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Degrange - Supplementary Information

The hind limb morphometry of terror birds (Aves, Cariamiformes, Phorusrhacidae): their functional implications for substrate preferences and locomotor lifestyle

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1. Phorusrhacid systematic arrangement

The systematic proposal of Alvarenga & Höfling (2003) (cf. Agnolín 2009) is followed here with some modifications and updates. The relationships between Phorusrhacidae and *Brontornis burmeisteri* and *Paleopsilopterus itaboraiensis* are not considered here (see Degrange 2012; Degrange *et al.* 2015).

2. Material studied

2.1. Fossil species: Phorusrhacidae

Andalgalornis steulleti (Kraglievich, 1931): MACN Pv 14374, distal fragment of left tarsometatarsus; MLP 88-IX-20-16, distal portion of left tibiotarsus.

Phororhacos steulleti Kraglievich, 1931: MACN Pv 4244, 1st phalanx of the 4th toe.

Phororhacos deautieri Kraglievich, 1931: MACN Pv 6932, distal fragment of right femur.

Andalgalornis ferox Patterson & Kraglievich, 1960: FM-P14357, skull, vertebral spine and pelvis.

Andalgalornis aff. ferox: MACN Pv 6737, left tarsometatarsus and 1st and 2nd phalanxes of 2nd toe.

Andrewsornis abbotti Patterson, 1941: FM-P14678, left femur.

? *Andrewsornis abbotti*: MLP 59-II-26-82, proximal portion of right femur; MLP 59-II-26-83, ungual phalanx.

Devincenzia pozzi (Kraglievich, 1931).

Phororhacos pozzi Kraglievich, 1931: MACN Pv 6554, distal portion of right tarsometatarsus; MACN Pv 6681, 3rd toe ungual phalanx.

Phororhacos longissimus mendocinus Kraglievich, 1931: MACN Pv 6930, proximal fragment of right femur.

Devincenzia gallinali Kraglievich, 1932: MNHN-M-189, right tarsometatarsus.

Onactornis depressus Cabrera, 1939: MLP 37-III-7-8, fragmentary skull and foot phalanxes.

Onactornis pozzii Brodkorb, 1967: MACN Pv 6681, 3rd ungual toe phalanx.

?*Onactornis pozzii*: MACN Pv 13243, distal portion of left tibiotarsus.

Kelenken guillermoi Bertelli *et al.*, 2007: BAR 3877-11, skull, left tarsometatarsus, a foot fragmentary phalanx and several indetermined fragments.

Llallawavis scagliai Degrange *et al.*, 2015: MMP 5050, an almost complete skeleton.

Mesembriornis incertus (Rovereto, 1914).

Prophororhacos incertus Rovereto, 1914: FM-P14422, tibiotarsus, fibula, tarsometatarsus and right foot phalanxes; MACN Pv 6934, a dorsal vertebra, humerus, fragment of coracoid, ulna and radius, fragment of pelvis, distal portion of right tarsometatarsus and three foot phalanxes.

Mesembriornis milneedwardsi Moreno, 1889: MLP 20-141, fragment of right tibiotarsus; MLP 20-142, right fibula; MLP 20-170, distal portion of right femur.

Paleociconia australis Moreno, 1889: MLP 20-87, distal fragment of left tarsometatarsus.

Hermosiornis milneedwardsi Rovereto, 1914: MACN Pv 5944, partially complete skeleton, with the skull missing.

Hermosiornis rapax Kraglievich, 1946: MMP 155-S, fragmentary skull, femora, tibiotarsi and right tarsometatarsus.

Paraphysornis brasiliensis (Alvarenga, 1982).

Physornis brasiliensis Alvarenga, 1982: MLP DGM-1418R, calcotype of fore limb, ribs, tarsometatarsi and feet.

Patagornithinae indet.: MLP 61-IV-6-3, proximal portion of right tarsometatarsus.

Patagornis marshi Moreno & Mercerat, 1891: CORD-PZ-1341, fragmentary skull, right scapula, right tarsometatarsus, foot phalanxes and fragmentary remains; MLP 20-147, synsacrum fragment; MLP 20-151, proximal part of right femur; MLP 20-152, distal portion of left femur; MLP 20-153, left femur shaft; MLP 20-154, distal portion of right tibiotarsus; MLP 20-155, left trochlea metatarsi III; MLP 20-157, ungual phalanx of the 4th toe; MLP 20-158, proximal portion of right tibiotarsus; MLP 20-164, ungual phalanx of the 2nd toe; MLP 20-184, ungual phalanx; MLP 20-189, 2nd right toe ungual phalanx; MLP 59-XII-14-14, distal portion of the right tibiotarsus; MLP 84-III-9-21, skull, jaw fragments, pelvis, left femur, tibiotarsi, fibula and tarsometatarsi and a foot phalanx.

Phororhacos inflatus Ameghino, 1891: AMNH 7005, distal portion of right tarsometatarsus and foot phalanxes; AMNH 7009, foot phalanxes; NHMUK-A516, partially complete skeleton with the vertebral column missing; FM-P13213, partially complete skeleton with the skull missing from a juvenile.

Phororhacos sp.: AMNH 9264, pelvis fragment, left femur, both tibiotarsi and fibula, right tarsometatarsus and right posterior incomplete autopod.

Paleociconia cristata Brodkorb, 1967: MLP 20-85, ungual phalanx; MLP 20-86, 2nd toe ungual phalanx.

Phorusrhacidae indet.: MACN Pv 191810, distal portion of right tarsometatarsus (cast); MACN A 52-193, foot phalanxes.

?Phorusrhacidae: MLP 20-584, phalanx.

Phorusrhacidae: MACN A 11030, several remains; MACN Pv 17749, distal portion of left tibiotarsus; MACN Pv 17748, distal portion of right tibiotarsus.

Phorusrhacinae: MNHN-1563, left tibiotarsus.

Phorusrhacos longissimus Ameghino, 1887: MACN Pv 8592, distal portion of left tibiotarsus; MLP 559-II to V, proximal portion of tarsometatarsus (cast); MPM-PV4241, jaw, vertebrae, left femur and tibiotarsus, both fibula and other scattered remains.

Phororhacos longissimus Ameghino, 1889: AMNH 7004, 2nd toe ungual phalanx; AMNH 7010, distal portion of the left tarsometatarsus.

Stereornis rollieri Moreno & Mercerat, 1891: MLP 20-119, proximal fragment of left tibiotarsus; MLP 20-120, proximal fragment of left tarsometatarsus.

Stereornis gaudryi Moreno & Mercerat, 1891: MLP 20-121, proximal portion of right tarsometatarsus.

Mesembriornis studeri Moreno & Mercerat, 1891: MLP 20-128, proximal portion of right femur; MLP 20-129, proximal portion of left femur; MLP 20-130, right tibiotarsus; MLP 20-131, right tarsometatarsus; MLP 20-132, distal portion of right tarsometatarsus.

Mesembriornis quatrefagesi Moreno & Mercerat, 1891: MLP 20-137, shaft of left tibiotarsus; MLP 20-138, distal portion of right tarsometatarsus; MLP 20-139, ungual phalanx.

Darwinornis copei Moreno & Mercerat, 1891: MLP 20-171, distal fragment of left tibiotarsus; MLP 20-172, left trochlea metatarsi III.

Darwinornis zitteli Moreno & Mercerat 1891: MLP 20-174, lateral condyle of right tibiotarsus; MLP 20-175, left trochlea metatarsi III.

Darwinornis socialis Moreno & Mercerat, 1891: MLP 20-176, left trochlea metatarsi III.

Owenornis affinis Moreno & Mercerat, 1891: MLP 20-177, right trochlea metatarsi III.

Owenornis lydekkeri Moreno & Mercerat, 1891: MLP 20-180, medial condyle of right tibiotarsus; MLP 20-181, right trochlea metatarsi III; MLP 20-182, left trochlea metatarsi IV.

Phororhacos sp.: AMNH 9146, left tarsometatarsus; AMNH 9497, left hind limb; MACN Pv 18602, distal portion of right tarsometatarsus; YPM-PU15856, ungual phalanx.

Phorusrhacos sp.: MLP 20-572, 2nd toe ungual phalanx; MLP 20-573, 1st phalanx of the 2nd toe; MLP 67-VIII-28-1, ungual phalanx of the 2nd toe; MLP 67-VIII-28-2, ungual phalanx of the 3rd toe; MLP 68-I-16-1, distal portion of right tarsometatarsus; MLP 76-V-10-11, right tarsometatarsus.

Phorusrhacos?: MLP 52-X-5-93, distal fragment of tarsometatarsus.

Physornis fortis Ameghino, 1895.

Aucornis euryrhyncus Ameghino, 1898: MACN A 52-185, proximal portion left tarsometatarsus; MACN A 52-187, fragmentary foot phalanx; MACN A 52-188, foot phalanx.

Aucornis sp.: FM-P 13340, mandible, scapula, quadrate bone, foot phalanxes and several fragments.

Psilopterinae indet.: MPEF-PV 1721, ungual phalanx; MPEF-PV 1722, proximal fragment of right tarsometatarsus; MLP 60-VI-15-7, fragmentary pelvis.

Phororhacos sp.: YPM-PU 15363, fragmentary hind limbs.

Psilopterus affinis (Ameghino, 1899).

Phororhacos affinis Ameghino, 1899: MACN A 52-184, right fragmentary tarsometatarsus.

Psilopterus bachmanni (Moreno & Mercerat, 1891): MLP s/n, fragmentary pelvis; MPM-PV 4243, fragmentary furcula, tracheal rings, vertebrae, left forelimb and hind limb and several fragmentary remains.

Patagornis bachmanni Moreno & Mercerat, 1891: MLP 20-165, proximal fragment of left femur; MLP 20-166, distal portion of left femur; MLP 20-167, distal fragment of left tibiotarsus; MLP 20-168, proximal portion of left tarsometatarsus.

Psilopterus communis Moreno & Mercerat, 1891: MLP 20-187, distal portion of left tarsometatarsus.

Psilopterus intermedius Moreno & Mercerat, 1891: MLP 20-190, distal portion of left tarsometatarsus.

Psilopterus minutus Ameghino, 1891: FM-PA-9, distal portion of left tibiotarsus and tarsometatarsus (cast).

?*Psilopterus delicatus* MLP 20-567, proximal portion of right tarsometatarsus.

Pelecyrornis pueyrredonensis Sinclair & Farr, 1932: YPM-PU 15904, partial skeleton. "Bird": AMNH 9154, fragmentary right tarsometatarsus.

Psilopterus colzecus Tonni & Tambussi, 1988: MLP 76-VI-12-2, incomplete jaw, humerus, fragmentary radius and ulna, both tibiotarsoi shaft, incomplete right femur, both tarsometatarsus incomplete shaft, distal portion of left tarsometatarsus, complete left foot.

Psilopterus lemoinei (Moreno & Mercerat, 1891): MPM-PV 3649, humerus, scapula, right femur and fíbula, both tibiotarsi and tarsometatarsi; MPM-PV 4240, left tibiotarsus; CORD-PZ-1340, distal portion of right tarsometatarsus.

Patagornis lemoinei Moreno & Mercerat, 1891: MLP 20-161, distal fragment of left femur; MLP 20-162, distal fragment of right tibiotarsus.

Psilopterus australis Moreno & Mercerat, 1891: AMNH 7006, distal portion of right tibiotarsus and foot phalanxes; AMNH 7008, distal fragment of left tarsometatarsus; FM-PA-5, distal portion of right tarsometatarsus (calcotype); FM-P 13260, distal fragment of left tarsometatarsus; MLP 20-188, distal portion of left tarsometatarsus; MLP 20-161, distal portion of left femur; MLP 20-162, distal portion of right tibiotarsus; MLP 20-188, distal portion of left tarsometatarsus.

Pelecymnis australis Moreno & Mercerat, 1891: AMNH 9257, skull, vertebral column, both humeri, pelvis, left hind limb and several remains; YPM-PU 15402, partial skeleton; YPM-PU 15479, right tarsometatarsus.

Pelecymnis tubulatus Ameghino, 1895: FM-PA-6, fragmentary femur and tarsometatarsus, dorsal vertebra and phalanxes (calcotype); FM-PA-7, distal portion of left tibiotarsus and tarsometatarsus (calcotype); FM-PA-8, left tarsometatarsus (calcotype); FM-PA-10, distal portion of left tibiotarsus (calcotype).

