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SUPPLEMENTARY ONLINE MATERIAL FOR

# New postcranial remains of large toxodontian notoungulates from the late Oligocene of Mendoza, Argentina and their systematic implications

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Published in *Acta Palaeontologica Polonica* 2017 62 (1): 195-210.
https://doi.org/10.4202/app.00301.2016

**Supplementary Online Material**

SOM 1

List of specimens consulted for comparison (direct revision or original photographs). See institutional abbreviations in text. Numbers in parentheses correspond to old catalogue numbers of the Ameghino collection in MACN, formerly used in publications.

1. **Homalodotheriidae**

*Asmodeus*
AMNH 11734 *Asmodeus osborni*, astragalus. Santa Cruz, Argentina.
AMNH 11735, *Asmodeus osborni*, calcaneum. Santa Cruz, Argentina.
MACN A 12326 (A 52-325), *Asmodeus osborni*, astragalus. Chubut, Argentina.
MACN A 12327 (A 52-326), *Asmodeus osborni*, holotype, calcaneum. Santa Cruz, Argentina.

*Homalodotherium*
AMNH 9261, *Homalodotherium cunninghami*, calcaneum. Santa Cruz, Argentina.
MACN A 5991, *Homalodotherium crassum*, calcaneum. Santa Cruz, Argentina.
MACN A 3137, *Homalodotherium cunninghami*, calcaneum. Santa Cruz, Argentina.
MACN A 3138 to 3139, *Homalodotherium cunninghami*, astragali. Santa Cruz, Argentina.
MACN A 3205, *Homalodotherium excursum*, holotype, astragalus. Santa Cruz, Argentina.
MACN A 8611, *Homalodotherium excursum*, calcaneum. Santa Cruz, Argentina.
MACN A 8612, *Homalodotherium excursum*, astragalus. Santa Cruz, Argentina.
MACN A 8613, *Homalodotherium segoviae*, calcaneum. Santa Cruz, Argentina.
MACN A 8614, *Homalodotherium segoviae*, astragalus. Santa Cruz, Argentina.
MLP 12-104, *Homalodotherium cunninghami*, astragalus. Santa Cruz, Argentina.
MLP 55-XII-13-229 and, *Homalodotherium* sp., calcaneum. Santa Cruz, Argentina.
55-XII-13-230, *Homalodotherium* sp., astragalus. Santa Cruz, Argentina.
MLP 58-IX-3-3, *Homalodotherium* sp., astragalus. Patagonia?, Argentina.
MLP 59-XII-14-10, *Homalodotherium* sp., astragalus. Santa Cruz, Argentina.
MLP 67-VIII-14-1 to 4, *Homalodotherium* sp., calcanei. Santa Cruz, Argentina.
MLP 67-VIII-15-1 to 4, *Homalodotherium* sp., astragali. Santa Cruz, Argentina.

2. **Leontiniidae**

*Leontinia*
MACN A 12544 (A 52-547), *Senodon platyarthrus*, syntype, labelled as *Leontinia gaudryi*, Santa Cruz, Argentina.

*Scarrittia*

AMNH 29582, *Scarrittia canquelensis*, Scarritt Pocket, Sierra Canquel, Chubut, Argentina; manus
AMNH 29585, *Scarrittia canquelensis*, Scarritt Pocket, Sierra Canquel, Chubut, Argentina; partial skeleton.
AMNH 29598, *Scarrittia canquelensis*, Scarritt Pocket, Sierra Canquel, Chubut, Argentina; carpal and tarsal bones.

3. **Notohippidae**

*Mendozahippus*
MCNAM-PV 4004, *Mendozahippus fierensis*, ectocuneiform and fragment of Mt III, part of the holotype. Quebrada Fiera, Mendoza, Argentina.

*Morphippus*
MACN A 12100 (A 52-77), *Morphippus imbricatus*, astragalus, Sarmiento Formation, Argentina.

*Rhynchippus*
YPM VP-52313, *Rhynchippus equinus*, calcaneum. Salla, Bolivia.

4. **Toxodontidae**

*Adinotherium*
AMNH 9275, *Adinotherium ovinum*, foot bones. Santa Cruz, Argentina.
AMNH 9184, *Adinotherium robustum*, forefoot. Santa Cruz, Argentina.
MACN A 8515 to 8518, *Adinotherium* sp., calcanei. Santa Cruz, Argentina.
MACN A 8519 to 8523, *Adinotherium* sp., astragali. Santa Cruz, Argentina.
MACN A 1016 to 1020, *Adinotherium* sp., calcanei. Santa Cruz, Argentina.
MACN A 1021 to 1027, *Adinotherium* sp., astragali. Santa Cruz, Argentina.
MACN A 8547, *Adinotherium* sp., calcaneum. Santa Cruz, Argentina.
MLP 67-XI-31-1 to 9. *Adinotherium* sp., astragali. Santa Cruz, Argentina.
MLP 68-VI-25-81 to 87, *Adinotherium* sp., metacarpal bones. Santa Cruz, Argentina.
MLP 67-XII-1-1 to 23, *Adinotherium* sp., calcanei. Santa Cruz, Argentina.
MLP 67-XII-8-1 to 2, *Adinotherium* sp., astragali. Santa Cruz, Argentina.
MLP 68-VI-25-76 to 80, *Adinotherium* sp., metatarsal bones. Santa Cruz, Argentina.
YPM VPPU-15158, *Adinotherium ovinum*, foot bones. Santa Cruz, Argentina.
YPM VPPU-15269, *Adinotherium ovinum*, tibia. Santa Cruz, Argentina.
YPM VPPU-15480, *Adinotherium ovinum*, tibia. Santa Cruz, Argentina.
YPM VPPU-15963, *Adinotherium ovinum*, hind limb bones. Santa Cruz, Argentina.
YPM VPPU-15016, *Adinotherium* sp., navicular. Santa Cruz, Argentina.

YPM VPPU-15916a, *Adinotherium* sp., metapodial. Santa Cruz, Argentina.
YPM VPPU-15818, *Adinotherium* sp., hind limb bones. Santa Cruz, Argentina.
YPM VPPU-15933, *Adinotherium* sp., calcaneum. Santa Cruz, Argentina.
YPM VPPU-15978, *Adinotherium* sp., hind limb bones. Santa Cruz, Argentina.

