Journal of Vertebrate Paleontology

Supplementary data

Supplementary Information S1

Ancestral radiation of paenungulate mammals (Paenungulatomorpha) - new evidence from the Paleocene of Morocco

EMMANUEL GHEERBRANT

CNRS, CR2P (CNRS-MNHN-Sorbonne Université), Museum national d'Histoire naturelle, CP38, 57 rue Cuvier, F-75231 Paris cedex 05, France, emmanuel.gheerbrant@mnhn.fr

1. Studied characters

Our character matrix includes 38 taxa and 209 characters numbered starting from 0. It corresponds to that of Gheerbrant, (2009) and Gheerbrant *et al.* (2021) with a few corrections and additions**.** The main changes with respect to Gheerbrant *et al.* (2021) correspond the replacement of the taxon Sirenia by the following three stem genera: *Prorastomus*, *Pezosiren*, and *Eotheroides*. Their coding, especially for *Pezosiren*, was made from Domning (2001), Domning et al. (2017), and Domning (in press).

Other minor changes were made :

- Character 6: state 0 redefined: I/2 “not enlarged” (states for proboscideans recoded 0, except for *Moeritherium*).
- Character 186 (mastoidy/amastoidy): in sirenians there is a mastoid exposure on the occiput, but it is a secondary state (Novacek and Wyss, 1987).
- Character 209 is added to account for the presence of surnumerary premolar (P5 and dP5) in stem sirenians.

The character matrix, including character list and description, is provided in Supplementary File (Nexus file).

2. Character matrix for *Hadrogeneios*

Matrix

The matrix includes 9 characters that are uninformative (4, 5, 63, 73, 102, 132, 178, 190, 199).

Taxa analysed

The basal out-group taxon (Eutheria) corresponds to the generalized eutherian morphotype.

38 terminal taxa

0 Eutheria (out-group)
1 *Abdounodus*
2 Anthracobunidae
3 Arctocyonidae
4 *Barytherium*
5 *Cambaytherium*
6 Desmostylia
7 *Eritherium*
8 *Eotherioides*
9 Hyopsodus
10 Hyracoidea
11 Macroscelidea
12 *Minchenella*
13 *Moeritherium*
14 *Numidotherium*
15 *Ocepeia*
16 *Orycteropus*
17 *Paschatherium*
18 Perissodactyla
19 *Pezosiren*
20 Phenacodontidae
21 *Phenacolophus*
22 *Phosphatherium*
23 *Potamogale*
24 Prorastomus
25 *Protungulatum*
26 *Ptolemaia*
27 *Radinskya*
28 *Teilhardimys*
29 *Todralestes*
30 *S. minor*
31 *Stylolophus major*
32 *Palaeoamasia*
33 *Hypsamasia*
34 *Crivadiatherium*
35 *Namatherium*
36 *Ars zitelli*
37 *Hadrogeneios*

Suprageneric taxa included in the matrix are coded on the basis of the most plesiomorphic genera included, by reference to the generalized morphotype of the group (see Gheerbrant, 2009). Their content follows Gheerbrant (2009): Eutheria corresponds to generalized eutherian morphotype represented by *Acristatherium*, *Prokennalestes*, *Asioryctes*, *Maelestes*, and *Cimolestes*; Arctocyonidae is based on *Loxolophus*, *Tricentes*, *Lambertocyon*, and *Chriacus*; Perissodactyla was coded based on the primitive perissodactyls *Hyracotherium*, *Cymbalophus*, *Pachynolophus*; Hyracoidea was coded based on the primitive hyracoids *Seggeurius*, *Microhyrax*, *Dimaitherium*, and *Saghatherium*. Anthracobunidae is based on *Anthracobune*; Desmostylia is based on *Behemetops* and *Ashoroa*; Phenacolophidae is based on *Phenacolophus* and *Minchenella*; Phenacodontidae is based on *Ectocion* and *Phenacodus*; Macroscelidea is based on primitive herodotine genera *Chambius* and *Herodotius* and on the extant genera *Petrodromus* and *Rhynchocyon*.

3. TNT analysis, method, cladograms, and characters at nodes

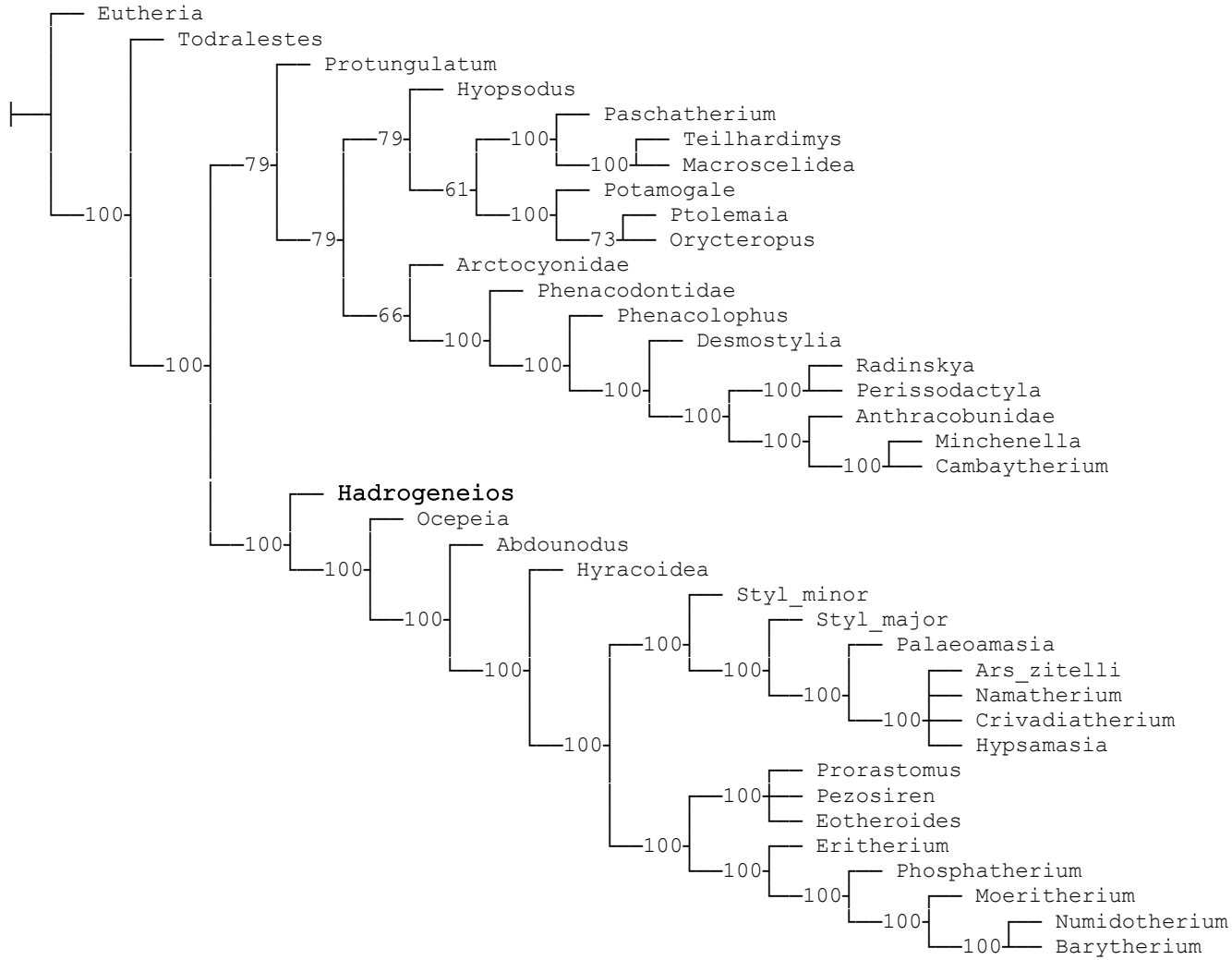
The parsimony analysis was developed using TNT 1.5 software. All analyses used the "traditional search" command with the option of Collapsing Branches with no possible support ("rule 3"). Bremer indices were calculated for 10000 trees with additional 10 steps longer than in the shortest obtained tree. The nine uninformative characters were made inactive before the analysis (command xinact). 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. Characters are numbered starting from 0 (default option of TNT and Winclada).
48 characters are treated as additive: 7, 11, 13, 27, 32, 35, 42, 43, 49, 50, 55, 58, 62, 63, 65, 68, 69, 75, 78, 86, 89, 93, 95, 104, 108, 109, 111, 113, 115, 116, 118, 119, 120, 122, 123, 128, 137, 138, 143, 149, 150, 154, 157, 158, 161, 182, 183, 192, 201.

