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Sex and age-biased exploitation and metric characterization of medium-sized deer in the Lower Paraná wetland, South America

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Abstract

In this paper, we present an analysis of the exploitation of medium-sized deer in the Lower Paraná wetland by pre-Columbian hunter-gatherers. To achieve this goal, we developed an osteometric frame of reference for the proper identification of hunted medium-sized deer, and the sex and age of captured individuals. An analysis of thirteen archaeofaunal assemblages showed that *Ozotoceros bezoarticus* ("pampas deer") was the medium-sized deer that was hunted with exclusivity. The presence of *Mazama gouazoubira* ("brown brocket deer"; "gray brocket deer"), which could have been another potentially hunted medium-sized deer, is absent from the record, although this area is indicated as being its southernmost distribution range in South America. These results restrict the distribution of this species to a more northern sector of this large wetland. The hunted individuals of *O. bezoarticus* are all older than two years of age, and preferentially males, although some methodological bias could be influencing these results. Issues related to sex-age selectivity in capturing these animals are discussed according to the development of conservation strategies for local resources.

Key-words: brocket deer, *Mazama gouazoubira*, pampas deer, *Ozotoceros bezoarticus*, fusion stages, osteometry, sexual dimorphism, South American deer

Introduction and objectives

In this paper, we analyze the exploitation of medium-sized deer by pre-Columbian hunter-gatherers from the late Holocene in the southernmost tropical wetland of South America. This peculiar environment is located in the southeast of the subcontinent, at the end of the Paraná River basin (Figure1). At the same time, we explore the sex and age categories of hunted individuals as part of the selectivity applied by the aboriginal population. To do this, faunal collections recovered by systematic excavation from thirteen archaeological sites are analyzed, which are dated from between 2300 ± 43 and 408 ± 30 ^{14}C years BP (Table 1). However, this kind of analysis is not simple; given the lack of a frame of reference in the bone metrics for the two species of medium-sized deer in the region, *Ozotoceros bezoarticus* (pampas deer) and *Mazama gouazoubira* (brown brocket, gray brocket or brocket deer; cf. Black-Décima et al., 2010). In this sense, a major problem in South American zooarchaeology is the correct identification of and differentiation between these species (Acosta et al., 2011; Mucciolo & Acosta, 2012). In the study region, there is also *Blastocerus dichotomus* (marsh deer), but its size is substantially larger than the previous ones (see metric data in Loponte 2004) and therefore, even the juveniles of this species do not approach to the metric values of *M. gouazoubira* or *O. bezoarticus*. These last two deer have a mostly sympatric distribution (Figure 2) and the designs and dimensional range of their postcranium bones are practically identical. However, since *M. gouazoubira* is slightly smaller than the larger individuals of *O. bezoarticus*, in zooarchaeological studies an *ad hoc* dimensional criterion has been used to differentiate between them. This kind of determination without any formal or adequate metric references has a high degree of uncertainty and error. Some of these problems have been exposed after DNA studies on bones identified as pampas deer, which turned out to correspond to brown brocket (Moreno et al., 2016).

In the lower Paraná River wetland, a detailed revision of 39 published archaeofaunal records of the Late Holocene shows that *M. gouazoubira* was identified in ten of them, and in low quantities (Acosta & Mucciolo, 2014). Those positive identifications were done using *ad-hoc* informal criteria, or with a methodology that was not described (Bonomo et al., 2009; Caggiano, 1984; Cione & Tonni, 1978; Cione et al., 1977). Unlike this methodology, a more careful investigation of this topic was done recently on archaeofaunal collections from the same region (Acosta & Mucciolo, 2014), where the absence of *M. gouazoubira* is absolute, whereas, on the contrary, *O. bezoarticus* is the only hunted medium-sized deer. Therefore, reasonable doubts have been raised about the proper identification of *M. gouazoubira*, especially in collections analyzed using informal or not described methods. On the other hand, the metric variability related to the sex and age of both deer, which is vital information when discussing human selectivity in hunting and other related issues, remains unknown.

