SUPPORTING INFORMATION

Paleocene emergence of elephant relatives and the rapid radiation of African ungulates

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Part I.
Supplementary Table 1.

Stratigraphic distribution of the elasmobranch association recovered from samples from the fossiliferous horizon (lower bone bed level of local phosphate bed IIa) of the type locality(*) of *Eritherium azzouzorum* n.g., n.sp. and from the matrix(**) of referred specimen MNHN PM42. The specific elasmobranch association characterizes the Thanetian in the local series. Beside species of broad Danian-Ypresian range, our samples recovered several species of restricted Thanetian range (Table 1, below): *Hologinglymostoma jaegeri*, *Palaeorhincodon daouii*, *Khouribgaleus gomphorhiza*, *Palaeogaleus larachei*, *Coupatezia larivei*, *Heterotorpedo brahimi*.
The Selandian is not differentiated in the Moroccan Phosphate series, so that the Thanetian phosphate beds directly overly the Danian beds "IIb" (which might be lacking by places). The lower bone bed horizon that yields *Eritherium azzouzorum* n.g., n. sp. and a new hyaenodontid creodont (1) is located in the lower part of the local Thanetian bed IIa, *i.e.* in the early Thanetian.
Maas.= Maastrichtian; Dan.= Danian; Than.= Thanetian; Ypr.= Ypresian; Lut.= Lutetian.

	Maas.	*Dan.*	*Than.*	*Ypres.*	*Lut.*
Squalus sp. (*)		X	X	X	
Squatina sp. (*)		X	X	X	
Cretolamna appendiculata (*)	X	X	X	X	
Striatolamia striata (*)			X	X	
Isurolamna sp. (*)(**)			X	X	
Hologinglymostoma jaegeri (*)			X		
Delpitoscyllium africanum (*)		X	X		
Palaeorhincodon daouii (*)			X		
Abdounia africana (*)(**)		X	X		
Khouribgaleus gomphorhiza (*)			X		
Palaeogaleus larachei (*)(**)			X		
Triakis antunesi (*)		X	X		
Premontreia (Oxysc.) subulidens (*)(**)		X	X	X	
Scyliorhinus entomodon (*)(**)		X	X		
Coupatezia larivei (*)			X		
Heterotorpedo brahimi (*)(**)			X		
Myliobatis raouxi (*)(**)		X	X	X	

Determinations by H. Cappetta.

Part II.
Studied characters of *Eritherium azzouzorum* n. g., n. sp

The character list corresponds to that of Gheerbrant et al. (2) with several detailed corrections and additions. Modified characters are commented upon, below the description of the character states.

Lower Dentition

Anterior lower dentition

1. Lower incisors shape and development. (0) Lower incisors small, peg like or spatulate; (1) Lower incisors higher or enlarged.

Macroscelidea: *Herodotius:* I/1-3 are not enlarged. Embrithopoda: *Crivadiatherium* shows especially large incisor root, but the crown is not high.

2. Lower incisors shape. (0) Lower incisors subvertical; (1) Lower incisors procumbent.

Arctocyonidae: Except specialized taxa such as *Thryptacodon*; *Eritherium:* lower incisors slender and forming a tooth comb-like structure (although excluding the canine). Macroscelidea: *Herodotius*: I/1-3 are not enlarged, but I/1-2 are somewhat procumbent whereas I/3 is subvertical. Embrithopoda: *Crivadiatherium*.

3. Development of I/1. (0) I/1 and I/2 of similar size; (1) I/1 slightly larger than I/2; (2) I/1 very enlarged; (3) I/1 hypsodont

Anthracobunidae: *Indobune* and "*Cambaytherium*". The hypsodont tusk of elephantiform prosboscideans is considered homologous to I/1 by Delmer (3). Hyracoids: weak size difference between I/2 and I/1 in *Saghatherium*. Macroscelidea: *Herodotius:* incisors of similar size. State 3 corresponds to Elephantiforms.

4. Development of I/2. (0) I/1 and I/2 of similar size; (1) I/2 larger than I/1.

Moeritherium is characterized by a I/1 smaller than I/2 which is probably secondarily according to Delmer (in 3). Hyracoids: weak size difference between I/2 and I/1 in *Saghatherium*.

5. Development of I/3. (0) I/3 present well developed; (1) I/3 very small and labial to C/1; (2) I/3 lost.

Phenacolophus: I/3 is even slightly larger than I/2. Hyracoids: I/3 of *Saghatherium* slightly smaller than I/2, but proportionally much less than in *Eritherium*, and it is not shifted labially with respect to C/1. *Ocepeia* resembles *Eritherium* in this feature. Embrithopoda: *Crivadiatherium*. *Phosphatherium*: I/3 is lost, but a small dI/3 was present and located labial to C/1, in close resemblance to I/3 of *Eritherium*.

6. Development of C/1. (0) C/1 present, well developed; (1) C/1 reduced (smaller than P/2); (2) C/1 very small; (3) C/1 absent.

C/1 is present and smaller in *Phosphatherium* (new material) than in *Eritherium*. Macroscelidea: *Herodotius* (4). The canine is large in *Anthracobune.* The canine is proportionnally smaller in *Eritherium* than in *Arsinoitherium*.

7. C/1 root(s). (0) Canine biradicular; (1) Canine uniradicular.

Hyracoidea: Probable secondary feature; Sirenia: Domning (5). Extant Macroscelidea have 2 roots according to Evans (6), but this character varies among the extant genera, and there is only one root in *Herodotius* (4).

8. P/1-P/2 diastema or C/1 –P/2 diastema: (0) Absent or very short; (1) present; (2) very long (in relation to loss of C and P/1).

The diastema is short in primitive desmostylians (*Behemetops*), but developed in advanced forms such as *Palaeoparadoxia* (7).

Lower premolars

9. Development of P/1. (0) P/1well developed; (1) P/1 small but more or less premolarized; (2) P/1 small and simple (basically conical; (3) P/1 absent.

In *Phosphatherium* (d)P/1 is present as a very small tooth in juvenile specimens (one alveolus in OCP DEG/GE 450), but (d)P/1 is absent in adult specimens. Macroscelidea: (d)P/1 small and simple or large and caniniform (6). The (d)P/1 is well developed and premolarized in *Crivadiatherium* (embrithopods). (d)P/1 is small in desmostylians and sirenians, but still larger and less simple than in *Eritherium.*

10. P/1 root(s). (0) P/1 biradicular; (1) P/1 uniradicular; P/1 lost.

Macroscelidea: Variation in extant genera; the biradicular P/1seen in *Herodotius* is probably representative of the primitive condition of the order.

11. Development of P/2. (0) P/2 well developed; (1) P/2 small, but premolariform; (2) P/2 small and simple (basically conical); (3) P/2 absent.

Phosphatherium as *Eritherium*, by contrast with *Daouitherium* which retains a well developed and biradicular P/2, as in *Numidotherium*. *Minchenella:* P/2 well developed (specimen V5600). P/2 is lost in Elephantiformes.

12. P/2 root(s). P/2 biradicular; (1) P/2 uniradicular.

Desmostylians: Roots fused in upper part.

13. P/3-4 root(s) and development. (0) Bi-rooted and large, (1) one root and smaller crown.

Desmostylians: Smaller crown, roots fused in upper part.

14. P/3 metaconid development. (0)Metaconid absent or weak; (1) metaconid present.

15. P/3 paraconid development. (0) Paraconid present; (1) paraconid absent or weak.

16. P/3 talonid development. (0) Talonid reduced (small) and simple (mostly cutting or piercing); (1) talonid developed (enlarged) and molariform with distinct basin and cusps.

Anthracobunids, desmostylians, sirenians: Talonid small, but with several cusps.

17. P/3-4 paraconid position. (0) Paraconid low; (1) paraconid high

The paraconid is weak in *Phosphatherium* (derived), but distinct and high in most specimens; it is present and high in *Daouitherium*.

18. P/4 paraconid development. (0) Paraconid present; (1) paraconid absent or weak

19. P/4 talonid development. (0) Talonid reduced (small) and simple (mostly cutting); (1) talonid developed (enlarged) and molariform with distinct basin and cusps
Microhyus: talonid large but not molarized.

20. P/4 metaconid. (0) Metaconid weak and distal with respect to protoconid; (1) metaconid present and lingual.

21. Lower premolars cingulum (at least P/4). (0) Labial cingulum (ectocingulid) absent; (1) labial cingulum present.

Lower molars

22. Lower molar pattern. (0) molar pattern tribosphenic, with high trigonid and sharp cusps; (1) bunodont pattern with low trigonid; (2) bunodont-lophodont pattern; (3) true lophodont pattern; (4) bunolophodont pattern.

23. M/1-3 lophs. (0) no lophs; (1) lophs oblique; (2) lophs transverse.

24. M/1-3 cusps. (0) Labial cusps (protoconid-hypoconid) larger than lingual cusps (metaconid-entoconid); (1) lingual cusps larger than labial cusps (or cusps subequal).
In *Ocepeia*, the hypoconid is much larger thant the entoconid, but the metaconid is slightly larger than the protoconid.

25. M/1-3 trigonid. (0) Trigonid more or less elongated with well differentiated (functional) paracristid; (1) trigonid short, strongly compressed mesio-distally, with paracristid weakened.

26. M/1-3 paraconid. (0) Paraconid present; (1) paraconid weak or absent.

27. M/1- 3 premetacristid. (0) Premetacristid weak or absent; (1) premetacristid developed.
Eritherium: Variable traces.

28. M/1- 3 postmetacristid. (0) Postmetacristid reduced or absent; (1) postmetacristid well developed; (2) postmetacristid more or less inflated as a metastylid.
Postmetacristid variable in desmostylians.

29. M/1- 3 protocristid. (0) Protocristid depressed by a deep median notch; (1) protocristid lophid-like, with no strong notch.

30. M/1- 3 hypolophid development. (0) Hypolophid absent; (1) hypolophid present.
Ocepeia: Hypolophid incipient.

31. M/1- 3 hypolophid shape. (0) Hypolophid absent or incomplete; (1) hypolophid depressed by a deep median notch; (2) hypolophid lophid-like.
Ocepeia: hypolophid incipient.

32. M/1- 3 entocristid. (0) Entocristid present; (1) entocristid reduced to absent.

33. M/1- 3 entoconulid. (0) Entoconulid absent; (1) entoconulid present.
Macroscelidea: enlarged.

34. M/1- 3 mesoconid. (0) Mesoconid absent; (1) mesoconid present.

35. M/1- 3 cristid obliqua. (0) Cristid obliqua strongly oblique, joining the trigonid in its lingual part; (1) cristid obliqua joining the trigonid at its mid-width; (2) cristid obliqua joining the trigonid in its labial part.

36. M/1- 3 postcristid. (0) Postcristid developed, linking hypoconid, hypoconulid and entoconid; (1) hypoconulid and entoconid separated by a narrow notch (postentocristid reduced), but the labial segment of the postcristid (posthypocristid) remains well developed between hypoconulid and hypoconid; (2) hypoconulid furthermore separated from the hypoconid: labial segment of the postcristid (posthypocristid) reduced to absent; (3) hypoconulid cingular-like, completely separated from entoconid and hypoconid (postcristid reduced).
This character is not additive.

37. M/1-2 hypoconulid position. (0) Hypoconulid median; (1) hypoconulid lingual; (2) hypoconulid labial.
In embrithopods the trend is a lingual location of the hypoconulid.
This character is not additive.

38. M/1-2 hypoconulid development. (0) Hypoconulid high and poorly distal with respect to hypoconid and entoconid; (1) hypoconulid low and poorly distal with respect to hypoconid and entoconid; (2) hypoconulid low and distal; (3) hypoconulid low and cingular-like.

39. M/1-2 postentoconulid. (0) Postentoconulid absent; (1) postentoconulid present, but weak; (2) postentoconulid well developed.

40. M/3 postentoconulid. (0) Postentoconulid absent; (1) postentoconulid present, but weak; (2) postentoconulid well developed.

41. M/1- 3 ectocingulid. (0) Ectocingulid and/or ectostylid weak or absent; (1) ectocingulid present
Labial cingulum and ectostylid variable, but generally reduced in *Eritherium.*

42. M/1 trigonid/talonid relative width. (0) trigonid narrower than talonid; (1) trigonid subequal to the talonid; (2) trigonid wider than the talonid.

43. M/2 trigonid/talonid relative width. (0) trigonid narrower than talonid; (1) trigonid subequal to the talonid; (2) trigonid wider than the talonid.

44. M/3 trigonid/talonid relative width. (0) trigonid wider than the talonid; (1) trigonid subequal to the talonid; (2) trigonid narrower than the talonid.

45. M/3 development. (0) M/3 of similar size to M/2, or slightly larger; (1) M/3 smaller than M/2; (2) M/3 significantly larger than M/2, which is larger than M/1.
M/3 small in *Eritherium*, but some variation occur with one specimen (MNHN PM55) with M/3 slightly larger than M/2.

Dentary

46. Extension of mandibular symphysis. (0) Short: extended to P/2 or more anterior; (1) long: posterior to P/2.
Ocepeia: Short but below P/3 because of the loss of P/1-2. Macroscelideans: *Herodotius* (4).

47. Fusion of mandibular symphysis. (0) Unfused (synchondrosis); (1) fused.

48. Horizontal ramus (body). (0) Low; (1) high.

49. Position of the coronoid apophysis. (0) Rising at level of M/3, or more distally; (1) rising anteriorly to M/3.

50. Orientation of the coronoid apophysis. (0) Anterior margin vertical of posteriorly canted; (1) anterior margin anteriorly canted.
Macroscelideans: modern forms.

51. Development of the coronoid apophysis.(0) Coronoid apophysis high; (1) coronoid apophysis low; (2) very low at articular level or lower.
Macroscelideans: Modern forms. The coronoid process is reduced in anthracobunids (8) and *Moeritherium*; it is high in the sirenian *Prorastomus*.

52. Articular condyle. (0) Low above the dental row; (1) high above the dental row.
Ocepeia: Low but higher than in *Phosphatherium.* Macroscelideans: Modern forms.

53. Coronoid foramen. (0) Absent; (1) present.

54. Angular process. (0) Reduced and/or narrow; (1) broad and distally projecting.

55. Anterior coronoid fossa. (0) Absence of fossa on the anterior margin of the ascending ramus (coronoid process); (1) presence of a fossa (with coronoid foramen) on the ascending ramus behind the M/3, which is delimited medially by the coronoid crest of the ascending ramus and laterally by the sharp mesio-laterally salient masseteric crest; (2) fossa enlarged, as the result of the posteriorly recurved coronoid crest (at basis) and of the sharper masseteric crest.
Eritherium: The coronoid fossa is enlarged in the proboscidean shape with a strong masseteric crest at the base, but the coronoid crest is not recurved as in *Phosphatherium* and more advanced proboscideans.

Upper Dentition

Anterior dentition (upper incisors and C1/)

56. Number of upper incisors. (0) Three; (1) two; (2) one; (3) none.

57. Relative size of upper incisors. (0) Small; (1) large.
Macroscelidea: Upper incisors slightly enlarged according to Evans (6).

58. Development of I1/. (0) Not enlarged (similar to I2/); (1) I1/>I1/.

59. Development of I2/. (0) Not enlarged (similar to I1/); (1) I2/>>I1/.

60. Upper anterior diastema. (0) Small or absent; (1) developed but short; (2) elongated (I2/-P2/)
Eritherium shows small but distinct diastemata between C1/ P1/ and P2/ very similar to *Phosphatherium*. Such diastemata are known in arctocyonids.

61. Development of C1/. (0) Well developed; (1) small; (2) absent.

62. C1/ root(s). (0) Two roots; (1) one root.
Advanced hyraxes have two or even three roots at C1/ (e.g., *Saghatherium*). Extant macroscelideans have two roots at C1/ (6).

Upper premolars

63. P1/ development. (0) Present; (1) absent.

64. P1/ root(s). (0) Two roots; (1) one root.

65. P2/ development. (0) Present; (1) absent.

66. P2/ root(s). (0) Two roots; (1) three roots; (2) one root.
Microhyus: *M. reisi* (9, 10). Palaeoamasiids seem to have only two roots.
This character is not additive.

67. P2/ protocone. (0) protocone absent, crown narrow transversely; (1) protocone present, crown slightly developed transversely; (2) protocone large, crown as long as wide.
Microhyus: M. reisi (9, 10).

68. P3/ root(s). (0) Two roots; (1) three roots.
Radinskya: After alveoli.

69. P3/ protocone. (0) Protocone absent or reduced; (1) protocone present; (2) protocone well developed, crown as wide as long.
Radinskya: After the alveoli. The protocone is well developed in P3/ of primitive Perissodactyla (*contra* Gheerbrant et al. (2)). The protocone is probably absent in P3/ of *Prorastomus.*

70. P3/ metacone. (0) Absent; (1) present and small; (2) large.

71. P3-4/ conules. (0) Absent; (1) present.

72. P4/ root(s). (0) Two roots; (1) three roots; (2) four roots.
Desmostylians have two rooted P4/, but there is apparently only one labial root (roots fused?).

