
52 (1) penultimate lower premolar paraconid distinctive
62 (1) molar size increasing posteriorly
87 (2) M2 postvallum shear with second rank extending to metastylar lobe
89 (1) M2 metaconule prominent, closer to protocone
119 (1) m2 talonid narrower than trigonid
126 (1) m2 labial postcingulid present

Placentalia
38 (0) penultimate upper premolar parastylar lobe absent or small
60 (0) ultimate lower premolar anterolingual cingulid absent
98 (3) M2 postcingulum present, extending to labial margin
140 (0) condyloid crest absent
311 (2) inferior petrosal sinus endocranial

Node U
49 (1) diastema separating first and second lower premolars present, subequal to

one tooth-root diameter or more
143 (0) angular process posteriorly directed
149 (1) condyle cylindrical
204 (0) palatine reaches infraorbital canal
230 (1) nuchal crest posterior relative to foramen magnum
249 (1) posterior opening of alisphenoid canal in common depression with foramen ovale
278 (0) promontorium flat
279 (1) promontorium higher relative to basioccipital
289 (1) tensor tympani fossa circular pit
392 (2) astragalar neck present, similar in length to body width

Node U_1 – Carnivora (*Vulpavus* + *Miacis*)
31 (0) tall, trenchant upper premolar in ultimate position
32 (1) first upper premolar procumbent
40 (1) ultimate upper premolar protocone shorter than paracone
42 (3) ultimate upper premolar metastylar lobe larger than parastylar lobe
44 (0) ultimate upper premolar postcingulum absent
57 (0) ultimate lower premolar talonid narrower than anterior portion of crown
96 (1) M2 protocone tall, approaching paracone and metacone
98 (1) M2 postcingulum present
107 (1) m2 paraconid subequal in height to metaconid
108 (1) m2 paraconid on lingual margin
127 (1) ultimate lower molar smaller than penultimate lower molar
147 (1) angular process anterior relative to condylar process
224 (1) orbitotemporal canal absent
227 (1) frontoparietal suture with anterior process of parietal off the midline
262 (1) posttympanic crest of squamosal present
285 (2) bony shelf lateral to promonotorium (lateral trough or tegmen tympani) prolonged anterior to promontorium
302 (0) cochlear fossula weak or absent
305 (0) paroccipital process vertical
395 (1) astragalar canal, dorsal foramen only

Node U_2 – *Gujaratia* (*Hyopsodus* + (*Meniscotherium* + *Phenacodus*))
43 (1) ultimate upper premolar precingulum present
63 (1) molar cusp form inflated, robust
64 (1) M2 wider than long (length more than 75% but less than 99% of width)
117 (2) m2 trigonid height subequal to talonid height
126 (1) m2 labial postcingulid present
364 (1) humeral articulation on radius two fossae
367 (1) radial articulation with carpals two fossae

Node U_3 – *Hyopsodus* + (*Meniscotherium* + *Phenacodus*)
58 (1) ultimate lower premolar talonid with two cusps
86 (2) M2 postprotocrista absent

87 (0) M2 postvallum shear present but only by first rank: postmetacrista
99 (2) M2 hypocone on postcingulum present, subequal to protocone
145 (1) angular process rounded, base as wide as tip
221 (1) optic foramen broadly separated from sphenorbital fissure
226 (1) frontal length on midline less than half that of parietal
234 (0) choanae as wide as posterior palate
267 (1) basicochlear fissure patent
333 (1) posttemporal canal present, small

Node U_4 – *Meniscotherium* + *Phenacodus*
11 (4) anteriormost upper incisor spatulate
45 (1) ultimate upper premolar conules prominent
70 (1) M2 stylar cusp A distinct but smaller than B
72 (1) M2 stylar cusp C, mesostyle present
82 (1) M2 centrocrista V-shaped
85 (2) M2 preprotocrista absent
185 (1) incisive foramen intermediate in length (length of 3 to 4 incisors)
289 (0) tensor tympani fossa shallow
354 (1) acromion proximal to glenoid articulation
373 (1) articular surface of femoral head limited to sphere of head
395 (0) astragalar canal present