Given the objectives of this paper, we first develop the key metrics for the bones of *O. bezoarticus* and *M. gouazoubira* based on modern collections, expressed as confidence intervals. This method allows both species to be identified with 95% confidence. We opted for this statistic because it provides a practical and precise frame of reference to be applied in a daily zooarchaeological analysis. At the same time, these metrics and the analysis of the fusion stages helps us to understand the sexual dimorphism and age categories of the skeletal structure. Once this comparative data-base was developed, we measured the selected bones of all the medium-sized deer recovered from the local archaeological sites. Thus, first we obtained a proper taxonomic identification, followed by the age and sex of the hunted individuals.

Distribution and morphology of *M. gouazoubira* and *O. bezoarticus*

Mazama gouazoubira

In phylogenetic terms, the *Mazama* genus is considered to be polyphyletic with various forms divided into two main clades (red and gray, or dun) with high individual polymorphism (Rossi, 2000). *M. gouazoubira* is included in the latter clade. The individuals of this species reach 65 cm tall at the shoulder and 25 kg in weight, with larger specimens tending toward the south of their geographical distribution (Black-Décima et al., 2010). As in most deer family species, the males develop antlers, which in this species are unbranched and more or less straight. There is no solid evidence of any other sexual dimorphism in the skeletons of this species, although no adequate studies on this topic have been carried out. Their distribution ranges from the center-east of Brazil and northwestern Bolivia, to the open plains of Santa Fe and Córdoba provinces in Argentina, extending to the entire the Lower Paraná wetland (Weber & González, 2003) (Figure 2). However, this southern limit is somewhat imprecise. In fact, the most southern current sightings correspond to the Pre-Delta National Park, where its presence is intermittent (Pereira et al., 2005; PIECAS-DP, 2008; Malvárez & Bó, 1995, Quintana et al., 2002). This area is located in section 1 of the Lower Paraná wetlands (Figure 3), about 200 km to the north of the area where the sites whose collections we are analyzing here are located. In section 2 of this wetland (see Figure 3), this species has not currently been identified; it was referred to by local inhabitants in the past (Bó & Quintana, 2013), although the latter identifications should be considered with caution. There are no modern or historical verified reports of *M. gouazoubira* in section 3 (see Figure 3).

Ozotoceros bezoarticus

O. bezoarticus has a light brown skin with white spots on its head, belly, back of the thighs, tail and neck. It reaches somewhat larger size than *M. gouazoubira*, 65-75 cm tall at the shoulder and weighs between 20 and 35 kg (Black-Décima et al., 2010; González et al., 2010; Richard & Juliá, 2001; Weber & González, 2003). Five subspecies have been identified based primarily on the color of the coat and some minor cranial differences. On the Pampas plain the form is *O. b. celer*; in the Chaco, and probably throughout Argentinian Mesopotamia, this species is classified as *O. b. leucogaster*; on the Uruguayan plain there are *O. b. arerunguaensis* and *O. b. uruguayensis*; and in southern Brazil there is *O. b. bezoarticus* (González, 2004; González et al., 2002). There are not enough studies evaluating the variability of the subspecies' weight or the related sexual dimorphism. The total weights reported by González et al. (2010) show similarities between the different geographic forms, except, perhaps, in the *O. b. arerunguaensis* subspecies found in western Uruguay, which seems to be lighter according to the values published by these authors. The females of *O. bezoarticus* tend to be quite small (Gonzalez et al., 2010), but individuals of both sexes have superimposed weights. Jackson (1978, 1987) considered that males are slightly larger, but with no sexual dimorphism in terms of weight, size or pelage. A study based on skull measurements of both Uruguayan species found some differences between males and females in skull width (González et al., 2002). Cassini and colleagues (2015), also based on cranial analysis, found a slight sexual dimorphism in the adults that was probably related to the intensity of the morphological variation, but not in their average size. Three-pointed antlers developed in the skulls of the males of this species. No studies of the post-cranium regarding these issues are available. This deer has a practically sympatric distribution for *M. gouazoubira*, except in the southernmost limit, as *O. bezoarticus* reaches the north of Patagonia and the area next to the Los Andes mountain range in the western semi-deserts of Argentina (Figure 2). The pampas deer did not enter (or did so marginally) the insular and mostly waterlogged prairies of the lower Paraná wetland, as shown by isotopic and zooarchaeological studies (Arrizurieta et al., 2010; Loponte & Corriale, 2019; Loponte et al., 2012, 2016). However, its distribution included the ecotone of the Pampas plains of Buenos Aires and Entre Ríos provinces including the wetland (Figure 3), where local aboriginal populations often encountered and hunted this species.