*Proadinotherium*
AMNH 29722, *Proadinotherium muensteri*, muzzle. Chubut, Argentina.
AMNH 116945 to116946, *Proadinotherium muensteri*, left M2 and M3. Chubut, Argentina.
AMNH 116433, *Proadinotherium* sp., maxillary fragment. Las Cascadas, Chubut, Argentina.
AMNH 116439, *Proadinotherium* sp., mandible fragment. Las Cascadas, Chubut, Argentina.
MACN A 12309 (A 52-308), *P. leptognathum*, syntype, I2. Santa Cruz, Argentina.
MACN A 12315 (A 52-314), *P. leptognathum*, mandible fragments with teeth. Chubut, Argentina.
MACN A 12316 (A 52-315), *P. leptognathum*, lectotype, m2. Santa Cruz, Argentina.
MACN A 12319 (A 52-318), *P. leptognathum*, syntype, astragalus. Santa Cruz, Argentina.
MACN A 12048 (A 52-24), *Proadinotherium*? *muensteri*, astragalus. Chubut, Argentina.
MACN A 12302 (A 52-301), *Proadinotherium*? *muensteri*, lectotype, mandible with m1–3. Chubut, Argentina.
MACN A 12303 (A 52-302), *Proadinotherium*? *muensteri*, lectotype, premaxilla and maxilla fragments with teeth. Chubut, Argentina.
MACN A 12304 (A 52-303), *Proadinotherium*? *muensteri*, lectotype, lower and upper teeth. Chubut, Argentina.
MACN A 12305 (A 52-304), *Proadinotherium*? *muensteri*, M1–2 . Chubut, Argentina
MACN A 12306 (A 52-305), *Proadinotherium*? *muensteri*, upper tooth and symphysis fragment. Chubut, Argentina.
MACN A 12307 (A 52-306), *Proadinotherium*? *muensteri*, mandible fragment with dp4/p4 and m1. Chubut, Argentina.
MACN A 12633b (A 52-642), *Proadinotherium*? *muensteri*, syntype, p3 and m3. Chubut, Argentina.
MACN A 12639 (A 52-648), *Proadinotherium*? *muensteri*, mandible fragment with m2. Chubut, Argentina.
MACN Pv 9292, *Proadinotherium* sp., maxilla. Argentina.
MACN Pv 17576, *Proadinotherium muensteri*, calcaneum (cast). Chubut, Argentina.
YPM VP-25075 to 25076, *Proadinotherium* sp., calcanei. Salla, Bolivia.
YPM VP-25077 to 25081, *Proadinotherium* sp., astragali. Salla, Bolivia.

*Nesodon*
AMNH 9190, *Nesodon* sp., tibia. Santa Cruz, Argentina.

AMNH 9513, *Nesodon* sp., tibia. Santa Cruz, Argentina.
AMNH 9553, *Nesodon* sp., tibia. Santa Cruz, Argentina.
MACN A 799, *Nesodon* sp., astragalus. Santa Cruz, Argentina.
MACN A 798 , *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
MACN A 961 to 965, *Nesodon* sp., astragali. Santa Cruz, Argentina.
MACN A 970 to 973, *Nesodon* sp., calcanei. Santa Cruz, Argentina.
MACN A 1001 to 1004, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
MACN A 958 , *Nesodon andium*, tibia and fibula. Santa Cruz, Argentina.
MACN A 1699, *Nesodon imbricatus*, calcaneum. Santa Cruz, Argentina.
MACN A 8514, *Nesodon imbricatus*, tibia and fibula. Santa Cruz, Argentina.
MLP 55-XII-13-16, *Nesodon* sp., cuboids (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-17, *Nesodon* sp., naviculars (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-18, *Nesodon* sp., cuneiforms (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-19, *Nesodon* sp., scaphoids (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-20, *Nesodon* sp., unciforms (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-21, *Nesodon* sp., lunars (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-22, *Nesodon* sp., magnums (different specimens). Santa Cruz, Argentina.
MLP 55-XII-13-23, *Nesodon* sp., pisciforms (different specimens). Santa Cruz, Argentina
MLP 55-XII-13-211, *Nesodon* sp., tibia. Santa Cruz, Argentina.
MLP 55-XII-13-237, *Nesodon* sp., calcaneum and tibia. Santa Cruz, Argentina.
MLP 68-VI-25-502, *Nesodon* sp., tibia and fibula. Santa Cruz, Argentina.
MLP 69-V-26-1, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
MLP 69-V-26-2, *Nesodon* sp., astragalus. Santa Cruz, Argentina.
MNHN, SCZ 30 (Tournouër collection, Paris), *Nesodon sullivani*, hind foot.
YPM VPPU-15207, *Nesodon imbricatus*, metapodials. Santa Cruz, Argentina.
YPM VPPU-15256, *Nesodon imbricatus*, limb bones. Santa Cruz, Argentina.
YPM VPPU-15262, *Nesodon imbricatus*, hindlimb bones. Santa Cruz, Argentina.
YPM VPPU-15460, *Nesodon imbricatus*, astragalus and metapodials. Santa Cruz, Argentina.
YPM VPPU-15745, *Nesodon imbricatus*, foot bones. Santa Cruz, Argentina.
YPM VPPU-16012, *Nesodon imbricatus*, tibia and calcaneum. Santa Cruz, Argentina.
YPM VPPU-15122, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
YPM VPPU-15231, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
YPM VPPU-15289, *Nesodon* sp., tibia. Santa Cruz, Argentina.
YPM VPPU-15335, *Nesodon* sp., foot bones. Santa Cruz, Argentina.
YPM VPPU-15607, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
YPM VPPU-15807, *Nesodon* sp., astragalus. Santa Cruz, Argentina.
YPM VPPU-15829, *Nesodon* sp., foot bones. Santa Cruz, Argentina.
YPM VPPU-15834, *Nesodon* sp., foot and manus bones. Santa Cruz, Argentina.
YPM VPPU-15974, *Nesodon* sp., calcaneum. Santa Cruz, Argentina.
YPM VPPU-15995, *Nesodon* sp., limb and fore foot bones. Santa Cruz, Argentina.

*Pronesodon*

MACN A 12311 (A 52-310), *Pronesodon robustus*, lectotype, labelled as *Leontinia gaudryi*, astragalus. Santa Cruz, Argentina.

MACN A 12312 (A 52-311), *Pronesodon cristatus*, lectotype, mandible fragment, Santa Cruz, Argentina.

MACN A 12637 (A 52-646), *Pronesodon vates*, syntype, M1. Chubut, Argentina.