Node V – (Euarchontaglires + ("Eulipotyphla" + (Xenarthra + "Afrotheria")))
3 (2) six postcanine tooth families
17 (1) anteriormost lower incisor procumbent
21 (1) posterior lower incisor(s) procumbent
23 (1) upper canine small
29 (2) three premolars
86 (0) M2 postprotocrista extends to mid-lingual surface of metacone
99 (2) M2 hypocone on postcingulum present, subequal to protocone
114 (2) m2 anterior and labial (mesio-buccal) cingular cuspule (f) present with shelf continuing along buccal border
152 (1) mandibular symphysis extends posteriorly to p2
157 (3) mandibular foramen recessed dorsally from ventral margin, at or above alveolar plane
209 (1) maxilla not excluded from medial orbital wall
210 (1) frontal and maxilla contact in medial orbital wall
308 (0) "tympanic process" absent
370 (1) pubic symphysis narrow

Node W – Euarchontaglires
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid
161 (2) premaxilla, facial process contacts frontal posteriorly
196 (1) posterior edge of anterior zygomatic root aligned with anterior molars
227 (1/2) frontoparietal suture with anterior process of parietal off/on midline
286 (1) Width of bony shelf lateral to promonotorium (lateral trough or tegmen

tympani) expanded anteriorly
300 (1) stapedius fossa small and shallow
356 (0) greater tubercle of humerus ventral to humeral head

Node W_1 – Euarchonta (*Ptilocercus* + (*Plesiadapis* + (*Notharctus* + *Adapis*)))
126 (1) M2 labial postcingulid present
179 (0) lacrimal foramen exposed on face
218 (1) postorbital bar present
274 (1) canal for stapedial artery on promontorium
294 (1) fossa incudis separated from epitympanic recess
317 (1) ectotympanic aphaneric or hidden
318 (0) ectotympanic ring-like
374 (0) greater trochanter lower than femoral head
375 (0) lesser trochanter of femur large
389 (1) sustentacular and navicular facets of astragalus contact
401 (1) calcaneal sustentacular facet expanded onto body
402 (2) calcaneal anterior peroneal tubercle at a distance from anterior end

Node W_2 – Primates (*Plesiadapis* + (*Notharctus* + *Adapis*))
43 (1) ultimate upper premolar precingulum present
58 (1) ultimate lower premolar talonid with two cusps
62 (1) molar size increasing posteriorly
151 (1) mandibular symphysis deep
203 (0) roots of molars not exposed in orbit floor
224 (1) orbitotemporal canal absent
226 (1) frontal length on midline less than half that of parietal
244 (1) exit for maxillary nerve within alisphenoid
248 (0) alisphenoid canal absent
251 (1) glenoid fossa partially on braincase
269 (2) rostral tympanic process of petrosal tall ridge, contributing to ventral bulla
301 (1) cochlear canaliculus visible canal in middle ear space
303 (1) fenestra cochleae posterior to fenestra vestibuli
304 (1) posterior septum shields fenestra cochleae
308 (2) “tympanic process” present, high
319 (0) anterior crus of ectotympanic does not broadly contacts facet on squamosal
320 (1) elongate ossified external acoustic canal
339 (1) atlantal foramen absent
396 (1) posterior trochlear shelf of astragalus strong
408 (1) deep groove for tendon of flexor fibularis present on calcaneum

Node W_3 – *Notharctus* + *Adapis*
3 (1) seven postcanine tooth families
8 (2) two lower incisors
16 (4) anteriormost lower incisor spatulate
17 (0) anteriormost lower incisor not procumbent
29 (1) four premolars

