

Dimorphism in Quaternary Scelidotheriinae (Mammalia, Xenarthra, Phyllophaga)

Ángel R. Miño-Boilini and Alfredo E. Zurita

ABSTRACT

The contributions concerning possible cases of sexual dimorphisms in fossil and living sloths are scarce. Until now, studies in fossil ground sloth sexual dimorphism have been limited to the subfamilies Megatheriinae (*Eremotherium*) and Mylodontinae (*Paramylodon*) from the Pliocene and Pleistocene of South America and North America. Scelidotheriinae constitutes an endemic lineage of ground sloths from South American, with a biochron age ranging the lapse “Friasian”-Lujanian SALMAs (middle Miocene-early Holocene). An integral phylogenetic and taxonomic revision of the Quaternary Scelidotheriinae shows that it is possible to recognize three genera and six species: *Scelidotherium* Owen (*Scelidotherium leptocephalum* and *S. bravardi*), *Valgipes* Gervais (*Valgipes bucklandi*), and *Catonyx* Ameghino (*Catonyx cuvieri*, *C. tarijensis*, and *C. chiliensis*). One of the most noticeable aspects in some specimens analyzed (n= 47) was the presence of two morphotypes in each species at the level of the dorsal crests of the skull (parasagittal crests and sagittal crest) and at the level of the distal-most region of the mandible (only in *C. tarijensis*). In all but two species (*S. leptocephalum* and *S. bravardi*) the two types involve the absence and presence of a sagittal crest. We suggest that specimens with sagittal crest are males, and specimens lacking sagittal crest are females. This represents the third reported ground sloth clade with evidence of sexual dimorphism of the skull and mandible.

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INTRODUCTION

Sexual dimorphism (i.e., differences in form between males and females belonging to the same species) is a widespread attribute in extant mammals (Ralls, 1977; Smith and Fisher, 2013), mainly represented by differences in body size (Isaac, 2005), but also including coloration, horns, and antlers (McDonald, 2006). In most species, males are larger than females. However, the existence of taxa in which females are larger has also been reported (e.g., Ralls, 1977; Lara-Ruiz and Chiarello, 2005).

Until now, most of the contributions on sexual dimorphism in extant mammals were limited to northern hemisphere taxa, whereas studies in tropical regions and the southern hemisphere were scarce (Isaac, 2005). Sexual dimorphism has recently been postulated for several extinct taxa, especially dinosaurs and mammals (Barden and Maidment, 2011; Smith and Fisher, 2013). This involves differences in body size and osteological characters (McDonald, 2006). McDonald (2006) and Czerwonogara and Fariña (2013) have recently suggested that the recognition of sexual dimorphism in extinct taxa could allow for the inference of some aspects of the ethological and social structure of populations under study. Sexual dimorphism also has taxonomic implications, because several species or subspecies may be actually based on males and females (see Kurtén, 1969; Frailey, 1986; McDonald, 2006).

Among mammals, the orders Artiodactyla, Carnivora, and Primates constitute the paradigmatic groups concerning studies on sexual dimorphism (including morphological and ethological differences), and thus have been used as analogous models for other groups of extinct mammals. However, as mentioned by McDonald (2006), one key question is whether these groups can be used to interpret possible sexual dimorphism in other clades such as ground sloths.

The order Xenarthra is a particular group of placental mammals, characteristic of the Neotropical region, and restricted to the American continent (Rose and Gaudin, 2010). This group includes three large clades: Cingulata (armadillos), Vermilingua (anteaters), and Tardigrada [=Phyllophaga or Folivora (ground sloths)]. Vermilingua and Tardigrada constitute the clade Pilosa (Delsuc et al., 2002; Gaudin and McDonald, 2008). Scelidotheriinae (middle Miocene-early Holocene) constitute one of the most diverse clades of Tardigrada, restricted to South America. According to the last taxonomic revision, three Quaternary genera and

six species are to be considered valid (Miño-Boilini, 2012; Corona et al., 2013).

The first studies on sexual dimorphism of some fossil ground sloths (e.g., Megatheriinae: *Eremotherium laurillardi* and Mylodontinae: *Paramylodon harlani*) were carried out by Cartelle and Bohórquez (1982) and McDonald (2006). These authors were able to recognize two morph types on the basis of crania, and concluded that they represent males and females.

Among the valid taxa of Scelidotheriinae, one of their most interesting characteristics are the morphological variations observable at the level of the dorsal crests (parasagittal crests and sagittal crest of the skull) and of the most distal region of the mandible. The goal of this contribution is to describe the two morph types present at skull level in each species. The possibility that this morphology represents sexual dimorphism is discussed.

MATERIAL AND METHODS

We studied skulls and mandibles of specimens of Quaternary Scelidotheriinae deposited in the collections of various institutions in Argentina and abroad (see institutional abbreviations). The following genera are recognized for the Quaternary period: *Scelidotherium* Owen, 1839, *Valgipes* Gervais, 1873, and *Catonyx* Ameghino, 1891 (see Pujos, 2000; McDonald and Perea, 2002; Cartelle et al., 2009; Miño-Boilini, 2012; Corona et al., 2013).

