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PALEONTOLOGY

A new derorhynchid (Mammalia, Metatheria) from the early Eocene Itaboraí fauna of Brazil with comments on its affinities

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Abstract: A new early Eocene, small-sized metatherian from the Itaboraí fauna is described. The new taxon is recognized on the basis of an incomplete dentary recovered from fissure fillings in the travertine limestones from the Itaboraí Basin, State of Rio de Janeiro, Brazil. The phylogenetic analysis placed the new genus and species as the sister taxon of *Derorhynchus*, undescribed Derorhynchidae, and *Coona* plus *Pauladelphys*. When compared to *Derorhynchus*, the new taxon exhibits a shorter dentary, in which the first lower premolar is not separated from the second by a diastema, and shows second and third lower molars with subequal trigonid and talonid width (in *Derorhynchus* the talonids are wider than the trigonids). This new taxon shows some plesiomorphic traits when compared with the remaining derorhynchids, such as the shallower dentary (less than 1.5 mm), and conical entoconids rather than flattened in shape. The combination of very small size (~13-20g), sharp crests, tall and slender cuspids, broad talonid basins, as well as trigonid taller than the talonid is suggestive of an insectivorous diet for the new taxon.

Key words: Notometatheria, Itaboraian SALMA, Paleogene, South America, Brazil.

INTRODUCTION

Derorhynchidae Marshall (1987) includes small-sized specialized “basal” notometatherians (i.e. the clade that also comprises *Herpetotherium,* Sternbergiidae and Marsupialia; Carneiro 2019), which are represented by three genera and, at least, five species. *Derorhynchus singularis* Paula Couto 1952 is known from the Itaboraí fauna (early Eocene – Itaboraian SALMA), Brazil. *Derorhynchus minutus*, *Pauladelphys juanjoi* Goin et al. 1999 and an indeterminate specimen are known from the La Meseta Formation (early Eocene), in Antarctica (Goin et al. 1999). *Derorhynchus* and *Pauladelphys* are also described for the Paso del Sapo fauna (early middle Eocene – “Sapoan” SALMA), in Chubut Province, Argentina (Tejedor et al. 2009). *Derorhynchus* has tentatively been suggested for the early Paleocene Punta Peligro, in Patagonia, southern Argentina (Peligran SALMA), through identification of an isolated petrosal (Forasiepi & Rougier 2009). More recently, Goin et al. (in press) confirmed the presence of *Derorhynchus* aff. *D. minutus* in that locality. Finally, *Coona pattersoni* Simpson 1938 and *C. gutierrezi* (Del Corro 1977) were described from the Cañadón Hondo locality (medial Eocene – Barrancan subage of the Casamayoran SALMA), also in Chubut Province, Argentina (Simpson 1938, Marshall 1982, Goin & Abello 2013). Therefore, the representatives of Derorhynchidae were widespread during the Eocene of South America, with a geographical distribution ranging from latitudes of about 22^{0}S (Rio de Janeiro, Brazil) to about 64^{0}S (Marambio/Seymor Island, Antarctica) (Figure 1).

Oliveira (1998) reviewed several previously undescribed specimens housed at the Museu de Ciências da Terra (MCT), and the Museu Nacional (MN), both at that Rio de Janeiro, RJ, Brazil; as well as the Museu de Ciências Naturais (MCN) at Porto Alegre, RS, Brazil. He identified several specimens of derorhynchids and, among these materials, a small dentary (DGM 650-M) which represents a new taxon that differs from *Derorhynchus singularis* on several mandibular and dental features. The purpose of this work is to describe the new taxon and to discuss its significance and affinities.

Fossil metatherians from Itaboraí were recovered from fissure fillings in the travertine limestones from the Itaboraí Basin, located at São José district, Itaboraí, State of Rio de Janeiro, Brazil (Figure 1). The Itaboraí fauna was the basis for the recognition of the Itaboraian SALMA, first thought to be Paleocene in age, until a recent dating suggested as more probable an early Eocene age (53–50 Ma, Oliveira & Goin 2011, Woodburne et al. 2014, Figure 1). The Itaboraí fauna represents one of the richest localities of metatherian diversity from the Cenozoic of South America, being crucial to the understanding of the early evolutionary history of Paleogene metatherians. Article register urn:lsid:zoobank.org:pub:6FEB1D67-7C6E-47EC-9EF1-D12C235EEC4F