**Character matrix** (Modified from Shockey et al. 2012 and Cerde¶o and Vera 2015; see text for changes and added taxa)

| | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| *Colbertia magellanica* | ?000000000 | 000?002000 | 1012000?00 | ????00??00 |
| *Anisotemnus distentus* | ?000000000 | 0001000000 | 0000000?0? | ?022011100 |
| *Tomashuxleya externa* | 1000000?00 | 000?00?000 | 000000?000 | 1010000000 |
| *Coquenia bondi* | 0021011000 | 0000a?0000 | 0001001011 | 0?00100100 |
| *Martinmiguelia fernandezi* | 0021011000 | 0?00????0? | ????001??? | ?????????? |
| *Taubatherium paulacoutoi* | 0?2????0?0 | 010?a1?000 | ??10001??? | ?1??1????1 |
| *Ancylocoelus frequens* | 002?0110?0 | 0101101001 | 0a11?01011 | 0100100a11 |
| *Leontinia gaudryi* | 0020011000 | 0101112001 | 1112001011 | 0100100011 |
| *Elmerriggsia fieldia* | 002?011000 | 0100102000 | 1002001011 | 0100100011 |
| *Scarrittia canquelensis* | 0021101000 | 0100112001 | 0a12001011 | 0100100a11 |
| *Anayatherium ekecoa* | 0221101000 | 0100112001 | 1?12001??? | ?????????? |
| *Anayatherium fortis* | 0021101000 | 010?112001 | 1112001??? | ?????????? |
| *Huilatherium pluriplicatum* | 022????010 | 010011000? | 0110011111 | 0001101111 |
| *Colpodon propinquus* | 011000a000 | 0100110101 | 0a10001011 | 1001101111 |
| *Colpodon antucoensis* | 021?00?000 | 0100110101 | 001??0???? | ?????????? |
| *Rhynchippus equinus* | 1010000000 | 0200001000 | 0011111000 | 1002101111 |
| *Rhynchippus pumilus* | 1010000000 | 0200001000 | 0011111000 | 10?2101111 |
| *Argyrohippus fraterculus* | 1110000010 | 022?001010 | 0011111000 | 1?22101111 |
| *Eurygenium pacegnum* | 1010000000 | 0210002010 | 0012011000 | 1022101110 |
| *Homalodotherium cunninghami* | 10a1001000 | 0100112001 | 1012000000 | 0000100000 |
| *Asmodeus petrasnerus* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Asmodeus osborni* | 1000001000 | 0?00102001 | 1002000000 | 0000100000 |
| *Gualta cuyana* | 0021100000 | 0100112101 | 111200111? | 0000100011 |
| *Nesodon imbricatus* | 2020011100 | 1200001010 | 0011121110 | 1022101111 |
| *Adinotherium ovinum* | 2020011100 | 1200001010 | 0011121110 | 1022101111 |
| *Proadinotherium muensteri* | 2020011100 | 120?001010 | 0011121??? | ?022101111 |

| | 4 | 5 | 6 | 7 |
|---|---|---|---|---|
| *Colbertia magellanica* | ?????????1 | 00a?10000? | ?????????? | 000000000? |
| *Anisotemnus distentus* | 0000100000 | 0000100011 | 000?0011?? | ?????????? |
| *Tomashuxleya externa* | 0000100000 | 001?20000? | 0?0?00???? | ?????0a00? |
| *Coquenia bondi* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Martinmiguelia fernandezi* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Taubatherium paulacoutoi* | ?????????? | ????2????? | ?????????? | 11202????? |
| *Ancylocoelus frequens* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Leontinia gaudryi* | 11101100?1 | 11??2?0??? | ????1???1? | 1120?11111 |
| *Elmerriggsia fieldia* | ?????????? | ?????????? | ?????????? | 1120b11111 |
| *Scarrittia canquelensis* | 1110110011 | 1101200001 | 11111021?0 | 1120211111 |
| *Anayatherium ekecoa* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Anayatherium fortis* | ?????????? | ?????????? | ????????1? | ?????????? |
| *Huilatherium pluriplicatum* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Colpodon propinquus* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Colpodon antucoensis* | ?????????? | ?????????? | ?????????? | ?????????? |
| *Rhynchippus equinus* | ????1?0011 | 1101201111 | 102?11110? | ?111211111 |
| *Rhynchippus pumilus* | ????1????1 | 110?00???? | ????????02 | ?111211111 |
| *Argyrohippus fraterculus* | ?????????1 | 110?2011?0 | 1????????? | ?????????? |
| *Eurygenium pacegnum* | ????110011 | 110010000? | 0011?01101 | 1111111111 |
| *Homalodotherium cunninghami* | 11100?0010 | 0?1201??01 | ?101?00100 | 1100000000 |
| *Asmodeus petrasnerus* | ?????????? | ?????????? | ??0??001?0 | 110010000? |
| *Asmodeus osborni* | ?????????? | ?????????? | ??????0100 | 110010000? |
| *Gualta cuyana* | ????110111 | 110??????? | ??1??????0 | 112001?111 |
| *Nesodon imbricatus* | 1111110011 | 11a1201111 | 2021112002 | 1111211121 |
| *Adinotherium ovinum* | 1111110011 | 11?1201111 | 2021112002 | ?111211121 |
| *Proadinotherium muensteri* | ?????????? | 11???????? | ?????????? | 112121112? |

| | |
|---|---|
| | 8 |
| *Colbertia magellanica* | 0 |
| *Anisotemnus distentus* | ? |
| *Tomashuxleya externa* | 0 |
| *Coquenia bondi* | ? |
| *Martinmiguelia fernandezi* | ? |
| *Taubatherium paulacoutoi* | ? |
| *Ancylocoelus frequens* | ? |
| *Leontinia gaudryi* | 1 |
| *Elmerriggsia fieldia* | 1 |
| *Scarrittia canquelensis* | 1 |
| *Anayatherium ekecoa* | ? |
| *Anayatherium fortis* | ? |
| *Huilatherium pluriplicatum* | ? |
| *Colpodon propinquus* | ? |
| *Colpodon antucoensis* | ? |
| *Rhynchippus equinus* | 1 |
| *Rhynchippus pumilus* | 1 |
| *Argyrohippus fraterculus* | 1 |
| *Eurygenium pacegnum* | 1 |
| *Homalodotherium cunninghami* | 0 |
| *Asmodeus petrasnerus* | 0 |
| *Asmodeus osborni* | 0 |
| *Gualta cuyana* | 1 |
| *Nesodon imbricatus* | 1 |
| *Adinotherium ovinum* | 1 |
| *Proadinotherium muensteri* | 1 |

**List of characters and character states** (Modified from Shockey et al. 2012 and Cerdeño and Vera 2015; see text for changes)