Most of the skulls and mandibles of the specimens correspond to adult individuals, are in good state of preservation and fairly complete. A total of 47 specimens were studied ($n = 10$ *Scelidotherium leptocephalum*; $n = 6$ *S. bravardi*; $n = 3$ *Valgipes bucklandi*; $n = 19$ *Catonyx tarijensis*; $n = 4$ *C. chilensis*; $n = 5$ *C. cuvieri*). The measures were taken with a digital caliper, with a range of error of 0.5 mm (Figure 1). The sagittal crest is defined as an evident dorsal hump on the sagittal line of the skull formed by the junction of sagittal crests and with a maximum transverse diameter of 25 mm (Figures 2-10).

Differences in skull measurements between the two morphotypes (*Scelidotherium leptocephalum* and *Catonyx tarijensis*) were assessed by Kruskal-Wallis test. This analysis was not performed in the remaining species because of the low number of available specimens. Differences were considered to be statistically significant at $p < 0.05$. Statistical analyses were performed using Infostat Software (Di Rienzo et al., 2012).

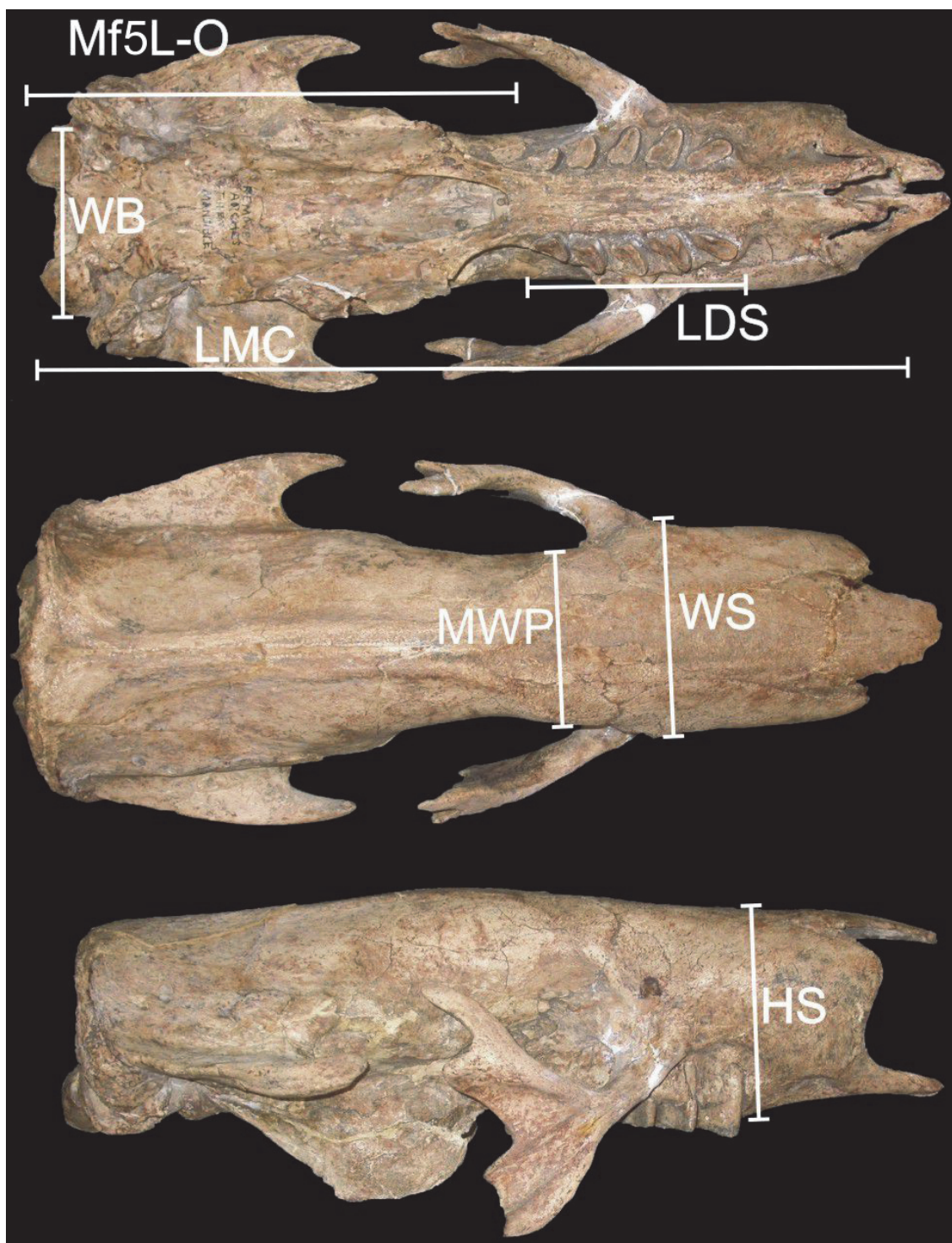


FIGURE 1. Measurements used for comparisons.