39 (0) penultimate upper premolar two roots
106 (1) m2 paraconid present
116 (2) m2 cristid obliqua attaching labial to notch in protocristid
117 (2) m2 trigonid height subequal to talonid height
129 (1) anteriormost mental foramen below p1
153 (1) mandibular symphysis fused
161 (1) premaxilla, facial process extends posteriorly beyond canine
169 (1) nasal does not overhangs external nasal aperture
181 (1) lacrimal foramen with maxillary contribution
196 (0) posterior edge of anterior zygomatic root aligned with last molar
261 (0) entoglenoid process of squamosal absent
390 (0) astragalar sustentacular facet does not reach medial edge of neck
397 (1) calcaneum narrow with sustentacular and ectal facets in line with long axis
403 (2) calcaneal plantar tubercle more proximal
407 (2) Cuboid facet much wider (mediolateral) than deep (dorsoventral)

Node W_4 – Glires
3 (3) five or fewer postcanine families
5 (1) lower diastema behind incisors enlarged
13 (1) anteriormost upper incisor enamel discontinous posteriorly
16 (2) anteriormost lower incisor anteroposteriorly compressed
18 (1) anteriormost lower incisor ever-growing, with large apical opening
19 (3) anteriormost lower incisor root extending posteriorly below molars
20 (1) anteriormost lower incisor enamel discontinous posteriorly
23 (2) upper canine absent
29 (3) two premolars
82 (2) M2 centrocrista absent
95 (2) substantial labial shift of M2 protocone
105 (1) metastylar lobe on ultimate molar present
106 (1) paraconid absent
114 (3) anterior and labial (mesio-buccal) cingular cuspule (f) absent
138 (1) masseteric fossa extending anteriorly onto mandibular body

Node W_5 – Duplicidentata (*Rhombomylus* + *Gomphos* + *Mimotona*)
75 (0) M2 preparacingulum absent

Node X – "Eulipotyphla + ("Afrotheria" + Xenarthra)
96 (1) M2 protocone height tall, approaching paracone and metacone
120 (0) m2 hypoconulid absent
135 (2) tilting of coronoid process near vertical (95^o to 105^o)
143 (3) angular process posterodorsally directed
146 (1) angular process vertical position at or near the alveolar border
190 (1) palatal expansion posterior to ultimate molar
383 (1) tibia and fibula fused distally
403 (0) calcaneal plantar tubercle absent

Node Y – "Eulipotyphla"
57 (0) ultimate lower premolar talonid narrower than anterior portion of crown
95 (0) no labial shift of M2 protocone
130 (3) posteriormost mental foramen at ultimate premolar and first molar junction or more posterior
169 (1) nasal does not overhang external nasal aperture
174 (1) maxillary process of frontal elongate and thin
202 (2) zygomatic arch incomplete
260 (1) suprameatal foramen present
307 (1) crista interfenestralis and caudal tympanic process of petrosal connected by curved ridge
308 (2) "tympanic process" present, high
318 (1) ectotympanic fusiform
407 (1) cuboid facet depth and width subequal

Node Y_1 – *Blarina* + *Erinaceus*
8 (2) two lower incisors
9 (1) anteriormost upper incisor alveoli separated by broad gap
27 (1) lower canine procumbent
64 (1) M2 wider than long (length more than 75% but less than 99% of width)
85 (0) M2 preprotocrista does not extend labially passed base of paracone
101 (1) M2 four roots
102 (1) ultimate molar two roots
108 (1) m2 paraconid on lingual margin
116 (3) m2 cristid obliqua attaching below middle posterior of protoconid
127 (1) ultimate lower molar size smaller than penultimate lower molar
179 (0) lacrimal foramen exposed on face
319 (0) anterior crus of ectotympanic does not broadly contact facet on squamosal

Node Y_2 – *Solenodon* + (*Eoryctes* + *Potamogale*)
17 (0) anteriormost lower incisor not procumbent
42 (2) ultimate upper premolar parastylar lobe larger than metastylar lobe
55 (1) ultimate lower premolar paraconid distinctive but low
76 (1) deep ectoflexus on penultimate and preceding molars
86 (1) M2 postprotocrista extends distal to metacone
114 (0) m2 anterior and labial (mesio-buccal) cingular cuspule (f) present
117 (0) m2 trigonid height twice or more talonid height
119 (0) m2 talonid very narrow, subequal to base of metaconid
235 (0) vomer does not contact pterygoid
285 (1) bony shelf lateral to promonotorium (lateral trough or tegmen tympani) confined posterolaterally
348 (1) five or fewer lumbar vertebrae
357 (1) deltopectoral crest reaches distal half of humerus

