



## New Pleistocene remains of megalonychid ground sloths (*Xenarthra: Pilosa*) from the intertropical Brazilian region

Gerardo De Iuliis,<sup>1</sup> Cástor Cartelle,<sup>2</sup> and François Pujos<sup>3</sup>

<sup>1</sup>Department of Ecology and Evolutionary Biology, University of Toronto, 25 Harbord Street, Toronto, Ontario M5S 3G5, Canada; and Section of Palaeobiology, Department of Natural History, Royal Ontario Museum, 100 Queen's Park Crescent, Toronto, Ontario M5S 2C6, Canada (gerry.deiuliis@utoronto.ca)

<sup>2</sup>Pontifícia Universidade Católica de Minas Gerais (PUC Minas), Avenida Dom José Gaspar, 290 Coração Eucarístico, Belo Horizonte, Minas Gerais, Brazil (cartelle@pucminas.br)

<sup>3</sup>Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA), CCT-CONICET-Mendoza, Avda. Ruiz Leal s/n, Parque Gral. San Martín, 5500 Mendoza, Argentina (fpujos@mendoza-conicet.gov.ar)

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**Abstract.**—The Pleistocene fossil sloth *Australonyx aquae* De Iuliis, Cartelle, and Pujos, 2009 (Mammalia, Xenarthra, Megalonychidae) was described from the intertropical region of Brazil. However, its mandible was not known and only cursory descriptions of the ear ossicles were included. The mandible was subsequently recognized among the remains originally collected from the type locality, and belongs to the holotype individual. As a particularly important skeletal element for specific recognition, it requires description to complement our understanding of this species. The ossicles, usually poorly represented in the fossil record, require further description to allow differentiation from those of other sloths. Comparisons of the mandible and ossicles are conducted with homologous elements of the contemporaneous and sympatric *Ahytherium aureum* Cartelle, De Iuliis, and Pujos, 2008, the only other megalonychid sloth known from intertropical Brazil, and reinforce the distinction between these two species detailed in their initial descriptions. Comparisons with other sloths (e.g., *Acratocnus*, *Megalonyx*, *Neocnus*) also reveal differences with *Au. aquae* in such features as form and size of the caniniform tooth, angular process, and mandibular condyle. Differences among the malleus and incus of *Au. aquae* and several species of other sloth clades reveal clade level distinctions among Megatheriidae, Nothrotheriidae, and Megalonychidae. A well-preserved skull from the Brazilian state of Rondônia is noted as probably belonging to *Au. aquae*. This skull cannot be assigned formally to this species because it is not deposited in a recognized institution, but it does extend considerably the known range of the species.

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### Introduction

Pleistocene remains of Megalonychidae from the intertropical region of Brazil are rare, and their taxonomy has undergone considerable revision. Pioneering efforts were undertaken by Lund (1839, 1840), the Danish paleontologist and “father of Brazilian paleontology” (Cartelle, 2002), in the area of Lagoa Santa (Minas Gerais) regarded the sloth remains that he collected as belonging to *Platyonyx oweni* Lund, 1839 and *Platyonyx bucklandi* Lund, 1839. Based on numerous subsequently recovered remains, Lund (1846) corrected his identifications to *Scelidotherium oweni* (Lund) Lund, 1846 and *Scelidotherium bucklandi* (Lund) Lund, 1846.

Winge (1915) revised Lund's Lagoa Santa material, which had by then been sent to Denmark, and recognized two scelidotheriine species, *Catonyx giganteus* Winge, 1915 and *Scelidotherium magnum* Burmeister, 1886. The valid names for these species were recognized by Cartelle et al. (2009) as *Catonyx cuvieri* (Lund) McDonald, 1987 and *Valgipes bucklandi* (Lund) Cartelle, De Iuliis, and Lopes, 2009, respectively.

Hoffstetter's (1954) work on the Lagoa Santa xenarthrans reconsidered the material that Lund and Winge had studied and arrived at opinions contrasting with those of the earlier researchers. Hoffstetter (1954) disagreed with Winge's (1915) conclusions on the postcranial remains that the latter had recognized as the scelidotheriine *C. giganteus*; instead, the former considered these remains as belonging to a megalonychid and created a new combination for them, *Ocnopus gracilis* (Lund) Hoffstetter, 1954 (see Cartelle et al., 2009 for further details). This author also considered an incomplete calcaneum, which Gervais (1874) had identified as *Valgipes deformis* Gervais, 1874, as megalonychid. Cartelle et al. (2009), based on more complete material including nearly complete skeletons of the two species, were able to determine that both “*O. gracilis*” and “*V. deformis*” are scelidotheriines and, indeed, conspecific. These authors demonstrated that the valid name for this species is *V. bucklandi*.