73. P4/ metacone development. (0) Absent; (1) small; (2) large.
The metacone is nearly absent in *Eritherium*. *Arsinoitherium* has a developed metacone on P/3-4, but this feature is poorly known in palaeoamasiids.

74. P4/ metacone relations. (0) Absent; (1) connate to paracone; (2) well developed and separated from paracone.

75. P4/ hypocone. (0) Absent; (1) present.

76. P4/ loph. (0) No loph; (1) at least one loph present.

77. P4/ (and P3/ when protocone is developed) postprotocrista. (0) Postprotocrista distinct; (1) postprotocrista absent or weak.
The absence of postprotocrista in P3/ and P4/ is a distinctive character of Paenungulata and especially of the Hyracoidea with respect to Perissodactyla according to Hooker (12).

Upper molars

78. Upper molar pattern. (0) Molar pattern tribosphenic, with hypocone weak or absent; (1) molar pattern incipiently quadritubecular with moderate hypocone; (2) molar pattern fully quadritubecular with large hypocone comparable to protocone.

79. Upper molar bunodonty. (0) More or less puncturing morphology with high and pointed cusps; (1) bunodont morphology with low and inflated crown and cusps.

80. (0) Strictly bunodont pattern (loph absent); (1) bunodont bilophodont pattern, with weak metaloph and protoloph; (2) bunodont bilophodont pattern, with developed (crest-like) metaloph and protoloph; (3) true lophodont pattern; (4) bunolophodont pattern.
The upper molar pattern of the phenacodontids is only incipiently bunodont-lophodont with respect to "altungulates". It is significantly less derived from the tetratubercular plan, with less individualized lophs: The metaloph is less developed, the postprotocrista is still well developed and linked to the large metaconule, the interloph is poorly differentiated (e.g., protocone and hypocone less separated), the hypocone is less developed, the protocone is more distal (less aligned with paracone), labial and lingual cusps are more separated, and the M3/ is small and tetra- to tritubercular (hypocone small and distal).
This character is not additive.

81. M1-3/ lophs. (0) No loph; (1) lophs transverse; (2) lophs oblique.
This character is not additive.

82. M1-3/ parastyle position. (0) Parastyle significantly labial to the paracone; (1) parastyle mesial.
Ocepeia, Embrithopoda: The parastyle labial is probably a secondary feature linked to dilambdodonty. The parastyle is more mesial in *Microhyrax* than in *Seggeurius*, in relation to the less advanced selenodonty.

83. M1-2/ parastyle development. (0) Parastyle large on M1-2/; (1) parastyle small on M1-2/
Ocepeia, Embrithopoda: Probably secondary feature linked to dilambdodonty. The parastyle is primitively larger on M3/ of *Numidotherium* and *Phosphatherium*. The parastyle is smaller among hyraxes in *Microhyrax* which is less selenodont than *Seggeurius*.

84. M1-3/ ectocingulum. (0) Ectocingulum reduced, or thin and isolated; (1) ectocingulum inflated and continuous with mesial and distal cingula.
Proboscideans: Secondary feature.

85. M1-3/ pericone. (0) Absent; (1) present.

86. M1-3/ Postcingulum. (0) Postcingulum in continuity with the hypocone via the distocrista; (1) (new)postcingulum extended lingually below the hypocone; (2) (new)postcingulum extended lingually below the hypocone and linked to a lingual cingulum.

87. M1-3/ Cingulum lingual. (0) Cingulum lingual absent, no hypocone; (1) cingulum lingual present, hypocone small or absent; (2) cingulum lingual and entostyle reduced, large hypocone; (3) cingulum lingual present, large hypocone.

88. M1-3/ mesostyle. (0) Mesostyle absent or weak; (1) present and inflated.

89. M1-3/ mesostyle position. (0) Mesostyle absent or weak; (1) mesostyle present and close to paracone and metacone; (2) mesostyle present and shifted labially with respect to paracone and metacone: Ectoloph selenodont, with dilambdodont pattern.

90. M1-3/ centrocrista development. (0) Centrocrista present; (1) reduced to absent.

91. M1-3/ centrocrista shape. (0) Centrocrista rectodont and not linked to mesostyle; (1) centrocrista linked to the lingual flank of the mesostyle and nearly rectodont; (2) centrocrista extensively linked to the mesostyle and noticeably dilambdodont (ectoloph selenodont); (3) centrocrista hyperdilambdodont with lingual migration of paracone and metacone.

92. M1-3/ postmetacrista. (0) Postmetacrista well developed and predominantly transversal; (1) postmetacrista weak and predominantly longitudinal.

93. M1-3/ preparacrista. (0) Preparacrista well developed and predominantly transversal; (1) preparacrista small and predominantly longitudinal; (2) Preparacrista absent or very weak.
Ocepeia, Hyracoidea, Embrithopoda: Probably secondary feature.

94. M3/ metacone. (0) Metacone smaller than paracone but well developed on M3/; (1) metacone weak or absent on M3/.

95. M1-3/ conules. (0) Conules well developed; (1) conules small; (2) conules absent (with possible occurrence of a slight paraconular swelling).
Conules small in *Microhyus musculus;* variability in *M. reisi*, from well developed to absent. The general trend is the reduction of conules in *Microhyus*.

96. M1-3/ postprotocrista. (0) Postprotocrista developed (linked to metaconule, if present); (1) postprotocrista reduced or absent (lophodont pattern).

97. M1-3/ prehypocrista. (0) Prehypocrista and metaloph absent or reduced; (1) prehypocrista absent or weak, metaloph formed by transversal alignment and close juxtaposition of hypocone, metaconule (if present) and metacone (2) prehypocrista developed forming the metaloph and joining metaconule or metacone base; (3) prehypocrista forming the metaloph and joining the metacone apex (true lophodonty).
Eritherium: Prehypocrista incipient (1-2), as especially illustrated by the confluent internal flanks of the metacone and the hypocone. *Titanohyrax tantulus*: Variability with prehypocrista restricted lingually or absent.
This character is not additive.

98. M1-3/ interloph. (0) Interloph not differentiated; (1) interloph developed transversally (extended lingually to a more or less developed entoflexus).

99. M1-3/ distocrista. (0) Distocrista absent; (1) distocrista present at least in M1-2/.
Distocrista absent in M3/ in *Eritherium.*

100. M1-3 postentoconule. (0) Postentoconule (hypostyle) absent; (1) postentoconule (hypostyle) present in M1-3/.
Postentoconule well distinct in M3/, and weak in M1-2/ in *Eritherium*.

101. M1/ and M2/ relative size. (0) M1/ and M2/ of roughly similar size; (1) M1/ significantly smaller than M2/.

102. M2/ and M3/ relative size. (0) M2/ and M3/ of roughly similar size; (1) M3/ smaller than M2/; (2) M3/ strongly reduced; (3) M3/ significantly larger than M2/ (molar size increase posteriorly).
Eritherium shows some variability of this feature, which might be indicative of the evolutionary trend of the enlargement of the M3/ in advanced proboscideans.
This character is not additive.

103. M1-2/ lingual root(s). (0) One simple lingual root; (1) lingual root enlarged and incipiently divided with a median sulcus; (2) at least 2 lingual roots (hypocone root).
Chambius (Macroscelidea) has two lingual roots which are partly fused.

104. M3/ protocone root. (0) Small and simple; (1) enlarged.

105. M3/ hypocone root. (0) Absent; (1) distal root present; (1) mesial and distal roots present.
The distal hypocone root is fused and nearly continuous with the metacone root in *Phosphatherium*, *Seggeurius,* and probably *Protosiren* (13); in *Eritherium* they are fused, but with a deep median sulcus; in *Palaeoamasia* they seem independent, but in *Arsinoitherium* the distal hypocone root is fused with the metacone root. In addition to a distal hypocone root, palaeoamasiids show an enlarged protocone root which is linked to hypocone, suggesting incipient division of an additional hypocone mesial root.
Primitive hyracoids such as *Seggeurius* and primitive proboscideans such as *Phosphatherium* (but not *Eritherium),* have an additional median sulcus in the protocone root, in addition to a distal root below the hypocone; *Microhyrax* and more advanced hyracoids such as *Saghatherium* have two separated mesial and distal hypocone roots. *Moeritherium*: including *M. chehbeurameuri* (14). Anthracobunidae: *Anthracobune*.

106. M1-3/ crown height. (0) Crown uniformly brachyodont; (1) lateral lingual and/or labial hypsodonty.

107. M1-3/ occlusal outline. (0) Occlusal outline extended transversally; (1) occlusal outline narrower squared or slightly elongated.

Skull

108. Pneumatization of skull bones. (0) Reduced pneumatization of skull bones; (1) significant pneumatization (developed sinuses/diploe).

109. Skull shape. (0) Skull elongated, with facial part at least as long as the cerebral part; (1) skull with facial part shorter than cerebral part.

110. Extension of upper tooth row. (0) Upper tooth row not extended more distally than mid skull length; (1) upper tooth row very extended distally, up to the two thirds of the skull length.
Eritherium: Based on specimen from private collection (photograph). In macroscelideans, the dental row is slightly longer than the mid-skull length.

111. Nasal development. (0) Nasal long and located anterior to the orbit; (1) nasal short and posteriorly shifted.

112. Nasal position. (0) Nasal low above the tooth row; (1) nasal high above the tooth row (high anterior vertical process of the maxillary).

113. Nasal fossa. (0) Nasal fossa anterior; (1) nasal fossa retracted.

114. Premaxillary-frontal contact. (0) Premaxillary-frontal contact absent (separated by the nasal); (1) premaxillary-frontal contact present.

115. Lacrimal. (0) Lacrimal present; (1) lacrimal absent.

116. Lacrimal tubercle. (0) Lacrimal tubercle absent; (1) lacrimal tubercle present.
Macroscelidea: Small lacrimal tubercle present according to Evans (6).

117. Orbit location. (0) Orbit located distal, above the molars; (1) orbit shifted anteriorly, anterior rim above P4/-M1/ level, and closer to infraorbital foramen; (2) orbit shifted anteriorly, extending well above the premolars as far as close to infraorbital foramen.
The orbit extends above P4/-M1/ in *Eritherium*, more distally than in *Phosphatherium* (P4-3/), but still more anteriorly than in artocyonids and perissodactyls for instance.Paleaomasiidae are characterized by an anterior orbit (state 2) by contrast to *Arsinoitherium* where the orbit is located above the molars, a probable reversion. Anthracobunidae: After Kumar (15:125). The orbit is strikingly distal in macroscelideans with respect to *Eritherium, Phosphatherium,* and hyraxes, so that it is poorly distinct from the temporal fossa. *Phenacolophus*: The orbit extends above M2/ (16: 69).

118. Maxillary/jugal relative orbital development. (0) Orbit bordered ventrally mostly or entirely by the jugal (reduced zygomatic process of the maxillary); (1) orbit bordered ventrally partly by the maxillary which extends between the lacrimal and jugal; (2) maxillary forms the antorbital rim (zygomatic process of the maxillary), the jugal being restricted distally to the orbit.
With respect to *Phosphatherium*, in *Eritherium* the jugal extends more anteriorly to the mesial part of lower rim of the orbit, although it probably does not join the lacrimal as hyraxes and the primitive eutherian condition. Palaeomasiids: The jugal extends below the orbit (M1/ level), bus does not contact the lacrymal, by contrast to *Arsnoitherium*. It should be noticed that hyracoids shows some variation in this feature, from jugal loosely linked to the lacrimal to jugal slightly retracted in extent *Procavia,* and in *Antilohyrax.* As a whole it seems the group is characterized some incipient anterior reduction of the jugal (17), which might be representative of the paenungulate condition. This feature remains to be checked in *Eritherium*, especially with respect to hyracoid ancestral condition.

119. Infraorbital foramen size. (0) Infraorbital foramen small; (1) infraorbital foramen large.
The infraorbital foramen is large in some phenacodonts such as *P.intermedius*.

120. Infraorbital foramen position. (0) Infraorbital foramen anterior to the orbit, long infraorbital canal; (1) Infraorbital foramen close to the orbit, short infraorbital canal; (2) Infraorbital foramen below to the orbit, short infraorbital canal.
In extant macroscelideans the two states 0-1 of this feature are known, but in *Herodotius* the infraorbital canal is long; it opens anteriorly above P3/, as in *Phosphatherium.*

121. Submaxillary fossa. (0) Submaxillary fossa absent; (1) submaxillary fossa present.

122. Tuber maxillae development. (0) Tuber maxillae reduced; (1) tuber maxillae large (sometime inflated).
The tuber maxillae is reduced in Palaeoamasiidae.

123. Tuber maxillae position. (0) Tuber maxillae anterior or lateral to the orbit; (1) tuber maxillae ventral or posterior to the orbit.

124. Ascending process of the palatine. (0) Ascending process of the palatine present between the maxillary and the frontal in the orbito-temporal fossa; (1) ascending process of the palatine palatine reduced (small) in the orbito-temporal fossa; (2) ascending process of the palatine absent in the orbito-temporal fossa (= contact between frontal and maxilla in orbito-temporal fossa).
New examination of the material of *Phosphatherium* confirms that the palatine is reduced to absent in the orbito-temporal fossa.

125. Morphology of the zygomatic arch. (0) Zygomatic arch narrow and slender without distinct ventral process at maxillary suture; (1) Zygomatic arch high dorso-ventrally with ventral process at maxillary suture.
Desmostylia: No ventral process of the zygomatic process at maxillary suture?

126. Jugal distal extension. (0) Jugal restricted distally to the anterior part the glenoid fossa; (1) jugal extended distally up to the distal part the glenoid fossa.
Numidotherium: The jugal extends far distally according to Mahboubi et al. (18).

127. Postorbital constriction. (0) Postorbital constriction strong; (1) postorbital constriction weak or absent.

128. Postorbital process of the frontal. (0) Postorbital process of the frontal developed, inflated; (1) postorbital process of the frontal reduced or absent.
The postorbital process of the frontal is present in Palaeoamasiidae. The postorbital process reduced in *Moeritherium* (19).

129. Postorbital process of the jugal. (0) Postorbital process of the jugal present but weak; (1) postorbital process of the jugal absent; (2) postorbital process of the jugal very developed.
This character is not additive.

130. Zygomatic arch shape. (0) Zygomatic arch poorly divergent laterally; (1) zygomatic arch widely divergent laterally.
Embrithopoda: Palaeoamasiidae, not *Arsinoitherium*. One specimen of *Eritherium* from a private collection seems to show well divergent zygomatic process of the maxilla.

131. Cerebral part of squamosal. (0) Squamosal: Cerebral part not extended dorsally; (1) squamosal: Cerebral part extended and inflated (=scale).

Not very extended dorsally in macroscelideans, but noticeably inflated.

132. Zygomatic process of the squamosal. (0) Zygomatic process of the squamosal moderately developed laterally; (1) Zygomatic process of the squamosal noticeably expanded laterally and robust.
In the macroscelideans, there is an important development of the squamosal process in the zygomatic arch.

133. Parietal-alisphenoid contact. (0) Parietal-alisphenoid contact; (1) frontal-squamosal contact.

134. External auditory meatus. (0) External auditory meatus poorly elevated above the tooth row; (1) external auditory meatus high above the tooth row (close to the orbit level).

135. Post-tympanic process. (0) Post-tympanic process reduced, external auditory meatus opened ventrally; (1) post-tympanic process developed, external auditory meatus still opened ventrally; (2) post-tympanic process developed joining the postglenoid process, external auditory meatus ventrally enclosed.

136. Sagittal crest. (0) Sagittal crest present; (1) sagittal crest reduced/absent.
The condition is unknown in Palaeoamasiidae. In macroscelideans, some genera reduce the sagittal crest, but it is well retained for instance in *Petrodromus*.

137. Nuchal crests. (0) Nuchal crests present; (1) Nuchal crest reduced/absent.
In macroscelideans, some genera reduce the nuchal crests, but it is well developed for instance in *Petrodromus*.

138. Periotic mastoidy. (0) Periotic mastoidy: Mastoid exposure large between squamosal and exoccipital; (1) Periotic amastoidy: Mastoid exposure absent.
Mastoidy in Macroscelidea according to Corbet & Hanks (11).

139. Periotic pars mastoidea. (0) Periotic: Pars mastoidea small; (1) Periotic: Pars mastoidea larger than pars cochlearis.

140. Periotic pars cochlearis. (0) Periotic (pars cochlearis): Fenestra rotunda (f. cochleae rotunda) and cochlear canal (cochleae canaliculus) present; (1) Periotic (pars cochlearis): Fenestra rotunda and cochlear canal absent, perilymphatic foramen present.

141. Postglenoid foramen. (0) Postglenoid foramen distal; (1) Postglenoid foramen shifted medially; (2) Postglenoid foramen entirely medial (=homologous with the canalis temporalis in Tassy (19)).

142. (0) Hypoglossal foramen present and isolated; (1) Hypoglossal foramen coalescent with *f. lacerum posterius* (= f. *metoticum*).

143. (0) Ethmoidal foramen far anterior to optic foramen, located median in the orbito-temporal fossa; (1) Ethmoidal foramen posteriorly shifted.
Macroscelidea: No distinct ethmoidal foramen.