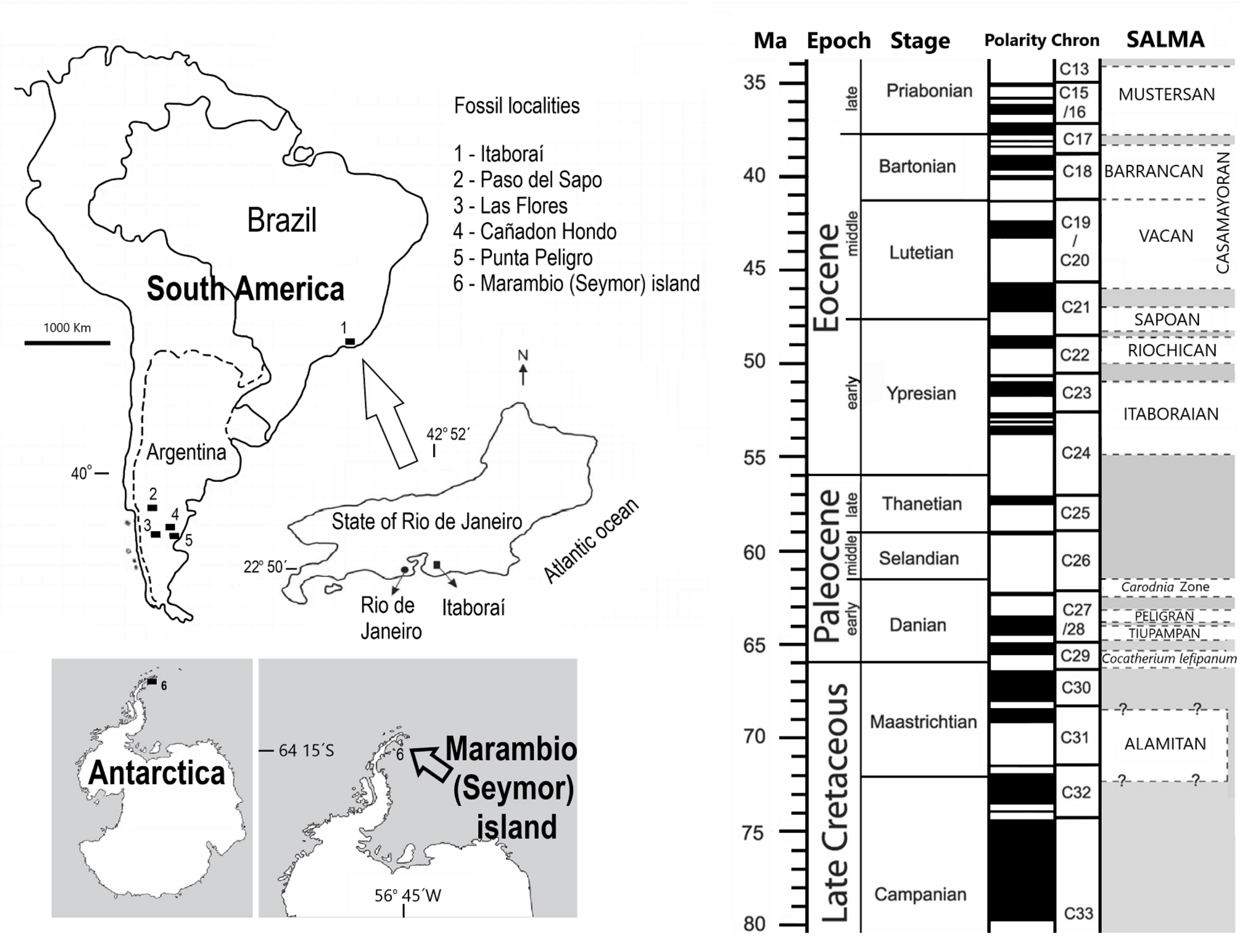

Figure 1. Location map showing the region and coordinates of the Itaboraí Basin, São José de Itaboraí, Rio de Janeiro, Brazil (22°45'9.9144''S,42°51'53.5536''W), the fossil localities with derorhynchids in Argentina and Antarctica, and late Cretaceous-Eocene biochronology (SALMAs); after Woodburne et al. (2014), Goin et al. (2018).

MATERIALS AND METHODS

The holotype is housed in the Museo de Ciências da Terra (MCT; ex DGM, Divisão de Geologia e Mineralogia) in Rio de Janeiro (State of Rio de Janeiro, Brazil), under the collection number DGM 650-M.

Scanning Electron Microscope (SEM) images of the new taxon were made at the Núcleo de Microscopia Eletrônica da COPPE, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil (UFRJ/RJ).

For molar cusp and crest nomenclature and terminology, we follow Goin et al. (2016). All measurements are in millimeters.

The data matrix of this study is based on the characters published in Ladevèze & Muizon (2010), Chornogubsky & Goin (2015), Beck (2017), Muizon et al. (2018), Carneiro (2019), Carneiro et al. (2018), Rangel et al. (2020) and Ladevèze et al. (2020).

In order to test the phylogenetic affinities of the new taxon, we performed a new technology search with TNT 1.5 (Goloboff & Catalano 2016) using the sectorial, ratchet, drift and tree-fusing strategies with 100 replications. Bremer supports and tree scores were calculated with TNT 1.5. The data matrix is composed of 536 unordered characters (164 dental, 21 jaw, 162 cranial, 189 post-cranial) and 56 therian taxa, including 52 metatherians and closely related taxa, from the Cretaceous and Cenozoic of North America, Asia, South America, Antarctica, Europe, and Australia. A list of the included characters, character codifications and character modifications by taxa can be accessed here: http://morphobank.org/permalink/?P3888.

Table I. Regression equations used for prediction of body mass of derorhynchids. References: BM- body mass (grams); r^2- determination coefficient.

	BM(g)= 1.519+3.374*lnLm2 (r^2=0.984)	BM(g)= 2.403+1.67*lnLxWm2 (r^2=0.984)	BM(g)= 1.59+3.228*lnLm3 (r^2=0.985)	BM(g)= 2.363+1.635*lnLxWm3 (r^2=0.982)	BM(g)= 1.874+3.078*lnLm4 (r^2=0.984)	BM(g)= 2.681+1.564 *lnLxWm4 (r^2=0.984)
Diogenesia brevirostris	14.2	20.0	13.8	17.8	16.0	17.1
Derorhynchus singularis	36.4	41.8	35.7	36.3	39.7	36.6
D. minutus			10.0	10.6		
Coona pattersoni			107.1	132.4		
C. gutierrezi			5.7	6.3		
Pauladelphys juanjoi			112.5	140.3		

In the estimation of the body mass of the new taxon and other derorhynchids, we used regression equations of Gordon (2003) obtained from a pooled sample of marsupials (Didelphidae and Dasyuridae) (Table I). This database contains molar measurements of 21 species of living didelphids and dasyurids. The regressions have the form ln*Y* = *a* + *b*(ln*X*), where *Y* is the natural logarithm of body mass; a is the intercept; b is the slope, and *X* is the natural logarithm of the molar measurement (length or area). All body mass estimates are shown in grams (Figure 2, Table I).