Based on very incomplete material from the Brazilian state of Ceará, Paula Couto (1980) erected *Xenocnus cearensis* Paula Couto, 1980 and created for its reception the megalonychid subfamily Xenocninae. This species is invalid, as its holotype is a

carpal, the unciform of *Eremotherium laurillardii* (Lund, 1842), and not, as Paula Couto had surmised, the astragalus of a megalonychid. Clearly, the subfamily is also invalid. Paula Couto's (1980) assignment of a mandibular fragment and incomplete molariform teeth to the species cannot be supported based on these remains, given that their state of preservation and incompleteness preclude confident identification (Cartelle et al., 2009). Consequently, remains from the Brazilian state of Piauí assigned to this species by Guérin et al. (2002) and Guérin and Faure (2006) are incorrect.

Cartelle et al. (2008) and De Iuliis et al. (2009), respectively, erected two Pleistocene megalonychid species from the intertropical region of Brazil: *Ahytherium aureum* Cartelle, De Iuliis, and Pujos, 2008 and *Australonyx aquae* De Iuliis, Pujos, and Cartelle, 2009, the remains of which were recovered from the submerged cave Poço Azul (municipality of Nova Redenção, Bahia, Brazil, Fig. 1). The skeleton (except for the manus) and dentition of the first species are almost completely known (Cartelle et al., 2008). The second species is not as completely known as the first, but the skull and several other skeletal elements have been described and figured (De Iuliis et al., 2009). The two species are the only megalonychids so far known from the intertropical region of Brazil. The current report complements the initial description by De Iuliis et al. (2009) in describing new material from Poço Azul of *Au. aquae* (Fig. 2.1–2.3). In addition, reference is made to material recovered from the Amazonian state of Rondônia (Fig. 3) that, we propose, belongs to this species.

## Material and methods

From among the material awaiting preparation in the paleontological collections of MCN PUC, we noted a nearly complete jaw that was recovered from the same locality that yielded the material of *Au. aquae* described by De Iuliis et al. (2009; Fig. 2). Although this element was overlooked during the latter publication, it is clear, as explained below, that it belongs to the same individual, MCL 23315, designated as holotype of this species. This dentary is cataloged as MCL 23315/4 (Fig. 4.1–4.3). The mandible is well preserved, missing only small portions of the symphysis and the angular and coronoid



**Figure 1.** Map showing location of the Poço Azul cave, Nova Redenção County, Chapada Diamantina, Brazil.

processes. This mandible is compared mainly with six specimens of the sympatric megalonychid *Ah. aureum*, each in different states of preservation, with the most comprehensive comparisons made to MCL 22834/04 (Fig. 4.4–4.6), the holotype of this species. Also, it is compared with the mandible of several other fossil megalonychids, including *Acratocnus* Anthony, 1916, *Megalocnus* Leidy, 1868, *Megalonyx* Harlan, 1825, *Neocnus* Arredondo, 1961, and *Parocnus* Miller, 1929.

De Iuliis et al. (2009) provided a cursory description of the malleus and incus of *Au. aquae*. A more comprehensive description is provided here (Fig. 5.1–5.3), with comparisons to the middle ear ossicles of the megatheriid *E. laurillardii* (Fig. 5.4–5.5; MCL 32819), the megalonychid *Neocnus douman* MacPhee, White, and Woods, 2000 (described and figured by Gaudin, 2011), the nothrotheriid *Nothrotherium maquinense* (Lund) Lydekker, 1889 (Fig. 5.5–5.6; MCL 23315/02), and the mylodontid *Valgipes bucklandi* (Fig. 5.7–5.8; MCL 4293/01). As noted, reference is made to a megalonychid skull recovered in Rondônia (Fig. 3). Preliminary observations and comparisons, based on images of this skull made available to us by M. Cozzuol (Fig. 3), suggest that it belongs to *Au. aquae*.

## Systematic paleontology

The following abbreviations are used in the text for institutional and anatomical acronyms:

C: upper caniniform; c: lower caniniform; M: upper molariform; m: lower molariform; MCL: paleontological collection of MCN PUC; MCN PUC: Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Brazil; Mt: metatarsal; ZMC: Zoologisches Museum, Copenhagen, Denmark.