Pelecymnis tenuirostris Sinclair & Farr, 1932: AMNH 9157, partial skeleton.

cf. Psilopterus lemoinei: MACN A 11030-68, distal portion of right tarsometatarsus. “Bird” YPM-PU 15477, fragmentary right femur and tarsometatarsus.

Psilopterus sp.: FM-P 15303, unguis phalanx; MLP 20-582, 1st phalanx of the 2nd right toe; MLP 20-586, distal portion of left tarsometatarsus.

Pelecymnis sp.: YPM-PU 15448, synsacrum.

Psilopterus?: MLP 20-583, 1st phalanx of the left 3rd toe.

Procariama simplex Rovereto, 1914: FM-P14525, an almost complete skeleton; FM-P15231, distal portion of left tibiotarsus and tarsometatarsus; MACN Pv 6939, right femur and tibiotarsus, several fragments of tarsometatarsi; MACN Pv 8225, neurocranium, pelvis, both femora, distal portion of left tibiotarsus, both tibiotarsi and right foot; MACN Pv 8275, unguis phalanxes of 2nd and 3rd toes; MMP 990, fragmentary left tibiotarsus and tarsometatarsus, foot phalanxes, left humerus and portion of the mandible symphysis.

cf. Procariama sp.: YPM-PU 23664, fragmentary remains.

Titanis walleri Brodkorb, 1963: MLP s/n. distal portion of left tibiotarsus (cast).

2.2. Remarks

Numerous birds that have been considered in the literature as related or belonging to Phorusrhacidae were removed from this family. Such is the case of *Brontornis burmeisteri* Moreno & Mercerat, 1891 and *Paleopsilopterus itaboraiensis* Alvarenga, 1985. *Aucornis solidus* Ameghino, 1899 (MACN Pv 11052) (considered as *nomen dubium* according to Tambussi & Degrange 2013) and the fragmentary remains originally assigned to *Smiliornis penetrans* Ameghino, 1891 (MACN A 183), *Riacama caliginea* Ameghino, 1899 (MACN A 52-189) and *Pseudolarus guaraniticus* Ameghino, 1899 (MACN Pv 52-190). *Ciconiopsis antarctica* Ameghino, 1899 (MACN A 11666) is considered a Phorusrhacidae by Tambussi & Degrange (2013). Meanwhile, the studied material of *Liornis sp.* (MLP 20-581), Phororhacoidea (MACN A 10890), ?Phorusrhacidae (MACN A 52-196; MACN A 20-585) and *Phororhacos* (MLP. YPM-PU 15866) are considered here as *incerti ordinis*. Also, the taxa assigned to the extinct family Ameghinornithinae Mourer-Chauviré, 1981 from the Eocene of France and *Strigogyps sapea* (Peters, 1987), whose differences with phorusrhacids have already been exposed (e.g., Alvarenga & Höfling, 2003; Mayr, 2005, 2009), were excluded.

2.3. Other fossil species: Anseriformes

Incertae familiae - *Brontornis burmeisteri* Moreno & Mercerat, 1891: NHMUK-A578, NHMUK-A580, MLP 20-88, MLP 20-90, MLP 20-91, MLP 20-92, MLP 20-568, MLP 20-569, MLP 20-574, MLP 20-575, MLP 20-576, MLP 20-579, MLP 20-580;

Brontornis sp.: FM-P15309, MLP 20-570, MLP 20-578, MLP 20-593;

?*Brontornis*: MLP 20-577;

Rostrornis floweri Moreno & Mercerat, 1891: FM-P13259, 20-94, 20-95, 20-96, 20-97, 20-108, 20-109, 20-110, 20-111, 20-112, 20-113, 20-114, 20-116.

2.4. Other fossil species: Cariamiformes

Incertae familiae - *Paleopsilopterus itaboraiensis* Alvarenga, 1985: MACN Pv 19163, MACN Pv 19170.

Cariamidae. *Chunga incerta* (Tonni, 1974): MLP 71-VII-5-1, MLP 71-VII-5-2, MLP 71-VII-5-4;

Cariama santacrucensis Noriega *et al.*, 2009: MPM-PV 3511.

2.5. Other fossil species: Palaeognathae

Dinornithidae. Emeus crassus: MLP 86-VI-15-1.

2.6. Extant species

For comparison, hind limb and pelvis elements of the extant species listed below were studied.

Anseriformes. Anas platalea (MLP 84, Anatidae);

Chauna torquata (MLP 569, Anhimidae).

Cariamiformes. Cariama cristata (MLP 533, MACN 3717^a, MACN 25919, FM 105635, AMNH 8604, Cariamidae);

Chunga burmeisteri (MACN 2351^a, FM 106731, MLP 52, MLP 535, Cariamidae).

Charadriiformes. Fratercula corniculata (MACN 22325, Alcidae);

Burhinus capensis (YPM 111287, Burhinidae);

Burhinus grallarius (YPM 102096, Burhinidae);

Burhinus oediconemus (MLP 531, Burhinidae);

Vanellus chilensis (MLP 615, Charadriidae);

Chionis alba (MLP 412, Chionididae);

Larus maculipennis (MLP 814, Laridae);

Catharacta maccormicki (MLP 871, Stercoraridae).

Ciconiiformes. Ardea cocoi (MACN 20958, Ardeidae);

Cochlearius cochlearius (YPM 102541, Ardeidae);

Egretta thula (MLP 410, Ardeidae);

Nycticorax nycticorax (MLP 804, Ardeidae);

Cathartes aura (MLP 3124, Cathartidae);

Coragyps atratus (MLP 344, Cathartidae);

Vultur gryphus (MLP 807, Cathartidae);

Ciconia maguari (MLP 712, Ciconiidae);

Jabiru mycteria (YPM 106519, Ciconiidae);

Leptoptilos crumeniferus (YPM 102534, YPM 102550, YPM 106133, Ciconiidae);

Leptoptilos dubius (YPM 102102, Ciconiidae).

Mycteria americana (YPM 105903, Ciconiidae);
Mycteria ibis (YPM 105272, Ciconiidae);
Mycteria leucocephala (YPM 102099, Ciconiidae);
Theristicus melanopis (MLP 474, Threskiornithidae).

Columbiformes. *Columba picazuro* (MLP 399, Columbidae);
Zenaida auriculata (MLP 261, Columbidae).

Coraciiformes. *Ceryle torquata* (MLP 6, Alcedinidae);
Buceros bicornis (YPM 103256, Bucerotidae).
Buceros rhinoceros (YPM 102223, Bucerotidae);
Rhyticeros undulatus (YPM 107215, Bucerotidae).

Cuculiformes. *Guira guira* (MLP 97, Cuculidae);
Opisthocomus hoazin (MLP 536, Ophistocomidae).

Falconiformes. *Buteo magnirostris* (MLP 362, Accipitridae);
Geranoaetus melanoleucus (MLP 696, Accipitridae);
Sagittarius serpentarius (YPM 102276, YPM 105490, YPM 111125, Sagittariidae);
Pandion haliaetus (MACN 20366, Pandionidae);
Falco femoralis (MLP 866, Falconidae);
Falco peregrinus (MLP 638, Falconidae);
Falco sparverius (MLP 56, Falconidae);
Polyborus plancus (MLP 62, Falconidae).

Galbuliformes. *Galbula ruficauda* (MLP 319, Galbulidae).

Galliformes. *Penelope purpurascens* (MACN 343438, Cracidae);
Lophortyx californica (MLP 364, Phasianidae).

Gaviiformes. *Gavia immer* (OUVC 10407, OUVC 10563, Gaviidae).

“Gruiformes”. *Aramus guarauna* (MACN 63320, Aramidae);
Grus canadensis (YPM 110401, YPM 102100, YPM 102538, Gruidae);

Ardeotis arabs (YPM 102540, Otididae).
Ardeotis kori (YPM 105866, Otididae);
Otis tarda (YPM 102227, Otididae);
Tetrax tetrax (YPM 102062, Otididae);
Psophia crepitans (YPM 102505, YPM 103260, YPM 110540, Psophiidae);
Psophia viridis (YPM 104524, Psophiidae);
Fulica armillata (MLP 49, Rallidae);
Porphyryla martinica (MLP 403, Rallidae);
Rallus maculatus (MLP 363, Rallidae).

Passeriformes. *Xiphocolaptes major* (MLP 178, Dendrocolaptidae);
Taraba major (MLP 185, Formicariidae);
Pseudoseisura lophotes (MLP 126, Furnariidae);
Psarocolius decumanus (MLP 355, Icteridae);
Turdus rufiventris (MLP 777, Turdidae);
Pitangus sulphuratus (MLP 141, Tyrannidae).

Pelecaniformes. *Phalacrocorax albiventer* (MLP 476, Phalacrocoracidae);
Sula leucogaster (MLP 482, Sulidae).

Phoenicopteriformes. *Phoenicopus chilensis* (MLP 564, Phoenicopteridae).

Piciformes. *Monasa nigrifrons* (MLP 330, Bucconidae);
Ramphastos toco (MACN 1390^a, Ramphastidae);
Ramphastos vitellinus (MLP 314, Ramphastidae).

Podicipediformes. *Podiceps major* (MLP 522, Podicipedidae).

Procellariiformes. *Macronectes giganteus* (MLP 812, Procellariidae);
Pagodroma nivea (MLP 488, Procellariidae);
Puffinus diomedea (MLP 79, Procellariidae).

Psittaciformes. *Cyanoliseus patagonus* (MLP 65, Psittacidae).

Strigiformes. *Asio otus* (MLP 541, Strigidae);

Bubo virginianus (MLP 401, Strigidae);

Tyto alba (MLP 53, Tytonidae).

Sphenisciformes. *Pygoscelis adeliae* (MLP 469, Spheniscidae).

Struthioniformes. *Dromaius novahollandie* (MLP 685, Dromaiidae);

Pterocnemia pennata (MLP 411, Rheidae);

Rhea americana (MLP 878, Rheidae); *Struthio camelus* (MLP 678, Struthionidae).

Tinamiformes. *Eudromia elegans* (MLP 327, Tinamidae);

Rhynchotus rufescens (MACN 68089, Tinamidae).

3. Institutional abbreviations

AMNH, American Museum of Natural History, New York, USA; BAR, Museo Asociación Paleontológica Bariloche, Río Negro, Argentina;; CORD-PZ, Museo de Paleontología de la Universidad de Córdoba, Córdoba, Argentina; FM, Field Museum of Natural History, Chicago, Illinois, USA; MACN, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; MLP, Museo de La Plata, Buenos Aires, Argentina; MMP, Museo Municipal de Ciencias Naturales Lorenzo Scaglia, Buenos Aires, Argentina; MPM-PV, Museo Padre Molina, Río Gallegos, Santa Cruz, Argentina; NHMUK, The Natural History Museum, London, UK; OUVC, Ohio University Vertebrate Collections, Columbus, Ohio, USA; YPM, Yale Peabody Museum, New Haven, Connecticut, USA.

4. References

- Agnolín, F. L. 2009. *Sistemática y filogenia de las aves fororracoideas (Gruiformes: Cariamae)*. Buenos Aires: Fundación Azara/Adrián Giacchino.
- Alvarenga, H. M. F. 1982. Uma gigantesca ave fóssil do Cenozóico brasileiro: *Physornis brasiliensis* sp. n. *Anais da Academia Brasileira de Ciências* **54**, 697–712.
- Alvarenga, H. M. F. 1985. Um novo Psilopteridae (Aves: Gruiformes) dos sedimentos Terciários de Itaboraí, Rio de Janeiro, Brasil. *Anais do Congresso Brasileiro de Paleontologia*, 8, *Série Geologia* **27**, 17–20.