Anatomical abbreviations: p1, p2, p3, lower premolars 1 to 3; m1, m2, m3, m4, lower molars 1 to 4.

Abbreviations for dental measurements: L, maximum mesiodistal length; W, maximum labiolingual width.

Other abbreviations: SALMA, South American Land Mammal Age.

Systematic paleontology

Mammalia Linnaeus, 1758
Metatheria Huxley, 1880
Ameridelphia Szalay, 1982
Sudameridelphia Szalay, 1994
Notometatheria Kirsch et al. 1997
†Derorhynchidae Marshall (1987)
†*Diogenesia* gen. nov.
(Figures 3-4)

Zoo Bank Life Science Identifier (LSID) – urn:lsid:zoobank.org:act:51B8C328-DEA9-4510-8D4B-951050CC4329

Type species: *Diogenesia brevirostris* sp. nov.

Etymology: The generic name honors the geologist and vertebrate paleontologist Diógenes de Almeida Campos, from MCT, Brazil.

Included species: The type only.

Diagnosis: As for the type and only known species.

†*Diogenesia brevirostris* sp. nov.
(Figures 3-4)

Zoo Bank Life Science Identifier (LSID) – urn:lsid:zoobank.org:act:847EFC8C-C24D-46D9-B628-3A90BEDCEF58

Holotype: DGM 650-M, incomplete right dentary with alveoli of p1-2, roots of p3-m1, and complete m2-4.

Hypodigm: The type only.

Etymology: The specific name derives from the Latin *brevis*, "short", and *rostrum*, alluding to the shorter length of the rostrum of this species in comparison to *Derorhynchus singularis*.

Locality and horizon: Fissure fillings in the travertine limestones from the Itaboraí Basin, São José district, Itaboraí, State of Rio de Janeiro, Brazil. Early Eocene (Itaboraian SALMA); 53-50 Ma according to Woodburne et al. (2014) and Goin et al. (2018).

Measurements. See Table II.

Diagnosis: Very small metatherian with body mass estimated between 13.8 and 20.0 g (Table I). Size of Lm3 is ~25 % smaller than *Derorhynchus singularis* and ~10% larger than *D. minutus*. Differs from *D. singularis* in having a shorter dentary, p1 not separated from p2 by a diastema, m3 with a less reduced paraconid, trigonid more mesiodistally compressed, and hypoconid less salient labially. Differs from *D. minutus* in having talonid wider, and by the hypoconulid placed at posterolingual corner of tooth. Size of Lm3 is ~47 % smaller than *Pauladelphys*; furthermore, differs from *Pauladelphys* in having a proportionally much

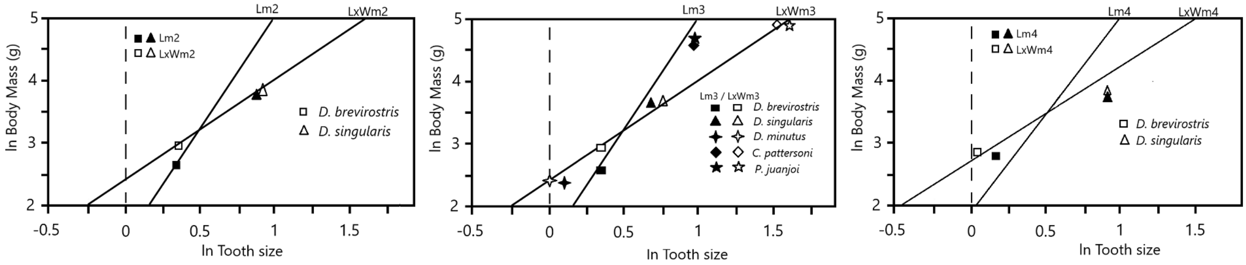

Figure 2. Regression plots showing the relationship between body size and tooth size for lower molars of derorhynchids. The molar measurements used in the regression analyzes are shown in Table I. Modified from Gordon (2003).

larger paraconid and much smaller entoconid and hypoconid, and in that the entoconid is conical rather than laterally compressed. Size of Lm3 is ~24% larger than *Coona gutierrezi* and ~47% smaller than *C. pattersoni*; furthermore, differs from *Coona* in having a less labially salient hypoconid, the entoconid is more conical in shape and is placed in a more mesial position than the hypoconid; the hypoconulid is distolingual to the entoconid; the hypoconulid of the m4 is taller than the entoconid.

Type locality: Itaboraí Basin, municipality of Itaboraí, State of Rio de Janeiro, Brazil. Early Eocene, Itaboraian SALMA (ca 53-50 Ma; according to Woodburne et al. 2014, Goin et al. 2018).