Analysis 1: standard analysis (unweighted, unconstrained)

Strict consensus of 180 trees (0 taxa excluded; two rounds of TBR analysis).

Tree lengths: 972. Retention index: 61.3. Consistency Index: 34.8.

Majority rule tree (from 180 trees, cut 50)


Eutheria
Todralestes
Protungulatum
Hyopsodus
Paschatherium
Teilhardimys
Macroscelidea
Potamogale
Ptolemaia
Orycteropus
Arctocyonidae
Phenacodontidae
Phenacolophus
Desmostylia
Radinskya
Perissodactyla
Anthracobunidae
Minchenella
Cambaytherium
Hadrogeneios
Ocepeia
Abdounodus
Hyracoidea
Styl_minor
Styl_major
Palaeoamasia
Ars_zitelli
Namatherium
Crivadiatherium
Hypsamasia
Prorastomus
Pezosiren
Eotheroides
Eritherium
Phosphatherium
Moeritherium
Numidotherium
Barytherium
79
100
79
79
61
100
100
100
73
79
66
100
100
100

Synapomorphies common to 180 trees of the standard analysis
(Node numbers refer to nodes in consensus)

Eutheria :
All trees:
No autapomorphies:

Abdounodus :
All trees:
Char. 19: 1 --> 0
Char. 32: 12 --> 0
Char. 39: 1 --> 2
Char. 41: 0 --> 2
Char. 42: 0 --> 1
Char. 43: 1 --> 2
Char. 45: 1 --> 0
Char. 50: 02 --> 1
Char. 98: 0 --> 1
Char. 111: 0 --> 1
Char. 164: 1 --> 2

Anthracobunidae :
All trees:
Char. 26: 1 --> 2
Char. 165: 1 --> 0
Char. 193: 0 --> 1
Some trees:
Char. 58: 2 --> 1

Arctocyonidae :
All trees:
Char. 72: 0 --> 1
Char. 174: 0 --> 1
Some trees:
Char. 31: 0 --> 1
Char. 46: 1 --> 2
Char. 155: 0 --> 1
Char. 156: 2 --> 1
Char. 180: 0 --> 1
Char. 196: 1 --> 0
Char. 197: 2 --> 0
Char. 204: 0 --> 2

Barytherium :
All trees:
Char. 34: 1 --> 3
Char. 55: 1 --> 2
Char. 57: 0 --> 2
Char. 63: 0 --> 1
Char. 69: 1 --> 2
Char. 77: 1 --> 3
Char. 79: 1 --> 0
Char. 125: 1 --> 0
Char. 164: 1 --> 3

Cambaytherium :
All trees:
Char. 16: 1 --> 0
Char. 18: 1 --> 0
Char. 21: 0 --> 1
Char. 22: 1 --> 0
Char. 23: 1 --> 0
Char. 25: 2 --> 1
Char. 39: 0 --> 2

Desmostylia :
All trees:
Char. 0: 0 --> 1
Char. 1: 0 --> 1
Char. 8: 1 --> 0
Char. 17: 0 --> 1
Char. 32: 2 --> 0
Char. 61: 1 --> 2
Char. 64: 0 --> 1
Char. 84: 3 --> 0
Char. 91: 0 --> 1
Char. 107: 0 --> 1
Char. 108: 0 --> 3
Char. 109: 1 --> 3
Char. 112: 0 --> 1
Char. 115: 12 --> 0
Char. 118: 1 --> 2
Char. 145: 0 --> 1
Char. 147: 0 --> 1
Char. 154: 1 --> 23
Char. 157: 1 --> 3
Char. 161: 0 --> 12
Char. 164: 1 --> 34
Char. 181: 0 --> 1
Some trees:
Char. 58: 2 --> 1
Char. 155: 0 --> 1

Hyopsodus :
All trees:
Char. 13: 0 --> 1
Char. 176: 0 --> 1
Char. 183: 0 --> 1
Char. 188: 0 --> 1
Char. 193: 0 --> 1
Some trees:
Char. 6: 0 --> 1
Char. 11: 1 --> 2
Char. 22: 0 --> 1
Char. 36: 0 --> 1
Char. 39: 1 --> 0
Char. 41: 0 --> 1
Char. 58: 2 --> 1
Char. 72: 0 --> 1
Char. 115: 1 --> 2
Char. 140: 0 --> 2
Char. 161: 0 --> 1

Hyracoidea :
All trees:

Char. 16: 0 --> 1
Char. 31: 1 --> 0
Char. 44: 0 --> 1
Char. 51: 0 --> 1
Char. 74: 0 --> 1
Char. 75: 0 --> 2
Char. 88: 0 --> 1
Char. 120: 1 --> 2
Char. 166: 0 --> 1
Char. 170: 0 --> 1
Char. 173: 0 --> 12
Char. 194: 0 --> 2
Char. 201: 2 --> 1