- Alvarenga, H. M. F. & Höfling, E. 2003. Systematic revision of the Phorusrhacidae (Aves: Ralliformes). *Papeis Avulsos de Zoologia* **43**, 55–91.
- Ameghino, F. 1887. Enumeración sistemática de las especies de mamíferos fósiles coleccionados por Carlos Ameghino en los terrenos Eocenos de la Patagonia austral y depositados en el Museo de La Plata. *Boletín del Museo La Plata* **1**, 1–26.
- Ameghino, F. 1889. Los mamíferos fósiles de la República Argentina. *Actas de la Academia Nacional de Ciencias de Córdoba* **6**, 1–1028.
- Ameghino, F. 1891. Caracteres diagnósticos de cincuenta especies nuevas de mamíferos fósiles argentinos. *Revista Argentina de Historia Natural* **1**, 129–67.
- Ameghino, F. 1895. Sobre las aves fósiles de Patagonia. *Boletín del Instituto Geográfico de Argentina* **15**, 501–602.
- Ameghino, F. 1899. Sinopsis geológico-paleontológica de la Argentina. *Segundo Censo de la República Argentina* **1**, 112–255.
- Bertelli, S., Chiappe, L. M. & Tambussi, C. P. 2007. A new phorusrhacid (Aves, Cariamae) from the middle Miocene of Patagonia, Argentina. *Journal of Vertebrate Paleontology* **27**, 409–19.
- Brodkorb, P. 1963. A giant flightless bird from the Pleistocene of Florida. *The Auk* **80**, 111–15.
- Brodkorb, P. 1967. Catalogue of fossil birds, Part III (Ralliformes, Ichthyornithiformes, Charadriiformes). *Bulletin of Florida State Museum* **2**, 99–220.
- Cabrera, A. 1939. Sobre vertebrados fósiles del Plioceno de Adolfo Alsina. *Revista del Museo La Plata* **2**, 3–35.
- Degrange, F. J. 2012. Morfología del cráneo y complejo apendicular en aves fororracoideas: implicancias en la dieta y modo de vida. Unpublished PhD Thesis, La Plata University, La Plata, 390 pp.
- Degrange, F. J., Tambussi, C. P., Taglioretti, M. L., Dondas, A. & Scaglia, F. 2015. A new Mesembriornithinae (Aves, Phorusrhacidae) provides new insights into the phylogeny and sensory capabilities of terror birds. *Journal of Vertebrate Paleontology* **35**, e912656. doi: 10.1080/02724634.2014.912656
- Kraglievich, L. 1931. Contribución al conocimiento de las aves fósiles de la época araucoentrerriana. *Physis* **10**, 304–15.
- Kraglievich, L. 1932. Una gigantesca ave fósil del Uruguay, *Devincenzia gallinali* n. gen. n. sp., tipo de una nueva familia, Devincenziidae, del Orden Stereornithes. *Anales del Museo Historia Natural de Montevideo* **3**, 323–55.

- Kraglievich, L. 1946. Noticia preliminar acerca de un nuevo y gigantesco estereornito de la fauna Chapadmalense. *Anales de la Sociedad Científica Argentina* **142**, 104–21.
- Mayr, G. 2005. “Old World phorusrhacids” (Aves: Phorusrhacidae): a new look at *Strigogyps* (“*Aenigmavis*”) *sapea* (Peters, 1987). *PaleoBios* **25**, 11–16.
- Mayr, G. 2009. *Paleogene Fossil Birds*. Berlin: Springer-Verlag.
- Moreno, F. P. 1889. Breve reseña de los progresos del Museo La Plata, durante el segundo semestre de 1888. *Boletín del Museo La Plata* **3**, 1–44.
- Moreno, F. P. & Mercerat, A. 1891. Catálogo de los pájaros fósiles de la República Argentina conservados en el Museo de La Plata. *Anales del Museo de La Plata* **1**, 7–71.
- Mourer-Chauviré, C. 1981. Première indication de la présence de Phorusrhacidés, famille d’oiseaux géants d’Amérique du Sud, dans le Tertiaire Européen: *Ameghinornis* nov. gen. (Aves, Ralliformes) des Phosphorites du Quercy, France. *Geobios* **14**, 637–47.
- Noriega, J. I., Vizcaíno, S. F. & Bargo, M. S. 2009. First record and a new species of seriema (Aves: Ralliformes: Cariamidae) from Santacrucian (Early–Middle Miocene) beds of Patagonia. *Journal of Vertebrate Paleontology* **29**, 620–26.
- Patterson, B. 1941. A new phorusrhacoid bird from the Deseado formation of Patagonia. *Field Museum of Natural History, Geological Series* **8**, 49–54.
- Patterson, B. & Kraglievich, L. 1960. Sistemática y nomenclatura de las aves fororracoideas del Plioceno Argentino. *Publicación del Museo Municipal Ciencias Naturales y Tradicionales de Mar del Plata* **1**, 1–51.
- Peters, D.S. 1987. Ein.“Phorusrhacidae.” aus dem Mittel-Eozan von Messel (Aves: Gruiformes: Cariamae). *Documents des Laboratoires de Géologie de Lyon* **99**, 71–87.
- Rovereto, C. 1914. Los estratos araucanos y sus fósiles. *Anales del Museo Nacional Historia Natural de Buenos Aires*, 25:1–247.
- Sinclair, W. & Farr, M. 1932. Aves of the Santa Cruz beds. In Scott, W. (ed.) *Reports of the Princeton University expeditions to Patagonia (1896-1899)*, Volume **7**, 157–91. New Jersey: Princeton University.
- Tambussi, C. P. & Degrange, F. J. 2013. *South American and Antarctic continental Cenozoic birds: paleobiogeographic affinities and disparities*. The Netherlands: Springer Briefs.

Tonni, E. P. 1974. Un nuevo cariámido (Aves, Gruiformes) del Plioceno superior de la provincia de Buenos Aires. *Ameghiniana* **11**, 366–72.

Tonni, E. P. & Tambussi, C. P. 1988. Un nuevo Psilopterinae (Aves: Ralliformes) del Mioceno tardío de la provincia de Buenos Aires, República Argentina. *Ameghiniana* **25**, 155–60.

Supplementary Table 1 Femur measurements (cm) of the Neornithes studied. The prefix “Prom” indicates that the measurements are the average of more than one individual. See text-Table 1 and text-Figure 2 for measurement explanation.

Catalog Number	Species	Order	Family	EA	EB	EC	ED	EE
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	9.911	10.603	2.480	2.254	2.606
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	4.140	4.319	0.911	0.820	0.889
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	7.969	8.521	1.883	1.671	2.071
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	6.018	6.452	1.629	1.427	1.673
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	3.788	4.093	0.718	0.604	0.840
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	3.671	3.899	0.729	0.656	0.758
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	5.233	5.672	1.104	1.054	1.207
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	5.922	6.195	1.223	1.020	1.300
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	4.670	5.070	0.920	0.860	1.110
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	5.590	6.010	1.290	0.970	1.360
MLP 531	<i>Burhinus oedicephalus</i>	Charadriiformes	Burhinidae	4.457	4.755	0.933	0.774	1.022
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	4.030	4.096	0.844	0.592	0.790
MLP 474	<i>Theristicus melanopus</i>	Ciconiiformes	Threskiornithidae	6.857	7.212	1.520	1.321	1.706
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	8.356	8.533	1.796	1.564	1.984
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	7.032	7.152	1.248	0.924	1.192
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	10.480	10.766	1.832	1.462	1.902
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	13.972	14.892	3.632	3.178	3.982
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	11.230	12.245	3.065	2.155	2.960
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	11.610	12.730	3.000	2.320	3.110
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	7.670	8.310	1.820	1.270	1.800
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	7.810	8.360	1.880	1.340	1.780
YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	8.370	9.060	1.890	1.310	1.950

MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	10.634	10.912	1.914	1.422	1.992
MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	4.242	4.463	0.865	0.634	0.805
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	2.781	2.925	0.563	0.443	0.542
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	8.350	8.700	1.980	1.640	1.790
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	1.338	1.393	0.294	0.210	0.268
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	3.259	3.280	0.704	0.537	0.682
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	3.875	3.951	0.680	0.546	0.662
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	6.332	6.461	1.301	0.892	1.247
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	10.772	11.087	2.156	1.473	2.442
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	6.548	6.842	1.311	0.685	1.364
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	7.554	7.856	1.832	1.286	1.776
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	9.710	10.510	2.470	2.020	2.510
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	7.726	7.958	1.634	1.474	1.726
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	3.943	4.202	0.792	0.546	0.722
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	9.626	10.204	1.940	1.556	1.826
OUCV 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	6.118	6.696	2.155	1.252	2.118
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	6.251	6.631	1.308	1.085	1.244
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	9.340	10.370	2.760	2.310	2.590
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	11.200	12.130	3.210	2.560	3.370
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	10.460	11.870	2.820	2.800	2.720
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	6.676	7.373	1.520	1.226	1.516
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	5.340	5.780	1.250	1.030	1.150
MLP 403	<i>Porphyryla martinica</i>	Gruiformes	Rallidae	4.877	5.020	0.949	0.697	0.863
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	10.710	11.750	2.080	1.850	2.370
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	8.558	8.932	1.692	1.446	1.712
MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	3.445	3.631	0.776	0.528	0.739

MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	2.632	2.792	0.584	0.338	0.596
MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	2.604	2.746	0.492	0.296	0.488
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	2.500	2.652	0.456	0.298	0.498
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	5.535	5.818	1.580	1.196	1.638
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	5.188	5.292	1.184	1.060	1.239
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	8.044	9.129	2.193	1.835	2.406
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	4.572	4.772	0.964	0.669	0.984
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	2.301	2.394	0.472	0.333	0.473
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	4.343	4.737	1.370	0.798	1.526
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	3.715	3.759	0.778	0.438	0.694
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	8.310	8.490	1.872	1.209	1.896
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	3.834	3.979	0.763	0.535	0.730
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	8.084	8.298	1.904	1.149	1.706
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	5.409	5.610	1.041	0.593	1.001
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	6.687	7.055	1.296	0.831	1.274
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	18.833	21.433	6.021	6.000	7.258
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	19.603	22.393	5.804	5.354	6.451
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	24.129	27.080	10.322	8.270	11.472
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	18.085	19.843	4.634	4.638	5.306
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	5.286	5.678	1.263	1.080	1.233

Catalog Number	Species	Order	Family	EF	EG	EH	EI
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	1.132	1.143	1.950	2.240
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	0.336	0.444	0.687	0.829
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	0.921	0.840	1.502	1.774
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	0.680	0.650	1.210	1.342
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	0.292	0.326	0.550	0.693
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	0.333	0.343	0.504	0.637
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	0.499	0.476	0.805	0.982
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	0.530	0.575	0.884	1.065
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	0.460	0.470	0.760	0.970
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	0.550	0.510	0.930	1.210
MLP 531	<i>Burhinus oedicephalus</i>	Charadriiformes	Burhinidae	0.415	0.435	0.803	0.899
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	0.334	0.368	0.546	0.722
MLP 474	<i>Theristicus melanopus</i>	Ciconiiformes	Threskiornithidae	0.665	0.694	1.215	1.374
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	0.943	0.988	1.189	1.696
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	0.482	0.482	0.976	1.076
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	0.828	0.836	1.624	1.852
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	2.026	1.952	2.638	3.388
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	1.600	1.535	2.305	3.035
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	1.640	1.680	2.510	3.180
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	0.930	0.830	1.480	1.910
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	0.960	0.880	1.620	1.870
YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	1.000	0.960	1.590	1.680
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	0.812	0.846	1.546	1.764
MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	0.396	0.392	0.608	0.684
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	0.238	0.234	0.410	0.414

YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	1.020	1.020	1.380	1.600
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	0.118	0.126	0.164	0.196
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	0.303	0.300	0.451	0.507
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	0.308	0.295	0.578	0.583
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	0.493	0.522	0.860	1.077
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	0.970	1.078	2.037	2.066
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	0.635	0.683	1.103	1.156
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	0.792	0.748	1.454	1.572
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	1.270	1.220	2.110	2.430
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	0.762	0.762	1.494	1.506
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	0.315	0.312	0.595	0.544
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	0.778	0.882	1.512	1.762
OUVK 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	0.898	1.161	0.971	1.539
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	0.540	0.586	0.895	1.183
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	1.340	1.250	2.380	2.310
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	1.430	1.430	2.790	2.740
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	1.310	1.360	2.580	2.720
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	0.723	0.726	1.276	1.426
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	0.530	0.550	1.040	1.000
MLP 403	<i>Porphyryula martinica</i>	Gruiformes	Rallidae	0.341	0.341	0.683	0.793
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	1.020	1.010	2.100	2.320
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	0.712	0.696	1.408	1.666
MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	0.361	0.305	0.426	0.636
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	0.262	0.232	0.352	0.474
MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	0.232	0.216	0.262	0.392
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	0.214	0.212	0.268	0.412

MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	0.647	0.828	0.916	1.071
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	0.630	0.641	0.795	0.999
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	1.100	0.980	1.656	2.380
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	0.434	0.410	0.556	0.782
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	0.204	0.211	0.287	0.354
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	0.543	0.617	0.743	1.064
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	0.310	0.292	0.415	0.540
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	0.728	0.776	1.270	1.451
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	0.367	0.326	0.590	0.595
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	0.873	0.913	1.188	1.567
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	0.446	0.430	0.698	0.949
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	0.558	0.519	0.841	1.091
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	2.942	2.998	5.073	7.021
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	2.587	2.618	5.093	6.361
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	3.910	4.204	7.035	7.912
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	2.119	2.108	4.209	5.135
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	0.540	0.450	0.933	1.035

Supplementary Table 2 Femur measurements (cm.) taken in all the available Phorusrhacidae.