Institutional abbreviations. BM(NH)M: British Natural History Museum, London, England; CTES-PZ: Paleozoología Corrientes, Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste, Corrientes, Argentina; FMNH P: Field Museum of Natural History, Chi-

cago, USA; MACN: Sección Paleontología Vertebrados, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; MCL: Museu de Ciências Naturais da Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Brazil; MD: Museo Municipal “Carlos Dar-



FIGURE 2. *Scelidotherium leptocephalum*. Skulls in dorsal view. 1, MMP 1155-M; 2, MACN 9625. Scale bar equals 10 mm.

win”, Punta Alta, Buenos Aires, Argentina; MFCA: Museo Universitario “Florentino y Carlos Ameghino”, Universidad Nacional de Rosario, Santa Fe, Argentina; MLP: División Paleontología Vertebrados, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Buenos Aires, Argentina; MHN-UNSL-GEO V: Museo de Historia Natural Universidad Nacional de San Luis, Geología Vertebrados, San Luis, Argentina; MMP: Museo Municipal de Ciencias Naturales de Mar del Plata, “Lorenzo Scaglia”, Buenos Aires, Argentina; MNPA: Museo Nacional Paleontológico-Arqueológico, Tarija (ex MUT: Museo Universitario de Tarija), Bolivia; MNHN: Muséum national d’Histoire naturelle, Paris, France; NRM-M: Swedish Museum of Natural History, Stockholm, Sweden, collection Nordenskiöld; PIMUZ A/V, Paleontologisches Institut und Museum der Universität der Zurich, Swiss; ROM: Royal Ontario Museum, Toronto, Canada; SGO-PV: Museo Nacional de Historia Natural, Santiago, Chile; ZMUC: Zoologisk

Museum Universitat Copenhagen, Copenhagen, Denmark.

Anatomical abbreviations. Mf/mf: upper/lower molariform tooth.

Measurement abbreviations. WB: width bicondylar; LMC: length maxillar-condylar; LDS: length of dental series; MWP: minimum width postorbital; OMf5L: distance between the occipital condyles and the posterior edge of molariform 5; WS: width of snout; HS: height of snout.

SYSTEMATIC PALEONTOLOGY

(Tables 1 and 2)

Superorder XENARTHRA Cope, 1889

Order TARDIGRADA Latham and Davies in Forster, 1795

Family MYLODONTIDAE Gill, 1872

Subfamily SCOLIDOTHERIINAE Ameghino, 1904

Genus *Scelidotherium* Owen, 1839



FIGURE 3. *Scelidotherium bravardi*. Skulls in dorsal view. 1, MMP 157-S; 2, holotype BM(NH)M 37626. Scale bar equals 10 mm.

Scelidotherium leptocephalum Owen, 1839
(Figure 2.1-2)

Referred material. FMNH P 14274, skull, mandible, right scapula, left humerus, right and left ulnas, left and right radius, some bones from the autopod; FMNH P 14267, skull; MACN 9625, partial skull; MACN 13880, partial skull; MACN 13883, skull; MLP 3-409, partial skull, toothless; MMP 1155-M, skull and mandible; MLP 3-402, skull; MLP 3-408, skull and right hemimandible; MFCA 757, skull.

Description. In dorsal view, the parasagittal crests start in the nuchal crest and end at the postorbital process of the frontal bone, as in all Quaternary Scelidotheriinae, but no sagittal crest is observed. This morphology allows the identification of two variants. In some specimens (FMNH P 14274, FMNH P 14267, MMP 1155, MLP 3-402, MFCA 757, and MLP 3-408), the parasagittal crests are parallel along all their extension (at the level of the parietal and frontal) (Figure 2.1). In other specimens (MACN 9625, MACN 13880, MACN 13883, and MLP 3-409), the parasagittal crests are parallel

to each other at the level of the parietal, but have a "horseshoe" shape at the level of the fronto-parietal suture, delimiting a rhomboidal morphology; in their most anterior portion, parasagittal crests become parallel again (Figure 2.2).

Scelidotherium bravardi Lydekker, 1886
(Figure 3.1-2)

Referred material. BM(NH)M 37626, skull almost complete; MMP 9-S, partial skull; MMP 31-S, skull and partial mandible; MMP 128-S, toothless skull; MMP 458-S, skull, mandible, left femur, right radius, patella; MMP 157-S, skull and mandible.

Description. The morphology observed is very similar to that of *Scelidotherium leptocephalum*, without the development of a sagittal crest. In some specimens, the parasagittal crests are parallel in all their extension (MMP 9-S, MMP 31-S, MMP 128-S, and MMP 157-S) (Figure 3.1), while in others they show a rhomboidal outline at the level of the fronto-parietal suture [BM(NH)M 37626 and MMP 158-S] (Figure 3.2).



FIGURE 4. *Valgipes bucklandi*. Skulls in dorsal view. 1, MCL 4294; 2, MCL 4293. Scale bar equals 10 mm.

Genus *Valgipes* Gervais, 1873
Valgipes bucklandi (Lund, 1839)
 (Figure 4.1-2)

Referred material. MCL 4262, skull almost complete, hemimandible with a portion of the symphysis, with the mf1-2 and dermal ossicles; MCL 4264, partial skull, partial right hemimandible, left and right astragali, right tibia and fibula; MCL 4293, partial skull, partial right hemimandible that preserves only the mf3, several vertebrae, almost complete hand, right femur, right tibia and fibula, right and left astragali.