Description: The dentary is moderately deep and with a straight ventral edge. The symphysis extends posteriorly at a point below p2; the anterior mental foramen is larger than the posterior foramen and is located below the anterior edge of p2; the posterior mental foramen is located below the distal edge of m1 (between the m1-2 embrasure). There is a relatively long retromolar space (~1.0 mm), between the last molar and the anterior edge of the coronoid process, corresponding to ~70% of m4 length (Figure 3a).

Judging from the preserved portion of the alveolus, the canine was well-developed and semi-procumbent. Judging from the alveolar roots, the p1 is the smallest premolar; it is not separated from p2 by diastema, and is slightly oblique to the dentary axis. The p2 is slightly smaller than the p3, which is comparable to the

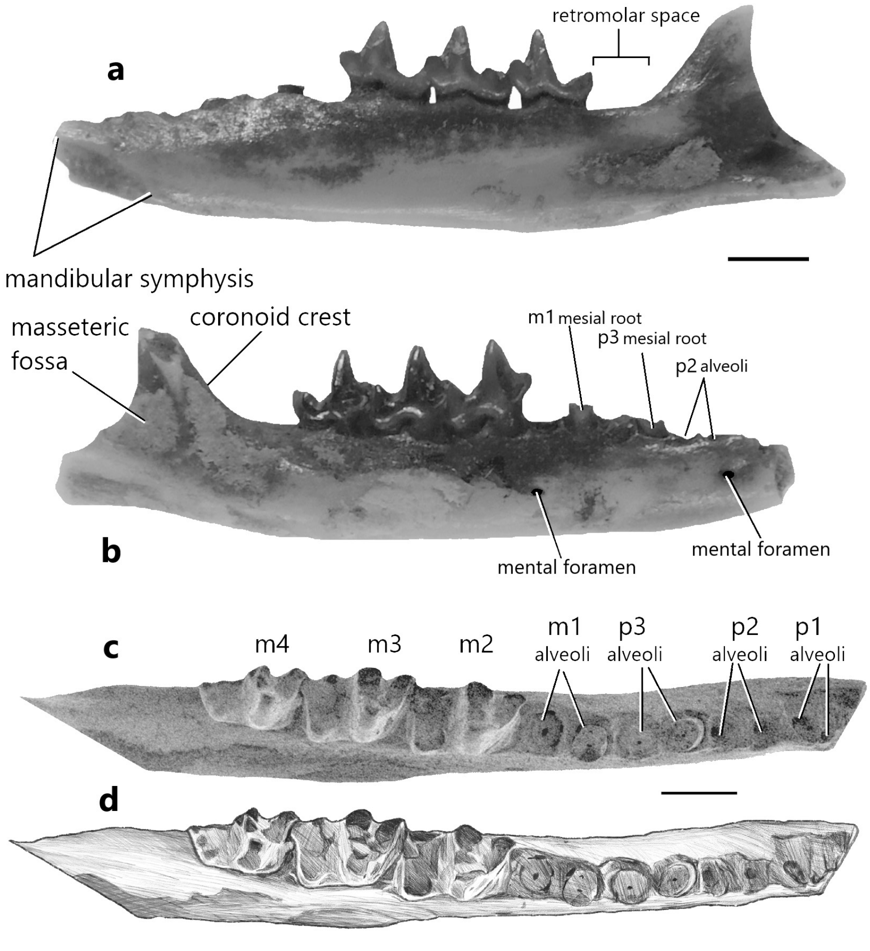

Figure 3. ***Diogenesia brevirostris*** **(DGM 650-M, holotype). a, dentary in lingual view; b, dentary in labial view; c, occlusal view of the dentary, showing the molars and premolars alveoli; d, drawing of occlusal view of the dentary, showing the molars and premolars alveoli. Scale bar = 1mm.**

m1, the latter being the largest of the premolars (Figures 3c-d).

The trigonid and talonid of m2 are equal in length and width. The metaconid is transversally aligned to the protoconid. The paraconid is not mesiodistally compressed, it is mesially tilted, and in volume is not reduced with respect to the metaconid. The protoconid is very high and shows an acute apex. The metaconid is broken at the apex but is clearly circular in section; a strong wear facet extends from the tip of the paraconid to the apex of the protoconid. The anterobasal cingulid is well-developed. The entoconid has a circular base; it is placed very close to the posterior face of the trigonid, being mesially placed to the hypoconid; it shows a strong wear facet at its anterolabial face. The hypoconulid is strong, dorsally compressed, posteriorly projected and is placed at the posterolingual corner of tooth. The hypoconid has an acute shape, it is located at the distolabial corner of the tooth, and its apex is distolabially oriented. The cristid obliqua is short and ends anteriorly in a position labial to the postprotocristid notch. The posthypocristid has a transversal trajectory in relation to the dental axis (i.e., it is not oblique); the cristid obliqua forms an angle between 60^0 and 70^0 with the posthypocristid. The posterior cingulid is well-developed. The m3 is structurally similar to m2, differing in that the talonid is shorter than the trigonid and the entoconid is slightly less robust. The m4 differs from the other teeth in having a relatively narrower talonid, and the hypoconid and entoconid are weakly developed. The hypoconulid projects backwards and is subequal in height to the hypoconid. The cristid obliqua ends at a point slightly labial to the postprotocristid notch. The distal cingulid is absent.