Part III.
Characters matrix for *Eritherium azzouzorum* n. g., n. sp. ,
characters summary list, taxa analyzed

Matrix

The characters matrix analyzed below corresponds to the revised matrix of Gheerbrant et al. (2), with detailed character corrections and additions (Part II), and with addition of new basal taxa. The matrix include the 143 characters described above, of which 16 are uninformative. Characters are treated as additive, except when mentioned.

```
Eutheria
00000000000000000000000000000000000000000000000000000000000000000000000[01]000[01]000
0000000000?00000000000000000000000000000000000000000000000000000000000000
Arctocyonidae
0000001[01][01][01]0000[01]0000[01][01]1000011000000[12]0100010[01][01]0000000000
00000001[01]1000100010000011001[01]00010000[01]1000000011[01][01]000000?000000000
00000000[01]00000000000000
Ocepeia
000010?[01]323?00101100010[01]00120[01]00[01]110110000[12]100100000?11???????1?1?
?120010000001000010?11202[01]001000001000000?????????????????????????????????
Monshyus
????????????????????????????????????????????????????????????????????????????2112
111002000011?212110??00011?????????????????????????????????
Microhyus
?????01010000010110001000110000110110100[01]01010000?????????????????0121101122[01]
002112111102000111?1211[01]1200011?????????????????????????????????
Phenacodontidae
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2112200021[01]0101003110111100[01]1110011[01]00000001000000[01]000000000[01]000001
00000000
Perissodactyla
000000100[01]000101001112100102011110120200 12[12]020100000000000000100000122112200
002122101013000011001210001110000000000010000011000000000100010000000
Radinskya
????????????????????????????????????????????????????????0000012?11210002122
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Macroscelidea
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Hyracoidea
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002112[01][01]10[12]31202100212110[01]321101000000001000000100100200000101100000
Anthracobunidae
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100012111210012112111013000011001111113111 01?????????10????????????????????????
Desmostylia
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010?0000101?000012112111013001?120011111101 1?01000010000[12]012001000000?01?12001
00200
Sirenia
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111111013001?120011111101110100011110020121010100001010110 1000000
```

Phenacolophus
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Minchenella
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Embrithopoda
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01210000?023120310021011013211010000100002112001100000100012?0101211
Eritherium
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Khamsaconus
??211?
1110?2??0?110212111???1?01?????????????????????????????????
Phosphatherium
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112131110002110112021311113111110000100002211101?1?00010110100110100
Numidotherium
112?23?23200001[01]111103211110112000132300000[01]211101211120101211l?01112101110
112131110002001?120213111132120111111000022121012110011111121011021O
Moeritherium
11?123?232000111101114211100011101232322l0[01]02111112l?120101111l?01112201220012
141110023001?12001[23]111132120101111001022121012111111111121011121O

Characters summary list

1. Lower incisors shape and development
2. Lower incisors shape.
3. Development of I/1.
4. Development of I/2.
5. Development of I/3.
6. Development of C/1.
7. C/1 root(s).
8. Anterior lower diastema.
9. Development of P/1.
10. P/1 root(s).
11. Development of P/2.
12. P/2 root(s).
13. P/3-4 root(s) and development.
14. P/3 metaconid development.
15. P/3 paraconid development.
16. P/3 talonid development.
17. P/3-4 paraconid position.
18. P/4 paraconid development.
19. P/4 talonid development.
20. P/4 metaconid.
21. Lower premolars cingulum.
22. Lower molar pattern.
23. M/1-3 lophs.
24. M/1-3 cusps.
25. M/1-3 trigonid.
26. M/1-3 paraconid.
27. M/1- 3 premetacristid.
28. M/1- 3 postmetacristid.
29. M/1- 3 protocristid.
30. M/1- 3 hypolophid development.
31. M/1- 3 hypolophid shape.
32. M/1- 3 entocristid.
33. M/1- 3 entoconulid.
34. M/1- 3 mesoconid.
35. M/1- 3 cristid obliqua.
36. M/1- 3 postcristid.
37. M/1-2 hypoconulid position.
38. M/1-2 hypoconulid development.
39. M/1-2 postentoconulid:
40. M/3 postentoconulid.
41. M/1-3 ectocingulid.
42. M/1 trigonid/talonid relative width.
43. M/2 trigonid/talonid relative width.
44. M/3 trigonid/talonid relative width.
45. M/3 development.
46. Extension of mandibular symphysis.
47. Fusion of mandibular symphysis.
48. Horizontal ramus (body).
49. Position of the coronoid apophysis.
50. Orientation of the coronoid apophysis.
51. Development of the coronoid apophysis.
52. Articular condyle.
53. Coronoid foramen.
54. Angular process.
55. Anterior coronoid fossa.
56. Number of upper incisors.
57. Relative size of upper incisors.
58. Development of I1/.
59. Development of I2/.
60. Upper anterior diastema.
61. Development of C1/.
62. C1/ root(s).
63. P1/ development.
64. P1/ root(s).
65. P2/ development.
66. P2/ root(s).
67. P2/ protocone.
68. P3/ root(s).
69. P3/ protocone.
70. P3/ metacone.
71. P3-4/ conules.
72. P4/ root(s).
73. P4/ metacone development.
74. P4/ metacone relations.
75. P4/ hypocone.
76. P4/ loph.
77. P4/ (and P3/ when protocone is developed) postprotocrista.
78. Upper molar pattern.
79. Upper molar bunodonty.
80. Upper molar lophodonty.
81. M1-3/ lophs.
82. M1-3/ parastyle position.
83. M1-2/ parastyle development.
84. M1-3/ ectocingulum.
85. M1-3/ pericone.
86. M1-3/ postcingulum.
87. M1-3/ cingulum lingual.
88. M1-3/ mesostyle development.
89. M1-3/ mesostyle position.
90. M1-3/ centrocrista development.
91. M1-3/ centrocrista shape.
92. M1-3/ postmetacrista.
93. M1-3/ preparacrista.
94. M3/ metacone.
95. M1-3/ conules.
96. M1-3/ postprotocrista.
97. M1-3/ prehypocrista.
98. M1-3/ interloph.
99. M1-3/ distocrista.
100. M1-3/ postentoconule.
101. M1/ and M2/ relative size.
102. M2/ and M3/ relative size.
103. M1-2/ lingual root(s).
104. M3/ protocone root.
105. M3/ hypocone root.
106. M1-3/ crown height.
107. M1-3/ occlusal outline.
108. Pneumatisation of skull bones.
109. Skull shape.
110. Extension of upper tooth row.
111. Nasal development.
112. Nasal position.
113. Nasal fossa.
114. Premaxillary-frontal contact.
115. Lacrimal.
116. Lacrimal tubercle.
117. Orbit location.
118. Maxillary/jugal relative orbital development.
119. Infraorbital foramen size.
120. Infraorbital foramen position.
121. Submaxillary fossa.
122. Tuber maxillae development.
123. Tuber maxillae position.
124. Ascending process of the palatine.
125. Morphology of the zygomatic arch.
126. Jugal distal extension.
127. Postorbital constriction.
128. Postorbital process of the frontal.
129. Postorbital process of the jugal.
130. Zygomatic arch shape.
131. Cerebral part of squamosal.
132. Zygomatic process of the squamosal.
133. Parietal-alisphenoid contact.
134. External auditory meatus.
135. Post-tympanic process.
136. Sagittal crest.
137. Nuchal crests.
138. Periotic mastoidy.
139. Periotic pars mastoidea.
140. Periotic pars cochlearis.
141. Postglenoid foramen.
142. Hypoglossal foramen.
143. Ethmoidal foramen.

Taxa analyzed

The primary aim of our analysis was a comparison of *Eritherium azzouzorum* n. g., n. sp. with primitive proboscideans and other early paenungulates in order to assess its ordinal relationships. The in-group comparison includes only selected primitive proboscideans such as *Khamsaconus*, *Phosphatherium*, *Numidotherium*, and *Moeritherium*. Comparison focused also on primitive representatives (*i.e.*, representatives of primitive ancestral morphotypes) of paenungulates and "altungulates" orders (=lophodont ungulates) and more basal taxa such as "condylarths". The basal out-group corresponds to the generalized eutherian morphotype, represented by leptictids and cimolestids (*e.g.*, 21). With respect to *Phosphatherium* study (2), the outgroup comparison is extended to the "condylarths" Arctocyonidae, Louisininae *Microhyus* and *Monshyus* (Apheliscidae *sensu* Zack et al. (22)), and primitive Macroscelidea (*Chambius* and *Herodotius*), in order to test basal relationships of Proboscidea.

List of taxa compared: *Phophatherium*, *Daouitherium*, *Numidotherium (N. koholense*), *Moeritherium*, *Khamsaconus* (holotype), anthracobunids (*A. pinfoldi, Indobune*), primitive sirenians (*Prorastomus*, *Pezosiren*, *Protosiren*, *Eosiren*, *Eotheroides*, *Prototherium*), desmostylians (*Behemotops* and others), phenacolophids (*Phenacolophus*, *Minchenella*, *Radinskya*), phenacodontids (*Ectocion*), *Ocepeia*, primitive perissodactyls (*Hyracotherium*, *Cymbalophus*, *Pachynolophus*), primitive hyracoids (*Seggeurius*, *Microhyrax*, Pliohyracidae), embrithopods (Palaeoamasiidae incl. *Crivadiatherium*, *Arsinoitherium*), louisinines *Microhyus* and *Monshyus*, primitive (*Chambius*, *Herodotius*) and extant (*Petrodromus*, *Rhynchocyon*) macroscelideans, arctocyonids (*Loxolophus*, *Tricentes*, *Lambertocyon*, *Chriacus*), leptictids (*Leptacodon*, *Leptictis*), cimolestids (*Cimolestes*).

Part IV.
TNT analysis, method, cladograms, diagnose of nodes

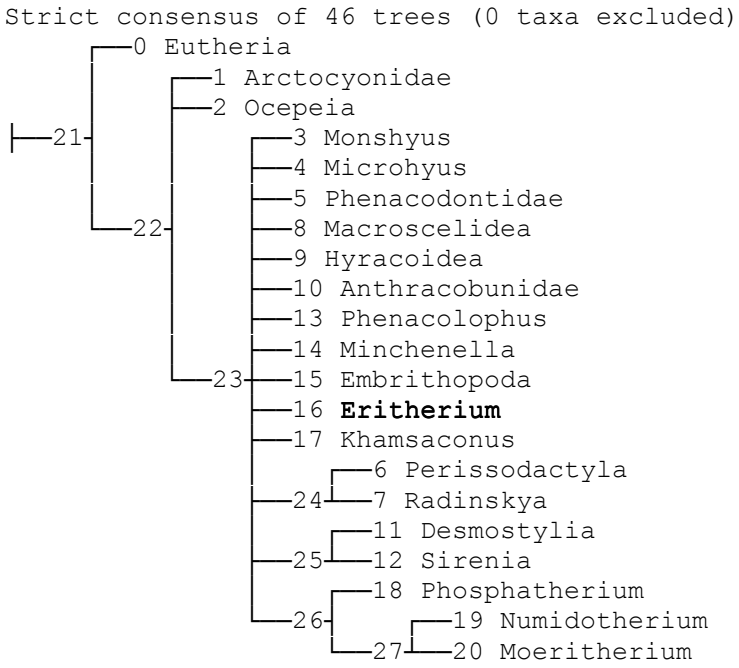
The parsimony analysis was developed by means of the TNT program (23). A preliminary analysis was developed (1) on the matrix including all taxa, i.e. including *Khamsaconus*. 46 most parsimonious (MPTs) were obtained of which the consensus tree is noticeably poorly resolved. The poor resolution results mainly of the unstable position of *Khamsaconus* as identified with the help of the "TNT pruned tree" procedure. We consequently developed the analysis excluding *Khamsaconus*. The analysis includes two steps: (2.1) an exact unweighted analysis (nelsen command) of all taxa (including *Khamasaconus*), which yielded 14 most parsimonious (MPTs) illustrated here by the consensus cladogram 2 (figure 2a); (2.2) an exact analysis with the standard TNT "implied weighting" procedure illustrated by the cladogram 3 (figure 2b).
Bremer indices were calculated for 10000 trees with additional 10 steps longer than in the shortest obtained tree. The 16 uninformative characters (K4, 13, 56, 65, 72, 75, 79, 85, 85, 92, 108, 113, 114, 115, 122, 128, 143) were made inactive before the analysis.
The interface WINCLADA associated with the heuristic algorithm NONA was used in complement of our study, especially for the revision of the matrix, for the preliminary explorative analysis of tree topology and for examination of character distribution in trees.

1. Analysis with *Khamasaconus*

Implicit enumeration, unweighted analysis

46 trees found, score 457. 1039.71 secs.

Cladogram 1



Tree lengths: 457. Retention index: 58.4; Consistency Index: 41.6

2. Analysis without *Khamasaconus*

20 active, 1 inactive taxa

20 terminal taxa are active:

0 Eutheria
1 Arctocyonidae
2 Ocepeia
3 Monshyus
4 Microhyus
5 Phenacodontidae
6 Perissodactyla
7 Radinskya
8 Macroscelidea
9 Hyracoidea
10 Anthracobunidae
11 Desmostylia
12 Sirenia
13 Phenacolophus
14 Minchenella
15 Embrithopoda
16 Eritherium
18 Phosphatherium
19 Numidotherium
20 Moeritherium

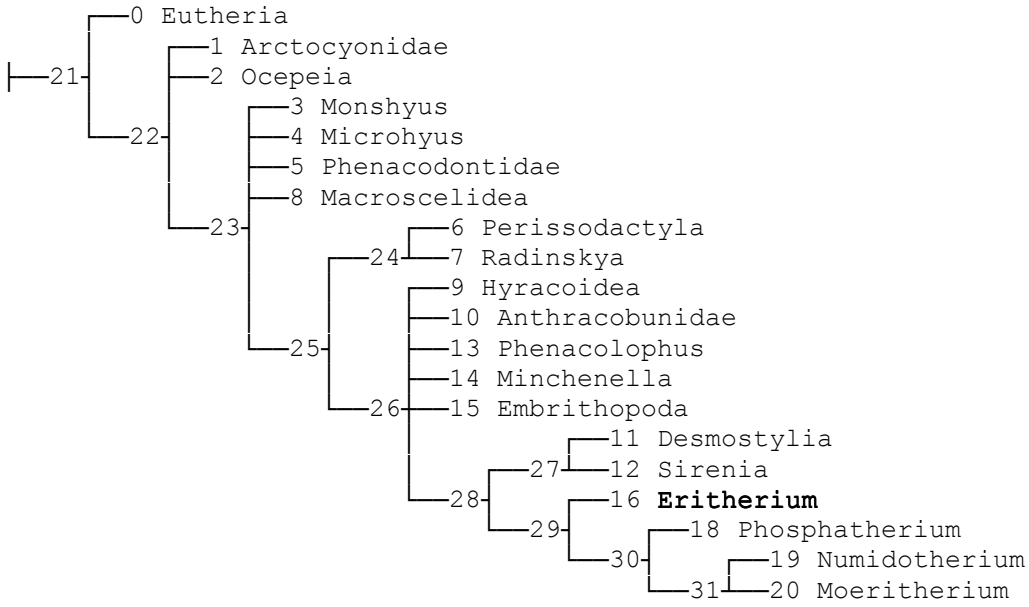
1 terminal taxa are inactive: 17 Khamsaconus

2.1 Implicit enumeration, unweighted analysis

Cladogram 2

Implicit enumeration, 14 trees found, score 455. 778.91 secs.