Mammalia Linnaeus, 1758

Xenarthra Cope, 1889

Pilosa Flower, 1883

Tardigrada Latham and Davies in Forster, 1795

Megalonychidae Gervais, 1855

Genus *Australonyx* De Iuliis, Pujos, and Cartelle, 2009

*Type species.*—*Australonyx aquae* De Iuliis, Pujos, and Cartelle, 2009 by monotypy.

*Australonyx aquae* De Iuliis, Pujos, and Cartelle, 2009

Figure 4.1–4.3 and Table 1

*Holotype.*—MCL 23315, representing a well-preserved individual including parts of the skull, much of the axial skeleton, forelimb and hind limb elements, and many elements of the pes.

*Material.*—Mandible MCL 23315/4.

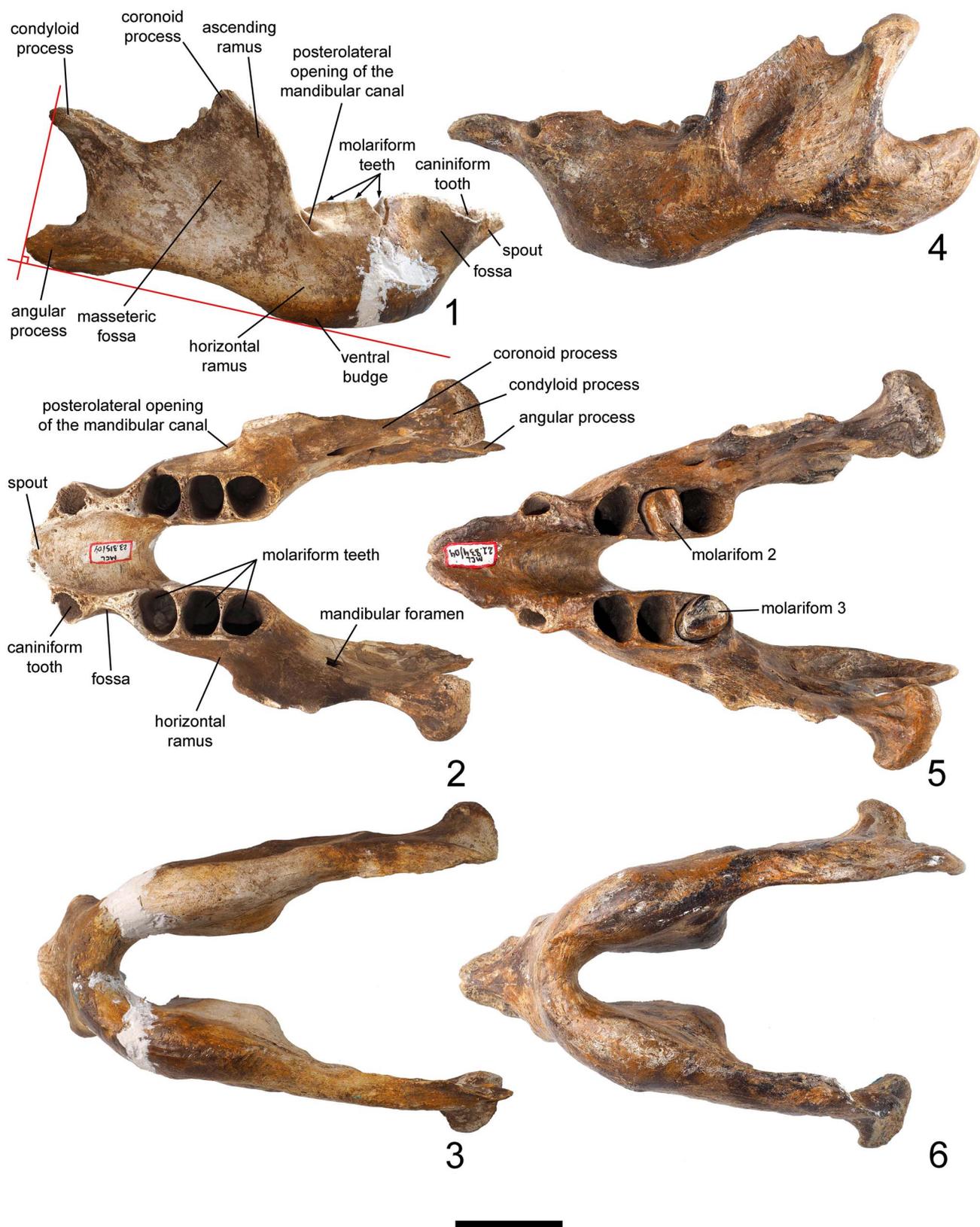
*Occurrence.*—Nova Redenção, Bahia, Brazil; late Pleistocene.