Remarks: Paula Couto (1970) was the first to mention the specimen DGM 650-M, assigning it to the hypodigm of *Monodelphopsis travassosi*. Later, Marshall (1987) included the DGM 650-M in the hypodigm of *Marmosopsis juradoi*. Finally, Oliveira (1998) separated this specimen from *Marmosopsis* and *Monodelphopsis*, suggesting that it belongs to a new taxon. DGM 650-M differs from *Marmosopsis* in the relatively more developed paraconid and entoconid, and the cristid obliqua has a more labial contact

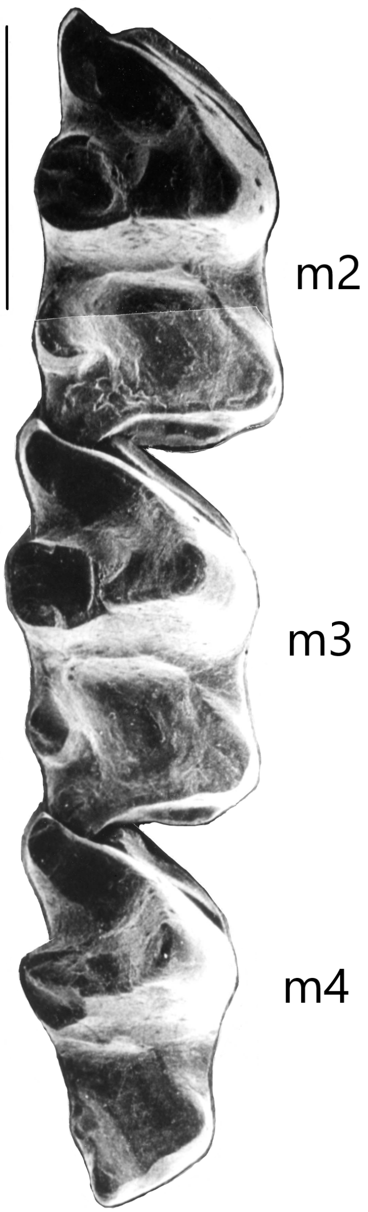

Figure 4. ***Diogenesia brevirostris*** **(DGM 650-M, holotype), m2-4 in lingual view. Scale bar = 1mm.**

with the distal wall of the trigonid. It differs from *Monodelphopsis* in the presence of a paraconid lingually aligned with the metaconid; the metaconid is transversely aligned with the protoconid; the entoconid is better developed; the cristid obliqua contacts the trigonid more labially, and the hypoconulid is distolingually placed. In relation to *Derorhynchus*, we compared *Diogenesia brevirostris* with the holotype and the specimens referred to *D. singularis* by Oliveira (1998) and Oliveira & Goin (2012) (see Figure 5).

Phylogenetic analysis

The phylogenetic analysis recovered 1 MPT (Score = 1450; CI = 0.423; RI = 0.591) (Figure 6). Metatheria comprises the clade that includes Deltatheroida plus Marsupialiformes. Ameridelphia is represented by the clade comprising *Turgidodon* and Stagodontidae plus Pediomyoidea, and an unnamed clade including *Mimoperadectes* as a sister-group to Sudameridelphia.

Sudameridelphia is represented by two major clades: (i) one that includes Pucadelphyda (i.e. Pucadelphyidae and Polydolopimorphia plus Sparassodonta – see Muizon et al. 2018 and Beck 2017); (ii) a second one (unnamed clade) that includes *Gaylordia* and *Marmosopsis* plus *Minusculodelphis* as the sister-taxa to Notometatheria. Notometatheria comprises Sternbergiidae and *Herpetotherium* plus Derorhynchidae as well as Marsupialia, which comprises *Djarthia*, Didelphimorphia, and Paucituberculata plus Australidelphia.

The clade encompassing *Herpetotherium* plus Derorhynchidae was recovered with low support (Bremmer Support '1') and is defined by the presence of large but not hypertrophied and procumbent incisors i2 and i3 (characters 157^2 and 158^1, respectively). In according to Muizon et al. (2018) and Ladevèze et al. (2020) we did not recover a monophyletic Herpetotheriidae plus Peratheriinae (*Peratherium*).

Derorhynchidae is supported by the presence of a mesially shifted entoconid in comparison to hypoconid (character 104^2), labial contact of the cristid obliqua with the distal wall of the trigonid (character 112^4) and P1/p1 oriented obliquely to the tooth row (character 139^1). *Diogenesia brevirostris* was recovered as the sister taxon of *Derorhynchus,* undescribed Derorhynchidae, and *Coona* plus *Pauladelphys.*

Table II. **Size range of lower premolars and molars loci of *Diogenesia brevirostris* and other derorhynchids. Measurements of *Pauladelphys juanjoi* and *Derorhynchus minutus* are based on Goin et al. (1999); measurements of *Coona pattersoni* are from Marshall (1982), and *C. gutierrezi* from Goin & Abello (2013).**

Taxa	Lm1	Wm1	Lm2	Wm2	Lm3	Wm3	Lm4	Wm4
Coona pattersoni					2.60	1.80		1.40
Coona gutierrezi	1.30	0.90			1.05	0.70		
Derorhynchus singularis	1.71	1.05	1.85	1.20	1.80-1.90	1.15	1.80	1.00
Derorhynchus minutus				0.71	1.25	0.80		
Diogenesia brevirostris			1.40	1.02	1.38	1.00	1.34	0.83
Pauladelphys juanjoi					2.64	1.84		

Diogenesia has only one autapomorphy (character 169^3): posterior mental foramen in the dentary placed distally to m1 (Figure 3b).