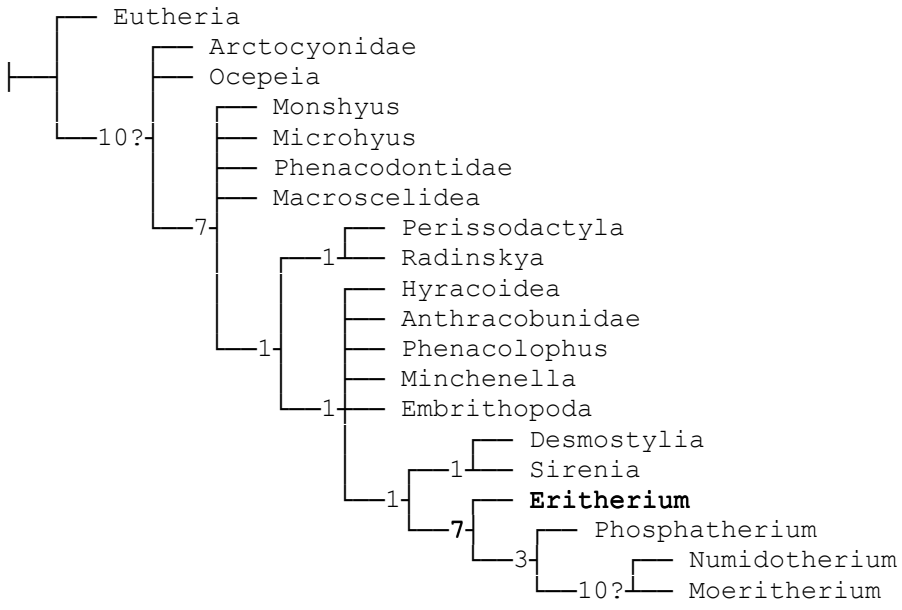
Strict consensus of 14 trees (1 taxa excluded)



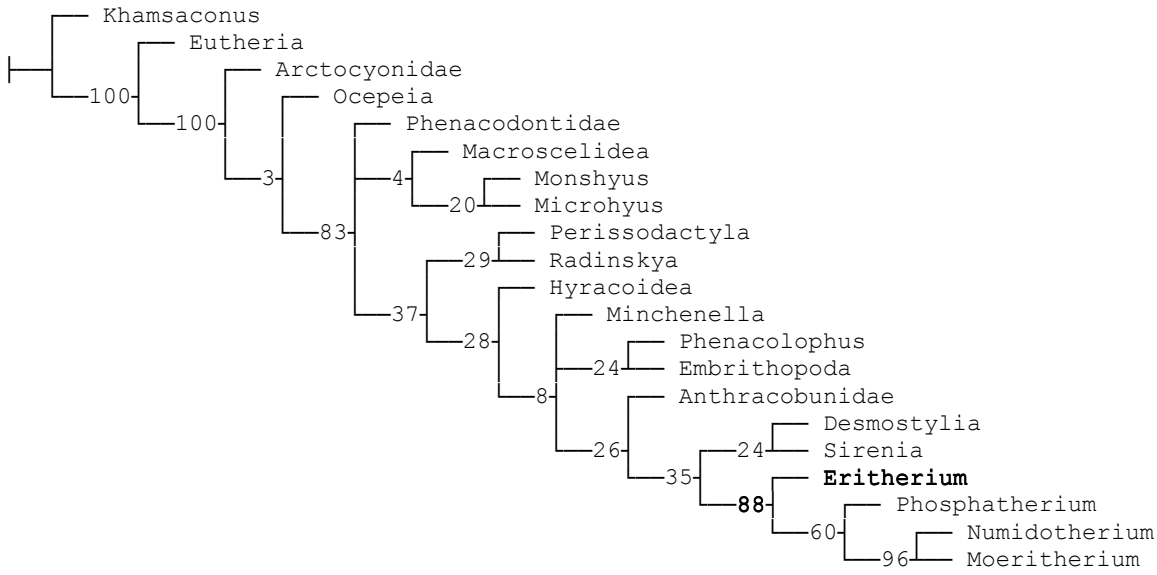
Tree lengths: 455. Retention index: 58.7; Consistency Index: 41.8

Suboptimal 10.000 x 0.000. Start swapping from 37 trees (score 454-464)...
Repl. Algor. Tree Score Best Score Time Rearrangs.
--- TBR 9999 of 10000 ------ 454 0:01:28 39,561,660
Completed TBR branch-swapping. Total rearrangements examined: 39,561,660. Best score (TBR): 454-464. 10000 trees found (overflow).

Bremer supports (from 10000 trees, cut 0)



Standard bootstrap



Average group support: 40.3

Diagnose of nodes of cladogram 2: Synapomorphies common to 14 trees

(Node numbers refer to nodes in consensus)

Important note: For correspondence with character description (Part II) and character summary list (Part III), number n of characters ***should be read as n+1*** because TNT starts numbering characters from 0.

Eutheria :
All trees:
No autapomorphies:

Arctocyonidae :
All trees:
Char. 63: 0 --> 1
Some trees:
Char. 40: 0 --> 1
Char. 101: 0 --> 1

Ocepeia :
All trees:
Char. 4: 0 --> 1
Char. 8: 01 --> 3
Char. 9: 01 --> 2
Char. 10: 0 --> 3
Char. 27: 1 --> 2
Char. 33: 0 --> 1
Char. 43: 0 --> 1
Char. 46: 0 --> 1
Char. 54: 0 --> 1
Char. 62: 0 --> 1
Char. 68: 01 --> 2
Char. 87: 0 --> 1
Char. 88: 0 --> 2
Char. 90: 0 --> 2
Some trees:
Char. 14: 0 --> 1
Char. 16: 0 --> 1
Char. 17: 0 --> 1
Char. 53: 0 --> 1
Char. 94: 0 --> 1

Monshyus :
Some trees:
Char. 94: 01 --> 2

Microhyus :
Some trees:
Char. 14: 0 --> 1
Char. 17: 0 --> 1
Char. 25: 0 --> 1
Char. 27: 1 --> 0
Char. 36: 1 --> 0
Char. 65: 0 --> 1
Char. 66: 0 --> 2

Phenacodontidae :
All trees:
Char. 33: 0 --> 1
Some trees:
Char. 9: 0 --> 1
Char. 27: 1 --> 2
Char. 34: 1 --> 0
Char. 53: 0 --> 1
Char. 69: 1 --> 2
Char. 80: 2 --> 0
Char. 82: 1 --> 0
Char. 86: 2 --> 3
Char. 87: 0 --> 1
Char. 88: 0 --> 1
Char. 90: 0 --> 1
Char. 96: 2 --> 1
Char. 100: 1 --> 0
Char. 111: 0 --> 1

Perissodactyla :
Some trees:
Char. 82: 1 --> 0
Char. 100: 1 --> 0

Radinskya :
All trees:
Char. 73: 2 --> 1
Some trees:
Char. 82: 01 --> 1
Char. 86: 3 --> 2
Char. 100: 01 --> 1

Macroscelidea :
All trees:
Char. 5: 0 --> 1
Char. 15: 0 --> 1
Char. 42: 1 --> 2
Char. 45: 0 --> 1
Char. 48: 0 --> 1
Some trees:
Char. 1: 0 --> 1
Char. 13: 0 --> 1
Char. 40: 1 --> 0
Char. 51: 0 --> 1
Char. 61: 1 --> 0
Char. 80: 2 --> 1
Char. 95: 1 --> 0
Char. 100: 1 --> 0
Char. 102: 0 --> 12
Char. 115: 0 --> 1
Char. 118: 0 --> 1
Char. 126: 0 --> 1
Char. 128: 0 --> 1
Char. 130: 0 --> 1

Hyracoidea :
All trees:
Char. 6: 1 --> 0
Char. 18: 1 --> 0
Char. 33: 0 --> 1
Char. 65: 0 --> 1
Char. 66: 0 --> 2
Char. 125: 0 --> 1
Char. 128: 0 --> 2
Some trees:
Char. 20: 1 --> 0
Char. 22: 1 --> 2
Char. 24: 0 --> 1
Char. 34: 0 --> 1
Char. 35: 3 --> 0
Char. 36: 1 --> 0
Char. 37: 3 --> 2
Char. 69: 1 --> 2
Char. 87: 0 --> 1
Char. 88: 0 --> 2
Char. 90: 01 --> 2
Char. 92: 1 --> 0
Char. 94: 0 --> 2
Char. 102: 1 --> 2
Char. 115: 0 --> 1
Char. 136: 0 --> 1

Anthracobunidae :
All trees:
Char. 43: 0 --> 12
Some trees:
Char. 0: 1 --> 0
Char. 9: 1 --> 0
Char. 26: 0 --> 1

Desmostylia :
All trees:
Char. 43: 0 --> 2
Some trees:
Char. 39: 2 --> 1
Char. 134: 1 --> 2

Char. 140: 01 --> 2

Sirenia :
All trees:
Char. 6: 1 --> 0
Char. 45: 0 --> 1
Char. 61: 1 --> 0
Char. 65: 0 --> 2
Char. 68: 1 --> 0
Char. 110: 0 --> 1
Char. 120: 0 --> 1
Char. 136: 0 --> 1
Char. 137: 1 --> 0
Some trees:
Char. 50: 1 --> 0
Char. 51: 0 --> 1
Char. 57: 0 --> 1
Char. 140: 012 --> 0

Phenacolophus :
All trees:
Char. 11: 0 --> 1
Char. 13: 1 --> 0
Char. 31: 1 --> 0
Char. 43: 0 --> 12
Char. 65: 0 --> 2
Char. 68: 2 --> 0
Some trees:
Char. 9: 0 --> 1
Char. 14: 0 --> 1
Char. 16: 1 --> 0
Char. 47: 0 --> 1
Char. 76: 1 --> 0
Char. 80: 2 --> 1
Char. 82: 0 --> 1
Char. 95: 1 --> 0
Char. 96: 2 --> 1
Char. 100: 1 --> 0
Char. 116: 12 --> 0

Minchenella :
All trees:
Char. 41: 0 --> 2
Char. 42: 1 --> 2
Some trees:
Char. 14: 0 --> 1
Char. 15: 0 --> 1
Char. 36: 01 --> 1
Char. 81: 1 --> 0
Char. 82: 01 --> 0
Char. 95: 1 --> 0
Char. 96: 12 --> 2
Char. 104: 1 --> 0

Embrithopoda :
All trees:
Char. 5: 0 --> 1
Char. 30: 1 --> 2
Char. 45: 0 --> 1
Char. 79: 1 --> 0
Char. 90: 012 --> 3
Some trees:
Char. 9: 01 --> 0
Char. 15: 0 --> 1
Char. 27: 2 --> 1
Char. 47: 01 --> 0
Char. 60: 0 --> 1
Char. 76: 01 --> 1
Char. 80: 2 --> 0
Char. 81: 1 --> 0
Char. 82: 01 --> 0
Char. 92: 1 --> 0
Char. 94: 0 --> 2
Char. 96: 12 --> 0
Char. 116: 012 --> 2
Char. 117: 0 --> 1
Char. 119: 01 --> 2
Char. 123: 0 --> 1
Char. 134: 1 --> 2
Char. 139: 0 --> 1
Char. 140: 01 --> 2
Char. 141: 0 --> 1

Eritherium :
All trees:
Char. 38: 1 --> 2
Char. 42: 1 --> 2
Char. 44: 2 --> 1
Char. 101: 3 --> 1

Phosphatherium :
All trees:
Char. 105: 0 --> 1
Some trees:
Char. 133: 1 --> 0

Numidotherium :
All trees:
Char. 33: 1 --> 0
Char. 34: 2 --> 1
Char. 38: 1 --> 0
Char. 39: 12 --> 0
Char. 59: 1 --> 2

Moeritherium :
All trees:
Char. 13: 0 --> 1
Char. 17: 1 --> 0
Char. 20: 0 --> 1
Char. 21: 3 --> 4
Char. 38: 1 --> 2
Char. 48: 0 --> 1
Char. 69: 1 --> 2
Char. 72: 1 --> 2
Char. 73: 1 --> 2
Char. 79: 3 --> 4
Char. 85: 0 --> 2
Char. 86: 2 --> 3
Char. 94: 2 --> 0
Char. 126: 0 --> 1
Char. 139: 0 --> 1

Node 22 :
All trees:
No synapomorphies

Node 23 :
All trees:
Char. 77: 01 --> 2
Char. 86: 1 --> 2
Char. 97: 0 --> 1
Char. 98: 0 --> 1
Some trees:
Char. 18: 0 --> 1
Char. 35: 0 --> 1
Char. 44: 0 --> 1
Char. 69: 0 --> 1
Char. 70: 0 --> 1
Char. 72: 0 --> 2
Char. 73: 0 --> 2
Char. 79: 0 --> 1
Char. 80: 0 --> 2
Char. 82: 0 --> 1
Char. 95: 0 --> 1
Char. 96: 0 --> 2
Char. 105: 0 --> 1
Char. 106: 0 --> 1

Node 24 :
All trees:
Char. 79: 1 --> 2
Char. 98: 1 --> 0
Some trees:
Char. 106: 1 --> 0
Char. 115: 0 --> 1
Char. 136: 0 --> 1

Node 25 :
All trees:
Char. 21: 1 --> 2
Char. 22: 0 --> 1
Char. 29: 0 --> 1
Char. 30: 0 --> 1
Char. 44: 1 --> 2

Char. 46: 0 --> 1
Char. 68: 1 --> 2
Char. 85: 0 --> 1
Some trees:
Char. 13: 0 --> 1

Char. 20: 0 --> 1
Char. 25: 0 --> 1
Char. 27: 1 --> 2
Char. 36: 1 --> 0
Char. 37: 1 --> 2
Char. 103: 0 --> 1

Node 26 : Paenungulata
All trees:
Char. 23: 0 --> 1
Char. 52: 0 --> 1
Char. 56: 0 --> 1
Char. 137: 0 --> 1
Some trees:
Char. 16: 0 --> 1
Char. 22: 1 --> 2
Char. 24: 0 --> 01
Char. 32: 1 --> 0
Char. 37: 2 --> 3
Char. 53: 0 --> 1
Char. 70: 1 --> 0
Char. 88: 01 --> 02
Char. 90: 01 --> 012
Char. 101: 1 --> 3
Char. 104: 0 --> 1
Char. 106: 01 --> 1

Node 27 :
All trees:
Char. 67: 1 --> 0
Char. 68: 2 --> 1
Char. 89: 0 --> 1
Char. 101: 3 --> 0
Some trees:
Char. 119: 1 --> 2

Node 28 :
All trees:
Char. 8: 0 --> 1
Char. 10: 0 --> 1
Char. 11: 0 --> 1
Char. 92: 1 --> 2
Some trees:
Char. 0: 0 --> 1
Char. 1: 0 --> 1
Char. 27: 2 --> 01
Char. 34: 0 --> 1
Char. 72: 2 --> 01
Char. 131: 0 --> 1

Node 29 : **Proboscidea**
All trees:
Char. 2: 0 --> 1
Char. 4: 0 --> 1
Char. 5: 0 --> 2
Char. 8: 1 --> 2
Char. 13: 1 --> 0
Char. 17: 0 --> 1
Char. 20: 1 --> 0
Char. 33: 0 --> 1
Char. 34: 1 --> 2
Char. 36: 0 --> 2
Char. 85: 1 --> 0
Char. 86: 3 --> 2
Char. 94: 0 --> 2
Some trees:
Char. 14: 0 --> 1
Char. 54: 0 --> 12
Char. 70: 1 --> 0
Char. 117: 0 --> 1

Node 30 :
All trees:
Char. 2: 1 --> 2
Char. 4: 1 --> 2
Char. 8: 2 --> 3
Char. 9: 1 --> 2
Char. 21: 2 --> 3
Char. 42: 1 --> 0
Char. 45: 0 --> 1
Char. 79: 1 --> 3
Char. 83: 1 --> 0
Char. 96: 1 --> 3
Char. 117: 1 --> 2
Char. 120: 0 --> 1

Node 31 :
All trees:
Char. 5: 2 --> 3
Char. 7: 0 --> 2
Char. 10: 12 --> 0
Char. 11: 1 --> 0
Char. 49: 0 --> 1
Char. 50: 1 --> 2
Char. 59: 0 --> 1
Char. 60: 0 --> 1
Char. 62: 0 --> 1
Char. 65: 0 --> 1
Char. 66: 0 --> 1
Char. 89: 0 --> 1
Char. 102: 1 --> 2
Char. 104: 1 --> 2
Char. 108: 0 --> 1
Char. 109: 0 --> 1
Char. 110: 0 --> 1
Char. 128: 0 --> 1
Char. 130: 0 --> 1
Char. 135: 0 --> 1
Char. 141: 0 --> 1
Some trees:
Char. 51: 0 --> 1
Char. 119: 1 --> 2
Char. 134: 1 --> 2
Char. 140: 1 --> 2

0.16 secs.

Characters transformation in cladogram 2

Important note: For correspondence with character description (Part II) and character summary list (Part III), number *n* of characters ***should be read as n+1*** because TNT starts numbering characters from 0.