*Description.*—In the dentary of *Au. aquae* (MCL 23315/04; Fig. 4.1–4.4, Table 1) the posterior margins of the mandibular condyle and the angular process project posteriorly to approximately the same level in lateral view. The angular process is not particularly high dorsoventrally and the convexity of its lateral

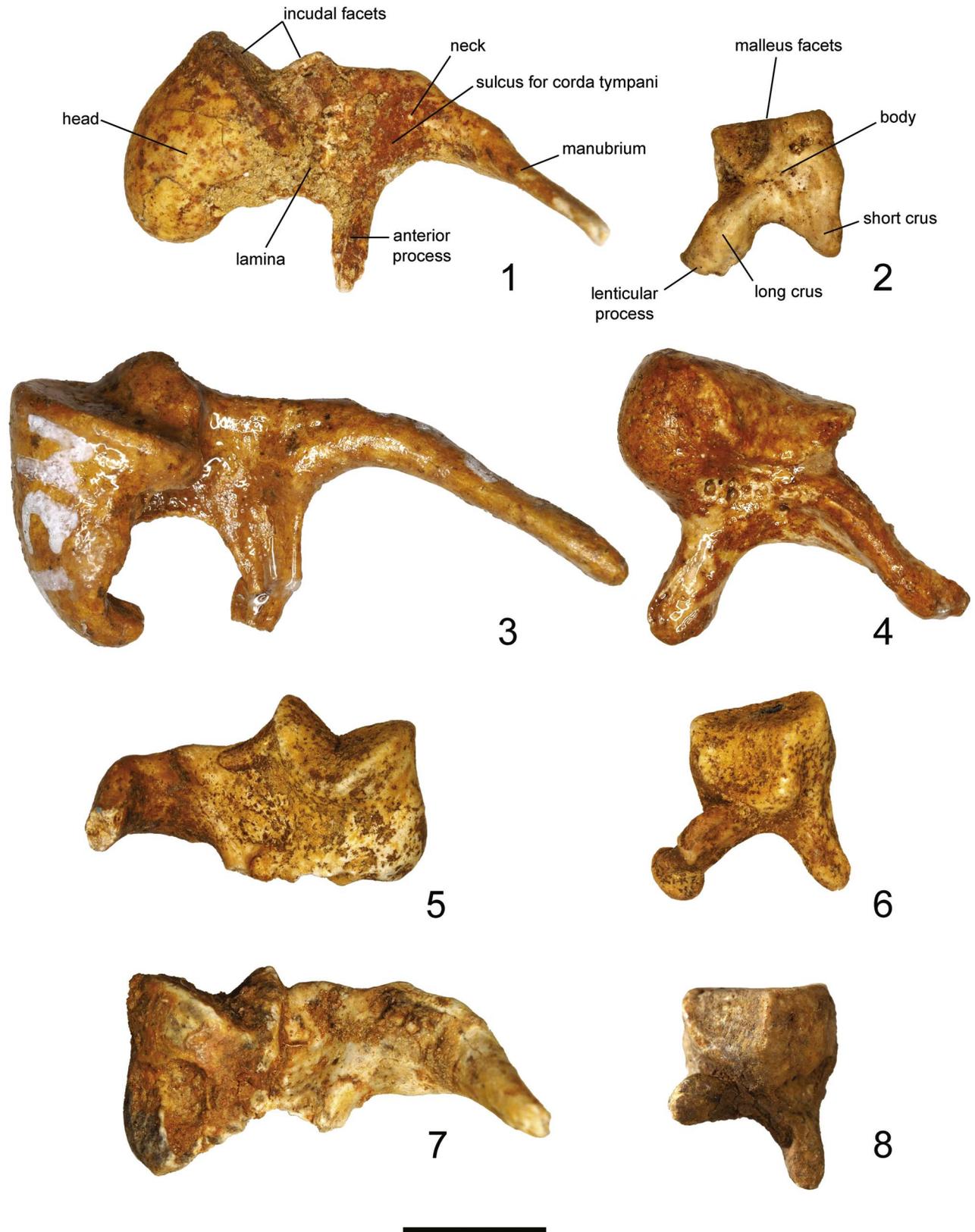




**Figure 3.** Skull of *Australonyx aquae* from the Brazilian state of Rondônia (1) in right lateral (anterior toward top right, dorsal toward top); (2) dorsal (anterior toward right), and (3) ventral (anterior toward right) views. Scale bar represents 50 mm.