Description. In dorsal view, the parasagittal crests start at the nuchal crest and end at the level of the postorbital process of the frontal. In some specimens (MCL 4294 and MCL 4262), a little behind the fronto-parietal suture, the parasagittal crests differ in the form of "wedge" in the direction of the postorbital processes, with the presence of a sagittal crest on the middle line of the parietal (Figure 4.1). In contrast, specimen MCL 4393 does not

have the sagittal crest, and its parasagittal crests have the same morphology (Figure 4.2).

Genus *Catonyx* Ameghino, 1891
Catonyx tarijensis (Gervais and Ameghino, 1880)
 (Figures 5.1-2, 6.1-2)

Referred material. CTES-PZ 7151, partial skull; CTES-PZ 1690, posterior portion of the skull; FCS 96.115/1/2, partial skull; FMNH P 14238, skull, mandible, left scapula, left and right humerus, ulna and radius, left femur; FMNH P 13733, partial skull; MACN 1138, posterior portion of the skull; MNPA-V 005769, skull and mandible; MNPA-V 005750 (former MUT 32), skull and mandible; MNPA-V 005766 (former MUT 298), skull and partial mandible; MNHN TAR 1260, holotype of *Scelidodon tarijensis*, partial skull and mandible associated; MNPA-V s/n (former MUT 166), skull and mandible associated; MNPA-V s/n (former MUT 446), partial mandible, with molariforms; MNPA-V s/n (former MUT 007), partial mandible, with molariforms; NRM-M 4444, skull and mandible; FMNH P 14243,



FIGURE 5. *Catonyx tarijensis*. Skull and mandible in dorsal view. 1 and 2 FMNH P 14243. Scale bar equals 10 mm.

skull and mandible, portions of the postcranial; MD-97-23, partial skull; MMP 3989, posterior portion of the skull; MMP 1267, complete skull, mandible nearly complete, humerus, ulna, radius, all in good state of preservation; PIMUZ A/V 0512, partial skull.

Description. The parasagittal crests originate in the nuchal crest and end at the level of the postorbital process of the frontals. In some specimens (FMNH P 14243, MNHN TAR 1260, MNPA-V 005750, MNPA 005766, MNPA-V 005769, MUT 166, MACN 1138, MMP 3989, NRM-M 4444, and CTES-PZ 7151), the sagittal crest has a high degree of development and is straight along all its extension, and diverges only in the most anterior part of the frontals (Figure 5.1). In other specimens (FMNH P 13733, MD 97-23, PIMUZ A/V 0512, MMP 1267, and CTES-PZ 1690), the sagittal crest starts diverging at the level of the fronto-parietal suture and ends at the post-orbital narrowing, acquiring an "hourglass" shape. Finally, only two specimens (FMNH P 14238 and FCS 96.115/1/2) show total absence of dorsal crests (Figure 6.1).

Catonyx chiliensis (Lydekker, 1886)
(Figure 7.1-2)

Referred material. BM(NH)M 2819, partial skull; SGO-PV 188, posterior portion of the skull; ROM 2089, partial skull, ROM 4572, partial skull; MHIN-UNSL-GEO V 199, partial skull in a good state of preservation, only preserving the right Mf1.

Description. In this taxon, the parasagittal crests start in the nuchal crest and end at the level of the postorbital process of the frontal, as in all Quaternary Scelidotheriinae. In some specimens (ROM 4572 and BM(NH)M 2819), the sagittal crest is slightly developed at the level of the parietals, and the parasagittal crests differ at the level of the fronto-parietal suture (Figure 7.1). In contrast, in other specimens (ROM 2089, SGO-PV 188, MHIN-UNSL-GEO V 199), the parasagittal crests fail to develop into a sagittal crest (Figure 7.2).

Catonyx cuvieri (Lund, 1839)
(Figure 8.1-2)

Referred material. MCL 4265, partial skull, right humerus, ulnas and left and right radii, partial right scapula, astragali and right and left calcanei, several vertebrae; MCL 4259, partial skull; MCL



FIGURE 6. *Catonyx tarijensis*. Skull and mandible in dorsal view. 1 and 2 FMNH P 14238. Scale bar equals 10 mm.

22682, partial skull; MCL 22683, partial skull; ZMUC 1668, partial skull.

Description. Like in the other taxa discussed above, the parasagittal crests start in the nuchal crest and end at the level of the postorbital process of the frontal (Figure 8.1). Some specimens (MCL 4265, MCL 4259) show a straight sagittal crest at the level of the sagittal line in parietals and frontals, whereas others (MCL 22682, MCL 22683, and ZMUC 1668) do not present the sagittal crest (Figure 8.2).

DISCUSSION AND CONCLUSIONS

Among Eutheria, Xenarthra has been interpreted as a clade with a low degree of sexual dimorphism (see Lara-Ruiz and Chiarello, 2005; Squarcia et al., 2009). This is in part corroborated by the fact that the only modern contributions to extant taxa are limited to the Tardigrada Bradypodidae *Bradypus torquatus* Illiger, 1811 (Lara-Ruiz and Chiarello, 2005) and the Cingulata Dasypodidae *Chaetophractus villosus* Desmarest, 1804 (Squarcia et al., 2009). This situation clearly con-

trasts with that observed in both fossil and living species belonging to other orders, such as Proboscidea, in which a clear sexual dimorphism has been established in *Mammuth americanum* Kerr, 1792 and *Loxodonta* Anonymous, 1827 (Smith and Fisher, 2013).