DISCUSSION

The taxonomic history of derorhynchids is as follows. Marshall (1987) included *Derorhynchus* and *Minusculodelphis* as representatives of the Derorhynchinae within Didelphidae. Marshall (1987:150) considered “the reduction in the size of premolars, elongation of the lower jaw anteriorly, and procumbent nature of canines and incisors” as synapomorphies of Derorhynchinae. Later, Goin et al. (1999) changed the rank of Derorhynchinae to Derorhynchidae, including in the new family *Derorhynchus* and *Pauladelphys*. Goin & Abello (2013) also included *Coona* within this group. Regarding *Minusculodelphis*, it was excluded from Derorhynchidae and assigned to Jaskhadelphyidae (Oliveira et al. 2016).

According to Goin (2003), derorhynchids are characterized by the following combination of derived features: (1) short talonids, (2) reduced paraconids, (3) salient hypoconids, (4) and large, tall, spire-like entoconids in the lower molars, (5) deep ‘V-shaped’ centrocrista, (6) metaconules (although small) larger than paraconules, and (7) a variable tendency towards the fusion of StC and StD in the upper molars. Interestingly, the characters 1, 3, and 4 are incipiently present in *Diogenesia brevirostris*, and the sister taxon relationship of *Diogenesia brevirostris* in relation to the other derorhynchids appears to be related to a more plesiomorphic condition of this new taxon, as for example the shallow dentary (character 165^0 – shallow less than 1.5). *Derorhynchus, Derorhynchidae* gen nov, *Coona* and *Pauladelphys* appear to be more derived than *Diogenesia* in the presence of more robust jaw (character 165^1 – intermediate between 1.5 and 2). Derorhynchidae gen nov, *Coona* and *Pauladelphys* share the presence of flattened and slightly twisted entoconid (character 106^3). Regarding *Pauladelphys*, it is one of the largest species of derorhynchid (Tables I and II).

Derorhynchids were widespread during the Paleogene of South America, with a geographical distribution ranging from latitudes of about 22^0S

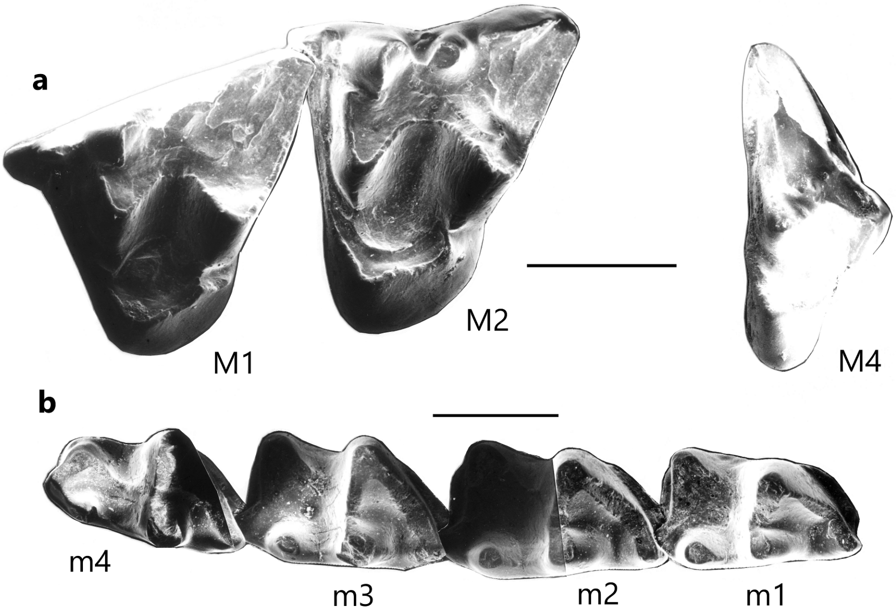

Figure 5. **Upper and lower molars assigned to *Derorhynchus singularis*. a, M1-2 and M4 (DGM 803-M) in occlusal view; b, m1-4 (DGM 651-M) in occlusal view. Scale bar = 1 mm.**

(Rio de Janeiro, Brazil) to about 64^{0}S (Marambio/Seymor Island, Antarctica). The only record of the Paleogene that is questionable concerning to an isolated and incomplete petrosal from the early Paleocene Punta Peligro (Patagonia, Argentina) tentatively referred to *Derorhynchus* by Forasiepi & Rougier (2009). Even though *Derorhynchus* was later confirmed for the Punta Peligro locality on the basis of dental materials (Goin et al. in press), the petrosal may belong to another taxon. On the basis of the derived features for metatherians identified by Ladevèze (2007), the Punta Peligro petrosal shares with metatherians only the absence of a groove for the