Char. 0 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 0
Phenacolophus: 01 -> 1
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 1 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Node 28: 0 -> 1
Char. 2 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 01
Node 29: 0 -> 1
Node 30: 1 -> 2
Char. 4 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 29: 0 -> 1
Node 30: 1 -> 2
Char. 5 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Embrithopoda: 0 -> 1
Node 29: 0 -> 2
Sirenia: 0 -> 01
Node 31: 2 -> 3
Char. 6 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Node 23: 01 -> 1
Hyracoidea: 1 -> 0
Sirenia: 1 -> 0
Char. 7 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Ocepeia: 0 -> 01
Macroscelidea: 0 -> 01
Anthracobunidae: 0 -> 01
Desmostylia: 0 -> 01
Node 31: 0 -> 2
Char. 8 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 3
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Node 25: 01 -> 0
Node 28: 0 -> 1
Node 29: 1 -> 2
Node 30: 2 -> 3
Char. 9 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 2
Microhyus: 01 -> 0
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 0
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 0
Phenacolophus: 01 -> 1
Minchenella: 01 -> 1
Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Node 30: 1 -> 2
Char. 10 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 3
Node 28: 0 -> 1
Node 29: 1 -> 12
Eritherium: 12 -> 2
Phosphatherium: 12 -> 2
Node 31: 12 -> 0
Char. 11 (super-sets from 14 trees):
Root: 0
Phenacolophus: 0 -> 1
Node 28: 0 -> 1
Desmostylia: 1 -> 01
Node 31: 1 -> 0
Char. 13 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Node 25: 0 -> 1
Phenacolophus: 1 -> 0
Node 29: 1 -> 0
Moeritherium: 0 -> 1
Char. 14 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 0
Node 25: 01 -> 0
Phenacolophus: 0 -> 1
Minchenella: 0 -> 1
Node 28: 0 -> 01
Node 27: 01 -> 0
Node 29: 01 -> 1
Char. 15 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Node 24: 0 -> 01
Perissodactyla: 01 -> 1
Anthracobunidae: 0 -> 01
Minchenella: 0 -> 1
Embrithopoda: 0 -> 1
Node 31: 0 -> 01
Moeritherium: 01 -> 1
Char. 16 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Perissodactyla: 01 -> 0
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 0
Minchenella: 01 -> 1
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 17 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 0
Node 25: 01 -> 0
Node 29: 0 -> 1
Moeritherium: 1 -> 0
Char. 18 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 0
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 1
Hyracoidea: 1 -> 0
Node 28: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 31: 01 -> 1
Char. 19 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Node 23: 0 -> 01
Microhyus: 01 -> 0
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 1
Char. 20 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Phenacodontidae: 0 -> 01
Node 25: 0 -> 01
Perissodactyla: 01 -> 1
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 1
Minchenella: 01 -> 1

Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Node 29: 1 -> 0
Moeritherium: 0 -> 1
Char. 21 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Node 25: 1 -> 2
Phenacolophus: 2 -> 3
Embrithopoda: 2 -> 3
Node 30: 2 -> 3
Moeritherium: 3 -> 4
Char. 22 (super-sets from 14 trees):
Root: 0
Node 25: 0 -> 1
Node 26: 1 -> 12
Hyracoidea: 12 -> 2
Anthracobunidae: 12 -> 2
Phenacolophus: 12 -> 1
Minchenella: 12 -> 1
Embrithopoda: 12 -> 1
Node 28: 12 -> 2
Char. 23 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 01
Node 26: 0 -> 1
Char. 24 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 0
Minchenella: 01 -> 0
Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Char. 25 (super-sets from 14 trees):
Root: 0
Microhyus: 0 -> 1
Node 25: 0 -> 01
Perissodactyla: 01 -> 1
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 0
Minchenella: 01 -> 1
Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Char. 26 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Ocepeia: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 0
Node 25: 01 -> 0
Anthracobunidae: 0 -> 1
Node 28: 0 -> 01
Node 27: 01 -> 0
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 27 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Ocepeia: 1 -> 2
Microhyus: 1 -> 0
Phenacodontidae: 1 -> 2
Node 25: 1 -> 2
Anthracobunidae: 2 -> 12

Embrithopoda: 2 -> 1
Node 28: 2 -> 01
Sirenia: 01 -> 0
Eritherium: 01 -> 1
Node 30: 01 -> 0
Char. 28 (super-sets from 14 trees):
Root: 0
Phenacolophus: 0 -> 1
Embrithopoda: 0 -> 1
Node 30: 0 -> 01
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 29 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 01
Node 25: 0 -> 1
Char. 30 (super-sets from 14 trees):
Root: 0
Node 25: 0 -> 1
Embrithopoda: 1 -> 2
Node 30: 1 -> 12
Phosphatherium: 12 -> 2
Numidotherium: 12 -> 2
Moeritherium: 12 -> 1
Char. 31 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 1
Macroscelidea: 01 -> 0
Node 25: 01 -> 1
Anthracobunidae: 1 -> 01
Phenacolophus: 1 -> 0
Node 30: 1 -> 01
Phosphatherium: 01 -> 0
Numidotherium: 01 -> 0
Moeritherium: 01 -> 1
Char. 32 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 01
Node 23: 0 -> 01
Microhyus: 01 -> 1
Macroscelidea: 01 -> 1
Node 26: 01 -> 0
Perissodactyla: 01 -> 1
Phosphatherium: 0 -> 01
Char. 33 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Phenacodontidae: 0 -> 1
Hyracoidea: 0 -> 1
Node 29: 0 -> 1
Numidotherium: 1 -> 0
Char. 34 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Arctocyonidae: 1 -> 12
Phenacodontidae: 1 -> 0
Node 25: 1 -> 01
Perissodactyla: 01 -> 1
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 0
Phenacolophus: 01 -> 0
Minchenella: 01 -> 0

Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Node 29: 1 -> 2
Numidotherium: 2 -> 1
Char. 35 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 0123
Perissodactyla: 0123 -> 2
Hyracoidea: 0123 -> 0
Anthracobunidae: 0123 -> 3
Phenacolophus: 0123 -> 3
Minchenella: 0123 -> 3
Embrithopoda: 0123 -> 3
Node 28: 0123 -> 3
Char. 36 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Microhyus: 1 -> 0
Node 25: 1 -> 01
Perissodactyla: 01 -> 0
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 0
Phenacolophus: 01 -> 1
Minchenella: 01 -> 1
Embrithopoda: 01 -> 1
Node 28: 01 -> 0
Node 29: 0 -> 2
Char. 37 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 0
Ocepeia: 01 -> 1
Microhyus: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 2
Node 26: 2 -> 23
Hyracoidea: 23 -> 2

Anthracobunidae: 23 -> 3
Phenacolophus: 23 -> 3
Minchenella: 23 -> 3
Embrithopoda: 23 -> 3
Node 28: 23 -> 3
Char. 38 (super-sets from 14 trees):
Root: 0
Node 28: 0 -> 01
Node 29: 01 -> 1
Eritherium: 1 -> 2
Numidotherium: 1 -> 0
Moeritherium: 1 -> 2
Char. 39 (super-sets from 14 trees):

Root: 0
Anthracobunidae: 0 -> 2
Minchenella: 0 -> 2
Node 28: 0 -> 12
Desmostylia: 12 -> 1
Sirenia: 12 -> 2
Eritherium: 12 -> 2
Phosphatherium: 12 -> 1
Numidotherium: 12 -> 0
Moeritherium: 12 -> 2
Char. 40 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 1
Node 23: 0 -> 01
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 0
Node 25: 01 -> 1
Node 28: 1 -> 01
Desmostylia: 01 -> 1
Sirenia: 01 -> 0
Phosphatherium: 01 -> 0
Numidotherium: 01 -> 0
Moeritherium: 01 -> 1
Char. 41 (super-sets from 14 trees):
Root: 0
Node 24: 0 -> 012
Perissodactyla: 012 -> 2
Hyracoidea: 0 -> 01

Minchenella: 0 -> 2
Desmostylia: 0 -> 01
Char. 42 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 12
Node 23: 01 -> 1
Phenacodontidae: 1 -> 12
Macroscelidea: 1 -> 2
Perissodactyla: 1 -> 12
Anthracobunidae: 1 -> 01
Phenacolophus: 1 -> 01
Minchenella: 1 -> 2
Embrithopoda: 1 -> 01
Desmostylia: 1 -> 01
Eritherium: 1 -> 2
Node 30: 1 -> 0
Moeritherium: 0 -> 01
Char. 43 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Ocepeia: 0 -> 1
Anthracobunidae: 0 -> 12
Phenacolophus: 0 -> 12
Desmostylia: 0 -> 2
Phosphatherium: 0 -> 01
Numidotherium: 0 -> 01
Char. 44 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 2
Eritherium: 2 -> 1
Char. 45 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Embrithopoda: 0 -> 1
Sirenia: 0 -> 1
Node 30: 0 -> 1
Char. 46 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 25: 0 -> 1
Node 29: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 31: 01 -> 1
Char. 47 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 1
Minchenella: 01 -> 1
Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Node 29: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 31: 01 -> 1
Char. 48 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Moeritherium: 0 -> 1
Char. 49 (super-sets from 14 trees):
Root: 0
Node 31: 0 -> 1
Char. 50 (super-sets from 14 trees):
Root: 0
Anthracobunidae: 0 -> 1
Node 28: 0 -> 01
Desmostylia: 01 -> 1
Sirenia: 01 -> 0
Node 30: 01 -> 1
Node 31: 1 -> 2
Char. 51 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Node 25: 0 -> 01
Perissodactyla: 01 -> 0
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 0
Embrithopoda: 01 -> 1
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Phosphatherium: 01 -> 0
Node 31: 01 -> 1
Char. 52 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 1
Char. 53 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 23: 0 -> 01
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 0
Node 26: 01 -> 1
Perissodactyla: 01 -> 0
Char. 54 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 26: 0 -> 01
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 0
Embrithopoda: 01 -> 1
Node 27: 01 -> 0
Node 29: 01 -> 12
Node 30: 12 -> 2
Char. 56 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 1
Char. 57 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 1
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Node 31: 01 -> 0
Char. 58 (super-sets from 14 trees):
Root: 0
Node 29: 0 -> 01
Node 31: 01 -> 1
Char. 59 (super-sets from 14 trees):
Root: 0
Node 31: 0 -> 1
Numidotherium: 1 -> 2
Char. 60 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 1
Node 31: 0 -> 1
Char. 61 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1

Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 0
Node 25: 01 -> 1
Hyracoidea: 1 -> 01
Sirenia: 1 -> 0
Char. 62 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Ocepeia: 0 -> 1
Node 31: 0 -> 1
Char. 63 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 1
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 1
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 65 (super-sets from 14 trees):
Root: 0
Microhyus: 0 -> 1
Hyracoidea: 0 -> 1
Phenacolophus: 0 -> 2
Sirenia: 0 -> 2
Node 31: 0 -> 1
Char. 66 (super-sets from 14 trees):
Root: 0
Microhyus: 0 -> 2
Hyracoidea: 0 -> 2
Node 31: 0 -> 1
Char. 67 (super-sets from 14 trees):
Root: 1
Eutheria: 1 -> 01
Node 27: 1 -> 0
Char. 68 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 0
Ocepeia: 01 -> 2
Node 23: 01 -> 1
Node 25: 1 -> 2
Phenacolophus: 2 -> 0
Node 27: 2 -> 1
Sirenia: 1 -> 0
Char. 69 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 0
Phenacodontidae: 01 -> 2
Macroscelidea: 01 -> 1
Node 25: 01 -> 12
Perissodactyla: 12 -> 2
Hyracoidea: 12 -> 2
Anthracobunidae: 12 -> 1
Phenacolophus: 12 -> 01
Node 28: 12 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 30: 01 -> 1
Moeritherium: 1 -> 2
Char. 70 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 1
Node 26: 1 -> 01
Hyracoidea: 01 -> 0
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 0
Embrithopoda: 01 -> 0
Node 29: 01 -> 0
Desmostylia: 01 -> 1
Char. 72 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 012
Microhyus: 012 -> 2
Phenacodontidae: 012 -> 2
Macroscelidea: 012 -> 2
Node 25: 012 -> 2
Node 28: 2 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 30: 01 -> 1
Moeritherium: 1 -> 2
Char. 73 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 012
Microhyus: 012 -> 2
Phenacodontidae: 012 -> 2
Macroscelidea: 012 -> 2
Node 25: 012 -> 2
Radinskya: 2 -> 1
Anthracobunidae: 2 -> 1
Node 28: 2 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 30: 01 -> 1
Moeritherium: 1 -> 2
Char. 75 (super-sets from 14 trees):
Root: 0
Node 30: 0 -> 01
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 76 (super-sets from 14 trees):
Root: 0
Anthracobunidae: 0 -> 1
Embrithopoda: 0 -> 1
Node 28: 0 -> 1
Char. 77 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Ocepeia: 01 -> 0
Node 23: 01 -> 2
Char. 79 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Monshyus: 01 -> 1
Microhyus: 01 -> 1
Macroscelidea: 01 -> 1
Node 25: 01 -> 1
Node 24: 1 -> 2
Embrithopoda: 1 -> 0
Node 30: 1 -> 3
Moeritherium: 3 -> 4
Char. 80 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 02
Monshyus: 02 -> 2
Microhyus: 02 -> 2
Phenacodontidae: 02 -> 0
Macroscelidea: 02 -> 1
Node 25: 02 -> 2
Phenacolophus: 2 -> 1
Embrithopoda: 2 -> 0
Node 28: 2 -> 12
Node 29: 12 -> 1
Desmostylia: 12 -> 2
Sirenia: 12 -> 1
Char. 81 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Ocepeia: 01 -> 0
Node 23: 01 -> 1
Hyracoidea: 1 -> 01
Minchenella: 1 -> 0
Embrithopoda: 1 -> 0
Char. 82 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Node 23: 0 -> 01
Monshyus: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Perissodactyla: 01 -> 0
Radinskya: 01 -> 1
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 1
Minchenella: 01 -> 0
Embrithopoda: 01 -> 0
Node 28: 01 -> 1
Char. 83 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 0
Ocepeia: 01 -> 1
Node 23: 01 -> 1
Node 30: 1 -> 0
Char. 85 (super-sets from 14 trees):
Root: 0
Node 25: 0 -> 1
Node 26: 1 -> 12
Anthracobunidae: 12 -> 1
Phenacolophus: 12 -> 2
Minchenella: 12 -> 2

Embrithopoda: 12 -> 2
Node 28: 12 -> 1
Node 29: 1 -> 0
Moeritherium: 0 -> 2
Char. 86 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Node 23: 1 -> 2
Phenacodontidae: 2 -> 3
Node 25: 2 -> 23
Node 26: 23 -> 3
Perissodactyla: 23 -> 3
Radinskya: 23 -> 2
Node 29: 3 -> 2
Moeritherium: 2 -> 3
Char. 87 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Phenacodontidae: 0 -> 1
Node 25: 0 -> 01
Node 24: 01 -> 0
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 0
Phenacolophus: 01 -> 1
Minchenella: 01 -> 0
Embrithopoda: 01 -> 1
Node 28: 01 -> 0
Node 29: 0 -> 01
Eritherium: 01 -> 1
Phosphatherium: 01 -> 1
Node 31: 01 -> 0
Char. 88 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 2
Phenacodontidae: 0 -> 1
Node 25: 0 -> 01
Node 24: 01 -> 0
Node 26: 01 -> 012
Hyracoidea: 012 -> 2
Anthracobunidae: 012 -> 0
Phenacolophus: 012 -> 2
Minchenella: 012 -> 0
Embrithopoda: 012 -> 2
Node 28: 012 -> 0
Node 29: 0 -> 01
Eritherium: 01 -> 1
Phosphatherium: 01 -> 1
Node 31: 01 -> 0
Char. 89 (super-sets from 14 trees):
Root: 0
Node 27: 0 -> 1
Node 31: 0 -> 1
Char. 90 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 2
Phenacodontidae: 0 -> 1
Node 25: 0 -> 01
Node 24: 01 -> 0
Node 26: 01 -> 012
Hyracoidea: 012 -> 2
Anthracobunidae: 012 -> 0
Phenacolophus: 012 -> 2
Minchenella: 012 -> 0
Embrithopoda: 012 -> 3
Node 28: 012 -> 01
Node 29: 01 -> 1
Char. 92 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Ocepeia: 01 -> 0
Node 23: 01 -> 1
Hyracoidea: 1 -> 0
Embrithopoda: 1 -> 0
Node 28: 1 -> 2
Char. 93 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Node 25: 01 -> 0
Char. 94 (super-sets from 14 trees):
Root: 0
Ocepeia: 0 -> 1
Node 23: 0 -> 01
Monshyus: 01 -> 2
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 0
Node 25: 01 -> 0
Hyracoidea: 0 -> 2
Embrithopoda: 0 -> 2
Node 29: 0 -> 2
Moeritherium: 2 -> 0
Char. 95 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Monshyus: 01 -> 1
Microhyus: 01 -> 1
Macroscelidea: 01 -> 0
Node 25: 01 -> 1
Phenacolophus: 1 -> 0
Minchenella: 1 -> 0
Char. 96 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 012
Monshyus: 012 -> 2
Microhyus: 012 -> 2
Phenacodontidae: 012 -> 1
Macroscelidea: 012 -> 2
Node 25: 012 -> 2
Anthracobunidae: 2 -> 1
Phenacolophus: 2 -> 1
Embrithopoda: 2 -> 0
Node 28: 2 -> 1
Eritherium: 1 -> 12
Node 30: 1 -> 3
Moeritherium: 3 -> 23
Char. 97 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 1
Minchenella: 1 -> 01
Char. 98 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 1
Node 24: 1 -> 0
Char. 99 (super-sets from 14 trees):
Root: 0
Microhyus: 0 -> 01
Anthracobunidae: 0 -> 1
Node 28: 0 -> 1
Char. 100 (super-sets from 14 trees):
Root: 01
Eutheria: 01 -> 0
Arctocyonidae: 01 -> 1
Ocepeia: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 0
Perissodactyla: 01 -> 0
Radinskya: 01 -> 1
Anthracobunidae: 01 -> 1
Phenacolophus: 01 -> 0
Minchenella: 01 -> 1
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 101 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 1
Node 23: 0 -> 012
Microhyus: 012 -> 2
Phenacodontidae: 012 -> 1
Macroscelidea: 012 -> 2
Node 25: 012 -> 123
Node 24: 123 -> 1
Node 26: 123 -> 3
Node 27: 3 -> 0
Eritherium: 3 -> 1
Char. 102 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Node 23: 0 -> 01
Monshyus: 01 -> 0
Microhyus: 01 -> 0
Phenacodontidae: 01 -> 1
Macroscelidea: 01 -> 12
Node 25: 01 -> 1
Node 26: 1 -> 12
Hyracoidea: 12 -> 2
Anthracobunidae: 12 -> 1
Minchenella: 12 -> 1
Embrithopoda: 12 -> 2
Node 28: 12 -> 1
Node 31: 1 -> 2
Char. 103 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Phenacodontidae: 0 -> 01
Node 25: 0 -> 1