Concerning fossil Xenarthra, sexual dimorphism cases reported only correspond to the Tardigrada Mylodontinae and Megatheriinae (Pujos et al., 2012). A pioneer work on this subject is that of Cartelle and Bohórquez (1982), who mentioned a series of characters that may indicate sexual dimorphism in specimens of *Eremotherium laurillardii* Lund, 1842, from Gruta das Onca, Município de Jacobina, Bahia State (Brazil) in the late Pleistocene-Holocene. The characters mentioned are present at the level of the skull, more precisely on the dorsal crests (sagittal crest, supraorbital crests). Cartelle and Bohórquez (1982) suggested that the sagittal crest is more developed in males and less developed in females and that this could have taxonomic implications. They thus suggested



FIGURE 7. *Catonyx chiliensis*. Skulls in dorsal view. 1, BM(NH)M 2819; 2, MHIN-UNSL-GEO V 199. Scale bar equals 10 mm.

possible synonymy among species of *Eremotherium*.

In a subsequent contribution, De Iuliis and Cartelle (1999) indicated that specimens of *Eremotherium eomigrans* De Iuliis and Cartelle, 1999, from the late Pliocene – early Pleistocene of Florida (USA), show the same distribution of characters as in *Eremotherium laurillardi*, suggesting the presence of sexual dimorphism in this taxon. In summary, and in agreement with Cartelle and Bohórquez (1982) and De Iuliis and Cartelle (1999), *E. laurillardi* and *E. eomigrans* show sexual dimorphism within Megatheriinae, and the characters are mainly at the level of the skull and mandible. In this context, it is important to remark that Cartelle and Bohórquez (1982) and De Iuliis and Cartelle (1999) expressed no hypotheses concerning possible social structure in this taxon.

More recently, McDonald (2006) conducted a study on the variation of the skull of Mylodontinae of the Pleistocene of Rancho La Brea (USA), where he analyzed two cranial morphologies tradi-

tionally interpreted as belonging to two subspecies, *Paramylodon harlani harlani* (Owen, 1840) and *Paramylodon harlani tenuiceps* (Stock, 1917). His results show that the specimens can be separated into two groups: one with relatively more robust skulls (*Paramylodon harlani harlani*) and the other with more slender skulls (*Paramylodon harlani tenuiceps*). McDonald (2006) also observed some variation in the occlusal surface of the caniniform (e.g., in lateral view, some have an oblique occlusal surface whereas others have a perpendicular one). In summary, McDonald (2006) observed two skull morphologies, a "robust" and a "slender" one, which could, in fact, correspond to males and females of the same species. Based on the ungulate model, McDonald (2006) suggested that *Paramylodon* would have solitary to semi-solitary habits or would have formed small, single-sex social groups during much of the year. On the other hand, and following the carnivore model, the medium-high sexual dimorphism observed in



FIGURE 8. *Catonyx cuvieri*. Skulls in dorsal view. 1, MCL 4265; 2, MCL 22683. Scale bar equals 10 mm.

Paramylodon could indicate a polygamous life-style.

Brandoni et al. (2010), in a revision of *Myiodon darwini* Owen, 1839, concluded that it was not possible to observe sexual dimorphism in this species.

Lastly, Czerwonogara and Fariña (2013) revised the two recognized species of *Lestodon* Gervais, 1855 (*Lestodon armatus* Gervais, 1855 and *Lestodon australis* Kraglievich, 1934), including an estimation of body mass. Their results suggested that no dimorphism is present in this genus, and that there is one valid species, *L. armatus*. These authors suggested that in large fossil ground sloths, such as *Eremotherium laurillardi*, it is possible to observe an evident sexual dimorphism, as in large mammals. However, one important point, as highlighted by McDonald (2006) in *Paramylodon* and by Czerwonogara and Fariña (2013) in *Lestodon*, is that in their samples skulls were not associated with the pelvis, suggesting

that their conclusions regarding sexual dimorphism are open to revision.

In this scenario, it is also important to note that Prothero and Raymond (2008) suggested that size sexual dimorphism in sloths is not as widespread a character as once believed.

In our study we were able to recognize two morphological variants in each species analyzed (Figures 9, 10). In *Valgipes bucklandi*, *Catonyx tarijensis*, *C. chilensis*, and *C. cuvieri*, the differences observed included the presence and absence of a sagittal crest. On the other hand, *C. tarijensis* is the only Scelidotheriinae that also shows two morphological variants at mandible level. One of these variants presents an edge at the level of the anterior portion of the mandibular ramus that is similar in occlusal view to a "duck's bill" (MNPA 005769 and FMNH P 14243) (Figures 5.2, 10.2), whereas the other lacks this edge (MNPA 005750, FMNH P 14248 and MRN-M 4444) (Figures 6.2, 10.4). These two morphologies seem to be related to the presence and absence of a sagittal crest, respec-