Macroscelidea :
All trees:
Char. 22: 0 --> 1
Char. 24: 0 --> 1
Char. 46: 1 --> 0
Char. 50: 0 --> 1
Char. 84: 2 --> 3
Char. 87: 1 --> 0
Char. 164: 1 --> 2
Some trees:
Char. 17: 1 --> 0
Char. 29: 1 --> 0
Char. 32: 0 --> 1

Minchenella :
All trees:
Char. 41: 0 --> 1
Char. 54: 0 --> 1
Char. 98: 1 --> 0
Char. 99: 1 --> 0
Char. 109: 1 --> 0
Char. 110: 1 --> 0
Char. 111: 1 --> 0
Char. 117: 2 --> 1
Char. 118: 1 --> 0
Char. 120: 1 --> 2
Some trees:
Char. 46: 1 --> 0

Moeritherium :
All trees:
Char. 2: 0 --> 1
Char. 6: 0 --> 1
Char. 21: 1 --> 0
Char. 25: 3 --> 4
Char. 27: 0 --> 2
Char. 31: 1 --> 0
Char. 42: 1 --> 2
Char. 57: 0 --> 1
Char. 67: 0 --> 1
Char. 70: 1 --> 0
Char. 76: 0 --> 2
Char. 79: 1 --> 3
Char. 80: 0 --> 1
Char. 84: 1 --> 3
Char. 85: 0 --> 1
Char. 87: 0 --> 1
Char. 95: 3 --> 4
Char. 114: 0 --> 2
Char. 145: 0 --> 1
Char. 153: 0 --> 1
Char. 154: 2 --> 3
Char. 156: 2 --> 3
Char. 161: 1 --> 2
Char. 164: 1 --> 5
Char. 165: 0 --> 1
Char. 171: 0 --> 1
Char. 172: 0 --> 1
Char. 191: 0 --> 1
Char. 203: 0 --> 1

Numidotherium :
All trees:
No autapomorphies:

Ocepeia :
All trees:
Char. 7: 0 --> 1
Char. 11: 12 --> 3
Char. 13: 0 --> 3
Char. 41: 0 --> 1
Char. 45: 1 --> 2
Char. 47: 0 --> 1
Char. 51: 0 --> 1
Char. 52: 0 --> 3
Char. 66: 0 --> 1
Char. 67: 0 --> 1
Char. 68: 0 --> 1
Char. 71: 0 --> 1
Char. 137: 0 --> 2
Char. 140: 0 --> 3
Char. 172: 0 --> 1
Char. 187: 0 --> 1
Char. 188: 0 --> 1
Char. 203: 0 --> 1
Some trees:
Char. 117: 1 --> 0
Char. 127: 1 --> 3
Char. 151: 1 --> 0
Char. 154: 1 --> 0

Orycteropus :
All trees:
Char. 10: 0 --> 12
Char. 13: 0 --> 2
Char. 14: 0 --> 1
Char. 15: 0 --> 1
Char. 20: 0 --> 1
Char. 57: 0 --> 2
Char. 63: 0 --> 3
Char. 68: 0 --> 2
Char. 69: 01 --> 2
Char. 74: 0 --> 2
Char. 77: 1 --> 2
Char. 83: 1 --> 3
Char. 135: 0 --> 1
Char. 139: 0 --> 1
Char. 141: 0 --> 1
Char. 147: 0 --> 1
Char. 160: 0 --> 2
Char. 183: 0 --> 2
Some trees:
Char. 2: 0 --> 1
Char. 8: 3 --> 5
Char. 45: 1 --> 2
Char. 58: 01 --> 2
Char. 61: 0 --> 1
Char. 159: 1 --> 0

Char. 164: 1 --> 0
Char. 179: 1 --> 0
Char. 192: 0 --> 2
Char. 194: 1 --> 2
Char. 203: 1 --> 0

Paschatherium :
All trees:
Char. 11: 1 --> 0
Char. 12: 1 --> 0
Char. 25: 1 --> 0
Char. 81: 1 --> 0
Char. 92: 1 --> 0
Char. 98: 1 --> 0
Some trees:
Char. 39: 1 --> 2

Perissodactyla :
All trees:
Char. 76: 0 --> 2
Char. 118: 1 --> 2
Char. 139: 0 --> 1
Char. 146: 0 --> 1
Char. 151: 1 --> 0
Char. 154: 1 --> 0
Char. 180: 0 --> 1

Phenacodontidae :
All trees:
Char. 38: 0 --> 1
Char. 140: 0 --> 2
Char. 146: 0 --> 1
Char. 193: 0 --> 1
Some trees:
Char. 11: 1 --> 2
Char. 151: 1 --> 0
Char. 189: 1 --> 0

Phenacolophus :
All trees:
Char. 6: 0 --> 1
Char. 8: 1 --> 3
Char. 21: 0 --> 1
Char. 33: 0 --> 1
Char. 74: 0 --> 2
Char. 109: 1 --> 0
Char. 110: 1 --> 0
Char. 113: 01 --> 2
Char. 126: 1 --> 0
Char. 204: 1 --> 3
Some trees:
Char. 46: 1 --> 2

Phosphatherium :
All trees:
Char. 58: 2 --> 1
Char. 134: 0 --> 2
Char. 140: 0 --> 2

Potamogale :
All trees:
Char. 46: 1 --> 0
Char. 50: 0 --> 2
Char. 114: 0 --> 1
Char. 153: 0 --> 1
Char. 158: 0 --> 2
Char. 161: 01 --> 2
Char. 172: 0 --> 1
Char. 184: 0 --> 1
Some trees:
Char. 48: 1 --> 0
Char. 53: 0 --> 1
Char. 65: 1 --> 2
Char. 70: 1 --> 0
Char. 92: 1 --> 0
Char. 98: 1 --> 0
Char. 109: 1 --> 0
Char. 110: 1 --> 0
Char. 111: 1 --> 0
Char. 142: 0 --> 2
Char. 146: 0 --> 1
Char. 154: 12 --> 3
Char. 156: 0 --> 3
Char. 157: 0 --> 12
Char. 163: 0 --> 1
Char. 197: 0 --> 1
Char. 198: 0 --> 1
Char. 202: 0 --> 2
Char. 203: 01 --> 1

Protungulatum :
All trees:
Char. 28: 0 --> 1
Char. 46: 1 --> 0
Char. 47: 0 --> 2
Char. 61: 1 --> 2

Ptolemaia :
All trees:
Char. 126: 1 --> 2
Char. 127: 1 --> 2
Some trees:
Char. 8: 3 --> 0
Char. 17: 1 --> 0
Char. 52: 0 --> 2
Char. 64: 1 --> 0
Char. 69: 01 --> 0
Char. 78: 1 --> 2
Char. 84: 0 --> 1
Char. 171: 1 --> 0