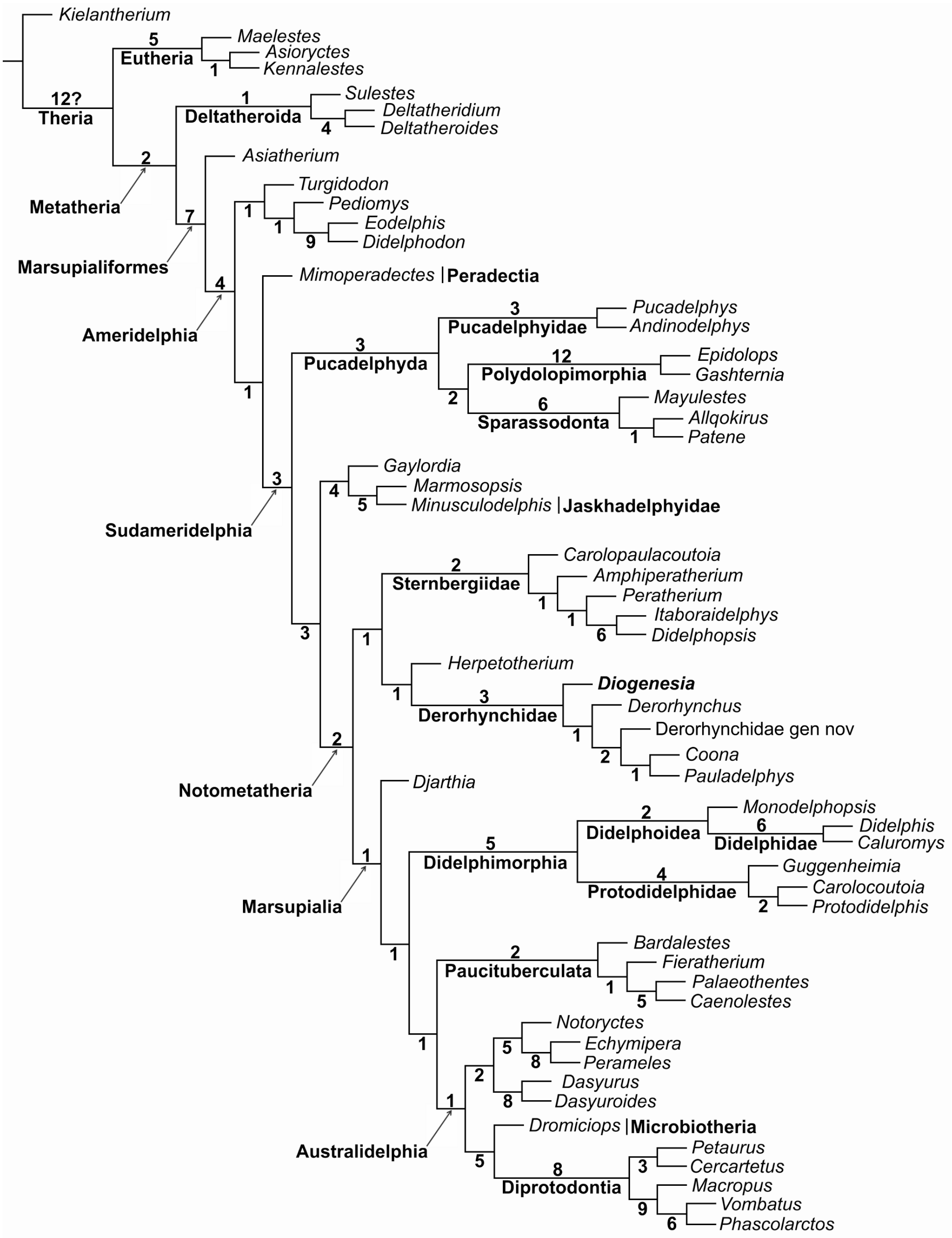

Figure 6. Strict consensus tree (Score = 1450; CI = 0.423; RI = 0.591). *Diogenesia brevirostris* is highlighted in bold. Numbers above and below the branches indicate the absolute Bremer Support.

stapedial artery, although it is also lost in several eutherians (Wible 1990). Based on regression analysis of petrosals (Ladevèze & Muizon 2010), none of the eight petrosal morphotypes were compatible in size with *Derorhynchus*. However, we have identified, at least, two more genera (including *Diogenesia*) of derorhynchids in the Itaboraí fauna. Judging by the m2 and m3 areas, the petrosal types III and V are comparable in size with *Diogenesia brevirostris*, but also with *Marmosopsis juradoi* (one of the most abundant named species of Itaboraí fauna; Beck, 2017) and *Gaylordia macrocynodonta,* more specifically the specimens previously assigned to *Gaylordia "doelloi"* (see Oliveira & Goin 2015).

According to Ladevèze & Muizon (2010), the petrosal type V is assigned to Paucituberculata, whereas petrosal type III is recovered as a stem Australidelphia (see Ladevèze & Muizon 2010:762). Based on the current taxonomical composition of marsupialiforms in Itaboraí, we have made new associations involving isolated petrosals. For example, petrosal Type VI is associated to an undescribed Derorhynchidae (probably a new genus, Figure 6), which is suggestive of a stem Australidelphia (Ladevèze & Muizon 2010). However, referral of petrosals to *Diogenesia* should be viewed with caution, considering that this taxon is based only on the type. In this way, following the hypothesis that one of these petrosals morphotypes (III or V) could be assigned to *Diogenesia*, and that the Type VI could belong to Derorhynchidae new genus, the Punta Peligro material would sharply differ from that of an expected derorhynchid petrosal.