**0) Cheekteeth orientation:** (0) strong anterior convergence of cheek teeth; (1) no substantial anterior convergence of cheek teeth; (2) anterior dental arcade transverse and [-shaped.
**1) Upper dental formula:** (0) complete upper dentition, (1) C absent; (2) more than one upper tooth absent (C and another tooth).
**2) Relative canine size:** (0) caliber and height of canine greater than any of the incisors; (1) canine subequal in size to incisors, but none of the incisors are greatly enlarged; (2) one of the incisors is caniniform and larger than any canine
**3) I1 form:** (0) incisiform (labiolingual compression, with transversely flat occlusal surface); (1) caniniform (ovoid or round in cross section with pointed cusp); (2) gliriform, much larger (broader and taller) than lateral incisors (if present).
**4) I1 enlarged caniniform:** (0) absent; (1) present.
**5) I2 enlarged caniniform:** (0) absent; (1) present.
**6) Labial cingulum of upper incisors presence/absence:** (0) present in all incisors except any that are hypertrophied; (1) absent.
**7) Incisor root form:** (0) incisors with determinate growth, roots form after crown formation; (1) incisors hypselodont (never form roots).
**8) Diastema in anterior upper dentition:** (0) absent, no significant gaps between anterior upper teeth; (1) present, large gap between anterior teeth and cheek teeth.
**9) Upper premolar root form: (**0) upper premolars with determinate growth, roots form after crown formation; (1) premolars hypselodont, roots do not form at least one premolar is hypselodont.
**10) Upper molar root form: (**0) all upper molars with determinate growth, roots form after crown formation; (1) molars hypselodont, roots do not form.
**11) Relative height of M1:** (0) brachydont (hypsodonty index [HI] of M1 < 1); (1) mesodont (HI of M1 ~ 1); (2) M1 hypsodont (HI > 1); (3) M1 euhypsodont (HI> 2).
**12) Cementum:** (0) absent; (1) variably present or present in small amounts on one or more tooth; (2) thick coating of cementum is invariably present.
**13) P1 orientation:** (0) ectoloph in same plane as that of the other upper premolars; (1) ectoloph obliquely oriented, parastyle distinctly medial to the paracone
**14) Parastyle cingulum of P1-3 form:** (0) may be separated from paracone ridge by a longitudinal valley, but does not form a sharp, distinctive mesiolabial "cingulum" that extends from the crown to the base of the tooth; (1) parastyle forms a sharp, distinctive mesiolabial "cingulum" that extends from the crown to the base of the tooth.
**15) Distolabial cingulum ("metastyle") of P1-3 presence/absence:** (0) absent; (1) present, distinctive longitudinal cingulum forms a sharp distal border of the ectoloph.
**16) Cristae of upper premolar ectolophs:** (0) separate cristae from ectoloph persist with modest wear, manifested by small loops in the labial side of the major fossette or enamel-lined pits between the fossette and ectoloph; (1) one or two cristae persist with moderate wear giving the central valley (or fossette) a branching appearance; (2) separation between cristae very shallow and quickly obscured by wear.
**17) P2-4 protoloph:** (0) robust, base inclined and extends to lingual extreme of tooth; (1) relatively small and recessed from lingual extreme, not inclined toward mesiolingual cingulum.
**18) Upper premolar mesiolingual cingulae:** (0) present; (1) absent.

**19) Upper premolar intermediate lingual cingulum extent:** (0) no lingual cingulum, or if mesiolingual and distolingual cingulae are present they are not united by lingual (intermediate) cingulum; (1) mesiolingual and distolingual cingulate are united by intermediate lingual cingulum.
**20) Upper premolar protocone lingual face groove:** (0) absent, without vertical groove; (1) present, with vertical groove on lingual face.
**21) Mesiolingual face of upper premolar protoloph ridge:** (0) absent, without ridge to mesiolingual cingulum; (1) present, with ridge to mesiolingual cingulum (separates the "leontiniid basin" in species having the ridge as well as mesio and intermediate lingual cingulate.
**22) Labial cingulum of M1 presence/absence:** (0) present; (1) absent.
**23) Cristae of upper molar ectolophs, persistence with wear:** (0) separate cristae from ectoloph persist with modest wear, manifested by variable numbers of small loops in the labial side of the major fossette or enamel-lined pits between the fossette and ectoloph; (1) one or two cristae persist with moderate wear giving the central valley (or fossette) a branching appearance; (2) separation between cristae very shallow and are quickly obscured by wear.
**24) Dominant upper molar crista:** (0) no single crista dominates; (1) first crista dominates, forming branch of anterior region of central valley.
**25) M1 mesiolingual cingulae:** (0) present, extends to "pseudohypocone"; (1) present, extends only to protoloph; (2) absent.
**26) Posterior fossette of upper molar:** (0) absent; (1) present
**27) Lower incisor orientation:** (0) long axis of lower incisors directed relatively vertically, at an angle greater than 40° to long axis of mandible; (1) incisors procumbent, long axis of incisors more in line with long axis of mandible (angle to mandibular ramus <40°).
**28) Third lower incisor (i3) size:** (0) not enlarged relative to other incisors; (1) larger than other lower incisors.
**29) Third lower incisor (i3) form:** (0) incisiform; (1) caniniform or tusk-like; (2) peg-like, very small or absent.
**30) Lower incisor labial cingulum presence/absence: (**0) present; (1) absent.
**31) Metaflexid of lower premolars shape:** (0) simple without branching; (1) with bifurcations.
**32) Lingual cingulid of lower premolars:** (0) distinct and continuous along the length of the tooth; (1) not distinct along metaconid, but appears anterior to metaconid and between metaconid and entoconid (or entolophid); (2) entirely absent (except for what may be manifest as a "paraconid"
**33) Labial cingulid of p2-p4:** (0) present on p2–p4; (1) present on p2, but absent on p4; (2) absent on p2–p4.
**34) Lower molar "pseudoparaconid" presence/absence:** (0) absent or minute; (1) presence of a substantial "pseudoparaconid" in a position similar to that of a paraconid, although it may be derived from the mesiolingual cingulum, rather than representing a true trigonid paraconid.
**35) Lower molar metaconid morphology:** (0) forms a simple, oblique crest; (1) possesses an accessory cusp.
**36) Labial cingulid of m1 presence/absence:** (0) present; (1) absent.
**37) Labial cingulid of m2 presence/absence:** (0) present; (1) absent.
**38) Hypoconulid of m1-2 length:** (0) short, extends little beyond the entolophid; (1) elongated, entolophid projects from near midpoint of talonid crest.
**39) Molar entolophid fossettid presence/absence:** (0) absent; (1) present.