Radinskya :
All trees:
Char. 84: 3 --> 1
Char. 164: 1 --> 0

Eotheroides :
All trees:
Char. 140: 0 --> 1
Char. 179: 1 --> 0
Some trees:
Char. 3: 1 --> 0
Char. 25: 2 --> 1
Char. 83: 1 --> 3
Char. 157: 3 --> 5
Char. 161: 1 --> 2
Char. 175: 0 --> 1

Pezosiren :
All trees:
Char. 172: 0 --> 1
Some trees:

Char. 194: 1 --> 2

Prorastomus :
All trees:
Char. 9: 1 --> 0
Char. 10: 0 --> 1
Char. 12: 1 --> 0
Char. 70: 1 --> 0
Some trees:
Char. 6: 0 --> 1
Char. 103: 0 --> 1

Teilhardimys :
All trees:
Char. 21: 0 --> 1
Char. 26: 0 --> 2
Char. 74: 0 --> 1
Char. 75: 0 --> 2
Char. 114: 0 --> 1
Char. 120: 01 --> 2
Char. 121: 0 --> 1
Char. 135: 0 --> 12
Some trees:
Char. 36: 0 --> 1

Eritherium :
All trees:
Char. 42: 1 --> 2
Char. 48: 2 --> 1
Char. 50: 2 --> 0
Char. 100: 0 --> 1
Char. 101: 3 --> 2
Char. 127: 3 --> 1

Char. 192: 1 --> 0

Todralestes :
All trees:
Char. 52: 0 --> 3
Char. 53: 0 --> 1
Some trees:
Char. 10: 0 --> 1
Char. 93: 0 --> 1

Styl_minor :
All trees:
Char. 31: 1 --> 0
Char. 50: 2 --> 1
Char. 58: 2 --> 1
Char. 140: 0 --> 2

Styl_major :
All trees:
Char. 135: 1 --> 2

Palaeoamasia :
All trees:
Char. 10: 0 --> 1
Char. 54: 0 --> 1
Some trees:
Char. 87: 0 --> 1
Char. 91: 1 --> 0

Hypsamasia :
Some trees:
Char. 80: 0 --> 1
Char. 87: 0 --> 1

Char. 91: 1 --> 0

Crivadiatherium :
Some trees:
Char. 24: 0 --> 1
Char. 44: 0 --> 1
Char. 45: 1 --> 0

Namatherium :
Some trees:
Char. 88: 0 --> 1
Char. 100: 0 --> 1
Char. 145: 0 --> 2
Char. 164: 0 --> 2

Ars_zitelli :
Some trees:
Char. 49: 0 --> 2
Char. 83: 1 --> 0
Char. 84: 2 --> 3
Char. 89: 0 --> 2
Char. 103: 1 --> 0
Char. 108: 12 --> 3
Char. 123: 1 --> 2
Char. 127: 3 --> 0
Char. 128: 2 --> 3
Char. 135: 1 --> 2
Char. 156: 2 --> 3
Char. 157: 23 --> 01
Char. 160: 01 --> 2
Char. 162: 1 --> 0
Char. 205: 1 --> 2

Hadrogeneios :
All trees:
Char. 11: 1 --> 0
Char. 22: 0 --> 1
Char. 41: 0 --> 3
Char. 53: 0 --> 3
Char. 114: 0 --> 2
Some trees:
Char. 115: 1 --> 0
Char. 127: 1 --> 0

Node 39 :
All trees:
Char. 40: 0 --> 1
Char. 43: 0 --> 1
Char. 94: 0 --> 1
Char. 95: 0 --> 1
Char. 103: 1 --> 0
Char. 109: 0 --> 1
Char. 110: 0 --> 1
Char. 115: 2 --> 3
Char. 118: 0 --> 1
Char. 120: 0 --> 1
Char. 121: 0 --> 1
Char. 157: 0 --> 12

Node 40 :
All trees:
Char. 31: 0 --> 1
Char. 34: 0 --> 1
Char. 35: 0 --> 1
Char. 105: 0 --> 1
Char. 115: 01 --> 2

Char. 130: 0 --> 1

Node 41 (*Hadrogeneios* + Paenungulatomorpha) :
All trees:
Char. 38: 0 --> 1
Char. 55: 0 --> 1
Char. 62: 0 --> 1
Char. 104: 0 --> 1
Char. 113: 0 --> 2
Some trees:
Char. 10: 0 --> 1

Node 42 :
All trees:
Char. 25: 0 --> 1
Char. 126: 0 --> 1
Some trees:
Char. 32: 0 --> 1
Char. 92: 0 --> 1
Char. 117: 0 --> 1
Char. 127: 0 --> 1

Node 43 :
All trees:
No synapomorphies

Node 44 :
All trees:
Char. 11: 1 --> 0
Char. 43: 0 --> 2

Node 45 :
All trees:
Char. 16: 0 --> 1
Char. 152: 0 --> 1

Node 46 :
All trees:
Char. 28: 0 --> 1
Char. 29: 0 --> 1
Char. 30: 0 --> 1
Char. 124: 0 --> 1
Char. 157: 0 --> 1
Some trees:
Char. 36: 0 --> 1

Node 47 :
All trees:
Char. 26: 0 --> 1
Char. 34: 0 --> 1
Char. 35: 0 --> 1
Char. 40: 0 --> 2
Char. 78: 1 --> 2
Char. 97: 0 --> 2
Char. 127: 1 --> 3
Char. 135: 0 --> 2

Node 48 :
All trees:
Char. 32: 1 --> 2
Char. 79: 0 --> 2
Char. 82: 0 --> 1
Char. 84: 0 --> 3
Char. 93: 2 --> 3
Char. 120: 0 --> 1
Char. 121: 0 --> 1
Char. 165: 0 --> 1
Some trees:
Char. 22: 0 --> 1
Char. 128: 0 --> 1
Char. 142: 0 --> 2
Char. 204: 0 --> 1

Node 49 :
All trees:
Char. 13: 2 --> 0
Char. 38: 1 --> 0
Char. 39: 2 --> 1
Char. 42: 1 --> 0
Char. 43: 12 --> 0
Char. 68: 1 --> 2
Char. 137: 0 --> 1
Char. 204: 1 --> 2
Char. 207: 2 --> 3

Node 50 :
All trees:
Char. 10: 0 --> 3
Char. 11: 2 --> 3
Char. 14: 1 --> 0
Char. 18: 0 --> 1
Char. 22: 0 --> 1
Char. 51: 0 --> 1
Char. 54: 0 --> 1
Char. 56: 0 --> 1
Char. 68: 0 --> 1
Char. 71: 0 --> 1
Char. 74: 0 --> 1
Char. 75: 0 --> 1
Char. 104: 1 --> 0
Char. 107: 0 --> 1
Char. 108: 0 --> 3
Char. 141: 0 --> 1
Char. 148: 0 --> 1
Char. 158: 1 --> 2
Char. 175: 0 --> 1
Char. 182: 1 --> 2
Char. 198: 0 --> 1