Char. 104 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 1
Anthracobunidae: 01 -> 1
Minchenella: 01 -> 0
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Node 31: 1 -> 2
Char. 105 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Monshyus: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Node 25: 01 -> 0
Phosphatherium: 0 -> 1
Char. 106 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Monshyus: 01 -> 1
Microhyus: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Node 24: 01 -> 0
Node 26: 01 -> 1
Char. 108 (super-sets from 14 trees):
Root: 0
Node 31: 0 -> 1
Char. 109 (super-sets from 14 trees):
Root: 0
Node 31: 0 -> 1
Char. 110 (super-sets from 14 trees):
Root: 0
Sirenia: 0 -> 1
Node 31: 0 -> 1
Char. 111 (super-sets from 14 trees):
Root: 0
Phenacodontidae: 0 -> 1
Node 25: 0 -> 01
Perissodactyla: 01 -> 0
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 115 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Node 24: 01 -> 1
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 0
Node 28: 01 -> 0
Char. 116 (super-sets from 14 trees):
Root: 0
Anthracobunidae: 0 -> 1
Embrithopoda: 0 -> 2
Node 28: 0 -> 12
Sirenia: 12 -> 2
Eritherium: 12 -> 1
Node 30: 12 -> 2
Char. 117 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 1
Node 28: 0 -> 01
Node 27: 01 -> 0
Node 29: 01 -> 1
Node 30: 1 -> 2
Char. 118 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Macroscelidea: 01 -> 1
Node 24: 01 -> 0
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 119 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 2
Node 28: 01 -> 12
Node 27: 12 -> 2
Eritherium: 12 -> 1
Phosphatherium: 12 -> 1
Node 31: 12 -> 2
Char. 120 (super-sets from 14 trees):
Root: 0
Sirenia: 0 -> 1
Node 30: 0 -> 1
Char. 122 (super-sets from 14 trees):
Root: 0
Node 25: 0 -> 01
Node 26: 01 -> 1
Perissodactyla: 01 -> 1
Radinskya: 01 -> 0
Char. 123 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 1
Node 28: 0 -> 01
Node 27: 01 -> 0
Node 29: 01 -> 012
Node 30: 012 -> 2
Char. 124 (super-sets from 14 trees):
Root: 0
Node 28: 0 -> 01
Node 29: 01 -> 1
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Char. 125 (super-sets from 14 trees):
Root: 0
Hyracoidea: 0 -> 1
Node 29: 0 -> 01
Node 31: 01 -> 1
Char. 126 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Moeritherium: 0 -> 1
Char. 128 (super-sets from 14 trees):
Root: 0
Arctocyonidae: 0 -> 01
Phenacodontidae: 0 -> 01
Macroscelidea: 0 -> 1
Hyracoidea: 0 -> 2
Node 31: 0 -> 1
Char. 129 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 1
Node 28: 01 -> 1
Char. 130 (super-sets from 14 trees):
Root: 0
Macroscelidea: 0 -> 1
Node 31: 0 -> 1
Char. 131 (super-sets from 14 trees):
Root: 0
Node 28: 0 -> 1
Char. 132 (super-sets from 14 trees):
Root: 0
Node 24: 0 -> 01
Perissodactyla: 01 -> 1
Node 29: 0 -> 01
Node 30: 01 -> 1
Char. 133 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 1
Node 27: 01 -> 1
Phosphatherium: 01 -> 0
Node 31: 01 -> 1
Char. 134 (super-sets from 14 trees):
Root: 0
Node 23: 0 -> 01
Phenacodontidae: 01 -> 1
Node 24: 01 -> 0
Node 26: 01 -> 1
Embrithopoda: 1 -> 2
Node 28: 1 -> 12
Desmostylia: 12 -> 2
Sirenia: 12 -> 1
Phosphatherium: 12 -> 1
Node 31: 12 -> 2
Char. 135 (super-sets from 14 trees):
Root: 0
Node 31: 0 -> 1
Char. 136 (super-sets from 14 trees):
Root: 0
Node 25: 0 -> 01
Node 24: 01 -> 1
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 0
Node 28: 01 -> 0
Sirenia: 0 -> 1
Char. 137 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 1
Sirenia: 1 -> 0

Char. 138 (super-sets from 14 trees):
Root: 0
Node 29: 0 -> 01
Node 30: 01 -> 1
Char. 139 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 1
Moeritherium: 0 -> 1

Char. 140 (super-sets from 14 trees):
Root: 0
Node 26: 0 -> 01

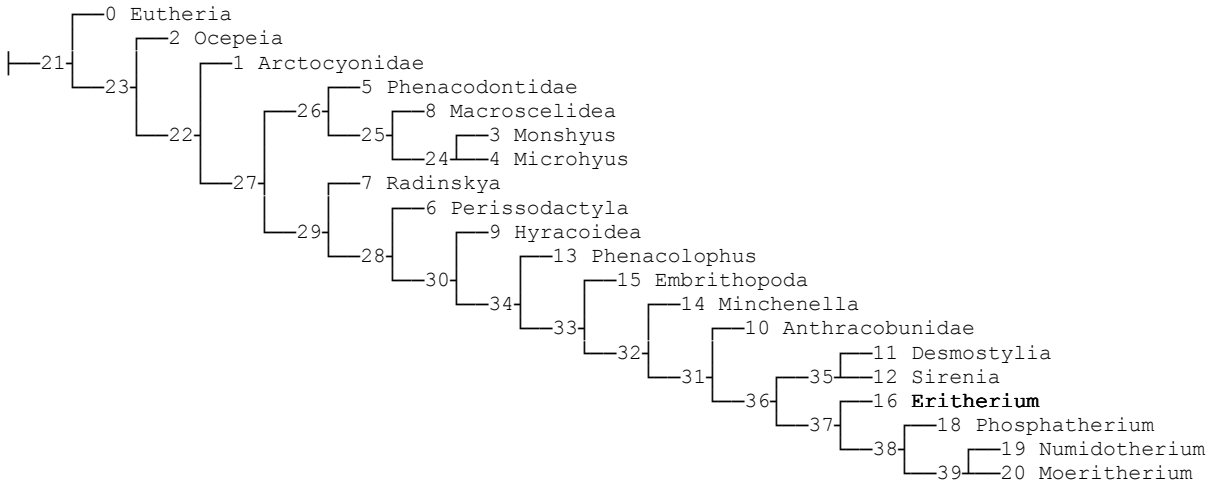
Hyracoidea: 01 -> 0
Embrithopoda: 01 -> 2
Node 28: 01 -> 012
Desmostylia: 012 -> 2

Sirenia: 012 -> 0
Node 30: 012 -> 12
Phosphatherium: 12 -> 1
Node 31: 12 -> 2
Char. 141 (super-sets from 14 trees):
Root: 0
Embrithopoda: 0 -> 1
Node 31: 0 -> 1

2.2. Implicit enumeration, Implied Weighting

Implied Weighting is ON
Weighting strength is 3.00000
Auto-collapse searches is OFF
Implicit enumeration, **1 trees found**, score 48.42500. 131.05 secs.

Cladogram 3



Tree length: 457
Consistency index: 41.6; Retention index: 58.4

Diagnose of nodes of cladogram 3 (implied weighting analysis): Synapomorphies

Important note: For correspondence with character description (Part II) and character summary list (Part III), number n of characters ***should be read as n+1*** because TNT starts numbering characters from 0.

Eutheria :
No autapomorphies
Arctocyonidae :
Char. 63: 0 --> 1
Ocepeia :
Char. 4: 0 --> 1
Char. 8: 0 --> 3
Char. 9: 01 --> 2
Char. 10: 0 --> 3
Char. 14: 0 --> 1
Char. 16: 0 --> 1
Char. 17: 0 --> 1
Char. 33: 0 --> 1
Char. 43: 0 --> 1
Char. 46: 0 --> 1
Char. 53: 0 --> 1
Char. 54: 0 --> 1
Char. 62: 0 --> 1
Char. 68: 01 --> 2
Char. 87: 0 --> 1
Char. 88: 0 --> 2
Char. 90: 0 --> 2
Char. 94: 0 --> 1
Monshyus :
No autapomorphies
Microhyus :
No autapomorphies
Phenacodontidae :
Char. 33: 0 --> 1
Char. 34: 1 --> 0
Char. 53: 0 --> 1
Char. 86: 2 --> 3
Char. 87: 0 --> 1
Char. 88: 0 --> 1
Char. 90: 0 --> 1
Char. 96: 2 --> 1
Char. 111: 0 --> 1
Perissodactyla :
Char. 15: 0 --> 1
Char. 35: 0 --> 2
Char. 41: 0 --> 2
Char. 132: 0 --> 1
Radinskya :
Char. 82: 0 --> 1
Macroscelidea :
Char. 5: 0 --> 1
Char. 13: 0 --> 1
Char. 15: 0 --> 1
Char. 42: 1 --> 2
Char. 45: 0 --> 1
Char. 48: 0 --> 1
Hyracoidea :
Char. 6: 1 --> 0
Char. 18: 1 --> 0
Char. 22: 1 --> 2
Char. 24: 0 --> 1
Char. 33: 0 --> 1
Char. 65: 0 --> 1
Char. 66: 0 --> 2
Char. 92: 1 --> 0
Char. 94: 0 --> 2
Char. 125: 0 --> 1
Char. 128: 0 --> 2
Anthracobunidae :
Char. 0: 1 --> 0
Char. 43: 0 --> 12
Desmostylia :
Char. 39: 2 --> 1
Char. 43: 0 --> 2
Sirenia :
Char. 6: 1 --> 0
Char. 45: 0 --> 1
Char. 50: 1 --> 0
Char. 61: 1 --> 0
Char. 65: 0 --> 2
Char. 68: 1 --> 0
Char. 110: 0 --> 1
Char. 120: 0 --> 1
Char. 136: 0 --> 1
Char. 137: 1 --> 0
Char. 140: 12 --> 0
Phenacolophus :
Char. 11: 0 --> 1
Char. 13: 1 --> 0
Char. 14: 0 --> 1
Char. 31: 1 --> 0
Char. 43: 0 --> 12
Char. 65: 0 --> 2
Char. 68: 2 --> 0
Char. 80: 2 --> 1
Char. 82: 0 --> 1
Char. 95: 1 --> 0
Minchenella :
Char. 14: 0 --> 1
Char. 41: 0 --> 2
Char. 42: 1 --> 2
Char. 95: 1 --> 0
Char. 104: 1 --> 0
Embrithopoda :
Char. 5: 0 --> 1
Char. 30: 1 --> 2
Char. 45: 0 --> 1
Char. 60: 0 --> 1
Char. 79: 1 --> 0
Char. 80: 2 --> 0
Char. 90: 2 --> 3
Char. 92: 1 --> 0
Char. 94: 0 --> 2
Char. 96: 12 --> 0
Char. 117: 0 --> 1
Char. 139: 0 --> 1
Char. 141: 0 --> 1
Eritherium :
Char. 38: 1 --> 2
Char. 42: 1 --> 2
Char. 44: 2 --> 1
Char. 101: 3 --> 1
Khamsaconus :
Char. 77: 0 --> 2
Char. 79: 0 --> 1
Char. 81: 0 --> 1
Char. 82: 0 --> 1
Char. 83: 0 --> 1
Char. 86: 0 --> 2
Char. 92: 0 --> 1
Char. 94: 0 --> 2
Char. 95: 0 --> 1
Char. 96: 0 --> 2
Char. 97: 0 --> 1
Char. 98: 0 --> 1
Char. 99: 0 --> 1
Char. 103: 0 --> 1
Char. 106: 0 --> 1
Phosphatherium :
Char. 105: 0 --> 1
Char. 133: 1 --> 0
Numidotherium :
Char. 33: 1 --> 0
Char. 34: 2 --> 1
Char. 38: 1 --> 0
Char. 39: 12 --> 0

Char. 59: 1 --> 2
Moeritherium :
Char. 13: 0 --> 1
Char. 17: 1 --> 0
Char. 20: 0 --> 1
Char. 21: 3 --> 4
Char. 38: 1 --> 2
Char. 48: 0 --> 1
Char. 69: 1 --> 2
Char. 72: 1 --> 2
Char. 73: 1 --> 2
Char. 79: 3 --> 4
Char. 85: 0 --> 2
Char. 86: 2 --> 3
Char. 94: 2 --> 0
Char. 126: 0 --> 1
Char. 139: 0 --> 1
Node 22 :
Char. 40: 0 --> 1
Char. 77: 0 --> 1
Char. 81: 0 --> 1
Char. 92: 0 --> 1
Char. 101: 0 --> 1
Node 23 :
No synapomorphies
Node 24 :
Char. 102: 1 --> 0
Node 25 :
Char. 16: 0 --> 1
Char. 82: 0 --> 1
Char. 93: 0 --> 1
Char. 101: 1 --> 2
Char. 105: 0 --> 1
Char. 106: 0 --> 1
Node 26 :
Char. 35: 0 --> 1
Char. 98: 0 --> 1
Node 27 :
Char. 18: 0 --> 1
Char. 69: 0 --> 12
Char. 70: 0 --> 1
Char. 72: 0 --> 2
Char. 73: 0 --> 12
Char. 77: 1 --> 2
Char. 86: 1 --> 2
Char. 96: 0 --> 2
Char. 97: 0 --> 1
Node 28 :
Char. 86: 2 --> 3
Char. 122: 0 --> 1
Node 29 :
Char. 68: 1 --> 2
Char. 85: 0 --> 1
Char. 103: 0 --> 1
Char. 136: 0 --> 1
Node 30 : Paenungulata
Char. 23: 0 --> 1
Char. 52: 0 --> 1
Char. 53: 0 --> 1
Char. 56: 0 --> 1
Char. 70: 1 --> 0
Char. 87: 0 --> 1
Char. 88: 0 --> 2
Char. 90: 0 --> 2
Char. 98: 0 --> 1
Char. 101: 1 --> 3
Char. 104: 0 --> 1
Char. 106: 0 --> 1
Char. 134: 0 --> 1
Char. 137: 0 --> 1
Node 31 :
Char. 22: 1 --> 2
Char. 24: 0 --> 1
Char. 36: 1 --> 0
Char. 82: 0 --> 1
Char. 85: 2 --> 1
Char. 99: 0 --> 1
Node 32 :
Char. 39: 0 --> 2
Char. 87: 1 --> 0
Char. 88: 2 --> 0
Char. 90: 2 --> 01
Node 33 :
Char. 76: 0 --> 1
Char. 116: 0 --> 12
Node 34 : Tethytheria
Char. 0: 0 --> 1
Char. 34: 1 --> 0
Char. 35: 0 --> 3
Char. 37: 2 --> 3
Node 35 :
Char. 67: 1 --> 0
Char. 68: 2 --> 1
Char. 89: 0 --> 1
Char. 101: 3 --> 0
Node 36 :
Char. 8: 0 --> 1
Char. 10: 0 --> 1
Char. 11: 0 --> 1
Char. 34: 0 --> 1
Char. 72: 2 --> 01
Char. 92: 1 --> 2
Node 37 : **Proboscidea**
Char. 2: 0 --> 1
Char. 4: 0 --> 1
Char. 5: 0 --> 2
Char. 8: 1 --> 2
Char. 13: 1 --> 0
Char. 14: 0 --> 1
Char. 17: 0 --> 1
Char. 20: 1 --> 0
Char. 33: 0 --> 1
Char. 34: 1 --> 2
Char. 36: 0 --> 2
Char. 85: 1 --> 0
Char. 86: 3 --> 2
Char. 94: 0 --> 2
Char. 117: 0 --> 1
Node 38 :
Char. 2: 1 --> 2
Char. 4: 1 --> 2
Char. 8: 2 --> 3
Char. 9: 1 --> 2
Char. 21: 2 --> 3
Char. 42: 1 --> 0
Char. 45: 0 --> 1
Char. 79: 1 --> 3
Char. 83: 1 --> 0
Char. 96: 1 --> 3
Char. 117: 1 --> 2
Char. 120: 0 --> 1
Node 39 :
Char. 5: 2 --> 3
Char. 7: 0 --> 2
Char. 10: 12 --> 0
Char. 11: 1 --> 0
Char. 49: 0 --> 1
Char. 50: 1 --> 2
Char. 59: 0 --> 1
Char. 60: 0 --> 1
Char. 62: 0 --> 1
Char. 65: 0 --> 1
Char. 66: 0 --> 1
Char. 89: 0 --> 1
Char. 102: 1 --> 2
Char. 104: 1 --> 2
Char. 108: 0 --> 1
Char. 109: 0 --> 1
Char. 110: 0 --> 1
Char. 128: 0 --> 1
Char. 130: 0 --> 1
Char. 135: 0 --> 1
Char. 141: 0 --> 1
0.00 secs.

Characters transformation in Cladogram 3 (implied weighting analysis)

Important note: For correspondence with character description (Part II) and character summary list (Part III), number ***n*** of characters ***should be read as n+1*** because TNT starts numbering characters from 0.