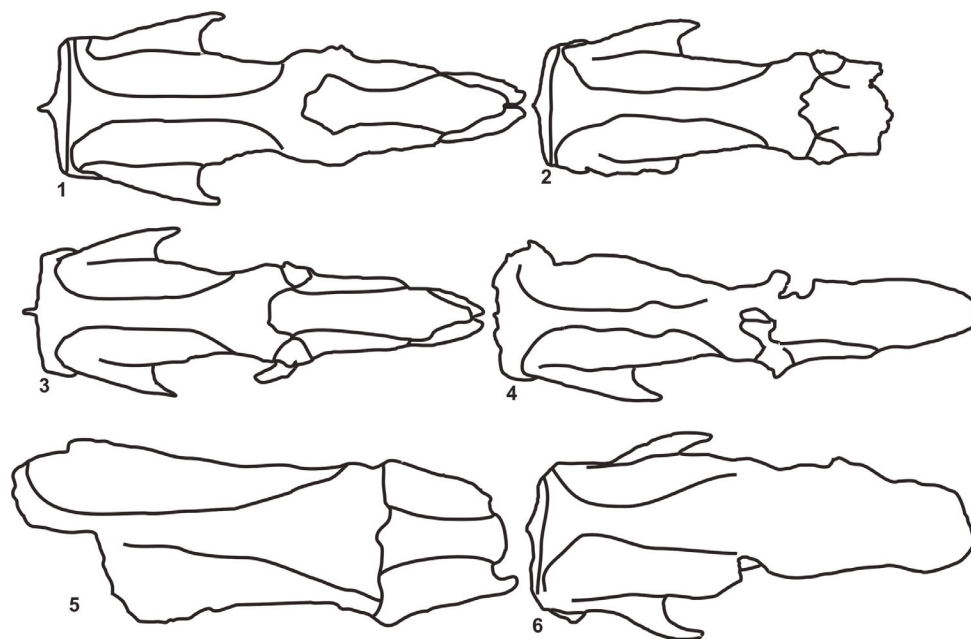


FIGURE 9. Skull outlines in dorsal view. 1 and 2, *Scelidotherium leptocephalum* (MMP 1155-M, MACN 9625); 3 and 4, *Scelidotherium bravardi* (MMP 157-S, BM(NH)M 37626); 5 and 6, *Valgipes bucklandi* (MCL 4294, 4393).

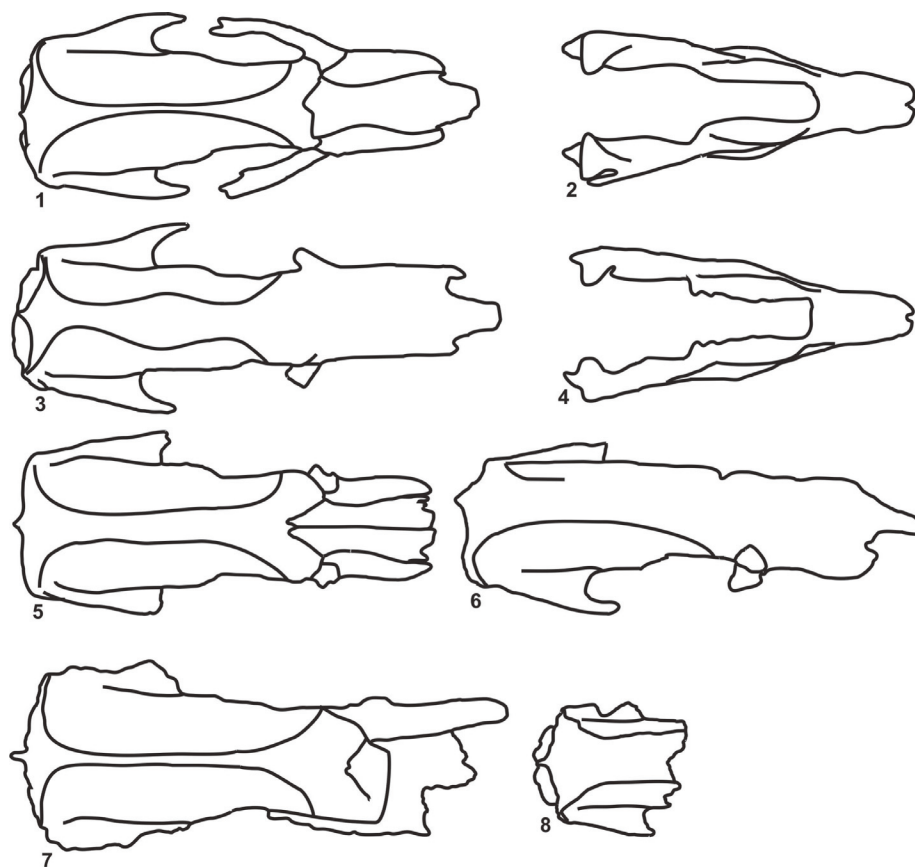


FIGURE 10. Skull and mandible outlines in dorsal view. 1 and 2, *Catonyx tarijensis* (FMNH P 14243); 3 and 4, *Catonyx tarijensis* (FMNH P 14238); 5 and 6, *Catonyx chiliensis* (BM(NH)M 2819 Type, MHIN-UNSL-GEO V 199); 7 and 8, *Catonyx cuvieri* (MCL 4265, MCL 22683).

TABLE 1. Comparative measurements (in mm) of skulls. *Approximate.