Catalog Number	Species	EA	EB	EC	ED	EE	EF	EG	EH	EI
FM-P 14678	<i>Andrewsornis abbotti</i>		20.316	4.714	4.668		2.408	2.128		
MLP 59-II-26-82	<i>Andrewsornis abbotti?</i>			4.535	3.854					
MMP 155-5	<i>Mesembriornis milneedwardsi</i>	25.692	26.944	8.2	4.734	7.736	3.432	3.292	6.644	6.886
MLP 20-170	<i>Mesembriornis milneedwardsi</i>									
MACN Pv 5944	<i>Mesembriornis milneedwardsi</i>	23.134	24.786	7.068	5.912	7.626	3.527	3.096	5.944	6.38
AMNH 9264	<i>Patagornis marshi</i>			4.734	4.452	5.528	2.272	2.376		
MLP 20-151	<i>Patagornis marshi</i>			5.572	4.53					
MLP 20-152	<i>Patagornis marshi</i>					6.398			4.697	5.142
MLP 84-III-9-21	<i>Patagornis marshi</i>						2.585	2.444		
NHMUK - A516	<i>Patagornis marshi</i>	21.2	21.71	5.71	3.89	5.98	2.58	2.405	4.635	5.17
AMNH 9497	<i>Phorusrhacos longissimus</i>					9.166				
MACN Pv 6932	<i>Phorusrhacos longissimus</i>									4.542
MPM-PV 4241	<i>Phorusrhacos longissimus</i>						4.106	4.176		
FM-P 14525	<i>Procariama simplex</i>	15.406	16.242	3.569	2.564	3.698	1.602	1.589	2.558	2.842
FM-P 14535	<i>Procariama simplex</i>			3.142	2.782		1.466	1.492		
MACN Pv 8225	<i>Procariama simplex</i>				2.868	3.6			2.846	3.216
MACN Pv 6939	<i>Procariama simplex</i>			2.872	2.512	2.902			2.272	2.622
YPM-PU 15904	<i>Psilopterus bachmanni</i>	11.392	11.725	2.314		2.35	0.914	1.202	1.93	2.314
MLP 20-165	<i>Psilopterus bachmanni</i>			2.635	2.035					
MLP 20-166	<i>Psilopterus bachmanni</i>					2.632			1.982	2.307
MPM-PV 4243	<i>Psilopterus bachmanni</i>			2.902	2.132	2.994			2.398	2.702
FM-PA-6	<i>Psilopterus lemoinei</i>			2.784	2.002					
YPM-PU 15477	<i>Psilopterus lemoinei</i>			3.256	2.518		1.414	1.712		
YPM-PU 15402	<i>Psilopterus lemoinei</i>	13.396	13.502	2.943	2.134	3.02	1.406	1.442	2.287	2.463

AMNH 9257	<i>Psilopterus lemoinei</i>	14.672	14.78	3.202	2.452	3.296	1.34	1.572		2.694
AMNH 9157	<i>Psilopterus lemoinei</i>	13.8	13.972	2.44	2.15	2.662			2.622	2.244
MLP 20-161	<i>Psilopterus lemoinei</i>									2.283
MPM-PV3650	<i>Psilopterus lemoinei</i>	14.917	15.286	2.944	2.576	3.468	1.453	1.56	2.659	2.936
MMP 5050	Mesembriornithinae gen. et sp. nov.	17.883	18.469	3.896	4.985	4.842	1.971	1.912	3.772	4.395

Supplementary Table 3 Average individuals for each phorusrhacid species based on femur measurements (cm).

Species	EA	EB	EC	ED	EE	EF	EG	EH	EI
<i>Andalgalornis steulleti</i>									
<i>Andrewsornis abbotti</i>		20.316	4.625	4.261		2.408	2.128		
<i>Devincenzia pozzi</i>									
<i>Kelenken guillermoi</i>									
<i>Mesembriornis incertus</i>									
<i>Mesembriornis milneedwardsi</i>	24.413	25.865	7.634	5.323	7.681	3.480	3.194	6.294	6.633
<i>Paraphysornis brasiliensis</i>									
<i>Patagornis marshi</i>	21.200	21.710	5.339	4.291	5.969	2.479	2.408	4.666	5.156
<i>Phorusrhacos longissimus</i>					9.166	4.106	4.176		4.542
<i>Physornis fortis</i>									
<i>Procariama simplex</i>	15.406	16.242	3.194	2.682	3.400	1.534	1.541	2.559	2.893
<i>Psilopterus affinis</i>									
<i>Psilopterus bachmanni</i>	11.392	11.725	2.617	2.084	2.659	0.914	1.202	2.103	2.441
<i>Psilopterus colzecus</i>									
<i>Psilopterus lemoinei</i>	14.196	14.385	2.928	2.305	3.112	1.403	1.572	2.523	2.524
Mesembriornithinae gen. et sp. nov.	17.883	18.469	3.896	4.985	4.842	1.971	1.912	3.772	4.395

Supplementary Table 4 Tibiotarsus measurements (cm) of the Neornithes studied. The prefix “Prom” indicates that the measurements are the average of more than one individual. See text-Table 1 and text-Figure 2 for measurement explanation.

Catalog Number	Species	Order	Family	ZA	ZB	ZC	ZD	ZE
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	19.080	18.078	1.904	2.491	2.227
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	7.277	6.918	0.768	0.887	0.754
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	20.326	19.286	1.658	2.421	1.420
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	14.816	14.157	1.310	1.877	1.075
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	9.396	9.094	0.724	0.950	0.641
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	7.983	7.598	0.602	0.812	0.641
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	8.503	8.130	1.052	1.399	0.850
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	10.571	10.010	1.086	1.305	0.978
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	10.750	9.990	0.890	1.280	0.780
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	14.860	13.830	1.140	1.550	1.190
MLP 531	<i>Burhinus oediconemus</i>	Charadriiformes	Burhinidae	9.707	9.362	0.998	1.073	0.719
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	7.052	6.618	0.636	0.648	0.602
MLP 474	<i>Theristicus melanopis</i>	Ciconiiformes	Threskiornithidae	13.382	12.839	1.361	1.674	1.381
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	13.922	13.457	1.638	1.932	1.300
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	12.200	12.068	1.040	0.988	0.944
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	27.134	26.756	1.590	1.508	1.532
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	23.652	22.464	3.176	3.702	2.592
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	31.490	30.140	2.465	2.940	1.990
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	33.660	32.770	2.540	2.420	2.170
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	21.830	20.970	1.500	1.710	1.250
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	24.390	23.270	1.540	1.720	1.190

YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	24.100	22.990	1.580	1.830	1.180
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	26.592	26.228	1.622	1.928	1.600
MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	6.042	5.952	0.708	0.838	0.622
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	4.002	3.969	0.453	0.501	0.420
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	12.290	12.210	1.660	1.450	1.780
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	2.109	2.051	0.224	0.243	0.208
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	4.385	4.363	0.527	0.522	0.428
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	6.165	6.090	0.599	0.658	0.528
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	9.048	8.953	1.134	1.143	0.988
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	15.008	14.519	1.813	2.085	2.030
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	8.661	8.552	1.128	1.349	1.218
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	12.288	12.148	1.408	1.542	1.336
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	27.240	26.230	2.200	2.810	2.050
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	12.926	12.394	1.342	1.214	1.478
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	5.557	5.431	0.646	0.794	0.496
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	14.198	13.984	1.600	1.688	1.152
OUV 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	19.472	14.506	1.426	1.741	1.458
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	12.330	11.490	1.109	1.363	1.018
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	22.220	21.010	2.260	2.990	2.050
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	24.800	22.960	2.380	3.470	2.160
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	20.760	19.640	2.370	3.140	2.160
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	14.883	14.170	1.410	1.803	1.173
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	9.720	9.240	1.130	1.230	0.950
MLP 403	<i>Porphyryula martinica</i>	Gruiformes	Rallidae	8.902	8.631	0.751	0.925	0.675
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	29.090	28.520	2.360	2.930	2.060
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	18.454	18.094	1.404	1.822	1.262

MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	4.890	4.632	0.618	0.822	0.530
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	4.902	4.708	0.514	0.706	0.432
MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	4.910	4.772	0.474	0.458	0.328
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	4.382	4.290	0.416	0.474	0.328
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	11.624	10.825	1.216	1.343	1.248
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	8.117	7.772	0.987	0.967	1.208
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	27.494	26.276	2.005	2.024	1.697
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	7.820	7.598	0.835	0.927	0.726
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	3.480	3.383	0.390	0.457	0.346
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	13.066	10.969	1.090	0.991	1.042
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	7.196	6.646	0.559	0.681	0.540
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	17.625	15.989	1.491	1.799	1.691
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	5.374	5.243	0.607	0.693	0.644
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	13.689	12.807	1.382	1.328	1.397
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	10.068	9.636	0.917	0.972	0.835
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	10.347	9.997	1.100	1.070	1.071
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	43.800	40.840	4.875	5.313	4.539
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	35.508	33.122	4.958	4.929	4.112
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	45.565	43.867	6.441	4.966	7.017
Prom. MLP	<i>Pterocnemia pennata</i>	Struthionifromes	Rheidae	31.384	29.900	4.464	3.995	3.211
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	7.934	7.734	0.902	1.195	0.804

Catalog Number	Species	Order	Family	ZF	ZG	ZH	ZI	ZJ
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	0.947	0.881	1.956	2.147	2.739
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	0.387	0.333	0.737	0.854	1.107
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	1.007	0.799	1.387	1.454	3.175
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	0.725	0.554	1.119	1.200	2.442
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	0.331	0.297	0.605	0.681	1.268
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	0.352	0.307	0.617	0.658	1.202
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	0.514	0.409	0.738	0.873	1.652
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	0.561	0.446	1.027	1.174	1.816
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	0.440	0.440	0.780	0.820	1.600
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	0.630	0.530	1.010	1.140	2.200
MLP 531	<i>Burhinus oedicephalus</i>	Charadriiformes	Burhinidae	0.437	0.391	0.724	0.843	1.598
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	0.336	0.312	0.664	0.746	1.076
MLP 474	<i>Theristicus melanopus</i>	Ciconiiformes	Threskiornithidae	0.648	0.620	1.195	1.289	1.947
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	0.863	0.653	1.236	1.341	2.058
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	0.536	0.446	0.976	1.028	1.324
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	0.904	0.830	1.678	1.754	2.114
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	1.648	1.436	2.538	2.662	4.264
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	1.230	1.135	2.365	2.505	3.555
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	1.330	1.330	2.530	2.660	3.680
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	0.820	0.730	1.480	1.480	2.160
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	0.840	0.800	1.540	1.530	2.370
YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	0.790	0.740	1.540	1.580	2.360
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	0.902	0.846	1.730	1.824	2.184
MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	0.377	0.325	0.678	0.717	0.878

MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	0.238	0.195	0.439	0.474	0.603
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	0.810	0.820	1.810	1.400	1.790
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	0.112	0.104	0.209	0.209	0.248
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	0.238	0.225	0.488	0.547	0.597
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	0.267	0.258	0.571	0.582	0.794
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	0.518	0.390	0.920	1.042	1.166
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	0.953	0.778	1.262	1.166	2.264
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	0.566	0.558	0.913	0.906	1.261
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	0.718	0.618	1.128	1.198	1.808
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	1.180	1.010	1.950	2.120	2.970
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	0.786	0.770	1.356	1.424	1.846
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	0.283	0.267	0.490	0.535	0.932
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	0.866	0.666	1.392	1.456	2.082
OUV 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	0.967	0.870	1.471	1.467	1.774
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	0.605	0.451	0.990	1.081	1.944
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	1.170	1.040	1.980	2.230	3.450
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	1.380	1.060	2.080	2.340	3.860
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	1.230	1.020	1.970	2.270	3.440
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	0.723	0.660	1.090	1.176	2.183
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	0.620	0.510	0.830	0.990	1.670
MLP 403	<i>Porphyryla martinica</i>	Gruiformes	Rallidae	0.336	0.349	0.680	0.723	1.185
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	1.320	1.080	1.990	2.170	3.980
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	0.788	0.640	1.298	1.398	2.210
MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	0.305	0.294	0.466	0.517	0.671
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	0.216	0.198	0.408	0.446	0.648
MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	0.206	0.204	0.376	0.394	0.624

MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	0.204	0.208	0.370	0.402	0.634
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	0.762	0.538	1.021	1.060	1.477
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	0.565	0.455	0.806	1.060	1.484
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	0.875	0.762	1.826	1.868	3.139
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	0.407	0.376	0.793	0.819	0.868
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	0.207	0.176	0.386	0.405	0.393
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	0.671	0.542	1.078	1.056	1.123
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	0.303	0.284	0.535	0.603	1.093
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	0.822	0.665	1.568	1.724	2.890
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	0.277	0.273	0.430	0.551	0.677
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	0.794	0.719	1.481	1.602	2.010
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	0.427	0.436	0.986	1.013	1.017
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	0.553	0.498	0.942	0.926	1.346
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	2.487	2.210	4.233	4.284	8.849
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	2.724	2.154	3.808	3.818	9.565
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	4.214	2.652	5.705	7.411	10.118
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	2.195	1.785	3.213	3.289	8.242
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	0.472	0.395	0.766	0.898	1.538

Supplementary Table 5 Tibiotarsus measurements (cm) taken in all the available Phorusrhacidae.

Catalog Number	Species	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
MACN Pv 13243	<i>Devincenzia pozzi</i>					7.432			7.222		
FM- P 14422	<i>Mesembriornis incertus</i>		35.042	4.300		3.506	2.566	2.094			
MMP 155-5	<i>Mesembriornis milneedwardsi</i>	45.452	42.330		8.194	5.638	3.232	3.038	5.174	5.464	12.480
MLP 20-141	<i>Mesembriornis milneedwardsi</i>						3.692	3.159			
MACN Pv 5944	<i>Mesembriornis milneedwardsi</i>		40.526			5.133	3.464	3.208	4.808	5.364	
AMNH 9264	<i>Patagornis marshi</i>	37.122	35.104	4.226	4.624	3.448	2.570	2.116	3.668	4.159	8.022
MLP 20-154	<i>Patagornis marshi</i>								3.876		
MLP 20-158	<i>Patagornis marshi</i>			4.816							
MLP 59-XII-14-14	<i>Patagornis marshi</i>					3.455			3.325		
MLP 84-III-9-21	<i>Patagornis marshi</i>	37.064	35.936			3.696	2.806	2.038	3.402	3.836	
NHMUK- A516	<i>Patagornis marshi</i>	39.130	36.470	4.780	5.840	4.100	2.890	2.580	3.970	4.480	
AMNH 9497	<i>Phorusrhacos longissimus</i>					5.634	3.702	3.186	5.164		
MLP 20-119	<i>Phorusrhacos longissimus</i>										
MLP 20-130	<i>Phorusrhacos longissimus</i>										
MLP 20-137	<i>Phorusrhacos longissimus</i>										
MLP 20-171	<i>Phorusrhacos longissimus</i>					7.234			6.382		
MLP 20-174	<i>Phorusrhacos longissimus</i>								5.685		
MLP 20-180	<i>Phorusrhacos longissimus</i>										
MPM-PV 4241	<i>Phorusrhacos longissimus</i>	52.312	49.016			6.126		4.252			13.852
AMNH 9158	<i>Phorusrhacos sp.</i>								5.879		
FM-P 14525	<i>Procariama simplex</i>	28.930	27.540	2.796	4.034	2.710	1.713	1.338	2.496	2.768	5.402
MACN Pv 6939	<i>Procariama simplex</i>					2.492			2.302	2.492	
MACN Pv 8225	<i>Procariama simplex</i>					2.494			2.362	2.706	
YPM-PU 15904	<i>Psilopterus bachmanni</i>	19.858	19.482	1.873	2.656	1.690	1.372	0.842	1.710	1.940	

MLP 20-167	<i>Psilopterus bachmanni</i>				1.759			1.782	1.919		
MPM-PV 4243	<i>Psilopterus bachmanni</i>				1.882			2.054	2.296		
FM-PA-10	<i>Psilopterus lemoinei</i>				1.762			1.988			
FM-PA-7	<i>Psilopterus lemoinei</i>				1.880			2.100	2.276		
YPM-PU 15402	<i>Psilopterus lemoinei</i>		22.112	2.238	3.116	1.924	1.452	1.257	2.092	4.100	
AMNH 7006	<i>Psilopterus lemoinei</i>				2.072			2.172			
AMNH 9257	<i>Psilopterus lemoinei</i>	23.876	23.558		2.022	1.492	1.286	2.210	2.502	4.494	
AMNH 9157	<i>Psilopterus lemoinei</i>	23.932	22.410	1.984	2.842	1.768		1.842	2.040	3.928	
MLP 20-162	<i>Psilopterus lemoinei</i>				2.022			2.256			
MPM-PV 3650	<i>Psilopterus lemoinei</i>	25.400	24.325	2.835	3.792	2.283	1.665	1.287	2.188	2.570	4.612
MPM-PV 4240	<i>Psilopterus lemoinei</i>		25.522				1.776	1.306			
MMP 5050	Mesembriornithinae gen. et sp. nov.	33.253	32.022	3.709	4.763	3.263	2.053	1.739	3.371	3.077	6.827

Supplementary Table 6 Average individuals for each phorusrhacid species based on tibiotarsus measurements (cm).

Species	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
<i>Andalgalornis steulleti</i>										
<i>Andrewsornis abbotti</i>										
<i>Devincenzia pozzi</i>					7.432			7.222		
<i>Kelenken guillermoi</i>										
<i>Mesembriornis incertus</i>		35.042	4.300		3.506	2.566	2.094			
<i>Mesembriornis milneedwardsi</i>	45.452	41.428		8.194	5.386	3.463	3.135	4.991	5.414	12.480
<i>Paraphysornis brasiliensis</i>										
<i>Patagornis marshi</i>	37.772	35.837	4.607	5.232	3.675	2.755	2.245	3.648	4.158	8.022
<i>Phorusrhacos longissimus</i>	52.312	49.016			6.331	3.702	3.719	5.778		13.852
<i>Physornis fortis</i>										
<i>Procariama simplex</i>	28.930	27.540	2.796	4.034	2.565	1.713	1.338	2.387	2.655	5.402
<i>Psilopterus affinis</i>										
<i>Psilopterus bachmanni</i>	19.858	19.482	1.873	2.656	1.777	1.372	0.842	1.849	2.052	
<i>Psilopterus colzecus</i>										
<i>Psilopterus lemoinei</i>	24.403	23.585	2.352	3.250	1.967	1.596	1.284	2.106	2.347	4.284
Mesembriornithinae gen. et sp. nov.	33.253	32.022	3.709	4.763	3.263	2.053	1.739	3.371	3.077	6.827

Supplementary Table 7 Tarsometatarsus measurements (cm) of the Neornithes studied. The prefix “Prom” indicates that the measurements are the average of more than one individual. See text-Table 1 and text-Figure 2 for measurement explanation.

Catalog Number	Species	Order	Family	AA	AB	AC	AD	AE
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	12.794	12.444	12.396	2.376	2.490
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	3.900	3.798	3.558	0.786	0.718
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	18.214	17.786	17.936	1.708	1.502
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	11.942	11.700	11.776	1.368	1.158
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	7.696	7.368	7.582	0.792	0.742
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	4.564	4.306	4.488	0.788	0.620
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	4.644	4.314	4.402	1.046	1.062
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	6.760	6.389	6.609	1.288	1.185
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	8.780	8.490	8.650	0.910	0.890
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	11.470	11.140	11.240	1.230	1.090
MLP 531	<i>Burhinus oediconemus</i>	Charadriiformes	Burhinidae	7.349	7.172	7.191	0.917	0.830
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	3.032	2.716	2.918	0.750	0.736
MLP 474	<i>Theristicus melanopis</i>	Ciconiiformes	Threskiornithidae	8.758	8.614	8.554	1.482	1.522
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	7.850	7.826	7.634	1.522	1.544
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	7.798	7.766	7.648	1.070	1.024
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	19.682	19.634	19.454	1.716	1.658
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	12.486	12.342	12.108	3.034	3.210
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	24.825	24.280	24.245	2.450	2.725
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	26.490	26.040	26.090	2.520	2.790
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	16.760	16.340	16.500	1.440	1.540
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	19.830	19.340	19.610	1.470	1.600

YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	20.290	19.850	20.000	1.510	1.680
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	19.196	19.152	18.992	1.834	1.852
MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	3.270	3.132	3.134	0.796	0.816
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	2.232	2.134	2.104	0.504	0.526
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	6.490	6.400	6.330	2.030	1.960
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	1.222	1.208	1.141	0.250	0.265
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	1.350	1.331	1.319	0.533	0.514
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	4.135	4.063	3.864	0.625	0.661
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	5.504	5.377	5.306	1.168	1.172
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	10.768	10.842	10.708	2.038	1.954
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	5.188	5.184	5.016	1.246	1.192
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	10.568	10.532	10.406	1.442	1.630
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	25.590	25.390	25.310	2.210	2.020
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	5.294	5.306	5.044	1.506	1.618
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	3.132	2.926	3.048	0.562	0.574
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	8.404	8.090	8.084	1.528	1.280
OUVC 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	10.110	8.940	9.930	1.790	1.250
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	7.062	6.494	6.868	1.120	1.088
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	17.320	16.750	16.730	2.330	2.400
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	18.020	17.340	17.470	2.410	2.400
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	15.290	14.620	14.860	2.540	2.570
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	11.436	11.050	11.166	1.296	1.253
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	6.650	6.300	6.350	1.130	1.140
MLP 403	<i>Porphyryla martinica</i>	Gruiformes	Rallidae	5.988	5.739	5.810	0.762	0.744
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	22.260	21.140	21.830	2.150	2.050
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramididae	13.882	13.444	13.690	1.528	1.478

MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	3.418	3.366	3.448	0.566	0.586
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	3.340	3.350	3.320	0.464	0.356
MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	3.588	3.568	3.558	0.422	0.376
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	2.912	2.908	2.886	0.426	0.362
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	6.042	5.978	6.070	1.336	1.486
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	4.738	4.789	4.550	1.276	1.453
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	26.136	25.568	25.920	1.982	1.952
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	5.026	4.887	4.827	0.927	0.994
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	2.141	2.078	2.024	0.438	0.486
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	6.504	6.546	6.038	1.242	0.864
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	3.642	3.476	3.582	0.642	0.656
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	9.148	8.690	8.898	1.873	1.759
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	2.168	1.968	2.031	0.711	0.878
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	3.254	3.108	2.947	1.634	2.266
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	7.102	7.162	6.980	0.992	1.142
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	6.032	6.100	5.804	1.148	1.320
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	34.642	33.372	33.800	5.434	4.712
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	32.184	30.952	31.119	4.219	4.076
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	21.404	20.620	19.366	7.970	9.868
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	29.739	28.767	29.123	4.157	4.165
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	4.666	4.380	4.528	0.922	1.042