**40) Coracoid process shape:** (0) distinctive, with recurved “beak”; (1) process present, but lacking a “beak”; (2) process indistinct or absent, scapular tuber small.
**41) Acromion border extent:** (0) extends distally to near the level of the glenohumeral joint or beyond; (1) limited to the region of the scapular body or scapular neck adjacent to the scapular body, but does not extend toward the region over the glenohumeral joint.
**42) Metacromion extent:** (0) extends distally to near the level of glenohumeral joint or beyond; (1) limited to the area above the region of the scapular body or the region of the scapular neck adjacent to the scapular body, but does not extend toward the region over the glenohumeral joint.
**43) Secondary metacromion presence/absence:** (0) absent; (1) present.
**44) Greater tubercle height:** (0) lower than the head of the humerus; (1) even with or higher than the head.
**45) Bicipital groove closure:** (0) well enclosed by greater and lesser tubercles; (1) open, relatively wide space between greater and lesser tubercles.
**46) Deltoid crest shape/position:** (0) distinctive, extending to more than 2/3 the length of the humeral shaft; (1) distinctive, proximally placed; (2) no well-defined crest or tuberosity for the deltoid muscles.
**47) Pectoral crest shape/position:** (0) distinctive, extending to more than 2/3 the length of the humeral shaft; (1) distinctive, proximally placed; (2) no well-defined crest or tuberosity for the deltoid muscles.
**48) Tuberosity for m. teres major presence/absence:** (0) present; (1) absent.
**49) Supinator crest:** (0) present, well developed, broad and bladelike; (1) inconspicuous (grades into shaft) or absent.
**50) Entepicondylar process, medial extent:** (0) extends medially with a dimension more than half that of the trochlear width; (1) medial extension short (dimension <40% that of the trochlea).
**51) Entepicondylar foramen presence/absence:** (0) present; (1) absent.
**52) Medial trochlear flange size:** (0) large; (1) small.
**53) Brachial index: I):** (0) length of radius subequal to that of humerus ($90 < Bi < 100$); (1) radius shorter than humerus ($Bi < 90$); (2) radius longer than humerus ($Bi > 110$).
**54) Olecranon shape in lateral view:** (0) major axis of olecranon the same as that of the ulnar shaft; (1) major axis of olecranon with upward curve (crouching stance morphology); (2) major axis of olecranon with downward curve (erect stance morphology).
**55) Olecranon shape in dorsal (anterior) view:** (0) major axis of olecranon in the same orientation as that of the ulnar shaft, (1) major axis of olecranon with distinct medial curvature
**56) Outline of proximal radial in proximal view:** (0) oval; (1) subrectangular.
**57) Radial head fossa:** (0) presence of simple fossa in proximal view; (1) depression of head is undulating.
**58) Capitular eminence (central process) of radial head presence/absence:** (0) absent, the radial head is smooth or undulating, without distinctive capitular eminence; (1) present, with distinctive (sharp) capitular eminence of the proximal end on the dorsal side (pronated) of the radius.
**59) Radial sesamoid presence/absence:** (0) absent; (1) present.
**60) Distal radius dorsal outline shape:** (0) dorsal outline convex with no styloid process; (1) outline oblique, with no distinct styloid process; (2) outline with distinctive styloid process with facet for scaphoid and lunar on the ulnar side of the process.
**61) Distal ulna articulation with pisiform presence/absence:** (0) present; (1) absent.
**62) Manus, digit number:** (0) pentadactyl; (1) tetradactyl; (2) tridactyl.

**63) Relative metacarpal/metatarsal lengths on digit III (Mc III/Mt III):** (0) metacarpals subequal in length to metatarsals, with the Mc III-to-Mt III ratio not exceeding 1.5; (1) metacarpals relatively elongate compared to metatarsals, with Mc III/Mt III greater than 1.5.
**64) Radial facet of lunar extent:** (0) extends over the dorsal surface of the lunar, to a region at least half way down the body of the lunar in dorsal view; (1) radial facet of lunar restricted to the proximal end of the element so that less than half of the dorsal surface of the lunar is devoted to the facet.
**65) Unciform facet angle:** (0) distal articulation transverse, with facet for Mc V (if present) at an angle less than 30° to Mc IV facet; (1) facet for Mc V at an angle nearly 45° to Mc IV facet.
**66) Ungual phalanx of manus digits compression:** (0) lateromedially compressed; (1) dorsopalmar compression, but distal region subequal in width to proximal; (2) hoof-like phalanx, distal region wider than proximal.
**67) Apex of ungual phalanx of manus, fissure presence/absence:** (0) lateromedially compressed; (1) dorsopalmar compression, but distal region subequal in width to proximal; (2) hoof-like phalanx, distal región wider than proximal.
**68) Suprapatellar medial femoral ridge presence/absence:** (0) absent; (1) present.
**69) Number of digits of the pes:** (0) pes pentadactyl, though Mt I may be reduced; (1) tetradactyl, Mt I absent; (2) tridactyl, Mt I absent and Mt V absent or reduced to tarsal-like element.
**70) Dorsal prominence of calcaneum orientation: (**0) oblique orientation; (1) orthogonal orientation.
**71) Calcaneal fibular facet size:** (0) small or absent; (1) large.
**72) Calcaneal fibular facet form: (**0) lenticular; (1) subquadrate; (2) wedge shaped, with proximal transverse dimension greater than the distal.
**73) Ectal facet of calcaneum or astragalus orientation:** (0) horizontal orientation; (1) steeply inclined articulation between calcaneum and astragalus.
**74) Calcaneal-navicular articulation development:** (0) absent; there is no evidence of a navicular facet of the calcaneum or a calcaneal facet of the navicular (there may be cuboastragalar contact [i.e., “alternating tarsus”]); (1) present; a small thin articular surface is present at the distal calcaneum that is not due to distal astragalar articulation but has evidence of being due to navicular contact; (2) well-developed navicular facet is present, indicating a strong “reverse alternating” tarsus.
**75) Astragalar foramen (superior):** (0) present, foramen is present within the fossa separating the astragalar trochlea with that of the flexor groove; (1) absent.
**76) Groove for tendon of flexor hallicus longus (or other flexor tendon) development:** (0) present; (1) united to the astragalar trochlea as a plantar component of the astragalar trochlea.
**77) Neck of astragalus shape:** (0) neck is well defined, being constricted behind the astragalar head and having a definable length between the head and astragalar body; (1) very short neck with little or no constriction behind the head, which lies very close to the body of the astragalus.
**78) Astragalar head shape:** (0) subspherical head that does not cover the lateral body in distal view (not expanded laterally); (1) ovoid, with head expanded laterally beyond the midpoint of the body in distal view; (2) teardrop shaped, due to lateral and plantar expansion of the head.
**79) Proximomedial astragalar buttress of navicular presence/absence:** (0) present; (1) absent.
**80) Symmetry of trochlea ridges of astragalus:** (0) symmetrical, lateral and medial trochlear ridges subequal in height; (1) asymmetric, lateral trochlear ridge distinctly higher than medial.