Taxa	LMC	LDS	MWP	WS	HS	OMf5L	WB
<i>S. leptocephalum</i> (FMNH P 14274)	520	110	109	100	125	295	117
<i>S. leptocephalum</i> (FMNH P 14267)	400	90	100	90	111	225	111
<i>S. leptocephalum</i> (MLP 3-409)	415	85	95	85	105	230	100
<i>S. leptocephalum</i> (MLP 3-408)	400	85	90	75	100	200	82
<i>S. leptocephalum</i> (MLP 3-402)	470	105	90	95	105	250	100
<i>S. leptocephalum</i> (MACN 13880)	550	110	100	100	125	290	110
<i>S. leptocephalum</i> (MACN 13883)	515	105	90	90	115	275	100
<i>S. leptocephalum</i> (MACN 9625)	---	110	105	97	---	270	100
<i>S. leptocephalum</i> (MMP 1155-M)	520	110	120	100	145	260	115
<i>S. leptocephalum</i> (MFCA 757)	510	111	94	93	105	254	98
<i>S. bravardi</i> (MMP 9-S)	410	90	75	75	113	230	105
<i>S. bravardi</i> (MMP 31-S)	500	109	95	95	135	295	112
<i>S. bravardi</i> (MMP 128-S)	405	100	85	85	116	242	120
<i>S. bravardi</i> (MMP 458-S)	385	88	80	81	110	213	77
<i>S. bravardi</i> (MMP 157-S)	560	113	96	80	117	278	116
<i>V. bucklandi</i> (MCL 4262)	365	110	87	70	100	190	95
<i>V. bucklandi</i> (MCL 4293)	405	110	90	77	110	230	100
<i>C. tarijensis</i> (CTES-PZ 7151)	540	120	97	123	113	300	120
<i>C. tarijensis</i> (MMP 1267)	540	135	90	110	140	283	125
<i>C. tarijensis</i> (FMNH P 14243)	500	120	90	120	125	285	123
<i>C. tarijensis</i> (FMNH P 14238)	550	135	100	105	127	285	123
<i>C. tarijensis</i> (FMNH P13733)	490	130	97	110	120	290	120
<i>C. tarijensis</i> (MD-97-23)	465	112	90	100	117	285	112
<i>C. tarijensis</i> (MNPA 005750)	482	130	97	110	120	290	120
<i>C. tarijensis</i> (MNPA 005766)	*466	126	110	106	---	*273	---
<i>C. tarijensis</i> (PIMUZ A/V 0512)	504	131	110	97	136	303	116
<i>C. chiliensis</i> (MHIN-UNSL GEO V199)	520	*120	---	*110	110	*300	110
<i>C. chiliensis</i> (ROM 2089)	450	*90	---	---	---	250	105
<i>C. cuvieri</i> (MCL 4265)	*370	100	*80	*85	---	220	120
<i>C. cuvieri</i> (MCL 4259)	350	100	*85	---	---	210	---

tively. It is important to highlight that two species of Quaternary Scelidotheriinae (*Scelidotherium leptocephalum* and *S. bravardi*) do not have a sagittal crest. In these taxa, the differences involve the morphology of the parasagittal crests. In some specimens, the parasagittal crests are parallel for their entire extension, while in others they show a rhomboidal outline at the level of the fronto-parietal suture.

No significant differences between the two morphotypes of *Scelidotherium leptocephalum* and *Catonyx tarijensis* of the dorsal crests of the skull were observed across all variables (Kruskal Wallis test, $p > 0.05$, $n = 10$ *S. leptocephalum*; $n = 9$ *C. tarijensis*) (Table 3).

Following Cartelle and Bohórquez (1982), we suggest that the specimens with sagittal crest likely represent males, while those lacking sagittal crests represent females. In the case of *Scelidotherium leptocephalum* and *S. bravardi*, the two recognized morphs do not involve the presence/absence of

sagittal crest but different morphologies of the parasagittal crests. Finally, it is important to remark that any hypothesis about sexual dimorphism in fossil ground sloths must be taken with care. This is mainly due to the fact that living sloths (*Bradypus* and *Choloepus*) represent a very different ecological model (i.e., a completely arboreal lifestyle) to these extinct species.

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TABLE 2. Acronyms and list of specimens of *Scelidotherium*, *Valgipes*, and *Catonyx* mentioned in the text.