Char. 0 (2 steps)
Root: 0
Node 34: 0 -> 1
Anthracobunidae: 1 -> 0
Char. 1 (2 steps)
Root: 0
Node 25: 0 -> 01
Macroscelidea: 01 -> 1
Node 32: 0 -> 01
Node 36: 01 -> 1
Char. 2 (2 steps)
Root: 0
Embrithopoda: 0 -> 01
Node 37: 0 -> 1
Node 38: 1 -> 2
Char. 3 (1 steps)
Root: 0
Node 37: 0 -> 01
Moeritherium: 01 -> 1
Char. 4 (3 steps)
Root: 0
Ocepeia: 0 -> 1
Node 37: 0 -> 1
Node 38: 1 -> 2
Char. 5 (5 steps)
Root: 0
Macroscelidea: 0 -> 1
Embrithopoda: 0 -> 1
Node 37: 0 -> 2
Sirenia: 0 -> 01
Node 39: 2 -> 3
Char. 6 (3 steps)
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Hyracoidea: 1 -> 0
Sirenia: 1 -> 0
Char. 7 (2 steps)
Root: 0
Ocepeia: 0 -> 01
Arctocyonidae: 0 -> 01
Macroscelidea: 0 -> 01
Anthracobunidae: 0 -> 01
Desmostylia: 0 -> 01
Node 39: 0 -> 2
Char. 8 (7 steps)
Root: 0
Ocepeia: 0 -> 3
Arctocyonidae: 0 -> 01
Node 25: 0 -> 01
Microhyus: 01 -> 1
Node 36: 0 -> 1
Node 37: 1 -> 2
Node 38: 2 -> 3
Char. 9 (7 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 2
Phenacodontidae: 01 -> 1
Node 25: 01 -> 0
Hyracoidea: 01 -> 0
Phenacolophus: 01 -> 1
Embrithopoda: 01 -> 0
Minchenella: 01 -> 1
Anthracobunidae: 01 -> 0
Node 36: 01 -> 1
Node 38: 1 -> 2
Char. 10 (7 steps)
Root: 0
Ocepeia: 0 -> 3
Node 36: 0 -> 1
Node 37: 1 -> 12
Eritherium: 12 -> 2
Phosphatherium: 12 -> 2
Node 39: 12 -> 0
Char. 11 (3 steps)
Root: 0
Phenacolophus: 0 -> 1
Node 36: 0 -> 1
Desmostylia: 1 -> 01
Node 39: 1 -> 0
Char. 12 (1 steps)
Root: 0
Node 35: 0 -> 01
Sirenia: 01 -> 1
Char. 13 (5 steps)
Root: 0
Node 29: 0 -> 01
Node 28: 01 -> 1
Macroscelidea: 0 -> 1
Phenacolophus: 1 -> 0
Node 37: 1 -> 0
Moeritherium: 0 -> 1
Char. 14 (5 steps)
Root: 0
Ocepeia: 0 -> 1
Arctocyonidae: 0 -> 01
Node 24: 0 -> 01
Microhyus: 01 -> 1
Phenacolophus: 0 -> 1
Minchenella: 0 -> 1
Node 37: 0 -> 1
Char. 15 (5 steps)
Root: 0
Macroscelidea: 0 -> 1
Perissodactyla: 0 -> 1
Node 33: 0 -> 01
Embrithopoda: 01 -> 1
Minchenella: 01 -> 1
Node 36: 01 -> 0
Node 39: 0 -> 01
Moeritherium: 01 -> 1
Char. 16 (4 steps)
Root: 0
Ocepeia: 0 -> 1
Node 25: 0 -> 1
Node 30: 0 -> 01
Hyracoidea: 01 -> 1
Phenacolophus: 01 -> 0
Node 33: 01 -> 1
Char. 17 (4 steps)
Root: 0
Ocepeia: 0 -> 1
Node 24: 0 -> 01
Microhyus: 01 -> 1
Node 37: 0 -> 1
Moeritherium: 1 -> 0
Char. 18 (5 steps)
Root: 0
Node 27: 0 -> 1
Node 24: 1 -> 01
Microhyus: 01 -> 0
Hyracoidea: 1 -> 0
Node 36: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 39: 01 -> 1
Char. 19 (2 steps)
Root: 0
Node 22: 0 -> 01
Node 27: 01 -> 1
Node 24: 1 -> 01
Microhyus: 01 -> 0
Char. 20 (4 steps)

Root: 0
Arctocyonidae: 0 -> 01
Node 29: 0 -> 01
Phenacodontidae: 0 -> 01
Perissodactyla: 01 -> 1
Hyracoidea: 01 -> 0
Node 33: 01 -> 1
Node 37: 1 -> 0
Moeritherium: 0 -> 1
Char. 21 (6 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Node 29: 1 -> 12
Node 28: 12 -> 2
Node 34: 2 -> 23
Phenacolophus: 23 -> 3
Embrithopoda: 23 -> 3
Node 32: 23 -> 2
Node 38: 2 -> 3
Moeritherium: 3 -> 4
Char. 22 (3 steps)
Root: 0
Node 29: 0 -> 01
Node 28: 01 -> 1
Hyracoidea: 1 -> 2
Node 31: 1 -> 2
Char. 23 (1 steps)
Root: 0
Ocepeia: 0 -> 01
Node 30: 0 -> 1
Char. 24 (2 steps)
Root: 0
Hyracoidea: 0 -> 1
Node 31: 0 -> 1
Char. 25 (4 steps)
Root: 0
Node 29: 0 -> 01
Node 24: 0 -> 01
Perissodactyla: 01 -> 1
Microhyus: 01 -> 1
Hyracoidea: 01 -> 1
Phenacolophus: 01 -> 0
Embrithopoda: 01 -> 0
Node 32: 01 -> 1
Char. 26 (6 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 1
Arctocyonidae: 01 -> 1
Node 27: 01 -> 0
Node 24: 0 -> 01
Microhyus: 01 -> 1
Node 31: 0 -> 01
Anthracobunidae: 01 -> 1
Node 35: 01 -> 0
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 27 (9 steps)
Root: 012
Eutheria: 012 -> 0
Node 23: 012 -> 12
Ocepeia: 12 -> 2
Arctocyonidae: 12 -> 1
Phenacodontidae: 12 -> 2
Node 25: 12 -> 1
Node 28: 12 -> 2
Node 24: 1 -> 01
Microhyus: 01 -> 0
Node 33: 2 -> 12
Embrithopoda: 12 -> 1
Minchenella: 12 -> 2
Node 36: 12 -> 01
Sirenia: 01 -> 0
Eritherium: 01 -> 1
Node 38: 01 -> 0
Char. 28 (4 steps)
Root: 0
Node 34: 0 -> 01
Phenacolophus: 01 -> 1
Embrithopoda: 01 -> 1
Node 32: 01 -> 0
Node 38: 0 -> 01
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 29 (1 steps)
Root: 0
Ocepeia: 0 -> 01
Node 29: 0 -> 01
Node 28: 01 -> 1
Char. 30 (4 steps)
Root: 0
Node 29: 0 -> 01
Node 28: 01 -> 1
Embrithopoda: 1 -> 2
Node 38: 1 -> 12
Phosphatherium: 12 -> 2
Numidotherium: 12 -> 2
Moeritherium: 12 -> 1
Char. 31 (5 steps)
Root: 0
Node 27: 0 -> 01
Node 28: 01 -> 1
Macroscelidea: 01 -> 0
Microhyus: 01 -> 1
Phenacolophus: 1 -> 0
Anthracobunidae: 1 -> 01
Node 38: 1 -> 01
Phosphatherium: 01 -> 0
Numidotherium: 01 -> 0
Moeritherium: 01 -> 1
Char. 32 (2 steps)
Root: 0
Ocepeia: 0 -> 01
Node 27: 0 -> 01
Node 25: 01 -> 1
Perissodactyla: 01 -> 1
Node 30: 01 -> 0
Phosphatherium: 0 -> 01
Char. 33 (5 steps)
Root: 0
Ocepeia: 0 -> 1
Phenacodontidae: 0 -> 1
Hyracoidea: 0 -> 1
Node 37: 0 -> 1
Numidotherium: 1 -> 0
Char. 34 (6 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Arctocyonidae: 1 -> 12
Phenacodontidae: 1 -> 0
Node 34: 1 -> 0
Node 36: 0 -> 1
Node 37: 1 -> 2
Numidotherium: 2 -> 1
Char. 35 (3 steps)
Root: 0
Node 26: 0 -> 1
Perissodactyla: 0 -> 2
Node 34: 0 -> 3
Char. 36 (6 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Node 29: 1 -> 01
Node 24: 1 -> 01
Perissodactyla: 01 -> 0
Microhyus: 01 -> 0
Hyracoidea: 01 -> 0
Node 34: 01 -> 1
Node 31: 1 -> 0
Node 37: 0 -> 2
Char. 37 (4 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 1
Arctocyonidae: 01 -> 0
Node 27: 01 -> 1
Node 29: 1 -> 12
Node 28: 12 -> 2
Node 34: 2 -> 3
Char. 38 (4 steps)

Root: 0
Node 36: 0 -> 01
Node 37: 01 -> 1
Eritherium: 1 -> 2
Numidotherium: 1 -> 0
Moeritherium: 1 -> 2
Char. 39 (6 steps)
Root: 0
Node 32: 0 -> 2
Desmostylia: 2 -> 1
Node 38: 2 -> 12
Phosphatherium: 12 -> 1
Numidotherium: 12 -> 0
Moeritherium: 12 -> 2
Char. 40 (5 steps)
Root: 0
Node 22: 0 -> 1
Node 25: 1 -> 01
Macroscelidea: 01 -> 0
Node 36: 1 -> 01
Desmostylia: 01 -> 1
Sirenia: 01 -> 0
Phosphatherium: 01 -> 0
Numidotherium: 01 -> 0
Moeritherium: 01 -> 1
Char. 41 (4 steps)
Root: 0
Perissodactyla: 0 -> 2
Hyracoidea: 0 -> 01
Minchenella: 0 -> 2
Desmostylia: 0 -> 01
Char. 42 (5 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Ocepeia: 1 -> 12
Arctocyonidae: 1 -> 01
Phenacodontidae: 1 -> 12
Macroscelidea: 1 -> 2
Perissodactyla: 1 -> 12
Phenacolophus: 1 -> 01
Embrithopoda: 1 -> 01
Minchenella: 1 -> 2
Anthracobunidae: 1 -> 01
Desmostylia: 1 -> 01
Eritherium: 1 -> 2
Node 38: 1 -> 0
Moeritherium: 0 -> 01
Char. 43 (5 steps)
Root: 0
Ocepeia: 0 -> 1
Arctocyonidae: 0 -> 01
Phenacolophus: 0 -> 12
Anthracobunidae: 0 -> 12
Desmostylia: 0 -> 2
Phosphatherium: 0 -> 01
Numidotherium: 0 -> 01
Char. 44 (3 steps)
Root: 0
Node 27: 0 -> 012
Node 26: 012 -> 1
Node 28: 012 -> 2
Eritherium: 2 -> 1
Char. 45 (4 steps)
Root: 0
Macroscelidea: 0 -> 1
Embrithopoda: 0 -> 1
Sirenia: 0 -> 1
Node 38: 0 -> 1
Char. 46 (4 steps)
Root: 0
Ocepeia: 0 -> 1
Node 29: 0 -> 01
Node 28: 01 -> 1
Node 37: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 39: 01 -> 1
Char. 47 (4 steps)
Root: 0
Node 34: 0 -> 01
Phenacolophus: 01 -> 1
Embrithopoda: 01 -> 0
Node 32: 01 -> 1
Node 37: 1 -> 01
Eritherium: 01 -> 0
Phosphatherium: 01 -> 0
Node 39: 01 -> 1
Char. 48 (2 steps)
Root: 0
Macroscelidea: 0 -> 1
Moeritherium: 0 -> 1
Char. 49 (1 steps)
Root: 0
Node 39: 0 -> 1
Char. 50 (3 steps)
Root: 0
Node 32: 0 -> 01
Node 31: 01 -> 1
Sirenia: 1 -> 0
Node 39: 1 -> 2
Char. 51 (5 steps)
Root: 0
Node 25: 0 -> 01
Macroscelidea: 01 -> 1
Node 30: 0 -> 01
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 1
Anthracobunidae: 01 -> 0
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Phosphatherium: 01 -> 0
Node 39: 01 -> 1
Char. 52 (1 steps)
Root: 0
Node 30: 0 -> 1
Char. 53 (3 steps)
Root: 0
Ocepeia: 0 -> 1
Phenacodontidae: 0 -> 1
Node 30: 0 -> 1
Char. 54 (5 steps)
Root: 0
Ocepeia: 0 -> 1
Node 30: 0 -> 01
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 1
Anthracobunidae: 01 -> 0
Node 35: 01 -> 0
Node 37: 01 -> 12
Node 38: 12 -> 2
Char. 55 (0 steps)
Root: 0
Char. 56 (1 steps)
Root: 0
Node 30: 0 -> 1
Char. 57 (3 steps)
Root: 0
Node 30: 0 -> 01
Hyracoidea: 01 -> 1
Embrithopoda: 01 -> 1
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Node 39: 01 -> 0
Char. 58 (1 steps)
Root: 0
Node 37: 0 -> 01
Node 39: 01 -> 1
Char. 59 (2 steps)
Root: 0
Node 39: 0 -> 1
Numidotherium: 1 -> 2
Char. 60 (2 steps)
Root: 0
Embrithopoda: 0 -> 1
Node 39: 0 -> 1
Char. 61 (3 steps)
Root: 01
Eutheria: 01 -> 0
Node 22: 01 -> 1
Node 25: 1 -> 01
Macroscelidea: 01 -> 0
Hyracoidea: 1 -> 01
Sirenia: 1 -> 0
Char. 62 (2 steps)

Root: 0
Ocepeia: 0 -> 1
Arctocyonidae: 0 -> 01
Node 39: 0 -> 1
Char. 63 (2 steps)
Root: 0
Arctocyonidae: 0 -> 1
Node 34: 0 -> 01
Node 33: 01 -> 1
Char. 64 (1 steps)
Root: 0
Ocepeia: 0 -> 1
Char. 65 (5 steps)
Root: 0
Node 24: 0 -> 01
Microhyus: 01 -> 1
Hyracoidea: 0 -> 1
Phenacolophus: 0 -> 2
Sirenia: 0 -> 2
Node 39: 0 -> 1
Char. 66 (5 steps)
Root: 0
Node 24: 0 -> 012
Microhyus: 012 -> 2
Hyracoidea: 0 -> 2
Node 39: 0 -> 1
Char. 67 (1 steps)
Root: 1
Eutheria: 1 -> 01
Node 35: 1 -> 0
Char. 68 (8 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 2
Arctocyonidae: 01 -> 0
Node 27: 01 -> 1
Node 29: 1 -> 2
Phenacolophus: 2 -> 0
Node 35: 2 -> 1
Sirenia: 1 -> 0
Char. 69 (8 steps)
Root: 0
Node 27: 0 -> 12
Phenacodontidae: 12 -> 2
Node 25: 12 -> 1
Node 24: 1 -> 01
Perissodactyla: 12 -> 2
Microhyus: 01 -> 0
Hyracoidea: 12 -> 2
Node 34: 12 -> 1
Phenacolophus: 1 -> 01
Node 36: 1 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 38: 01 -> 1
Moeritherium: 1 -> 2
Char. 70 (4 steps)
Root: 0
Node 27: 0 -> 1
Node 30: 1 -> 0
Node 32: 0 -> 01
Anthracobunidae: 01 -> 1
Node 37: 01 -> 0
Desmostylia: 01 -> 1
Char. 71 (1 steps)
Root: 1
Eutheria: 1 -> 01
Node 35: 1 -> 01
Sirenia: 01 -> 0
Char. 72 (6 steps)
Root: 0
Node 27: 0 -> 2
Node 36: 2 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 38: 01 -> 1
Moeritherium: 1 -> 2
Char. 73 (7 steps)
Root: 0
Node 27: 0 -> 12
Node 26: 12 -> 2
Radinskya: 12 -> 1
Perissodactyla: 12 -> 2
Hyracoidea: 12 -> 2
Node 31: 12 -> 1
Node 36: 1 -> 01
Desmostylia: 01 -> 0
Eritherium: 01 -> 0
Node 38: 01 -> 1
Moeritherium: 1 -> 2
Char. 74 (0 steps)
Root: 0
Macroscelidea: 0 -> 01
Microhyus: 0 -> 01
Char. 75 (2 steps)
Root: 0
Node 38: 0 -> 01
Phosphatherium: 01 -> 1
Numidotherium: 01 -> 1
Moeritherium: 01 -> 0
Char. 76 (1 steps)
Root: 0
Node 33: 0 -> 1
Char. 77 (2 steps)
Root: 0
Node 22: 0 -> 1
Node 27: 1 -> 2
Char. 78 (1 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Char. 79 (6 steps)
Root: 0
Node 27: 0 -> 012
Node 26: 012 -> 01
Node 29: 012 -> 12
Node 25: 01 -> 1
Radinskya: 12 -> 2
Perissodactyla: 12 -> 2
Node 30: 12 -> 1
Embrithopoda: 1 -> 0
Node 38: 1 -> 3
Moeritherium: 3 -> 4
Char. 80 (7 steps)
Root: 0
Node 27: 0 -> 02
Node 29: 02 -> 2
Phenacodontidae: 02 -> 0
Node 25: 02 -> 012
Macroscelidea: 012 -> 1
Node 24: 012 -> 2
Phenacolophus: 2 -> 1
Embrithopoda: 2 -> 0
Node 36: 2 -> 12
Node 37: 12 -> 1
Desmostylia: 12 -> 2
Sirenia: 12 -> 1
Char. 81 (3 steps)
Root: 0
Node 22: 0 -> 1
Hyracoidea: 1 -> 01
Node 33: 1 -> 01
Embrithopoda: 01 -> 0
Minchenella: 01 -> 0
Node 31: 01 -> 1
Char. 82 (4 steps)
Root: 0
Arctocyonidae: 0 -> 01
Node 25: 0 -> 1
Radinskya: 0 -> 1
Hyracoidea: 0 -> 01
Phenacolophus: 0 -> 1
Node 31: 0 -> 1
Char. 83 (3 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 1
Arctocyonidae: 01 -> 0
Node 27: 01 -> 1
Node 38: 1 -> 0
Char. 84 (1 steps)
Root: 0
Microhyus: 0 -> 1
Char. 85 (6 steps)
Root: 0