SOM 3
The following reduced consensus is obtained after prunning the most unstable taxa:
==========

Note: for consensus calculation, trees will be temporarily collapsed (when min. branch length = 0)

Strict consensus of 408 trees

```
   ÚÄÄ Col_magellanica
   ł    ÚÄÄ Tom_externa
   ł    ÃÄÄ Ani_distentus
ÃÄÄ´     ł    ÚÄÄe Asm_osborni
   ł    ÃÄÄ>eÁÄÄ Hom_cunninghami
   ł    ł  ÚÄÄ Eur_pacegnum
   ŔÄÄ>e´   ł  ÚÄÄ Arg_fraterculus
        ł  ł  ÃÄÄ Rhy_pumilus
        ł  ÃÄÄĹÄÄ Rhy_equinus
        ł  ł  ł  ÚÄÄ Pro_muensteri
        ŔÄÄ´  ŔÄÄĹÄÄ Adi_ovinum
           ł     ŔÄÄ Nes_imbricatus
           ł           ÚÄÄ Elm_fieldia
           ł           ÃÄÄabcdf Cog_bondi
           ŔÄÄabdf>abcdf´          ÚÄÄc Leo_gaudryi
                       ł          ł      ÚÄÄ Gua_cuyana
                       ŔÄÄabc>abdf´      ÃÄÄ Ana_fortis
                                  ŔÄÄabdfĹÄÄ Ana_ekecoa
                                         ŔÄÄ Sca_canquelensis
```

Legends:
a: Mar_fernandezi (4)
b: Tau_paulacoutoi (5)
c: Anc_frequens (6)
d: Hui_pluriplicatum (12)
e: Asm_petrasnerus (20)

f: node 31 of consensus

```
   ÚÄÄ Col_antucoensis
ÃÄÄÁÄÄ Col_propinquus
```

---
The following taxa are unstable and collapse nodes in the strict consensus:
---
---
Asm_petrasnerus
Scoring the following characters may help to resolve its position:
3 6 11 14 15 16 19 20 22 23 30 32 33 34 36 37 49 51 53 54 55 60
---
Node 31 of the strict consensus
This node includes the following taxa: 14 13
The following characters support alternative positions in different trees:
0 1 2 4 5 6 8 11 14 15 16 19 21 23 25 27 28 29 30 31 32 33 36 37 53 54 60 68 72 73
---
Hui_pluriplicatum
The following characters support alternative positions in different trees:
1 2 21 30
Scoring the following characters may help to resolve its position:
3 5 6 19 53 54 60 68 72 73
---
Anc_frequens
The following characters support alternative positions in different trees:
13 15 19 20 23
Scoring the following characters may help to resolve its position:
3 53 54 60 68 72 73
---
Tau_paulacoutoi
The following characters support alternative positions in different trees:
19 23 31

Scoring the following characters may help to resolve its position:
1 3 5 6 16 20 21 30 33 36 37 38 53 60 68
---
Mar_fernandezi
Scoring the following characters may help to resolve its position:
11 14 15 16 19 20 21 22 23 27 30 31 33 36 37 38 39 53 54 60 68 72 73
---
The following taxa form polytomies in which all descendants are unstable:
---
The following taxa form an unstable clade that appears in the reduced consensus [absent from the strict consensus]):
This node includes the following taxa: 3 7 8 9 10 11 15 16 17 18 22 23 24 25
.
The following characters support alternative positions in different trees:
6 11 14 16 19 20 22 23 34 49 54 55 70 71 74
---
The following taxa form an unstable clade that appears in the reduced consensus [absent from the strict consensus]):
This node includes the following taxa: 19 21
.
The following characters support alternative positions in different trees:
2 11 16 20 22 23 25 26 33 34 36 37 38 39 49 50 51 53 54 60 68 72 73 74 75 77 78 80
---
Tom_externa
The following characters support alternative positions in different trees:
23 30 33 36 37 54
Scoring the following characters may help to resolve its position:
16 53 61 70 71 72 73 74
---
Ani_distentus
The following characters support alternative positions in different trees:
23 53 54 61
Scoring the following characters may help to resolve its position:
30 70 71 72 73 74 76
---
Gua_cuyana
Scoring the following characters may help to resolve its position:
53 60
---
Ana_fortis
Scoring the following characters may help to resolve its position:
27 31 47 53 60 74
---
Ana_ekecoa
Scoring the following characters may help to resolve its position:
27 31 47 53 60 74
---
Sca_canquelensis
The following characters support alternative positions in different trees:
20 31 53 60
---
Node 33 of the strict consensus
This node includes the following taxa: 25 24 23
The following characters support alternative positions in different trees:
1 8 12 16 23 24 39 53 54 56 57 59 60 69 73
---
Arg_fraterculus
Scoring the following characters may help to resolve its position:
53 58 62 65 66 67 69 78
---
Rhy_pumilus
Scoring the following characters may help to resolve its position:
53 56 57 58 60 62 65 66 67
---

Rhy_equinus
The following characters support alternative positions in different trees:
66
Scoring the following characters may help to resolve its position:
69

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EVALUATING CHARACTERS INVOLVED IN ALTERNATIVE POSITIONS OF UNSTABLE TAXA TOOK 17 SECONDS