**Figure 4.** Mandible of *Australonyx aquae* (1–3, specimen MCL 23315/04) in (1) right lateral (anterior toward right, occlusal edge toward top); (2) occlusal (anterior toward left); and (3) ventral (anterior toward left) views; and of *Ahytherium aureum* (4–6, specimen MCL 21834/04) in (4) left lateral (anterior toward left, occlusal edge toward top); (5) occlusal (anterior toward left); and (6) ventral (anterior toward left) views. Scale bar represents 50 mm.



**Figure 5.** Middle ear ossicles of Brazilian ground sloths, malleus in lateral view (1, 3, 5, and 7) and incus in lateral view (2, 4, 6, and 8). (1, 2) *Australonyx aquae* (Megalonychidae) left malleus (1, MCL 23315/02) and left incus (2, MCL 23315); (3, 4) *Ereumotherium laurillardii* (Megatheriidae) left malleus (3, MCL 32819) and right incus (4, MCL 32831, reversed from the original); (5, 6) *Nothrotherium maquinense* (Nothrotheriidae) right malleus (5, MCL 21731, reversed from the original) and left incus (6, MCL 21731); (7, 8) *Valgipes bucklandi* (Mylodontidae scelidotheriine) left malleus (7, MCL 4293) and left incus (8, MCL 4293). Scale bar represents 50 mm.

**Table 1.** Mandibular measurements of *Australonyx aquae* (MCL 23315/04) and *Ahytherium aureum* (MCL 22834/04)

Parameter	<i>Au. aquae</i> (MCL 23315/04)	<i>Ah. aureum</i> (MCL 22834/04)
Distance between anterior margin of ascending ramus and posterior margin of mandibular condyle	115	105
Distance between anterior margin of ascending ramus and posterior margin of angular process	127	123
Length of tooth row (alveolar)	99	92
Depth of body of horizontal ramus at level of m2.	53	63
Distance between vestibular margins of caniniform alveoli	66	63
Width of m3 alveoli	32	26
Width of symphysis at level of diastema	39	30
Distance between mesial margin of c1 and posterior margin of mandibular condyle	200	185
Distance between mesial margin of c1 and posterior margin of angular process	208	207
Ventral width of mandibular body at level of m2	27	34
Mesiodistal length of c1 (alveolar)	16	11

All measurements are in millimeters.

surface and the concavity of its medial surface are not pronounced. A shallow masseteric fossa is present and the ventral bulge of the horizontal ramus occurs below m2-m3. The posterolateral opening of the mandibular canal lies lateral to the anterior margin of the base of the ascending ramus. The basal length of the coronoid process is nearly equal to the distance between the posterior margin of the ascending ramus and the posterior margin of the mandibular condyle. Reflecting the large size of the caniniform, the lateral projection of the caniniform alveolar wall is pronounced, so that a deep fossa lies between this projection and the more posterior projection of the alveolar wall of m1 (that is, effectively at the level of the diastema). In dorsal view the lingual margins of the caniniform and molariforms are nearly aligned and the dorsal margin of the dentary between c1 and m1 (i.e., at the diastema) is thin mediolaterally. In ventral view the ventral margins of the dentary below the molariforms are narrow and the symphysis is wide. The medial surface of the dentary is nearly vertical, with ample space between the tooth rows.

Only the C1s of *Au. aquae* are known (De Iuliis et al., 2009), as the upper molariforms and the lower dentition were not recovered. The c1 alveoli suggest that c1 was a large tooth, similar in size to C1, longitudinally rectilinear (i.e., not curved), oval and narrowed distally in section (Fig. 4.2). The form of C1 (Fig. 2.1, 2.3) indicates that wear on c1 was pronounced, producing a wedge-shaped occlusal portion, the apex of which is mesial in C1 and distal in c1. The lingual margins of c1 and the molariforms are aligned, as already noted, and the left and right tooth rows are parallel to each other (Fig. 4.2).

The skull recovered from the Brazilian state of Rondônia (see Discussion; Fig. 3) is nearly complete, although the nasals are apparently broken anteriorly. The morphology, proportions and ontogenetic stage are clear from the images and the accompanying scale bar. Based on sutural closure and the development of the sagittal crest, the Rondônia individual was probably slightly older than the holotype of *Au. aquae* (MCL 23315, Fig. 2), as is also suggested by the former's slightly larger size. The Rondônia skull preserves the palate and inflated pterygoid sinuses (Fig. 3.1, 3.3). Of these regions the holotype of *Au. aquae* preserves only the roof of the m3 and m4 alveoli and the base of the pterygoid sinuses (Fig. 2.1, 2.3). The positions of these regions, however, coincide nearly exactly between the two specimens. This applies to other features, such as the anatomically complex posterolateral and posteroventral regions (= basicranium), which encompass multiple cranial

foramina and the otic region. One difference between the specimens is that the preorbital constriction is slightly more pronounced in the Rondônia skull (Figs 2.3, 3.3).