Catalog Number	Species	Order	Family	AF	AG	AH	AI	AJ
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	1.082	0.838	1.092	0.752	1.154
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	0.432	0.354	0.422	0.302	0.474
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	0.694	0.772	0.634	0.544	0.872
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	0.516	0.616	0.514	0.428	0.692
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	0.318	0.258	0.312	0.224	0.444
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	0.278	0.268	0.278	0.212	0.438
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	0.412	0.336	0.422	0.322	0.578
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	0.486	0.471	0.475	0.432	0.756
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	0.340	0.370	0.330	0.280	0.470
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	0.470	0.470	0.420	0.340	0.860
MLP 531	<i>Burhinus oedicephalus</i>	Charadriiformes	Burhinidae	0.329	0.293	0.328	0.250	0.518
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	0.430	0.302	0.408	0.272	0.456
MLP 474	<i>Theristicus melanopis</i>	Ciconiiformes	Threskiornithidae	0.674	0.468	0.668	0.408	0.794
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	0.692	0.558	0.698	0.526	0.952
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	0.504	0.392	0.490	0.324	0.582
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	0.786	0.636	0.754	0.566	0.888
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	1.604	1.032	1.638	0.998	1.984
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	1.025	0.985	0.995	1.760	1.445
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	1.090	1.040	1.020	0.810	1.480
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	0.610	0.660	0.610	0.520	0.880
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	0.660	0.670	0.640	0.550	0.960
YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	0.640	0.700	0.600	0.570	0.950
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	0.792	0.680	0.720	0.590	0.912

MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	0.400	0.302	0.402	0.252	0.462
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	0.236	0.180	0.242	0.152	0.244
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	0.990	0.830	0.840	0.660	0.820
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	0.111	0.089	0.111	0.089	0.123
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	0.284	0.190	0.284	0.190	0.385
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	0.308	0.242	0.290	0.189	0.321
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	0.493	0.349	0.480	0.322	0.508
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	0.940	1.016	0.852	0.848	1.570
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	0.586	0.540	0.548	0.426	0.432
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	0.640	0.578	0.622	0.510	0.396
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	0.920	1.000	0.720	0.660	1.150
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	0.980	0.508	0.938	0.588	0.702
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	0.252	0.210	0.262	0.194	0.260
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	0.712	0.494	0.636	0.464	0.812
OUV 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	0.590	0.910	0.590	0.910	1.070
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	0.496	0.458	0.510	0.432	0.508
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	0.840	1.010	0.780	0.780	1.370
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	0.910	1.090	0.840	0.830	1.470
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	0.940	0.930	0.890	0.850	1.330
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	0.620	0.513	0.546	0.403	0.743
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	0.420	0.390	0.410	0.340	0.640
MLP 403	<i>Porphyryla martinica</i>	Gruiformes	Rallidae	0.472	0.328	0.386	0.256	0.428
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	0.880	0.840	0.750	0.620	1.240
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	0.596	0.526	0.570	0.472	0.802
MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	0.292	0.332	0.268	0.264	0.368
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	0.196	0.258	0.184	0.182	0.228

MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	0.172	0.214	0.162	0.154	0.196
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	0.162	0.220	0.162	0.164	0.194
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	0.594	0.482	0.646	0.424	0.560
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	0.760	0.403	0.753	0.397	0.887
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriformes	Phoenicopteridae	0.626	0.782	0.568	0.588	1.108
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	0.287	0.389	0.285	0.369	0.410
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	0.201	0.166	0.201	0.155	0.255
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	0.358	0.550	0.366	0.488	0.812
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	0.239	0.229	0.239	0.229	0.352
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	0.687	0.612	0.681	0.606	1.066
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	0.336	0.199	0.336	0.199	0.267
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	1.635	0.571	1.620	0.641	1.509
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	0.432	0.356	0.462	0.332	0.218
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	0.540	0.432	0.578	0.396	0.424
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	2.176	2.138	1.648	1.802	1.022
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	1.741	2.111	1.624	1.850	1.569
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	4.224	2.496	4.178	2.450	3.610
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	1.606	1.822	1.555	1.481	1.626
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	0.376	0.372	0.376	0.358	0.548

Catalog Number	Species	Order	Family	AK	AL	AM	AN
MLP 569	<i>Chauna torquata</i>	Anseriformes	Anhimidae	1.806	12	10	2.164
MLP 84	<i>Anas platalea</i>	Anseriformes	Anatidae	0.706	14	13	0.794
MLP 533	<i>Cariama cristata</i>	Cariamiformes	Cariamidae	0.994	10	8	1.398
MLP 535	<i>Chunga burmeisteri</i>	Cariamiformes	Cariamidae	0.694	11	9	1.136
MLP 615	<i>Vanellus chilensis</i>	Charadriiformes	Charadriidae	0.682	8	10	0.734
MLP 814	<i>Larus maculipennis</i>	Charadriiformes	Laridae	0.528	10	11	0.720
MLP 412	<i>Chionis alba</i>	Charadriiformes	Chionididae	0.528	13	16	0.829
MLP 871	<i>Catharacta maccormicki</i>	Charadriiformes	Stercorariidae	1.029	9	9	1.073
YPM 111287	<i>Burhinus capensis</i>	Charadriiformes	Burhinidae	0.900	10	10	0.830
YPM 102096	<i>Burhinus grallarius</i>	Charadriiformes	Burhinidae	1.110	12	12.75	1.080
MLP 531	<i>Burhinus oedincnemus</i>	Charadriiformes	Burhinidae	0.736	7.5	9	0.794
MACN 22325	<i>Fratercula corniculata</i>	Charadriiformes	Alcidae	0.420	13.5	11	0.648
MLP 474	<i>Theristicus melanopis</i>	Ciconiiformes	Threskiornithidae	0.784	13	13	1.249
MLP 344	<i>Coragyps atratus</i>	Ciconiiformes	Cathartidae	0.612	12	13	1.174
MLP 804	<i>Nycticorax nycticorax</i>	Ciconiiformes	Ardeidae	0.706	9	8	1.154
MLP 712	<i>Ciconia maguari</i>	Ciconiiformes	Ciconiidae	1.372	7	11	1.964
MLP 807	<i>Vultur gryphus</i>	Ciconiiformes	Cathartidae	1.022	16.5	14	2.206
Prom. YPM	<i>Leptoptilos crummeniferus</i>	Ciconiiformes	Ciconiidae	1.615	8.75	8	2.410
YPM 102102	<i>Leptoptilos dubius</i>	Ciconiiformes	Ciconiidae	1.890	10.75	11.25	2.510
YPM 105903	<i>Mycteria americana</i>	Ciconiiformes	Ciconiidae	1.060	8	8	1.560
YPM 105272	<i>Mycteria ibis</i>	Ciconiiformes	Ciconiidae	1.290	8.5	10	1.550
YPM 102099	<i>Mycteria leucocephala</i>	Ciconiiformes	Ciconiidae	0.980	6.5	7	1.580
MACN 20958	<i>Ardea cocoi</i>	Ciconiiformes	Ardeidae	2.122	7	5	2.112

MLP 399	<i>Columba picazuro</i>	Columbiformes	Columbidae	0.498	20	20	0.776
MLP 261	<i>Zenaida auriculata</i>	Columbiformes	Columbidae	0.340	24	16	0.492
YPM 103256	<i>Buceros bicornis</i>	Coraciiformes	Bucerotidae	1.990	20	18	1.910
MLP 319	<i>Galbula ruficauda</i>	Coraciiformes	Galbulidae	0.283	8	11.5	0.210
MLP 6	<i>Ceryle torquata</i>	Coraciiformes	Alcedinidae	0.390	13	16.5	0.452
MLP 97	<i>Guira guira</i>	Cuculiformes	Cuculidae	0.341	10	16	0.650
MLP 536	<i>Opisthocomus hoazin</i>	Cuculiformes	Opisthocomidae	0.951	20	14	1.190
MLP 696	<i>Geranoaetus melanoleucus</i>	Falconiformes	Accipitridae	0.592	9	12	1.588
MLP 438	<i>Falco peregrinus</i>	Falconiformes	Falconidae	1.132	11	16	1.042
MLP 62	<i>Polyborus plancus</i>	Falconiformes	Falconidae	1.614	10	11	1.285
YPM 111125	<i>Sagittarius serpentarius</i>	Falconiformes	Sagittariidae	1.040	11.5	10	1.970
MACN 26366	<i>Pandion haliaetus</i>	Falconiformes	Accipitridae	1.462	19	21	1.422
MLP 364	<i>Lophortyx californica</i>	Galliformes	Odontophoridae	0.370	11	13	0.598
MACN 343438	<i>Penelope purpurascens</i>	Galliformes	Cracidae	0.926	12	11	1.498
OUV 10563	<i>Gavia immer</i>	Gaviiformes	Gaviidae	1.710	7	7	2.120
MLP 49	<i>Fulica armillata</i>	Gruiformes	Rallidae	0.838	10	11	1.094
YPM 102540	<i>Ardeotis arabs</i>	Gruiformes	Otididae	1.780	12.5	14	2.090
YPM 105866	<i>Ardeotis kori</i>	Gruiformes	Otididae	2.030	12.5	14	2.270
YPM 102227	<i>Otis tarda</i>	Gruiformes	Otididae	2.310	11.5	14	2.150
Prom. YPM	<i>Psophia crepitans</i>	Gruiformes	Psophiidae	0.963	12.83	13.66	1.180
YPM 102062	<i>Tetrax tetrax</i>	Gruiformes	Otididae	0.780	14.5	17	0.980
MLP 403	<i>Porphyryla martinica</i>	Gruiformes	Rallidae	0.825	15	12	0.875
YPM 102538	<i>Grus canadensis</i>	Gruiformes	Gruidae	1.420	10.7	12.5	1.700
MACN 63320	<i>Aramus guarauna</i>	Gruiformes	Aramidae	1.542	8	6	1.512
MLP 178	<i>Xiphocolaptes major</i>	Passeriformes	Furnariidae	0.504	13	10	0.554
MLP 126	<i>Pseudoseisura lophotes</i>	Passeriformes	Furnariidae	0.320	18	10	0.536

MLP 777	<i>Turdus rufiventris</i>	Passeriformes	Turdidae	0.256	14.5	11	0.492
MLP 141	<i>Pitangus sulphuratus</i>	Passeriformes	Tyraniidae	0.226	8	15.5	0.411
MLP 476	<i>Phalacrocorax albiventer</i>	Pelecaniformes	Phalacrocoracidae	0.846	16	16	1.528
MLP 482	<i>Sula leucogaster</i>	Pelecaniformes	Sulidae	0.732	15	17.5	1.136
MLP 564	<i>Phoenicopterus chilensis</i>	Phoenicopteriiformes	Phoenicopteridae	1.354	5	5	1.846
MLP 314	<i>Ramphastos vitellinus</i>	Piciformes	Ramphastidae	0.683	9	12	0.880
MLP 330	<i>Monasa nigrifrons</i>	Piciformes	Bucconidae	0.215	8.5	18	0.436
MLP 522	<i>Podiceps major</i>	Podicipediformes	Podicipedidae	0.834	7	9	1.384
MLP 488	<i>Pagodroma nivea</i>	Procellariiformes	Procellariidae	0.350	9	7.5	0.540
MLP 812	<i>Macronectes giganteus</i>	Procellariiformes	Procellariidae	1.507	12	8.5	1.851
MLP 65	<i>Cyanoliseus patagonus</i>	Psittaciformes	Psittacidae	0.274	25	20	0.507
MLP 469	<i>Pygoscelis adeliae</i>	Sphenisciformes	Spheniscidae	0.852	34	30	1.111
MLP 53	<i>Tyto alba</i>	Strigiformes	Tytonidae	0.588	9	10	0.966
MLP 401	<i>Bubo virginianus</i>	Strigiformes	Strigidae	0.616	8	15	1.108
MLP 685	<i>Dromaius novahollandie</i>	Struthioniformes	Casuariidae	7.616	11	12.5	3.972
MLP 878	<i>Rhea americana</i>	Struthioniformes	Rheidae	2.256	8.5	10	4.379
MLP 86-VI-15-1	<i>Emeus crassus</i>	Struthioniformes	Dinornithidae	3.424	23.5	25	5.454
Prom. MLP	<i>Pterocnemia pennata</i>	Struthioniformes	Rheidae	2.995	11.25	13	3.821
MLP 327	<i>Eudromia elegans</i>	Tinamiformes	Tinamidae	0.558	15	15	0.852

Supplementary Table 8 Tarsometatarsus measurements (cm) taken in all the available Phorusrhacidae.