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SOM 4 - Figures

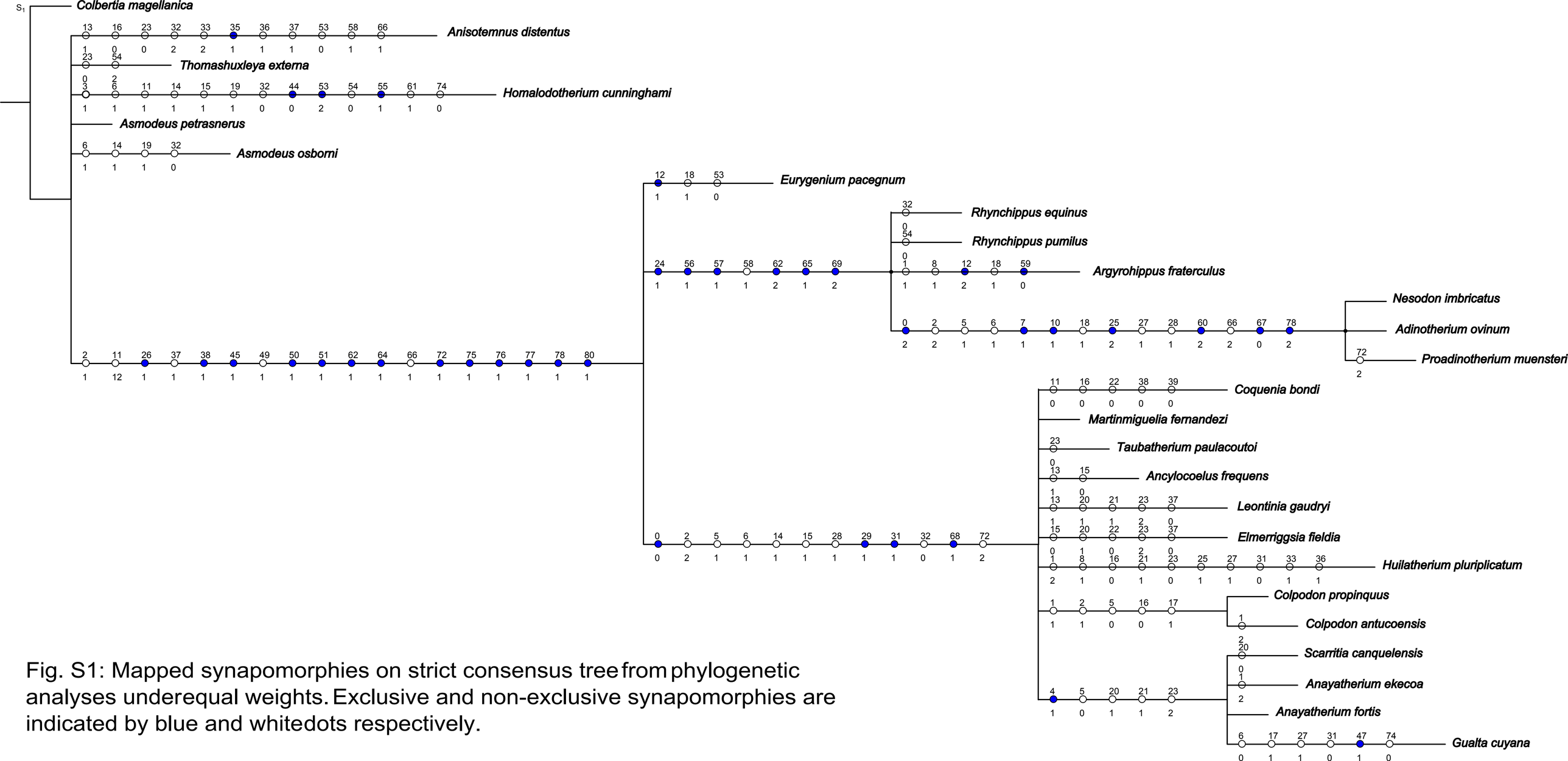


Fig. S1: Mapped synapomorphies on strict consensus tree from phylogenetic analyses underequal weights. Exclusive and non-exclusive synapomorphies are indicated by blue and whitedots respectively.

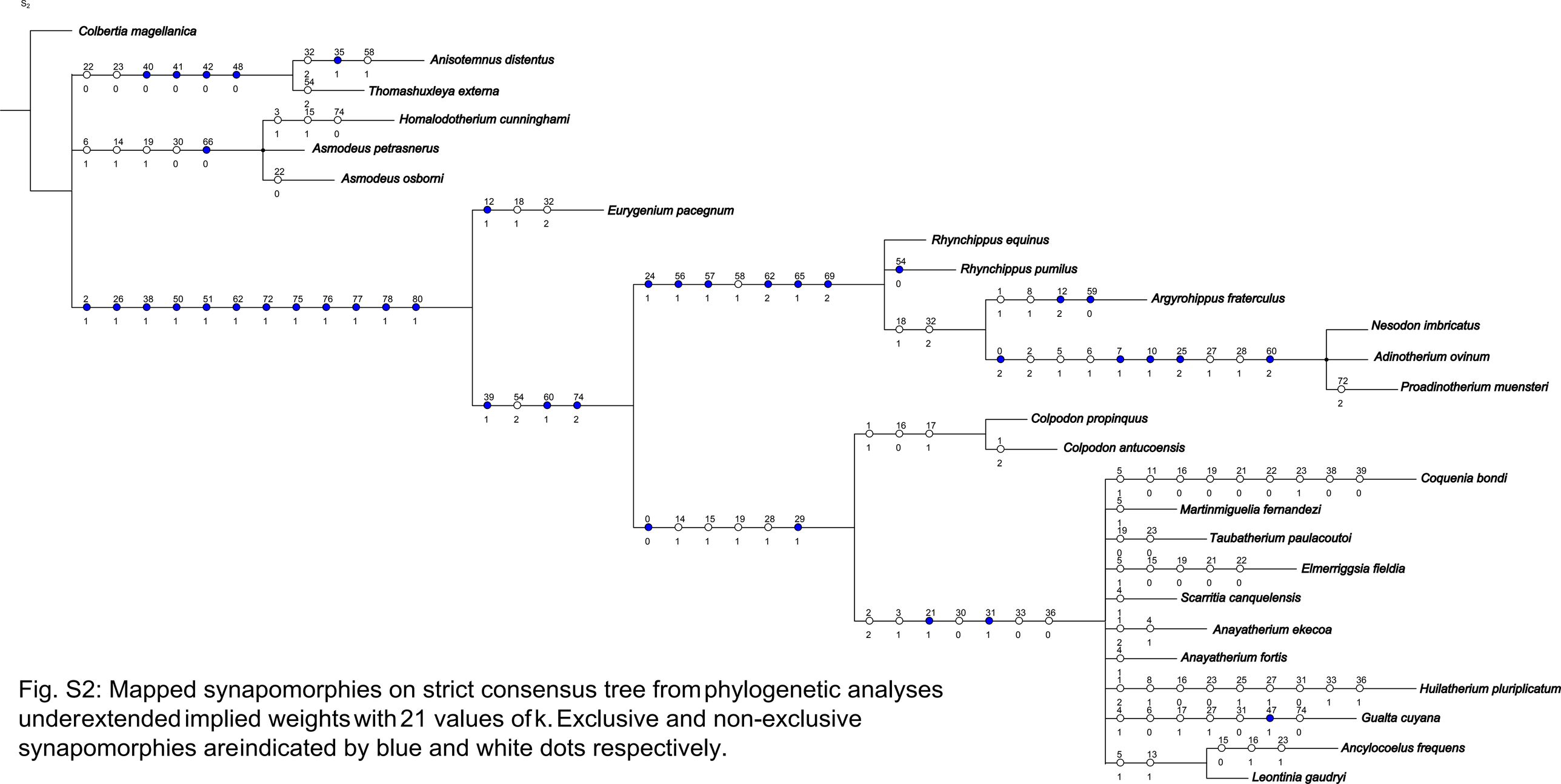


Fig. S2: Mapped synapomorphies on strict consensus tree from phylogenetic analyses underextended implied weights with 21 values of k. Exclusive and non-exclusive synapomorphies areindicated by blue and white dots respectively.