In the malleus of *Au. aquae* the head (MCL 23315/02; Fig. 5.1, Table 1) is smooth, dorsally convex and anteriorly narrowed. The concave articular facet for the incus lies posteriorly and consists of dihedral planes meeting at nearly 90°. The area of the dorsal part is approximately thrice that of the ventral part. A shallow depression is present medially on the malleal neck to accommodate passage of the chorda tympani. The manubrium is narrowed ventrally and curves slightly anteriorly (Fig. 5.1). The medial surface proximal to the neck bears a muscular process that served for the attachment of the tendon of the tensor tympani muscle. The anterior process is about a third as long as the manubrium.

The articular surface of the incus (MCL 23315/02; Fig. 5.2, Table 1) comprises a flattened part and a concave part, with the latter about one-third the size of the former. The long crus is slightly curved medially and bears a lenticular process for articulation with the stapes distally. The short crus, projecting posteriorly, is thinner and tapers toward its tip.

**Comparisons.**—The inflated pterygoid sinuses (Fig. 3.1, 3.3) at the base of the pterygoid that are present in *Au. aquae* resemble those in *Choloepus*, *Megalocnus*, and *N. maquinense* (see Naples, 1982; Cartelle and Fonseca, 1983; Patterson et al., 1992). The dentary of *Au. aquae* is immediately distinguishable from that of the megalonychids *Parocnus* and *Megalocnus*, in which the angular process is large and relatively dorsal in position. As well, the most mesial tooth in *Megalocnus* is incisoriform rather than caniniform. The dentary of *Megalonyx* is also easily distinguished from that of *Au. aquae*. In the former the angular process is considerably larger, the most mesial tooth is mesiodistally elongated and worn nearly flat, and the symphysis is not drawn anteriorly into a symphyseal spout.

The ventral bulge of the horizontal ramus is more strongly developed in *Au. aquae* than in *Ah. aureum* and occurs below m1-m2, rather than m2-m3 (Fig. 3.1). Among other megalonychids, the conformation of the ventral bulge resembles that in *Acratocnus*, *Megalonyx*, and *Neocnus*, although in the last two genera the angular process is farther ventral. In *Au. aquae* and *Ah. aureum* the bulge is more pronounced, resembling more that of *Megalonyx*.

In contrast to *Au. aquae* (MCL 23315/04; Fig. 4.1–4.3, Table 1), the angular process of *Ah. aureum* clearly extends

more posteriorly than does the mandibular condyle. This is also true of *Megalonyx* and *Parocnus*, whereas *Acratocnus*, *Megalocnus*, and *Neocnus* resemble more the condition in *Au. aquae*. The angular process of *Ah. aureum* is also more robust and higher than in *Au. aquae*, and its lateral convexity and medial concavity are more pronounced (Fig. 4.4–4.6). *Au. aquae* differs in form of the condyle from these other megalonychids, including *Ah. aureum*, in being notably tapered posteriorly in lateral view.

The posterolateral opening of the mandibular canal lies just medial to the ascending ramus of the dentary in *Ah. aureum*, rather than lateral as in *Au. aquae*, (Fig. 4.1, 4.2). In the other megalonychids the opening lies lateral to the base of the ascending ramus but is often farther ventral, so it appears removed from the ascending ramus and opens on the lateral surface of the dentary (see De Iuliis et al., 2014). In *Au. aquae* the basal length of the coronoid process nearly equals the distance between the posterior margin of the ascending ramus and the posterior margin of the mandibular condyle, but in *Ah. aureum* the basal length of the coronoid process clearly exceeds the distance between the posterior margins of the ramus and mandibular condyle (Fig. 4.4, 4.5). The first condition applies also to *Megalocnus*, *Megalonyx*, *Neocnus*, and *Parocnus*, whereas the second condition occurs in *Acratocnus*.