Catalog Number	Species	AA	AB	AC	AD	AE	AF	AG	AH
MACN A 11030-68	<i>cf. Psilopterus lemoinei</i>								
MNHM-M-189	<i>Devincenzia pozzi</i>	40.980		39.380			5.380		5.310
MACN Pv 6554	<i>Devincenzia pozzi</i>								
BAR 3877-11	<i>Kelenken guillermoi</i>	48.520	45.140	46.480	10.850	9.900	5.900	5.170	5.700
FM-P 14422	<i>Mesembriornis incertus</i>	30.976	30.464		4.454		1.818	2.552	1.816
MACN Pv 6737	<i>Mesembriornis incertus</i>					3.896			1.616
MMP 155-5	<i>Mesembriornis milneedwardsi</i>			36.900	6.054		2.656	2.772	2.554
MLP 20-87	<i>Mesembriornis milneedwardsi</i>								2.014
MACN Pv 5944	<i>Mesembriornis milneedwardsi</i>	36.132		34.992	5.918		2.522	2.878	2.502
MACN Pv 19170	<i>Paleopsilopterus itaboraiensis</i>				2.818				
MLP DGN 1418R	<i>Paraphysornis brasiliensis</i>	30.002	28.912	28.918	9.274	9.732	5.352	2.992	5.306
AMNH 9264	<i>Patagornis marshi</i>	27.188	26.178	26.552	4.158	3.994	1.976	1.784	1.976
MLP 84-III-9-21	<i>Patagornis marshi</i>					3.848	2.040	2.009	1.988
NHMUK - A56	<i>Patagornis marshi</i>				4.460	4.380			
MLP 76-V-10-11	<i>Phorusrhacos longissimus</i>	39.866	39.086	38.622	8.368	8.062	3.852	2.686	3.632
AMNH 9146	<i>Phorusrhacos longissimus</i>						3.636	3.202	3.182
MLP 68-I-16-1	<i>Phorusrhacos longissimus</i>					6.358			
MLP 20-121	<i>Phorusrhacos longissimus</i>				9.570				
MLP 20-120	<i>Phorusrhacos longissimus</i>				8.883				
MLP 20-131	<i>Phorusrhacos longissimus</i>						3.404	3.478	3.404
MACN Pv 18602	<i>Phorusrhacos sp.</i>					5.032			
MACN A 52-185	<i>Physornis fortis</i>				10.520				
FM-P 14525	<i>Procarriama simplex</i>	21.577	20.902	21.043	3.022	2.748	1.238	1.378	1.290
MACN Pv 8225	<i>Procarriama simplex</i>				2.984	2.586			

MACN Pv 6939	<i>Procariaama simplex</i>				2.786	2.559			
MMP 990	<i>Procariaama simplex</i>					3.322			1.372
MACN Pv 12184	<i>Psilopterus affinis</i>				2.094	2.194	0.954	0.976	
YPM-PU 15904	<i>Psilopterus bachmanni</i>	14.784	14.235	14.362		2.013	0.934	1.016	0.902
AMNH 9154	<i>Psilopterus bachmanni</i>				1.866				
MLP 20-187	<i>Psilopterus bachmanni</i>								
MLP 20-567	<i>Psilopterus bachmanni</i>				2.003				
MLP 20-168	<i>Psilopterus bachmanni</i>				2.046				
MPM-PV 4243	<i>Psilopterus bachmanni</i>								
MLP 76-VI-12-2	<i>Psilopterus colzecus</i>					2.620	1.088	1.295	1.078
MPM-PV 3650	<i>Psilopterus lemoinei</i>	18.422	17.818	17.962	2.814	2.694	1.222	1.272	1.222
FM-PA-5	<i>Psilopterus lemoinei</i>					2.704			
FM-PA-6	<i>Psilopterus lemoinei</i>				2.252				
FM-PA-7	<i>Psilopterus lemoinei</i>				2.452				
FM-PA-8	<i>Psilopterus lemoinei</i>	17.282	16.766	16.966	2.378	2.184	1.030	1.188	1.030
FM-P 13260	<i>Psilopterus lemoinei</i>					2.708			
YPM-PU 15477	<i>Psilopterus lemoinei</i>				2.782				
YPM-PU 15479	<i>Psilopterus lemoinei</i>						1.306	1.368	1.306
YPM-PU 15402	<i>Psilopterus lemoinei</i>					2.376	1.064	1.120	1.042
AMNH 7008	<i>Psilopterus lemoinei</i>					2.614			
AMNH 9257	<i>Psilopterus lemoinei</i>	17.858	17.214	17.426	2.616	2.574	1.198	1.234	1.134
AMNH 9157	<i>Psilopterus lemoinei</i>	18.006		17.712	2.444				
MLP 20-188	<i>Psilopterus lemoinei</i>								
MMP 5050	Mesembriornithinae gen. et sp. nov.	29.434	28.571	28.941	3.982	3.406	1.529	1.922	1.477

Catalog Number	Species	AI	AJ	AK	AL	AM	AN
MACN A 11030-68	<i>cf. Psilopterus lemoinei</i>						
MNHN-M-189	<i>Devincenzia pozzi</i>					15	
MACN Pv 6554	<i>Devincenzia pozzi</i>						
BAR 3877-11	<i>Kelenken guillermoi</i>	4.760			14.3	12.2	
FM-P 14422	<i>Mesembriornis incertus</i>	1.702		2.754	13		3.538
MACN Pv 6737	<i>Mesembriornis incertus</i>	2.192			8	9	
MMP 155-5	<i>Mesembriornis milneedwardsi</i>	2.658				11	
MLP 20-87	<i>Mesembriornis milneedwardsi</i>				12		
MACN Pv 5944	<i>Mesembriornis milneedwardsi</i>	2.698	3.236	3.244		8	4.568
MACN Pv 19170	<i>Paleopsilopterus itaboraiensis</i>						
MLP DGN 1418R	<i>Paraphysornis brasiliensis</i>	2.618	4.886	4.826	16	17	6.128
AMNH 9264	<i>Patagornis marshi</i>	1.784	2.178	2.230	7.	7.5	3.552
MLP 84-III-9-21	<i>Patagornis marshi</i>	1.840					
NHMUK - A56	<i>Patagornis marshi</i>		2.470	2.670			
MLP 76-V-10-11	<i>Phorusrhacos longissimus</i>	2.482		4.932	13	12.5	
AMNH 9146	<i>Phorusrhacos longissimus</i>	3.022				13	
MLP 68-I-16-1	<i>Phorusrhacos longissimus</i>						
MLP 20-121	<i>Phorusrhacos longissimus</i>		4.347	5.037			5.800
MLP 20-120	<i>Phorusrhacos longissimus</i>		3.850	5.181			
MLP 20-131	<i>Phorusrhacos longissimus</i>	3.478					
MACN Pv 18602	<i>Phorusrhacos sp.</i>						
MACN A 52-185	<i>Physornis fortis</i>		4.922	4.816			6.492
FM-P 14525	<i>Procarriama simplex</i>	1.324	1.582	1.564	7.75	7.25	2.402
MACN Pv 8225	<i>Procarriama simplex</i>			1.367			

MACN Pv 6939	<i>Procariaama simplex</i>					
MMP 990	<i>Procariaama simplex</i>	1.412			7	9
MACN Pv 12184	<i>Psilopterus affinis</i>			1.156		1.762
YPM-PU 15904	<i>Psilopterus bachmanni</i>	0.997	1.252	1.044	6.75	7.25
AMNH 9154	<i>Psilopterus bachmanni</i>		1.112	1.042		1.572
MLP 20-187	<i>Psilopterus bachmanni</i>					
MLP 20-567	<i>Psilopterus bachmanni</i>		1.144	1.044		1.635
MLP 20-168	<i>Psilopterus bachmanni</i>					
MPM-PV 4243	<i>Psilopterus bachmanni</i>		1.260	1.344		
MLP 76-VI-12-2	<i>Psilopterus colzecus</i>	1.147				
MPM-PV 3650	<i>Psilopterus lemoinei</i>	1.112	1.618	1.646	8	9
FM-PA-5	<i>Psilopterus lemoinei</i>					
FM-PA-6	<i>Psilopterus lemoinei</i>		1.304	0.946		1.758
FM-PA-7	<i>Psilopterus lemoinei</i>		1.300	1.332		1.936
FM-PA-8	<i>Psilopterus lemoinei</i>	1.000	1.210	1.342	9	7
FM-P 13260	<i>Psilopterus lemoinei</i>					
YPM-PU 15477	<i>Psilopterus lemoinei</i>			1.588		2.116
YPM-PU 15479	<i>Psilopterus lemoinei</i>	1.368				6.5
YPM-PU 15402	<i>Psilopterus lemoinei</i>	1.066			10	7
AMNH 7008	<i>Psilopterus lemoinei</i>					
AMNH 9257	<i>Psilopterus lemoinei</i>	1.068	1.608	1.324	9	8
AMNH 9157	<i>Psilopterus lemoinei</i>		1.204	1.138		1.638
MLP 20-188	<i>Psilopterus lemoinei</i>					
MMP 5050	Mesembriornithinae gen. et sp. nov.	1.499	1.916	1.961	7.5	8.5
						3.063

Supplementary Table 9 Average individuals for each phorusrhacid species based on tarsometatarsus measurements (cm).

Species	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
<i>Andalgalornis steulleti</i>											
<i>Andrewsornis abbotti</i>											
<i>Devincenzia pozzi</i>	40.980		39.380			5.380		5.310			
<i>Kelenken guillermoi</i>	48.520	45.140	46.480	10.850	9.900	5.900	5.170	5.700	4.760		
<i>Mesembriornis incertus</i>	30.976	30.464		4.454	3.896	1.818	2.552	1.716	1.947		2.754
<i>Mesembriornis milneedwardsi</i>	36.132		35.946	5.986		2.589	2.825	2.357	2.678	3.236	3.244
<i>Paraphysornis brasiliensis</i>	30.002	28.912	28.918	9.274	9.732	5.352	2.992	5.306	2.618	4.886	4.826
<i>Patagornis marshi</i>	27.188	26.178	26.552	4.309	4.074	2.008	1.897	1.982	1.812	2.324	2.450
<i>Phorusrhacos longissimus</i>	39.866	39.086	38.622	8.940	6.484	3.631	3.122	3.406	2.994	4.099	5.050
<i>Physornis fortis</i>				10.520						4.922	4.816
<i>Procariama simplex</i>	21.577	20.902	21.043	2.931	2.804	1.238	1.378	1.331	1.368	1.582	1.466
<i>Psilopterus affinis</i>				2.094	2.194	0.954	0.976				1.156
<i>Psilopterus bachmanni</i>	14.784	14.235	14.362	1.972	2.013	0.934	1.016	0.902	0.997	1.192	1.119
<i>Psilopterus colzecus</i>					2.620	1.088	1.295	1.078	1.147		
<i>Psilopterus lemoinei</i>	17.892	17.266	17.517	2.534	2.551	1.164	1.236	1.147	1.123	1.374	1.331
Mesembriornithinae gen. et sp. nov.	29.434	28.571	28.941	3.982	3.406	1.529	1.922	1.477	1.499	1.916	1.961

Species	AL	AM	AN
<i>Andalgalornis steulleti</i>			
<i>Andrewsornis abbotti</i>			
<i>Devincenzia pozzi</i>		15	
<i>Kelenken guillermoi</i>	14.3	12.2	
<i>Mesembriornis incertus</i>	10.5	9	3.538
<i>Mesembriornis milneedwardsi</i>	12	9.5	4.568
<i>Paraphysornis brasiliensis</i>	16	17	6.128
<i>Patagornis marshi</i>	7	7.5	3.552
<i>Phorusrhacos longissimus</i>	13	12.75	5.800
<i>Physornis fortis</i>			6.492
<i>Procariama simplex</i>	7.375	8.125	2.402
<i>Psilopterus affinis</i>			1.762
<i>Psilopterus bachmanni</i>	6.75	7.25	1.625
<i>Psilopterus colzecus</i>			
<i>Psilopterus lemoinei</i>	9	7.5	1.927
Mesembriornithinae gen. et sp. nov.	7.5	8.5	3.063

Supplementary Table 10 Principal component analysis of the phorusrhacids and extant birds analysed using femur measurements.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	0.841961	98.48884	98.4888
2	0.005015	0.58660	99.0754
3	0.003353	0.39217	99.4676
4	0.001421	0.16627	99.6339
5	0.001130	0.13220	99.7661
6	0.000969	0.11333	99.8794
7	0.000653	0.07635	99.9558
8	0.000342	0.04005	99.9958
9	0.000036	0.00417	100.0000

Supplementary Table 11 Variable–Component correlation (factor loading) of the first three components of the femur PCA.