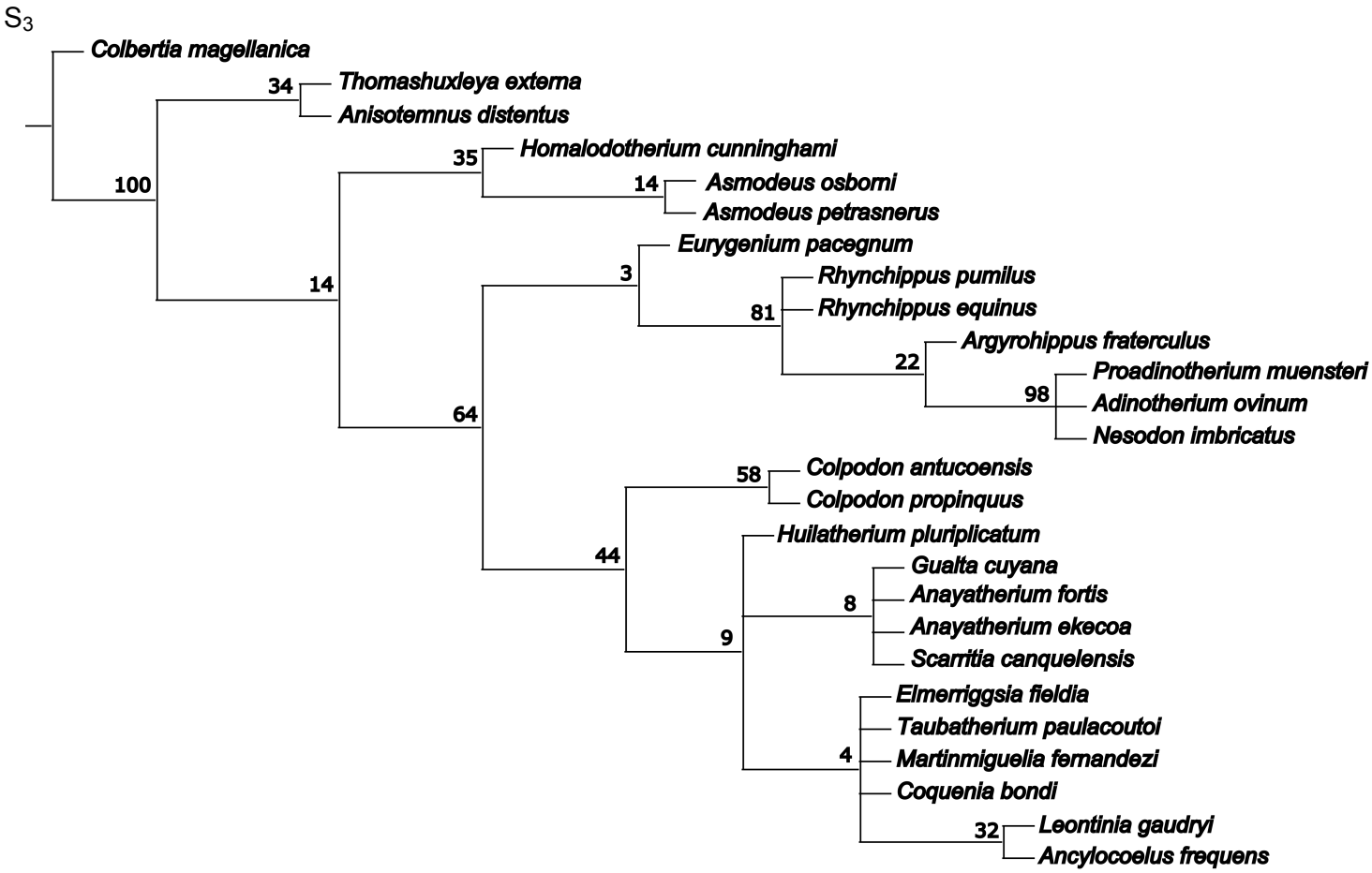


Fig. S3: Strict consensus tree from phylogenetic analyses under extended implied weights with k=2.72.

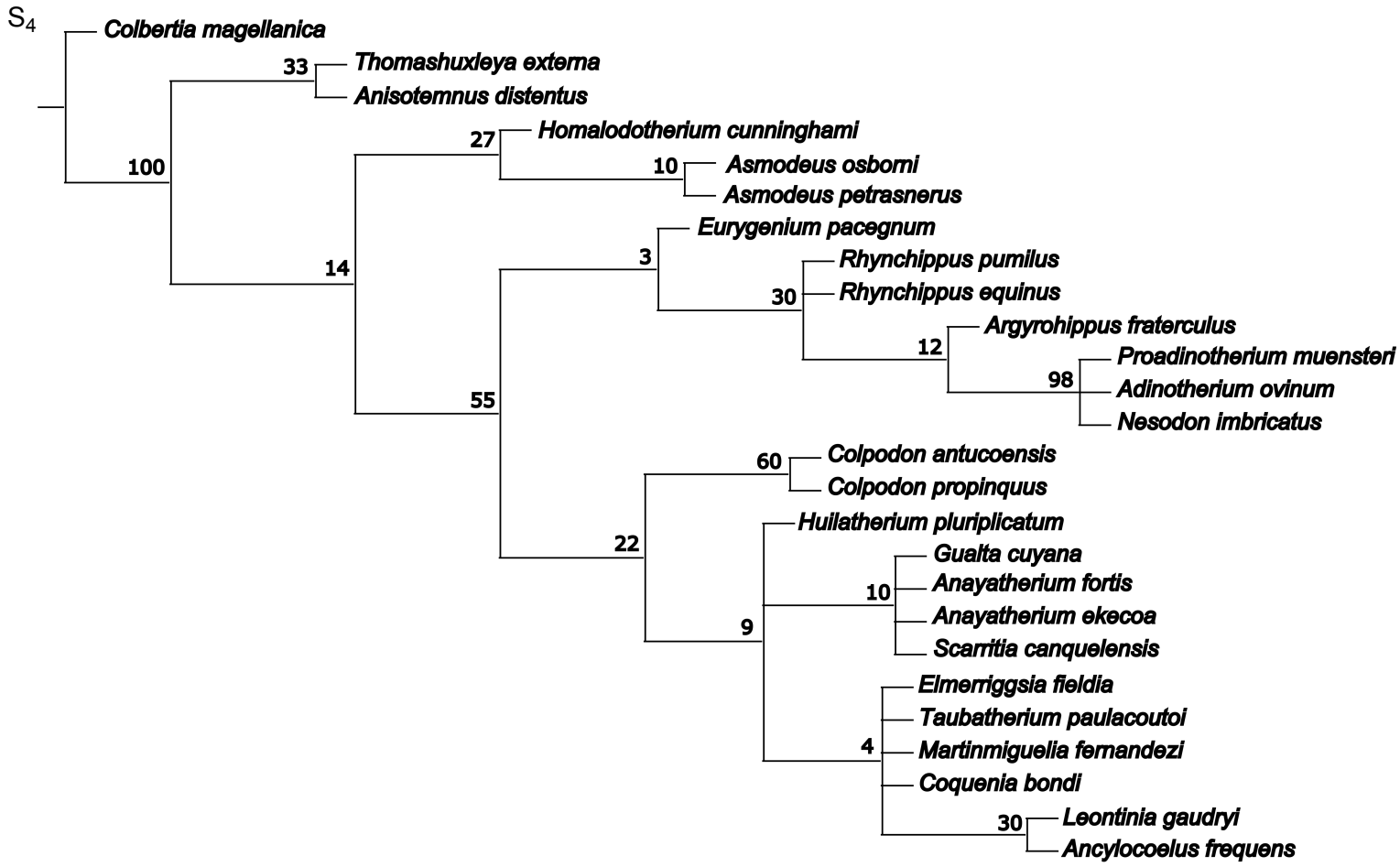


Fig. S4: Strict consensus tree of phylogenetic analyses under extended implied weights with k=6.10.