The interesting record of derorhynchids in the early Eocene of Antarctica (*Derorhynchus* and *Pauladelphys*) has raised some proposal linking these metatherians to australidelphians, paucituberculatans or to the enigmatic early Eocene *Djarthia* from Australia (Goin 2003, Goin et al. 2009, Oliveira & Goin 2011). Goin (2003) noted that the derorhynchid dental pattern is similar to that of generalized peramelemorphians. We observed that the lower molars of *Diogenesia* (e.g. m2-3) share some features with early peramelemorphians, including the posthypocristid transversal to the dental axis and the circular (or oval) and mesially shifted entoconid. Is particularly noticeable that in both derorhynchids and basal peramelemorphians, the cristid obliqua forms an angle between 60^0 and 70^0 with the posthypocristid. Regarding the upper molars (e.g. M1-2), in *Derorhynchus* the most noticeable similarities include at least the protocone transversely compressed so that the postprotocrista is almost longitudinally oriented, a deep centrocrista, a shallow ectoflexus and a salient metastyle (Oliveira, 1998, see Figure 5a). Interestingly, these characters can be observed in the oldest peramelemorphians described from Australia (Travouillon et al. 2013). Later Goin et al. (2009) suggested that derorhynchids show some features that anticipate the molar pattern of Paucituberculata, including large (although not proportionally huge) StB, a deeply V-shaped centrocrista, winged metaconule that is larger than the paraconule, and molars with a salient hypoconid and, in some cases, a slightly labiolingually compressed entoconid. Regarding only the lower dentition, *Diogenesia* lacks a salient hypoconid in relation to paucituberculatans, a condition that in derorhynchids is consistently present in *Pauladelphys juanjoi* and *Derorhynchus singularis* (Goin et al. 2009, Oliveira & Goin 2012). Contrasting these two potential phylogenetic links, we verified that derorhynchids share a greater combination of features with peramelemorphians, as advocated by Goin (2003). However, additional specimens (dental and postcranial) will probably be required to clarify these potential relationships, as our results recovered derorhynchids as more closely related to herpetotheriids (see also Oliveira 1998).

In addition to the comparisons between derorhynchids and paucituberculatans or peramelemorphians, Oliveira (1998), Goin (2003) and Oliveira & Goin (2011, 2012) have drawn attention to the similarities between taxa from Itaboraí and from the early Eocene Tingamarra fauna at Murgon locality, Australia, where are registered the oldest Australian metatherians, including *Djarthia*, *Chulpasia*, *Thylacotinga* and *Archaeonothos* (Godthelp et al. 1999, Beck 2015). Unfortunately, phylogenetic analyses of *Djarthia* have not included taxa from Itaboraí (e.g. Beck et al. 2008; but see Beck 2017, which includes *Epidolops*), being important to note that *Djarthia* was recognized exclusively on teeth (Godthelp et al. 1999). While Beck et al. (2008) based largely on tarsal evidence suggests that *Djarthia* is a plesiomorphic australidelphian, another research based on total evidence phylogeny and focused on Dasyuromorphia recovered *Djarthia* outside Australidelphia (Kealy & Beck 2017). In our phylogenetic analysis, *Djarthia* was recovered as the sister taxon to Marsupialia (Figure 6). Pending the inclusion in a denser phylogeny of this taxon together with Itaboraí taxa, we consider that Itaboraí metatherians such as Sternbergiidae and Derorhynchidae constitute important elements of comparisons in this context. For example, derorhynchids share several features with *Djarthia*, including salient hypoconids, posthypocristid transversely oriented, well-developed entoconids, hypoconulid placed at the posterolingual corner of tooth, upper molars with StB>StC>StD, deep v-shaped centrocrista, labially compressed protocone (at least in M1 of *Djarthia* and in M1-2 of *Derorhynchus*) and M4 with a straight mesial face containing the parastyle that is transversely aligned with the preparacrista, paracone, paraconule and protocone.

Regarding to paleobiology, members of Derorhynchidae (e. g. *Derorhynchus* and *Coona*) have been interpreted as very small insectivores, in general with less than 100 g (Goin et al. in press). Measurements using m3 to predict body mass for six species of derorhynchid suggest that they vary from 5.7/6.3g in *Coona gutierrezi* to 112/140.3g in *Pauladelphys juanjoi* (see Table I, Figure 2). The best fit to the regression lines is represented by the molar area (Figure 2). *Diogenesia brevirostris* presented an estimated body mass between 17 to 20 g using m2, m3 and m4 areas. As seen above, *D. brevirostris* is one of smallest derorhynchid and some dental features suggest an insectivorous diet for it, including molars with sharp crests, tall and slender cuspids, broad basins, and trigonid taller than the talonid.

CONCLUSIONS

Diogenesia brevirostris represents a new derorhynchid taxon from the Itaboraí fauna. This new taxon indicates that during the Early Eocene of South America the Derorhynchidae was more diverse than previously thought, with at least three genera (*Derorhynchus*, *Diogenesia* and *Coona*). Derorhynchids were widespread during the Eocene of South America, with a geographical distribution ranging from latitudes of about 22^{0}S (Rio de Janeiro, Brazil) to about 64^{0}S (Marambio/Seymor Island, Antarctica). The only dubious Paleogene record for southern South America concerning to an isolated and incomplete petrosal tentatively referred to *Derorhynchus* sp. Due to the fragmentary condition of this petrosal, the presence of unambiguous derived features of metatherians could not be verified. The interesting record of derorhynchids in

Antarctica has raised some proposal linking these metatherians to australidelphian or to paucituberculatan marsupials. Contrasting these two potential phylogenetic links, we verified that derorhynchids share a greater combination of features with peramelemorphians, as well as with *Djarthia* and relatives, both representing Australian groups. We also highlight the possible affinities of derorhynchids with herpetotheriids as recovered by our phylogenetic analysis. *Diogenesia brevirostris* was one of the smallest representatives of the Itaboraí fauna and probably had an insectivorous diet. It seems to represent one of the earliest lineages of Derorhynchidae, mainly due to its short and shallow dentary in comparison with the more derived condition of *Derorhynchus, Coona* and *Pauladelphys* which have relatively longer and deeper dentaries.

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