Node 51 :
All trees:
Char. 3: 1 --> 2
Char. 7: 1 --> 2
Char. 8: 4 --> 5
Char. 25: 2 --> 3
Char. 32: 1 --> 0
Char. 45: 1 --> 2
Char. 46: 1 --> 2
Char. 90: 0 --> 1
Char. 95: 1 --> 3
Char. 120: 1 --> 23
Char. 135: 1 --> 2
Char. 157: 3 --> 4
Char. 162: 0 --> 1
Char. 188: 0 --> 1
Char. 202: 1 --> 0
Char. 204: 0 --> 1
Char. 207: 0 --> 2

Node 52 :
All trees:

Char. 7: 0 --> 1
Char. 39: 1 --> 2
Char. 41: 0 --> 2

Node 53 :
All trees:
Char. 98: 0 --> 1
Char. 155: 0 --> 1

Node 54 :
All trees:
Char. 40: 1 --> 2
Char. 72: 0 --> 1
Char. 91: 0 --> 1
Char. 100: 1 --> 0
Char. 118: 1 --> 2
Char. 157: 12 --> 3
Char. 161: 0 --> 1
Char. 181: 0 --> 1
Char. 183: 0 --> 12
Some trees:
Char. 127: 1 --> 3
Char. 159: 0 --> 1

Node 55 :
All trees:
Char. 10: 1 --> 0
Char. 25: 1 --> 2
Char. 26: 0 --> 2
Char. 28: 0 --> 1
Char. 29: 0 --> 1
Char. 30: 0 --> 1
Char. 48: 0 --> 2
Char. 58: 1 --> 2
Char. 79: 0 --> 1
Char. 84: 0 --> 2
Char. 97: 0 --> 1
Char. 115: 3 --> 4
Char. 116: 1 --> 2
Char. 128: 0 --> 1
Char. 131: 0 --> 1
Char. 133: 0 --> 1
Char. 135: 0 --> 1
Some trees:
Char. 81: 2 --> 1

Node 56 :
All trees:
Char. 17: 0 --> 1
Char. 45: 2 --> 0
Char. 124: 1 --> 0

Node 57 :
All trees:
Char. 37: 0 --> 1
Char. 40: 0 --> 1
Char. 78: 1 --> 2
Char. 93: 2 --> 3
Char. 94: 0 --> 1
Char. 95: 0 --> 1
Char. 128: 0 --> 1
Char. 134: 0 --> 1
Some trees:
Char. 19: 0 --> 1
Char. 27: 0 --> 1

Node 58 :
All trees:
Char. 79: 0 --> 1
Char. 84: 0 --> 2
Char. 127: 1 --> 2
Some trees:
Char. 48: 0 --> 1
Char. 53: 0 --> 1

Node 59 :
All trees:
Char. 71: 0 --> 1
Char. 155: 0 --> 1
Some trees:
Char. 11: 12 --> 3
Char. 44: 1 --> 0
Char. 59: 0 --> 1
Char. 86: 2 --> 1
Char. 87: 1 --> 0
Char. 93: 2 --> 0
Char. 103: 1 --> 0
Char. 115: 1 --> 0
Char. 140: 0 --> 1
Char. 145: 0 --> 1
Char. 156: 2 --> 0
Char. 167: 0 --> 1
Char. 175: 0 --> 1

Node 60 :
All trees:
Char. 95: 1 --> 2
Char. 120: 1 --> 2
Char. 127: 3 --> 1
Char. 135: 2 --> 0
Char. 184: 0 --> 1

Node 61 :
All trees:
Char. 20: 0 --> 1
Char. 51: 0 --> 1
Char. 54: 0 --> 1
Char. 148: 0 --> 1
Char. 149: 0 --> 2
Char. 150: 0 --> 2
Char. 208: 0 --> 1
Some trees:
Char. 15: 0 --> 1
Char. 61: 1 --> 2
Char. 68: 0 --> 1
Char. 74: 0 --> 2
Char. 77: 1 --> 2
Char. 164: 1 --> 2
Char. 194: 0 --> 1

Node 62 :
All trees:
Char. 25: 2 --> 3
Char. 33: 0 --> 1
Char. 35: 1 --> 2
Char. 38: 1 --> 0
Char. 39: 1 --> 0
Char. 41: 0 --> 1
Char. 55: 1 --> 0
Char. 67: 0 --> 1
Char. 81: 1 --> 0
Char. 96: 0 --> 1

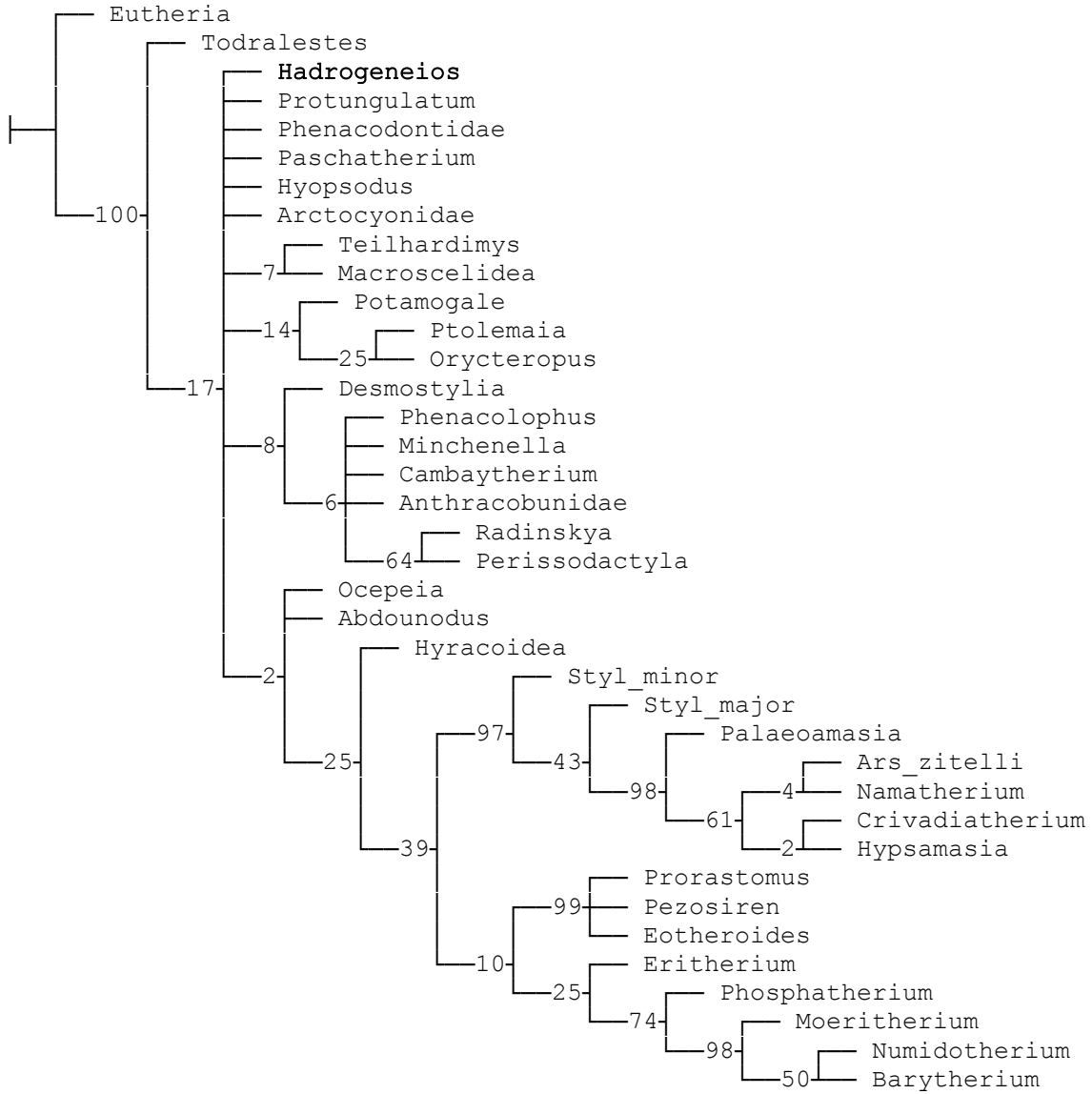
Char. 103: 0 --> 1
Char. 104: 1 --> 2
Char. 107: 0 --> 2
Char. 110: 1 --> 0
Char. 113: 2 --> 3
Char. 114: 0 --> 2
Char. 119: 0 --> 1
Char. 122: 0 --> 1
Char. 123: 0 --> 1
Char. 136: 0 --> 1
Char. 143: 0 --> 1