Variable	Component 1	Component 2	Component 3
Log ₁₀ EA	-0.985530	0.147940	0.057522
Log ₁₀ EB	-0.990120	0.126664	0.044081
Log ₁₀ EC	-0.995509	-0.046974	0.025910
Log ₁₀ ED	-0.988467	-0.022741	-0.142257
Log ₁₀ EE	-0.995604	-0.052180	0.004224
Log ₁₀ EF	-0.992791	-0.071736	0.052872
Log ₁₀ EG	-0.992040	-0.089747	0.051280
Log ₁₀ EH	-0.992681	0.073565	-0.040007
Log ₁₀ EI	-0.996276	0.008467	0.002761

Supplementary Table 12 Principal component analysis of the phorusrhacids and extant birds analysed using tibiotarsus measurements.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	0.856116	97.08505	97.0851
2	0.011359	1.28818	98.3732
3	0.006753	0.76577	99.1390
4	0.002727	0.30929	99.4483
5	0.001555	0.17639	99.6247
6	0.001415	0.16044	99.7851
7	0.000785	0.08898	99.8741
8	0.000660	0.07487	99.9490
9	0.000343	0.03885	99.9878
10	0.000107	0.01216	100.0000

Supplementary Table 13 Variable–Component correlation (factor loading) of the first three components of the tibiotarsus PCA.

Variable	Component 1	Component 2	Component 3
Log ₁₀ ZA	-0.974596	0.220652	0.008033
Log ₁₀ ZB	-0.974516	0.221372	0.003767
Log ₁₀ ZC	-0.993325	-0.077889	0.002029
Log ₁₀ ZD	-0.980264	-0.052710	-0.139314
Log ₁₀ ZE	-0.983132	-0.119729	0.081259
Log ₁₀ ZF	-0.992210	-0.080653	0.027323
Log ₁₀ ZG	-0.992940	-0.041788	0.051346
Log ₁₀ ZH	-0.991277	-0.002612	0.101429
Log ₁₀ ZI	-0.991348	-0.020670	0.070607
Log ₁₀ ZJ	-0.980483	-0.030397	-0.166582

Supplementary Table 14 Principal component analysis of the phorusrhacids and extant birds analysed using tarsometatarsus measurements.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	1.264172	88.01315	88.0131
2	0.112203	7.81172	95.8249
3	0.018022	1.25472	97.0796
4	0.015659	1.09017	98.1698
5	0.008243	0.57389	98.7436
6	0.006048	0.42109	99.1647
7	0.005284	0.36788	99.5326
8	0.002435	0.16953	99.7021
9	0.001986	0.13827	99.8404
10	0.001412	0.09832	99.9387
11	0.000516	0.03594	99.9747
12	0.000241	0.01677	99.9914
13	0.000100	0.00696	99.9984
14	0.000023	0.00161	100.0000

Supplementary Table 15 Variable–Component correlation (factor loading) of the first three components of the tarsometatarsus PCA.

Variable	Component 1	Component 2	Component 3
Log ₁₀ AA	0.933883	0.344292	-0.026926
Log ₁₀ AB	0.929108	0.354416	-0.027480
Log ₁₀ AC	0.928455	0.358533	-0.027118
Log ₁₀ AD	0.986367	-0.134627	0.003583
Log ₁₀ AE	0.972056	-0.188578	0.002003
Log ₁₀ AF	0.950171	-0.287705	0.017450
Log ₁₀ AG	0.982908	-0.053933	0.046226
Log ₁₀ AH	0.943001	-0.304081	0.049256
Log ₁₀ AI	0.974144	-0.109495	0.085714
Log ₁₀ AJ	0.944045	-0.148206	0.192803
Log ₁₀ AK	0.934251	-0.028929	-0.287925
Log ₁₀ AN	-0.111609	-0.799396	-0.279223
Log ₁₀ AO	-0.129891	-0.825875	-0.213294
Log ₁₀ AP	0.986907	-0.049973	-0.037390

Supplementary Table 16 Principal component analysis of the phorusrhacids and extant birds analysed using the whole hind limb measurements.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	2.681229	92.44654	92.4465
2	0.118536	4.08701	96.5336
3	0.019340	0.66684	97.2004
4	0.017614	0.60732	97.8077
5	0.012625	0.43531	98.2430
6	0.009775	0.33702	98.5800
7	0.008023	0.27662	98.8567
8	0.005883	0.20284	99.0595
9	0.004040	0.13928	99.1988
10	0.003687	0.12713	99.3259
11	0.003185	0.10981	99.4357
12	0.002866	0.09882	99.5346
13	0.002425	0.08361	99.6182
14	0.001888	0.06509	99.6833
15	0.001472	0.05074	99.7340
16	0.001201	0.04141	99.7754
17	0.001124	0.03877	99.8142
18	0.000959	0.03305	99.8472
19	0.000882	0.03041	99.8776
20	0.000793	0.02734	99.9050
21	0.000651	0.02243	99.9274
22	0.000470	0.01619	99.9436
23	0.000331	0.01141	99.9550
24	0.000281	0.00969	99.9647
25	0.000259	0.00892	99.9736
26	0.000216	0.00745	99.9811
27	0.000193	0.00665	99.9877
28	0.000168	0.00578	99.9935
29	0.000101	0.00350	99.9970
30	0.000035	0.00122	99.9982
31	0.000024	0.00083	99.9990
32	0.000020	0.00069	99.9997
33	0.000008	0.00026	100.0000

Supplementary Table 17 Variable–Component correlation (factor loading) of the first three components of the hind limb PCA.

Variable	Component 1	Component 2	Component 3
Log ₁₀ EA	0.980742	-0.065499	0.036446
Log ₁₀ EB	0.986336	-0.052924	0.028570
Log ₁₀ EC	0.988237	-0.109420	0.000512
Log ₁₀ ED	0.979324	-0.101659	-0.000131
Log ₁₀ EE	0.990313	-0.082125	0.015930
Log ₁₀ EF	0.987269	-0.088030	0.032087
Log ₁₀ EG	0.985771	-0.111244	0.014887
Log ₁₀ EH	0.986539	-0.060602	0.003660
Log ₁₀ EI	0.994776	-0.033293	0.001485
Log ₁₀ ZA	0.971388	0.177814	0.010072
Log ₁₀ ZB	0.971830	0.176097	0.012323
Log ₁₀ ZC	0.993970	-0.047058	0.017376
Log ₁₀ ZD	0.978365	0.030217	0.058926
Log ₁₀ ZE	0.984964	-0.115256	-0.031016
Log ₁₀ ZF	0.991543	-0.064144	0.033112
Log ₁₀ ZG	0.993250	-0.039546	0.003548
Log ₁₀ ZH	0.991767	-0.034084	-0.032657
Log ₁₀ ZI	0.990222	-0.058777	-0.014634
Log ₁₀ ZJ	0.975767	0.019571	0.053690
Log ₁₀ AA	0.919746	0.380594	-0.002335
Log ₁₀ AB	0.917403	0.383714	-0.003263
Log ₁₀ AC	0.914318	0.393381	-0.001570
Log ₁₀ AD	0.990527	-0.097197	-0.018908
Log ₁₀ AE	0.972984	-0.167045	-0.011963
Log ₁₀ AF	0.948754	-0.267913	-0.003978
Log ₁₀ AG	0.980749	-0.013063	0.018443
Log ₁₀ AH	0.940183	-0.292334	0.024285
Log ₁₀ AI	0.971496	-0.093905	0.023227
Log ₁₀ AJ	0.930776	-0.107920	0.182684
Log ₁₀ AK	0.908912	0.025729	-0.392775
Log ₁₀ AN	-0.157315	-0.781012	-0.109678
Log ₁₀ AO	-0.211291	-0.798304	-0.068400
Log ₁₀ AP	0.982585	-0.006600	-0.078531

Supplementary Table 18 Principal component analysis of the phorusrhacids and extant birds analysed using hind limb ratios measurements.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	0.530733	51.21692	51.2169
2	0.128818	12.43124	63.6482
3	0.099694	9.62069	73.2689
4	0.064833	6.25655	79.5254
5	0.053793	5.19118	84.7166
6	0.042441	4.09563	88.8122
7	0.022671	2.18782	91.0000
8	0.018054	1.74221	92.7423
9	0.015812	1.52589	94.2681
10	0.014059	1.35676	95.6249
11	0.011456	1.10550	96.7304
12	0.010018	0.96679	97.6972
13	0.007404	0.71451	98.4117
14	0.006175	0.59589	99.0076
15	0.003212	0.30992	99.3175
16	0.002801	0.27027	99.5878
17	0.002382	0.22990	99.8177
18	0.000816	0.07875	99.8964
19	0.000359	0.03464	99.9311
20	0.000321	0.03100	99.9621
21	0.000237	0.02290	99.9850
22	0.000156	0.01503	100.0000

Supplementary Table 19 Variable–Component correlation (factor loading) of the first three components of the hind limb ratios PCA.

Variable	Component 1	Component 2	Component 3
EA/EB	-0.471218	-0.034904	0.206271
EC/ED	-0.176388	-0.186711	0.657679
EC/EE	-0.366726	-0.361277	0.316726
EF/EG	0.138868	0.022250	0.067758
EI/EH	0.125612	-0.038338	0.281557
ZB/ZA	-0.178406	-0.053170	-0.225944
ZD/ZC	0.374706	0.197886	0.217298
ZJ/ZD	0.011700	0.044001	-0.700861
ZC/ZE	0.300274	0.098452	0.069826
ZF/ZG	0.016809	0.314282	-0.273805
ZH/ZI	0.202413	-0.040420	0.213972
AA/AB	-0.100461	-0.054431	0.004083
AA/AC	-0.585034	-0.052676	-0.139949
AD/AP	-0.374695	0.424243	-0.264325
AD/AE	0.427844	0.016645	0.309516
AJ/AK	-0.373353	0.915534	0.093245
AF/AG	-0.879071	-0.074779	-0.363023
AH/AI	-0.801439	-0.067055	-0.397899
AN/AO	-0.050027	-0.141577	0.102053
EB/ZB	-0.551999	-0.039778	0.230906
ZB/AA	-0.960714	-0.091793	0.135027
EB/AA	-0.942313	-0.085467	0.198807

Supplementary Table 20 Principal component analysis of the pelvis in dorsal view. 69 individuals were analysed (five phorusrhacids) using nine landmarks. Only the first ten components are shown.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	1.23315	65.98	65.98
2	0.57298	14.24	80.22
3	0.38892	6.56	86.78
4	0.32193	4.50	91.28
5	0.2876	3.59	94.87
6	0.18711	1.52	96.39
7	0.16165	1.13	97.52
8	0.14708	0.94	98.46
9	0.12821	0.71	99.17
10	0.09126	0.36	99.54

Supplementary Table 21 Principal component analysis of the pelvis in lateral view. 69 individuals were analysed (five phorusrhacids) using 13 landmarks and 18 semilandmarks. Only the first ten components are shown.

Component	Eigenvalue	% Variance	Cumulative % Variance
1	0.80533	41.83	41.83
2	0.55563	19.91	61.74
3	0.39779	10.20	71.94
4	0.3277	6.93	78.87
5	0.297	5.69	84.56
6	0.22792	3.35	87.91
7	0.1913	2.36	90.27
8	0.18025	2.10	92.36
9	0.14756	1.40	93.77
10	0.12529	1.01	94.78

Supplementary Figure 1 Profiles of the birds shown in text-figures 5–9, 11 and 13



Phorusrhacidae