Node Y_3 – *Eoryctes* + *Potamogale*
44 (0) ultimate upper premolar postcingulum absent

176 (1) lacrimal absent
210 (0) frontal and maxilla do not contact in medial orbital wall
265 (1) alisphenoid tympanic process present
266 (1) basisphenoid tympanic process present
305 (0) paroccipital process vertical

Node Z – "Afrotheria" + Xenarthra
129 (0) anteriormost mental foramen below incisors (or anteriormost mandible)
134 (1) coronoid process narrow, subequal to or less than one molar length
138 (1) masseteric fossa extending anteriorly onto mandibular body
152 (2) mandibular symphysis extends posteriorly to p3 or more posterior
203 (0) roots of molars not exposed in orbit floor
293 (2) epitympanic recess lateral wall with no squamosal contribution
322 (1) entotympanic present
367 (1) radial articulation with carpals two fossae

Node Z_1 – Xenarthra (*Chaetophractus* + (*Bradypus* + *Tamandua*))
2 (1) simple peg-like teeth without enamel
130 (0) posteriormost mental foramen in canine and anterior premolar region
132 (0) space between ultimate molar and coronoid process absent
140 (1) condyloid crest present
179 (0) lacrimal foramen exposed on face
188 (3) multiple small major palatine foramina
191 (0) postpalatine torus absent
228 (1) temporal lines do not meet on midline to form sagittal crest
239 (2) entopterygoid process approaches ear region
273 (1) perbullar carotid canal present
281 (2) tympanic aperture of hiatus Fallopii absent
285 (1) bony shelf lateral to promonotorium (lateral trough or tegmen tympani) confined posterolaterally
291 (1) hypotympanic sinus formed by squamosal, petrosal, and alisphenoid
294 (1) fossa incudis separated from epitympanic recess
331 (0) anterior semicircular canal does not form lateral wall of subarcuate fossa aperture
348 (1) six or more lumbar vertebrae
349 (1) xenarthrous articulations on lumbar vertebrae present
351 (1) sacral vertebrae fused to pelvis

Node Z_2 – *Bradypus* + *Tamandua*
143 (0) angular process posteriorly directed
202 (2) zygomatic arch incomplete
233 (2) foramina for temporal rami absent
234 (0) choanae as wide as posterior palate
251 (1) glenoid fossa partially on braincase
335 (1) posttemporal canal position dorsal to external acoustic meatus
353 (0) suprascapular incisure absent

356 (0) greater tubercle of humerus ventral to humeral head
372 (1) articular surface of femoral head limited to sphere of head
374 (0) greater trochanter lower than femoral head
376 (0) third trochanter of femur absent
383 (0) tibia and fibula distally fused
393 (0) astragalar head convexity absent
405 (1) calcaneal facet for fibula absent

Node Z_3 – "Afrotheria" ((*Orycteropus* + *Rhynchocyon*) + (*Moeritherium* + *Procavia*))
4 (1) upper diastema narrow between canine and premolars
14 (1) ultimate upper incisor between maxilla and premaxilla
252 (4) glenoid fossa convex, open anteriorly
300 (1) stapedius fossa small and shallow
370 (0) pubic symphysis extensive
388 (1) cotylar fossa on astragalus present
391 (1) astragalar medial planar tuberosity protruding

Node Z_4 – *Orycteropus* + *Rhynchocyon*
177 (0) facial process of lacrimal large, triangular and pointed anteriorly
202 (1) zygomatic arch delicate
204 (0) palatine reaches infraorbital canal
205 (0) lacrimal contributes to maxillary foramen
208 (1) sphenopalatine foramen proximal to maxillary foramen
210 (0) frontal and maxilla do not contact in medial orbital wall
313 (1) jugular foramen separated from opening for inferior petrosal sinus
318 (1) ectotympanic fusiform
336 (2) one mastoid foramen in mastoid
347 (0) 13 or fewer thoracic vertebrae
381 (1) articulation between femur and fibula present
384 (1) trochlear groove moderately deep (U-shaped)