Node 63 :
All trees:
Char. 108: 0 --> 1
Char. 109: 1 --> 2
Char. 162: 0 --> 1

Node 64 :
All trees:
Char. 74: 0 --> 1
Char. 75: 0 --> 1
Char. 76: 0 --> 2
Char. 128: 1 --> 2
Char. 129: 0 --> 1
Char. 164: 1 --> 0

Node 65 :
Some trees:
Char. 48: 2 --> 0
Char. 75: 1 --> 2
Char. 109: 2 --> 3
Char. 119: 1 --> 2
Char. 122: 1 --> 2
Char. 143: 1 --> 2
Char. 204: 0 --> 1
Char. 205: 0 --> 1

Standard Bootstrap



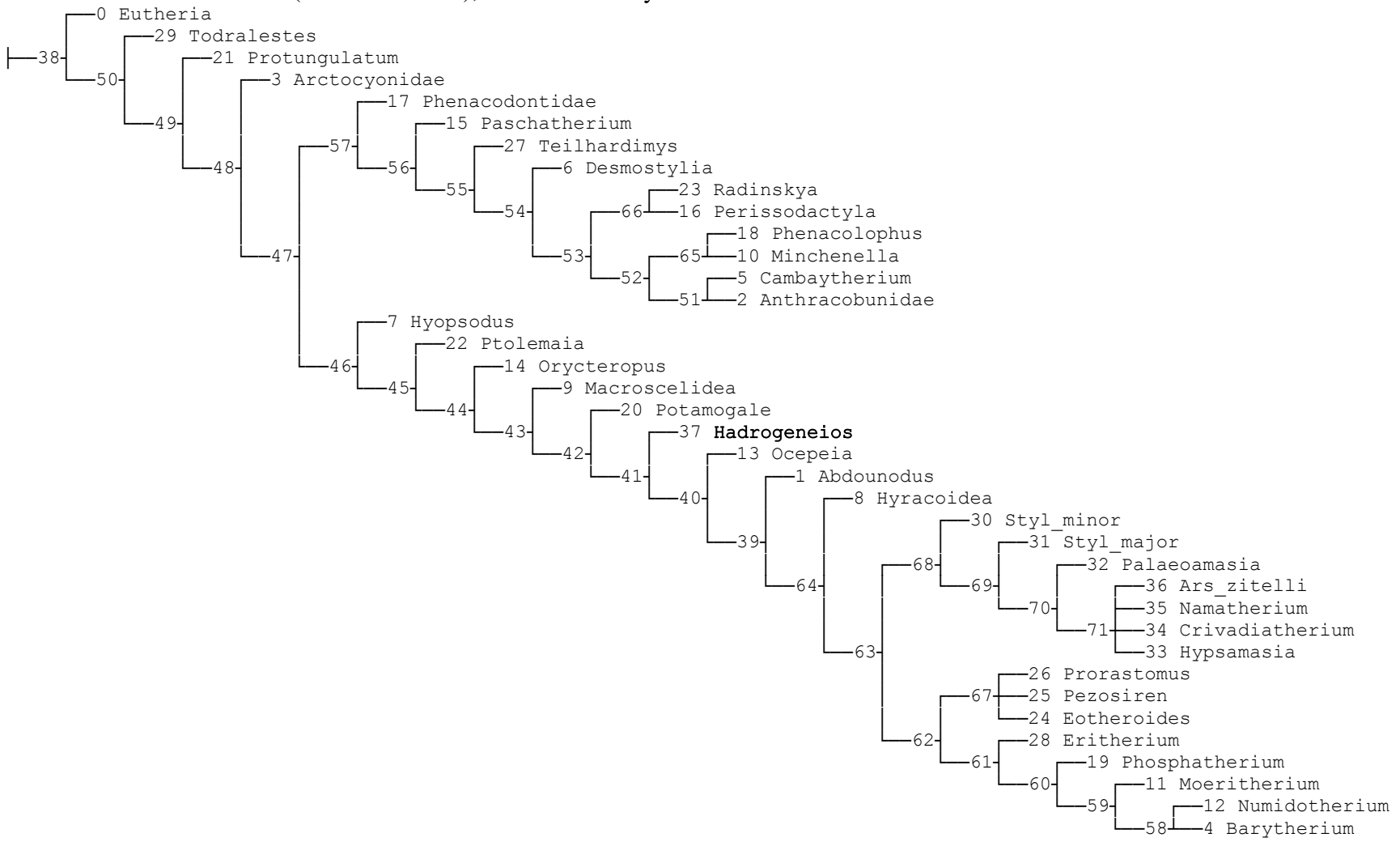
Analysis 2: Clade Afrotheria constrained

In this analysis the following taxa are constrained to gather in the same clade Afrotheria: 1 *Abdounodus*; 4 *Barytherium*; 8 *Hyracoidea*; 9 *Macroscelidea*; 11 *Moeritherium*; 12 *Numidotherium*; 13 *Ocepeia*; 14 *Orycteropus*; 19 *Phosphatherium*; 20 *Potamogale*; 24 *Eotheroides*; 25 *Pezosiren*; 26 *Prorastomus*; 28 *Eritherium*; 30 *Stylophus_minor*; 31 *Stylophus _major*; 32 *Palaeoamasia*; 33 *Hypsamasia*; 34 *Crivadiatherium*; 35 *Namatherium*; 36 *Arsinoitherium zitelli*.
The used TNT command was: force +[1 4 8 9 11 12 13 14 19 20 24 25 26 28 30 31 32 33 34 35 36];constrain =;

1 - *Hadrogeneios* constrained to be included in Afrotheria.