Material	Taxa	Stratigraphic and geographic precedence
FMNH P 14274	<i>S. leptocephalum</i>	Pleistocene, Río Quequén, Buenos Aires, Argentina.
FMNH P 14267		Pleistocene, Buenos Aires, Argentina.
MACN 9625		"Upper Pampean", Laguna Vital, Chascomús, Buenos Aires, Argentina.
MACN 13880		"Pampean", Necochea, Buenos Aires, Argentina.
MACN 13883		"Pampean", Necochea, Buenos Aires, Argentina.
MLP 3-409		"Upper Pampean", Argentina.
MLP 3-402		"Pampean", Buenos Aires, Argentina.
MLP 3-408		"Upper Pampean", Buenos Aires, Argentina.
MMP 1155		Lobería Formation, Lujanian, Mar del Plata, Buenos Aires, Argentina.
MFCA 757		"Pampean" Formation, right bank of the Paraná River, Alvear, Santa Fe, Argentina.
BM(NH)M 37626 (Type)	<i>S. bravardi</i>	Ensenada Formation, "Toscas" del Río de La Plata, Buenos Aires, Argentina.
MMP 9-S		Ensenadan, NE of the city of Mar del Plata, in front of Santa Elena beach, General Pueyrredón, Buenos Aires, Argentina.
MMP 31-S		Ensenadan?, coastal cliffs in front of Parque Camet, Mar del Plata, Buenos Aires, Argentina.
MMP 128-S		Miramar Formation, base of the cliffs in front the dairy farm of the field of Cobo Mar del Plata, Buenos Aires, Argentina.
MMP 458-S		Ensenadan, coastal cliff, 800 m to the NNE of the pipe drain of the city of Mar del Plata, Buenos Aires, Argentina.
MMP 157-S		Ensenadan?, Estrada beach, Mar del Plata, Buenos Aires, Argentina.
MCL 4262	<i>V. bucklandi</i>	Late Pleistocene, Serra do Ramallo, North of Minas Gerais, Brazil.
MCL 4293		Pleistocene, Gruta Volta da Serra 3, São José das Missões, Minas Gerais, Brazil.
MCL 4264		Late Pleistocene, Iraquara, Brazil.
CTES-PZ 7151	<i>C. tarijensis</i>	Late Pleistocene, Lavalle, Corrientes, Argentina.
CTES-PZ 1690		Yupoí/Toropí Formation, Late Pleistocene, arroyo Toropí, Corrientes, Argentina.
FCS 96.115/1/2		Pleistocene, Olavarría, Buenos Aires, Argentina.
FMNH P 14243		Pleistocene, Padcaya, Bolivia.
FMNH P 14238		Pleistocene, Tarija, Bolivia.
FMNH P 13733		Pleistocene, Tarija, Bolivia.
MNH TAR 1260 (Type)		Pleistocene, Tarija, Bolivia.
MNPA-V 005769		Pleistocene, Tarija, Bolivia.
MNPA-V 005750		Pleistocene, Tarija, Bolivia.
MNPA-V 005766		Pleistocene, Tarija, Bolivia.
MNPA-V s/n (MUT 166)		Pleistocene, Tarija, Bolivia.
MNPA-V s/n (MUT 446)		Pleistocene, Tarija, Bolivia.
MNPA-V s/n (MUT 007)		Pleistocene, Tarija, Bolivia.
NRM-N 4444		Pleistocene, Tarija, Bolivia.
MACN 1138		Pleistocene, Tarija, Bolivia.
MMP 3989		Ensenadan, Mar del Plata, Buenos Aires, Argentina.
MMP 1267		Bonaerian, north of Mar del Plata, Buenos Aires, Argentina.
MD-97-23		Bonaerian-Lujanian, Playa del Barco, Pehuén Cú, Buenos Aires, Argentina.
PIMUZ A/V 0512		Pleistocene, arroyo Maciel, Buenos Aires, Argentina.

TABLE 2 (continued).

Material	Taxa	Stratigraphic and geographic precedence
BM(NH)M 2819	<i>C. chiliensis</i>	Late Pleistocene, Tamarugal, Tarapacá district, Chile.
SGO-PV 188		Late Pleistocene, close to the Desaguadero River, Ulloma, La Paz, Bolivia.
ROM 2089		Late Pleistocene, Guayas Department, Ecuador.
ROM 4572		Late Pleistocene, Guayas Department, Ecuador.
MHN-UNSL-GEO-V 199		Late Pleistocene, Uspara Formation, Pasos Malos, Merlo, San Luis, Argentina.
MCL 4265	<i>C. cuvieri</i>	Late Pleistocene, Iraquara, Brazil.
MCL 4259		Late Pleistocene, Gruta do Túnel, Santana, Brazil.
MCL 22682		Pleistocene, Brazil.
MCL 22683		Pleistocene, Brazil.
ZMUC 1668		Late Pleistocene, Lapa Grande de Genette, Minas Gerais, Brazil.

TABLE 3. Mean of the measurements of the skulls from the two morph types of dorsal crests of *Scelidotherium leptcephalum* and *Catonyx tarijensis*. ($\pm$) is standard deviation. (*) indicate significant differences in the medians with a Kruskal-Wallis Test ($p < 0.05$).

Taxa	Variable	Measurements	p values
<i>S. leptcephalum</i>	LCM	x 477,37 ($\pm$ 55,10)	0,581
	LDS	x 102,1 ($\pm$ 10,94)	0,900
	MWP	x 99,3 ($\pm$ 9,79)	0,981
	WS	x 92,5 ($\pm$ 7,96)	0,957
	HS	x 115,24 ($\pm$ 13,51)	0,676
	OMf5L	x 254,9 ($\pm$ 29,91)	0,352
	WB	x 103,3 ($\pm$ 10,30)	0,828
<i>C. tarijensis</i>	LCM	x 508,8 ($\pm$ 31,02)	0,603
	LDS	x 126,56 ($\pm$ 7,78)	0,263
	MWP	x 97,89 ($\pm$ 7,80)	0,999
	WS	x 109,00 ($\pm$ 8,44)	0,111
	HS	x 124,75 ($\pm$ 9,32)	0,317
	OMf5L	x 290,13 ($\pm$ 7,49)	0,984
	WB	x 119,8 ($\pm$ 4,19)	0,968

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