Among *Acratocnus*, *Megalocnus*, *Neocnus*, and *Parocnus* the form of c1 of *Acratocnus* most resembles that of *Au. aquae* and *Ah. aureum*, although it is stouter and more triangular in section. In *Megalocnus* and *Parocnus* the most mesial tooth is crescentic in section and not sharply worn. In dorsal view the area of the caniniform alveolus in *Au. aquae* is approximately twice that of *Ah. aureum* (Fig. 4.1, 4.4), but about half that in *Acratocnus* (see Anthony, 1926: plate 38). The latter resembles more *Au. aquae* in a narrow dorsal surface of the dentary between c1 and m1 (i.e., at the diastema), but more *Ah. aureum* in that the lingual margin of the c1 alveolus is more laterally positioned, rather than nearly aligned with the lingual margins of the molariform alveoli as in *Au. aquae*. The wear pattern on the occlusal surface of C1 and c1 in *Au. aquae* is similar to that in *Ah. aureum* and *Acratocnus*, producing a strongly wedge-shaped occlusal portion. The shape of the molariform alveoli of these three genera are closely similar.

The fossa on the lateral surface of the dentary between c1 and m1 (i.e., at the diastema) is shallower in *Ah. aureum* (Fig. 4.5), partly reflecting a smaller caniniform (see below), than in *Au. aquae*. Anteroventrally the margin of the mandible of *Ah. aureum* describes a regularly curved arc that ends as a spout-like projection (Fig. 4.4), whereas in *Au. aquae* the anteroventral ventral margin is more vertically oriented for about half its length (Fig. 4.1). This suggests, even though the most anterior portion of the symphysis is not preserved, that the symphysis would have been less narrow and anteriorly-projecting than in *Ah. aureum*.

The ventral margins of the dentary below the molariforms are considerably narrower in *Au. aquae* than in *Ah. aureum*. In ventral view, the medial surface of the dentary is more obliquely oriented dorsomedially in *Ah. aureum* (Fig. 4.3). In consequence, the space between the tooth rows and the width of the symphysis are greater in *Au. aquae*.

The malleus of *Au. aquae* (MCL 23315/02; Fig. 5.1) is easily distinguished from that of the megalonychid *Neocnus*

*dousman* (see Gaudin, 2011: Fig. 6). For example, in *Au. aquae* the anterior projection of the mallear head is more pronounced, the arc between the anterior process and manubrium is more closed, and the muscular process, located at the base of the manubrium, projects more strongly.

The smooth, dorsally convex, and anteriorly narrowed mallear head (MCL 23315/02; Fig. 5.1) of *Au. aquae* lacks the pronounced hook-like process that extends anteroventrally from the mallear head in *E. laurillardii* (MCL 32.819; Fig. 5.3). In *N. maquinense* (MCL 21731; Fig. 5.5) the head, in addition to being short, is convex dorsally and anteriorly.

The form of the incudal facet, formed by two planes that meet at nearly 90° described above for *Au. aquae*, is similar in *E. laurillardii* and *N. maquinense*. In these last two species the area of the dorsal portion of this facet is slightly greater than that of the ventral portion, but in *Au. aquae* the area of the dorsal portion is approximately thrice that of the ventral. The malleus of *V. bucklandi* (MCL 4293; Fig. 5.7) is more robust than that of *Au. aquae*. Its anterior process is incomplete but is sufficiently well preserved to indicate that it was more robust than that of *Au. aquae*, in which the anterior process is thin and spike-like. The mallear head in *E. laurillardii* is more robust and ends in a small, dorsally-projecting process, which is incomplete, missing about 2 mm (Fig. 5.3).

The mallear neck bears a shallow depression medially to accommodate passage of the chorda tympani in *Au. aquae*, *N. maquinense*, and *V. bucklandi*, whereas in *E. laurillardii* a sulcus rather than a depression is present. The manubrium of the malleus of *Au. aquae* is narrowed ventrally and curves slightly anteriorly (Fig. 5.1). The muscular process for the attachment of the tendon of the tensor tympani muscle, on the medial surface proximal to the neck, is closely similar in *E. laurillardii* (Fig. 5.3), although it is proportionately more robust in *Au. aquae* and *N. maquinense* (Fig. 5.5).

The mallear articular surface of the incus of *Au. aquae* comprises a flattened part and a concave part. In *E. laurillardii* (MCL 32.831; Fig. 5.4) the flattened part is C-shaped, whereas the concave surface is about one-third the size of the former, similar to the proportion present in *Au. aquae*. As in *Au. aquae*, the distal end of the long crus bears the lenticular process (Fig. 5.4). The incus of *N. maquinense* (Fig. 5.6) closely resembles that of *Au. aquae*. *V. bucklandi* (MCL 4293/01; Fig. 5.8) preserves both the left and right incus. The left incus is missing the long crus and the right is missing the short crus. The latter is straighter, whereas the former is more robust and longer, and bears the lenticular process distally.