Node Z_5 – *Moeritherium* + *Procavia*
5 (1) lower diastema behind incisors enlarged
8 (2) two lower incisors
43 (1) ultimate upper premolar precingulum present
86 (2) M2 postprotocrista absent
87 (3) M2 postvallum shear absent
125 (1) m2 hypolophid present
130 (1) posteriormost mental foramen below penultimate premolar
131 (1) mandibular body deep and short
145 (1) angular process rounded, base as wide as tip
153 (1) mandibular symphysis fused
175 (0) preorbital length less than one third skull length
247 (1) foramen ovale on ventral surface of skull
254 (0) glenoid process of jugal present, with articular facet
337 (1) amastoidy or lack of occipital exposure of mastoid present

354 (2) acromion absent
360 (1) entepicondylar foramen absent

Part VII. Wilcoxon Rank Sum Tests

Wilcoxon rank sum (or Templeton) and winning-sites test results of competing topologies as reported in PAUP (Swofford, 2002). Tree numbers correspond to those given below the table. Rejected competing hypotheses are identified with asterisks. P values are given for 2-tailed tests. Those for 1-tailed tests do not change acceptance/rejection of null hypothesis (alpha = 0.05), except in moving Templeton P for tree #5 (*Purgatorius*-Primates) from 0.0495 to over 0.05 (Rohlf and Sokal, 1994: table V).

Tree #1 is one of the three optimal trees. Tree #2 includes a Zalambdalestidae-Glires clade (Archibald et al., 2001). Tree #3 includes a Zalambdalestidae-Duplicendentata clade (Van Valen, 1964). Tree #4 includes Ungulatomorpha (Zhelestidae with "condylarths" + Cetartiodactyla) (Archibald, 1996; Nessov et al., 1998; Archibald et al., 2001; Kielan-Jaworowska et al., 2004). Tree #5 includes *Purgatorius* with Primates (Clemens, 1974, 2004; Van Valen, 1994). Tree #6 includes *Batodon* with "Eulipotyphla" (McKenna and Bell, 1997). Tree #7 includes *Gypsonictops* and *Leptictis* with "Eulipotyphla" (Novacek, 1986). Tree #8 includes *Deccanolestes* with Euarchonta and Tree #9 includes *Purgatoris* and *Deccanolestes* as the first and second outgroups to Euarchonta (Kielan-Jaworowska et al., 2004). Tree #10 places Cimolestidae (*Cimolestes*, *Batodon*, and *Maelestes*) with Carnivora (*Cimolestes* and *Batodon* were allocated to Ferae by Kielan-Jaworowska et al., 2004). Tree #11 places *Hyopsodus*, *Phenacodus*, and *Meniscotherium* with Paenugulata within Afrotheria (Asher et al., 2003). Tree #12 includes Zhelestidae with Paleocene and Eocene "condylarths", Carnivora, and

Cetartiodactyla (Averianov and Archibald, 2005). Tree #13 includes Ungulata, i.e.,

Paleocene and Eocene “condylarths” with Cetartiodactyla (Archibald, 1998).

Lengths of trees in memory:
Character-status summary:
Of 408 total characters:
All characters are of type 'unord'
All characters have equal weight
1 character is constant
20 variable characters are parsimony-uninformative
Number of parsimony-informative characters = 387
Gaps are treated as "missing"
Multistate taxa interpreted as uncertainty ("min" values for CI, RI, and RC are minimum-possible character lengths)

Tree # 1 2 3 4 5 6 7 8 9 10 11 12 13
Length 2296 2331 2359 2321 2305 2319 2316 2315 2319 2330 2326 2318 2321

Templeton (Wilcoxon signed-ranks) and winning-sites (sign) tests:

		Templeton				Winning-sites	
Tree	Length	Rank sums*	N	z	P**	counts	P**
1 best	2296	(best)					
2 zalam-glires	2331	1998.0	73	-4.0964	<0.0001*	54	0.0001*
		-703.0				-19	
3 zalam-lago	2359	4316.0	103	-6.2076	<0.0001*	83	<0.0001*
		-1040.0				-20	
4 zhe-ungulates	2321	1041.0	53	-3.2555	0.0011*	38	0.0025*
		-390.0				-15	
5 purg-primates	2305	165.0	21	-1.9640	0.0495*	15	0.0784
		-66.0				-6	
6 batodon-lipoty	2319	350.0	27	-4.4264	<0.0001*	25	<0.0001*
		-28.0				-2	
7 gyp-lep-lipoty	2316	1220.0	60	-2.5820	0.0098*	40	0.0142*
		-610.0				-20	
8 dec-euarc	2315	360.0	29	-3.5282	0.0004*	24	0.0005*
		-75.0				-5	
9 dec-euarc-purg	2319	609.0	39	-3.4284	0.0006*	30	0.0014*
		-171.0				-9	
10 cimolest-car	2330	1592.5	64	-4.2500	<0.0001*	49	<0.0001*
		-487.5				-15	
11 con-paenungu	2326	1861.5	72	-3.5355	0.0004*	51	0.0006*
		-766.5				-21	
12 zhe-car-con-c	2321	976.0	36	-3.6667	0.0002*	29	0.0005*
		-129.5				-7	
13 protox-con-c	2303	270.0	29	-1.2999	0.1936	18	0.2649
		-165.0				-11	