Node 29: 0 -> 1
Node 30: 1 -> 12
Node 34: 12 -> 2
Node 31: 2 -> 1
Node 37: 1 -> 0
Moeritherium: 0 -> 2
Char. 86 (6 steps)
Root: 01
Eutheria: 01 -> 0
Node 23: 01 -> 1
Node 27: 1 -> 2
Phenacodontidae: 2 -> 3
Node 28: 2 -> 3
Node 37: 3 -> 2
Moeritherium: 2 -> 3
Char. 87 (6 steps)
Root: 0
Ocepeia: 0 -> 1
Phenacodontidae: 0 -> 1
Node 30: 0 -> 1
Node 32: 1 -> 0
Node 37: 0 -> 01
Eritherium: 01 -> 1
Phosphatherium: 01 -> 1
Node 39: 01 -> 0
Char. 88 (9 steps)
Root: 0
Ocepeia: 0 -> 2
Phenacodontidae: 0 -> 1
Node 30: 0 -> 2
Node 32: 2 -> 0
Node 37: 0 -> 01
Eritherium: 01 -> 1
Phosphatherium: 01 -> 1
Node 39: 01 -> 0
Char. 89 (2 steps)
Root: 0
Node 35: 0 -> 1
Node 39: 0 -> 1
Char. 90 (9 steps)
Root: 0
Ocepeia: 0 -> 2
Phenacodontidae: 0 -> 1
Node 30: 0 -> 2
Embrithopoda: 2 -> 3
Node 32: 2 -> 01
Minchenella: 01 -> 0
Anthracobunidae: 01 -> 0
Node 37: 01 -> 1
Char. 91 (1 steps)
Root: 01
Eutheria: 01 -> 0
Node 27: 01 -> 1
Phenacolophus: 1 -> 01
Minchenella: 1 -> 01
Char. 92 (4 steps)
Root: 0
Node 22: 0 -> 1
Hyracoidea: 1 -> 0
Embrithopoda: 1 -> 0
Node 36: 1 -> 2
Char. 93 (1 steps)
Root: 0
Node 25: 0 -> 1
Char. 94 (11 steps)
Root: 0
Ocepeia: 0 -> 1
Node 24: 0 -> 012
Monshyus: 012 -> 2
Hyracoidea: 0 -> 2
Embrithopoda: 0 -> 2
Node 37: 0 -> 2
Moeritherium: 2 -> 0
Char. 95 (4 steps)
Root: 0
Node 27: 0 -> 01
Node 29: 01 -> 1
Macroscelidea: 01 -> 0
Node 24: 01 -> 1
Phenacolophus: 1 -> 0
Minchenella: 1 -> 0
Char. 96 (6 steps)
Root: 0
Node 27: 0 -> 2
Phenacodontidae: 2 -> 1
Node 34: 2 -> 12
Phenacolophus: 12 -> 1
Embrithopoda: 12 -> 0
Minchenella: 12 -> 2
Node 31: 12 -> 1
Eritherium: 1 -> 12
Node 38: 1 -> 3
Moeritherium: 3 -> 23
Char. 97 (1 steps)
Root: 0
Node 27: 0 -> 1
Minchenella: 1 -> 01
Char. 98 (2 steps)
Root: 0
Node 26: 0 -> 1
Node 30: 0 -> 1
Char. 99 (1 steps)
Root: 0
Microhyus: 0 -> 01
Node 31: 0 -> 1
Char. 100 (5 steps)
Root: 01
Eutheria: 01 -> 0
Ocepeia: 01 -> 1
Arctocyonidae: 01 -> 1
Phenacodontidae: 01 -> 0
Radinskya: 01 -> 1
Macroscelidea: 01 -> 0
Perissodactyla: 01 -> 0
Microhyus: 01 -> 1
Phenacolophus: 01 -> 0
Node 33: 01 -> 1
Char. 101 (5 steps)
Root: 0
Node 22: 0 -> 1
Node 25: 1 -> 2
Node 30: 1 -> 3
Node 35: 3 -> 0
Eritherium: 3 -> 1
Char. 102 (5 steps)
Root: 0
Node 22: 0 -> 01
Node 27: 01 -> 1
Macroscelidea: 1 -> 12
Node 24: 1 -> 0
Node 30: 1 -> 12
Hyracoidea: 12 -> 2
Embrithopoda: 12 -> 2
Node 32: 12 -> 1
Node 39: 1 -> 2
Char. 103 (1 steps)
Root: 0
Arctocyonidae: 0 -> 01
Node 29: 0 -> 1

Phenacodontidae: 0 -> 01
Char. 104 (3 steps)
Root: 0
Node 30: 0 -> 1
Phenacolophus: 1 -> 01
Minchenella: 1 -> 0
Node 39: 1 -> 2
Char. 105 (2 steps)
Root: 0
Node 25: 0 -> 1
Phosphatherium: 0 -> 1
Char. 106 (2 steps)
Root: 0
Node 25: 0 -> 1
Node 30: 0 -> 1
Char. 107 (1 steps)
Root: 0
Numidotherium: 0 -> 1
Char. 108 (1 steps)
Root: 0
Node 39: 0 -> 1
Char. 109 (1 steps)
Root: 0
Node 39: 0 -> 1
Char. 110 (2 steps)

Root: 0
Sirenia: 0 -> 1
Node 39: 0 -> 1
Char. 111 (2 steps)
Root: 0
Phenacodontidae: 0 -> 1
Node 34: 0 -> 01
Node 33: 01 -> 1
Char. 112 (1 steps)
Root: 0
Sirenia: 0 -> 1
Char. 113 (1 steps)
Root: 0
Sirenia: 0 -> 1
Char. 114 (1 steps)
Root: 0
Moeritherium: 0 -> 1
Char. 115 (3 steps)
Root: 0
Node 27: 0 -> 01
Node 29: 01 -> 1
Phenacodontidae: 01 -> 0
Macroscelidea: 01 -> 1
Node 34: 1 -> 01
Node 33: 01 -> 0
Char. 116 (4 steps)
Root: 0
Node 33: 0 -> 12
Embrithopoda: 12 -> 2
Anthracobunidae: 12 -> 1
Sirenia: 12 -> 2
Eritherium: 12 -> 1
Node 38: 12 -> 2
Char. 117 (3 steps)
Root: 0
Embrithopoda: 0 -> 1
Node 37: 0 -> 1
Node 38: 1 -> 2
Char. 118 (2 steps)
Root: 0
Node 26: 0 -> 01
Macroscelidea: 01 -> 1
Node 34: 0 -> 01
Node 33: 01 -> 1
Char. 119 (4 steps)
Root: 0
Node 34: 0 -> 012
Node 33: 012 -> 12
Embrithopoda: 12 -> 2
Node 35: 12 -> 2
Eritherium: 12 -> 1
Phosphatherium: 12 -> 1
Node 39: 12 -> 2
Char. 120 (2 steps)
Root: 0
Sirenia: 0 -> 1
Node 38: 0 -> 1
Char. 121 (1 steps)
Root: 0
Perissodactyla: 0 -> 1
Char. 122 (1 steps)
Root: 0
Node 28: 0 -> 1
Char. 123 (3 steps)
Root: 0
Node 34: 0 -> 01
Embrithopoda: 01 -> 1
Node 35: 01 -> 0
Node 37: 01 -> 012
Node 38: 012 -> 2
Char. 124 (2 steps)
Root: 0
Node 32: 0 -> 01
Node 37: 01 -> 1
Desmostylia: 01 -> 0
Sirenia: 01 -> 1
Char. 125 (2 steps)
Root: 0
Hyracoidea: 0 -> 1
Node 37: 0 -> 01
Node 39: 01 -> 1
Char. 126 (2 steps)
Root: 0
Node 25: 0 -> 01
Macroscelidea: 01 -> 1
Moeritherium: 0 -> 1
Char. 127 (1 steps)
Root: 0
Moeritherium: 0 -> 1
Char. 128 (3 steps)
Root: 0
Arctocyonidae: 0 -> 01
Node 26: 0 -> 01
Macroscelidea: 01 -> 1
Hyracoidea: 0 -> 2
Node 39: 0 -> 1
Char. 129 (1 steps)
Root: 0
Node 34: 0 -> 01
Node 33: 01 -> 1
Char. 130 (2 steps)
Root: 0
Node 25: 0 -> 01
Macroscelidea: 01 -> 1
Node 39: 0 -> 1
Char. 131 (1 steps)
Root: 0
Node 32: 0 -> 01
Node 36: 01 -> 1
Char. 132 (2 steps)
Root: 0
Perissodactyla: 0 -> 1
Node 37: 0 -> 01
Node 38: 01 -> 1
Char. 133 (2 steps)
Root: 0
Node 34: 0 -> 01
Node 33: 01 -> 1
Phosphatherium: 1 -> 0
Char. 134 (5 steps)
Root: 0
Node 26: 0 -> 01
Phenacodontidae: 01 -> 1
Node 30: 0 -> 1
Node 34: 1 -> 12
Embrithopoda: 12 -> 2
Desmostylia: 12 -> 2
Sirenia: 12 -> 1
Phosphatherium: 12 -> 1
Node 39: 12 -> 2
Char. 135 (1 steps)
Root: 0
Node 39: 0 -> 1
Char. 136 (3 steps)
Root: 0
Node 29: 0 -> 1
Node 34: 1 -> 01
Node 33: 01 -> 0
Sirenia: 0 -> 1
Char. 137 (2 steps)
Root: 0
Node 30: 0 -> 1
Sirenia: 1 -> 0
Char. 138 (1 steps)
Root: 0
Node 37: 0 -> 01
Node 38: 01 -> 1
Char. 139 (2 steps)
Root: 0
Embrithopoda: 0 -> 1
Moeritherium: 0 -> 1
Char. 140 (5 steps)
Root: 0
Node 34: 0 -> 012
Node 33: 012 -> 12
Embrithopoda: 12 -> 2
Desmostylia: 12 -> 2
Sirenia: 12 -> 0
Phosphatherium: 12 -> 1
Node 39: 12 -> 2
Char. 141 (2 steps)
Root: 0
Embrithopoda: 0 -> 1
Node 39: 0 -> 1
Char. 142 (1 steps)

Root: 0	Embrithopoda: 0 -> 1	0.03 secs.

Implications for characters distribution among Paenungulata

Our cladistic analysis of *Eritherium* and an examination of the characters distribution in resulting topology (Figs. 3a and 3b) allow to a new evaluation of the characters of the ancestral morphotype of paenungulates (characters of node 26, cladogram 2 (§2.1), and nodes 30, cladogram 3), tethytherians (characters of node 34, cladogram 3) and proboscideans (see text and Table 1).
We retain several important potential synapomorphies for paenungulates, tethytherians, whatever hypotheses of distribution in resulting cladograms (delayed or accelerated transformation): Tables 2 & 3, below.

SI Table 2: Tethytherian features

r, c: reversal and convergence (outgroup); *not homoplastic

Char. N°	Description	Comment
K1(1), 2(1)	Lower incisors enlarged and procumbent	*Crivadiatherium* large and robust root of I/1-2 resembles *Eritherium* and *Phosphatherium*. r?: Anthracobunidae.
K36(3)*, 38(3)*	Hypoconulid cingular-like	
K40(1)	Postentoconulid in M/3	r: Embrithopoda, *Phenacolophus.*
K64(1)	P1/: one root	*Phenacolophus? Minchennella?* Desmostylia? c: Arctocyonidae.
K77(1)	Absence of postprotocrista on P3-4/	r: *Phenacolophus. Minchennella?* Sirenia?
K100(1)	Postentoconule in M1-3/	r: Embrithopoda, *Phenacolophus, Minchennella.*
K117(1)	Orbit located at least above P4/-M1/ level	r?: *Phenacolophus.* More anterior orbit (K117(2)): Convergence in Sirenia and Proboscidea.
K119(1)	Large infraorbital foramen	*Phenacolophus? Minchennella?* Anthracobunidae? c: Macroscelidea.
K120(1)*	Infraorbital foramen close to the orbit, short infraorbital canal	*Phenacolophus? Minchennella*? Anthracobunidae? Infraorbital foramen below the orbit (K120(2)): Convergence in Tethytheria.
K130(1)*	Zygomatic arches widely divergent	*Phenacolophus? Minchennella*? Anthracobunidae? Desmostylia?

Eritherium study shows that some of previously accepted tethytherian features such as orbit position (K117(2)) and submaxillary fossa (K121(1)) evolved convergently. Most significant tethytherian features retained here are the large lower incisors, cingular-like hypoconulid, postentoconule and wide zygomatic arches.

SI Table 3: Paenungulate features

r, c: reversal and convergence (outgroup); ? = uncertain paenungulate synapomorphy;*****not homoplastic

Char. N°	Description	Comment
K17(1)	Paraconid high in P/3-4	c?: *Ocepeia*, Macroscelidea, *Microhyus; r: Phenacolophus.*
K22(2)	Lower molar bunodont-lophodont	c: Perissodactyla.
K24(1)*	Lingual cusp larger than labial ones on lower molars	
K25(1)	Trigonid short with paracristid shortened	r: *Minchenella, Phenacolophus*, Embrithopoda.
K26(1)	Molar paraconid reduced	r: *Phenacolophus,* Embrithopoda. c: Perissodactyla, *Microhyus*.
K30(1), 31(1)	Hypolophid distinct and “broken”	c: Perissodactyla.
K53(1)*	Coronoid foramen present	*Phenacolophus*? *Minchenella?* Sirenia?
?K54(1)	Angular process broad and slightly projecting	*Phenacolophus*? *Minchenella?* Sirenia? c: *Ocepeia*, Phenacodontidae.
?K55(1)	Coronoid retromolar fossa distinct	*Minchenella?* r?: Anthracobunidae, Sirenia, Desmostylia. c: *Ocepeia.*
K57(1)	Upper incisors enlarged	*Phenacolophus*? *Minchenella?* Anthracobunidae? *Eritherium?*
?K71(1)	Upper premolars without conules	Sirenia? r?: Anthracobunidae, Desmostylia.
K80(1)	Upper molar bunodont-lophodont with weak lophs	Possible more inclusive synapomorphy for Paenungulata + Macroscelidea, Louisininae. Perissodactyla differs by developed (crest-like) lophs.
?K88(1)	Upper molars with mesostyle	r?: *Minchenella,* Anthracobunidae, Desmostylia, Sirenia; or c?: Hyracoidea, *Phenacolophus*?, Embrithopoda, Proboscidea.
K105(1)	M3/ bearing a distinct and single hypocone root	*Phenacolophus*? Desmostylia? r: *Minchenella.*
K123(1)	Tuber maxillae ventral or posterior to the orbit	*Phenacolophus*? *Minchenella*? Anthracobunidae? c: Perissodactyla.
K135(1)	Posttympanic process developed	*Phenacolophus*? *Minchenella*? Anthracobunidae? *Eritherium*? c: Phenacodontidae.
K138(1)	Amastoidy	*Phenacolophus*? *Minchenella*? Anthracobunidae? r?: Sirenia.

Most significant paenungulate features retained here are the hypolophid distinct, hypocone root on M3/, coronoid foramen, and lower molars with large lingual cusps.

Part V.
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Caption of SI Tables

SI Table 1: Stratigraphic distribution of the elasmobranch association recovered from samples from the fossiliferous horizon (lower bone bed level of local phosphate bed IIa) of the locality(*) of *Eritherium azzouzorum* n.g., n.sp. and from the matrix(**) of referred specimen MNHN PM42.

SI Table 2: Tethytherian features. r, c: reversal and convergence (outgroup)

SI Table 3: Paenungulate features. r, c: reversal and convergence (outgroup); ? = uncertain paenungulate synapomorphy;*****not homoplastic