## Discussion

The new mandibular remains described here (Fig. 4.1–4.3) belong to the same individual that was designated the holotype of *Au. aquae* by De Iuliis et al. (2009; Fig. 2) and therefore is cataloged with the same number, MCL 23315. The mandible articulates perfectly with the skull, though both are incomplete, and the two elements correspond in form and in the position of the caniniform and molariform alveoli.

Although the dentary of *Au. aquae* (Fig. 4.1–4.3) bears a strong general resemblance to that of *Ah. aureum* (Fig. 4.4–4.6), the elements differ in several features that allow them to be

distinguished. As noted above, the anterior portion of the mandibular symphysis of *Au. aquae* (Fig. 4.1, 4.2) is broken, but it is clear that compared to the dorsal surface of the symphysis, the anterior portion was narrower than in the mandible of *Ah. aureum*; the area of the caniniform alveolus in *Ah. aureum* (Fig. 4.5) is about half that in *Au. aquae* (Fig. 4.2); the width between the lateral walls of the caniniform alveoli in *Au. aquae* exceeds the length of the molariform series and nearly equals the distance between the ventral margin of the angular process and the dorsal margin of the mandibular condyle (Fig. 4.1), whereas in *Ah. aureum*, the width between the caniniform alveoli nearly equals the length of the molariform series (Fig. 4.5). These, as well as other marked differences between the dentaries MCL 23315/04 and MCL 22834/04 described above, reflect the generic and specific distinctions between *Au. aquae* and *Ah. aureum* and reinforce the differences between these contemporaneous and sympatric species from the intertropical region of Brazil that were noted by De Iuliis et al. (2009).

The skull recovered over a decade ago from fluvial deposits in Rondônia (Fig. 3) was compared with the skull material of *Au. aquae* from Poço Azul (Fig. 2). These skulls differ only in that the preorbital constriction is slightly more pronounced in the Rondônia skull (Fig. 3.2, 3.3), a feature that may be the result of intraspecific variation, age differences, and/or post-mortem preservation. Such differences have been well documented in other sloths (e.g., Cartelle, 1992; De Iuliis, 1996; Esteban, 1996; McDonald, 2006). There is also a difference in the dorsal profile of the skulls, in that MCL 23315/01 is deeper dorsoventrally at its very anterior tip (Fig. 2.1), but this is almost certainly due to the missing anterior portion of the nasals in the Rondônia skull. However, in other respects, such as size, proportions, sutural patterns, and other detailed aspects of morphology, the Rondônia skull resembles that described by De Iuliis et al. (2009) so strongly that it is difficult to arrive at any conclusion other than that the skulls are conspecific. This skull is not available for formal systematic work because it is not housed in an institutional repository, but is, rather, in the possession of an individual who is not associated with a research institution. It cannot, therefore, be assigned formally to *Au. aquae*. Nonetheless, we think that it is prudent to note the strong similarities between this specimen and that from Poço Azul and its almost certain specific identity, thereby signaling its existence in the published literature, with the hope that it soon will be deposited into an institution so that it may be more fully described. In addition, the existence of this skull expands considerably the known geographic range for *Au. aquae*, which was formerly restricted to the state of Bahia.

## Conclusions

The mandibular remains of *Au. aquae* described here belong to the same individual (MCL 23315) designated by De Iuliis et al. (2009) as holotype of this species, and must therefore be considered part of the holotype.

Specific assignment of the mandibular remains is based on size, precise articulation with the skull remains, correspondence between upper and lower caniniform and molariform alveoli, and the recovery of the mandible from the same locality as the skull.

Conspecificity between the material described by De Iuliis et al. (2009) and a skull from Rondônia is proposed. Although the latter cannot be formally assigned to *Au. aquae* because it is not curated in an institutional repository, its existence expands the known range of this species.

Of the eleven known pilosan species from the Pleistocene of Brazil, only two, *Nothrotherium maquinense* and *Au. aquae*, possess inflated pterygoids.

There is overall similarity between the malleus of the megalonychids *Au. aquae* and *Neocnus dousman*, although several minor differences were noted above. Comparisons of the malleus and incus among *Au. aquae*, *Neocnus dousman*, the megatheriid *E. laurillardi*, and the nothrotheriid *N. maquinense* indicate morphological differences that distinguish them and reflect the commonly-recognized separation of Megalonychidae, Megatheriidae, and Nothrotheriidae. In the past, species of the latter have been assigned to one or the other of the first two clades.

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