* Wilcoxon signed-ranks test statistic is the smaller of the absolute values of the two rank sums.
** Approximate probability of getting a more extreme test statistic under the null hypothesis of no difference between the two trees (two-tailed test). Asterisked values in table (if any) indicate significant difference at P < 0.05. Consult a table for critical values of Wilcoxon rank sum when N is 25 or less.

```
#NEXUS
BEGIN TREES;

      TRANSLATE
            1     Nanolestes,
            2     Peramus,
            3     Vincelestes,
            4     Kielantherium,
            5     Deltatheridium,
            6     Mayulestes,
            7     Pucadelphys,
            8     Eomaia,
            9     Prokennalestes,
            10    Murtoilestes,
            11    Bobolestes,
            12    Montanalestes,
            13    Paranyctoides,
            14    Eozhelestes,
            15    Sheikhdzheilia,
            16    Alostera,
            17    Lainodon,
            18    Avitotherium,
            19    Gallolestes,
            20    Parazhelestes,
            21    Aspanlestes,
            22    Zhelestes,
            23    Cimolestes,
            24    Maelestes,
            25    Batodon,
            26    Bulaklestes,
            27    Daulestes,
            28    Uchkudukodon,
            29    Kennalestes,
            30    Asioryctes,
            31    Ukhaatherium,
            32    Deccanolestes,
            33    Kulbeckia,
            34    Zhangolestes,
            35    Alymlestes,
            36    Zalambdalestes,
            37    Barunlestes,
            38    Gypsonictops,
            39    Leptictis,
            40    Purgatorius,
            41    Protungulatum,
            42    Oxyprimus,
            43    Vulpavus,
            44    Miacis,
            45    Gujaratia,
            46    Hyopsodus,
            47    Meniscotherium,
            48    Phenacodus,
            49    Ptilocercus,
            50    Plesiadapis,
            51    Northarctus,
            52    Adapis,
            53    Tribosphenomys,
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            54    Paramys,
            55    Rhombomylus,
            56    Gomphos,
            57    Mimotona,
            58    Blarina,
            59    Erinaceus,
            60    Solenodon,
            61    Eoryctes,
            62    Potamogale,
            63    Orycteropus,
            64    Rhynchocyon,
            65    Procavia,
            66    Moeritherium,
            67    Chaetophractus,
            68    Bradypus,
            69    Tamandua
      ;
      TREE 'best' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),((40,(41,4
2)),(((43,44),(45,(46,(47,48)))),(((49,(50,(51,52))),((53,54),(55,(56,5
7)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))))
,(15,(16,17,((18,19),(20,(21,22)))))))))))));
      TREE 'zalam-glires' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((38,39),((40,(41,42)),(((43,44),(45,(46,
(47,48)))),(((49,(50,(51,52))),((33,(34,(35,36,37))),((53,54),(55,(56,5
7)))))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22)))))))))))));
      TREE 'zalam-lago' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((38,39),((40,(41,42)),(((43,44),(45,(46,
(47,48)))),(((49,(50,(51,52))),((53,54),(55,((33,(34,(35,36,37))),(56,5
7)))))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22)))))))))))));
      TREE 'zhe-ungulates' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,((13,14),(((23,(24,25)),((26
,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),(40,(((43,4
4),((15,(16,17,((18,19),(20,(21,22))))),((41,42),(45,(46,(47,48)))))),(
((49,(50,(51,52))),((53,54),(55,(56,57)))),(((58,59),(60,(61,62))),(((6
3,64),(65,66)),(67,(68,69))))))))))))))))));
      TREE 'purg-primates' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),((41,42),(
((43,44),(45,(46,(47,48)))),(((49,(40,(50,(51,52)))),((53,54),(55,(56,5
7)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))))
,(15,(16,17,((18,19),(20,(21,22)))))))))))));
      TREE 'batodon-lipoty' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,24),((26,(27
,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),((40,(41,42)),(
((43,44),(45,(46,(47,48)))),(((49,(50,(51,52))),((53,54),(55,(56,57))))
,((((58,59),(60,(61,62))),25),(((63,64),(65,66)),(67,(68,69))))))))))))
,(15,(16,17,((18,19),(20,(21,22)))))))))))));
      TREE 'gyp-lep-lipoty' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((40,(41,42)),(((43
,44),(45,(46,(47,48)))),(((49,(50,(51,52))),((53,54),(55,(56,57)))),(((
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(58,59),(60,(61,62))),(38,39)),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));
      TREE 'dec-euarc' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),((33,(34,(35,36,37))),((38,39),((40,(41,42)),
(((43,44),(45,(46,(47,48)))),((((49,(50,(51,52))),32),((53,54),(55,(56,
57)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));
      TREE 'dec-euarc-purg' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),((33,(34,(35,36,37))),((38,39),((41,42),(((43
,44),(45,(46,(47,48)))),(((((49,(50,(51,52))),40),32),((53,54),(55,(56,
57)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));
      TREE 'cimolest-car' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((26,(27,28)),(29
,(30,31))),(32,((33,(34,(35,36,37))),((38,39),((40,(41,42)),((((43,44),
(23,(24,25))),(45,(46,(47,48)))),(((49,(50,(51,52))),((53,54),(55,(56,5
7)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));
      TREE 'con-paeungulu' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),((40,(41,4
2)),(((43,44),45),(((49,(50,(51,52))),((53,54),(55,(56,57)))),(((58,59)
,(60,(61,62))),(((63,64),((46,(47,48)),(65,66))),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));
      TREE 'zhe-car-con-c' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,((13,14),(((23,(24,25)),((26
,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),(40,((((43,
44),((41,42),(45,(46,(47,48))))),(15,(16,17,((18,19),(20,(21,22))))))),(
((49,(50,(51,52))),((53,54),(55,(56,57)))),(((58,59),(60,(61,62))),(((6
3,64),(65,66)),(67,(68,69))))))))))))))))));
      TREE 'protoxy-con-c' =  [&R]
(1,(2,(3,(4,((5,(6,7)),(((8,9),10),(11,(12,(((13,14),(((23,(24,25)),((2
6,(27,28)),(29,(30,31)))),(32,((33,(34,(35,36,37))),((38,39),(40,(((43,
44),((41,42),(45,(46,(47,48))))),(((49,(50,(51,52))),((53,54),(55,(56,5
7)))),(((58,59),(60,(61,62))),(((63,64),(65,66)),(67,(68,69))))))))))
,(15,(16,17,((18,19),(20,(21,22))))))))))))));

END;
```

Part VIII. References

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