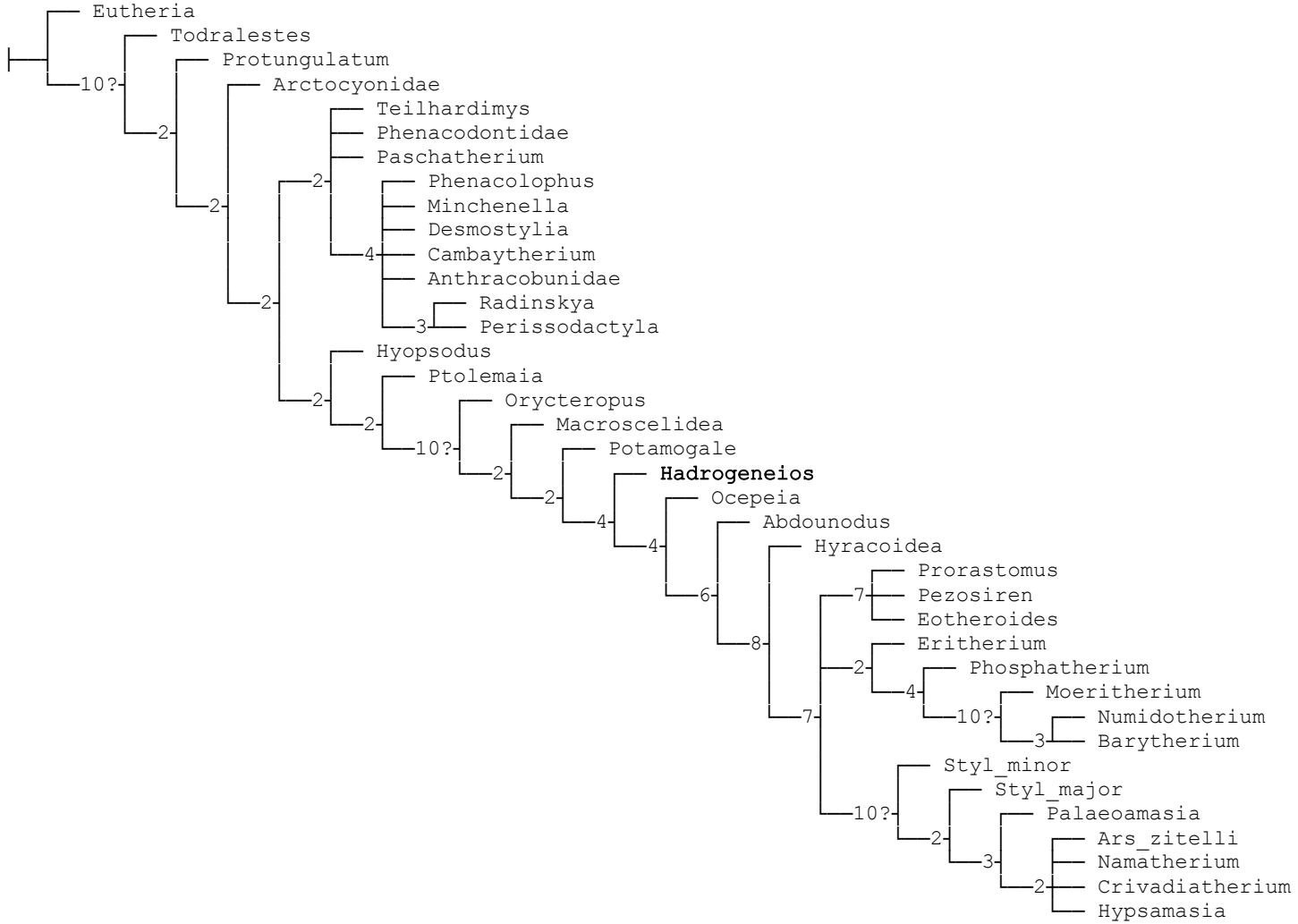
Used TNT command: force +[1 4 8 9 11 12 13 14 19 20 24 25 26 28 30 31 32 33 34 35 36 37]; constrain =;

Strict consensus of 30 trees (0 taxa excluded), first round analysis



Tree lengths: 986. Retention index: 60.5. Consistency Index: 34.3.

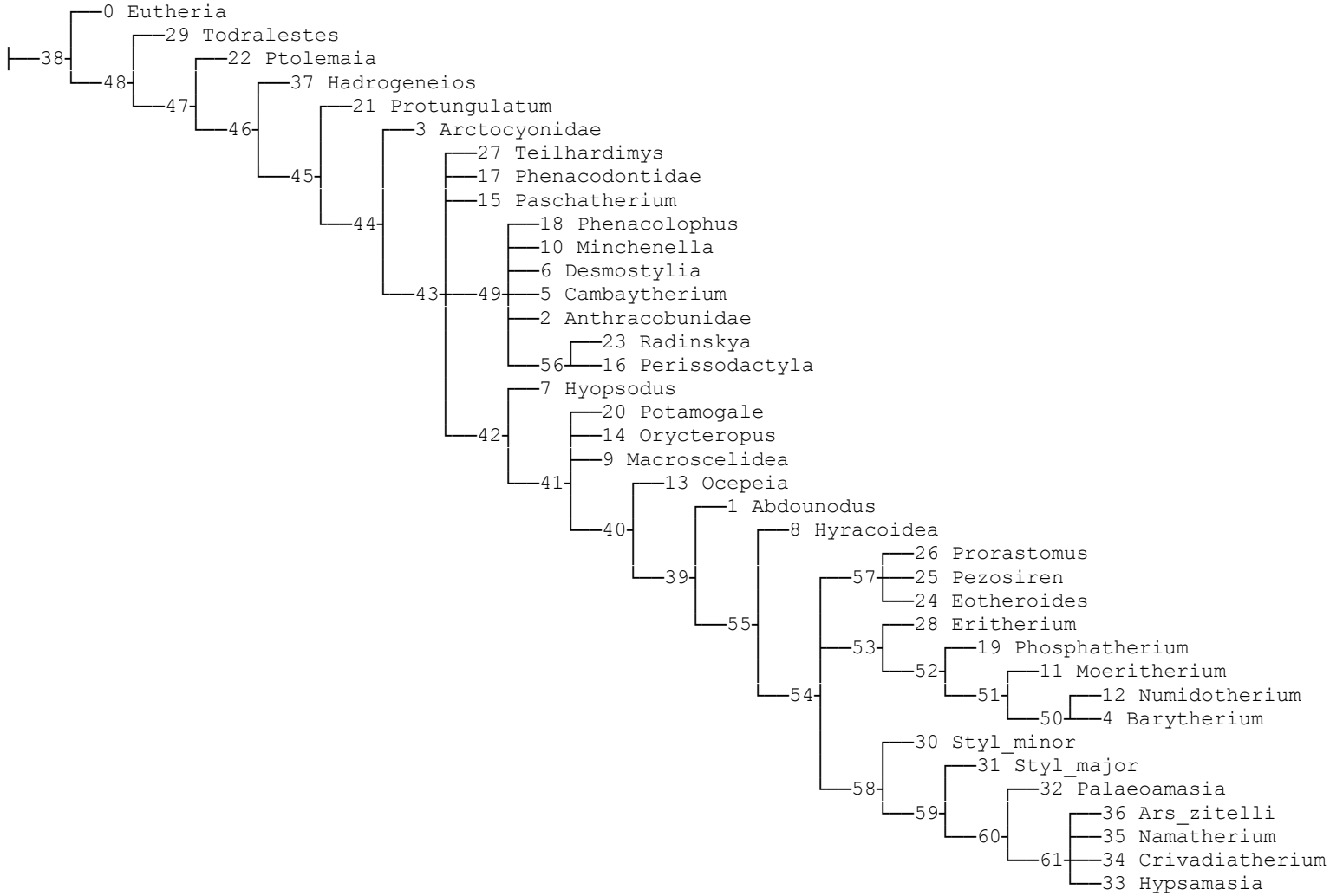
Bremer supports (from 10000 trees, cut 2)



2 - *Hadrogeneios* position not constrained

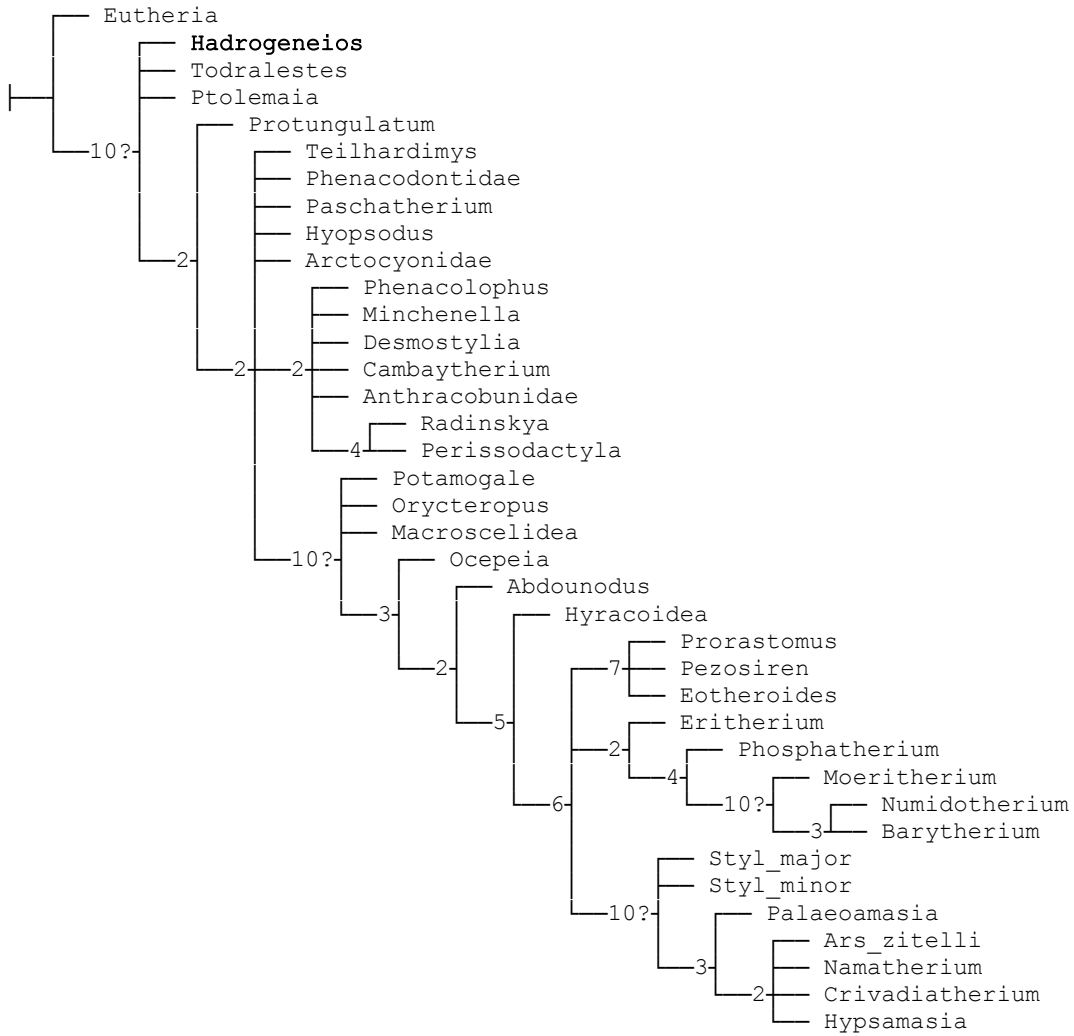
Used command TNT: force +[1 4 8 9 11 12 13 14 19 20 24 25 26 28 30 31 32 33 34 35 36];constrain =;

Strict consensus of 530 trees (two rounds of TBR analysis)



Tree lengths: 987. Retention index: 60.5. Consistency Index: 34.2.

Bremer support >2 (from 10000 trees, cut 2)



References

Domning, D. P. 2001. The earliest known fully quadrupedal sirenian. Nature 413:625–627.

Domning, D. P. in press. The Sirenia (Mammalia: Prorastomidae) of the Eocene Seven Rivers site, Jamaica; pp. in R. W. Portell and D. P. Domning (eds.), The Sirenia (Mammalia: Prorastomidae) of the Eocene Seven Rivers site, Jamaica, Springer.

Domning, D. P., G. J. Heal, and S. Sorbi. 2017. *Libysiren sickenbergi,* gen. et sp. nov.: a new sirenian (Mammalia, Protosirenidae) from the middle Eocene of Libya. Journal of Vertebrate Paleontology 37:e1299158.

Gheerbrant, E. 2009. Paleocene emergence of elephant relatives and the rapid radiation of African ungulates. Proceedings of the National Academy of Sciences 106:10717–10721.

Novacek, M. J., and A. R. Wyss. 1987. Selected Features of the Desmostylian Skeleton and Their Phylogenetic Implications. American Museum Novitates, 8:1-8.