Materials and methods

Hunting *O. bezoarticus* is forbidden in Argentina, as it considered as "near threatened" by the International Union for Conservation of Nature (UICN) (González et al., 2016). In academic repositories, the availability of its post-cranial skeleton is very limited, which over time has been one of the largest limitations for anatomic studies. To construct a database for *O. bezoarticus*, we measured the bones of 24 individuals, including juveniles and adults, and males and females, with a greater component of the latter (Table S1).

Although *M. gouazoubira* is considered to be of "least concern" for the UICN (Bláck-Décima & Voglioti, 2016), the post-cranial skeletons of this species are extremely rare in academic collections. To construct a reference database for *M. gouazoubira*, four modern adult male specimens from different parts of northeastern Argentina were measured (Table S1). Given that among polygynous mammals males tend to be larger than females (Glucksmann, 1974), which is certainly true among deer in general (*i.e.* Clutton-Brock et al., 1982; Wemmer & Wilson, 1987), and as is apparent in *O. bezoarticus* (González et al., 2010), the sex-age composition of our reference sample discriminates properly for the analysis we are proposing here, as we are comparing a sample that essentially comprises *O. bezoarticus* females (supposedly smaller than the males of this species) and *M. gouazoubira* males (supposedly larger than the females of this species).

All these modern individuals are curated in the Mastozoology Divisions of the Museo Argentino de Ciencias Naturales (Buenos Aires) and the Museo de Ciencias Naturales (Universidad Nacional de La Plata); in the Instituto Nacional de Antropología y Pensamiento Latinoamericano (Buenos Aires) and Fundación Azara (Universidad Maimónides, Buenos Aires). The sexes of the individuals were established according to their craniums; those which did not have one were classified as indeterminate. For *O. bezoarticus*, their ages in years were assigned according to the time of death for individuals from wildlife enclosures, while in the remaining specimens they were assigned based on the eruption sequences and dental wear obtained for this species (Bianchini & Deluppi, 1993). For the few individuals which lacked a skull, their ages were determined according to the fusion stages and sizes of each bone compared to the former. For *M. gouazoubira*, the ages were determined according to the eruption sequences and teeth attrition described for this species (Maffei, 2001); concurrently, the fusion stages were used following the general pattern available for ungulates (Todd & Todd, 1938) and for the closest phylogenetic deer such as *Odocoileus virginianus* (Flinn et al., 2013; Purdue, 1983), *Blastocerus dichotomus* (Loponte, 2004) and *O. bezoarticus* (this study). Once the ages and sexes of the specimens had been established, different bone measurements were done for all the individuals of both species. The measurements were done using a digital caliber three times in succession by the same operator and then the values were averaged. The measurements of each bone follow the guidelines proposed by von den Driesch (1976) with some exceptions, as indicated on the measurement maps (Figure S1). With these results, 95% confidence intervals (CIs) were calculated for each particular measurement of both species (Table 2) using the InfoStat package (Di Rienzo et al., 2012). When the number of samples allowed, the bone measurements were compared with a General Lineal Model. Given the unbalanced design, we used the type III sum of squares (with a "car" package), as advised by Quinn and Keough (2002). We checked for homoscedasticity and normality assumptions (Levene and Shapiro-Wilk tests, respectively). We also inspected the residual plots and verified that the residuals did not deviate from normality and homoscedasticity. When the homoscedasticity of the residuals was not met, we used the varident structure (Pinheiro et al., 2017; Zuur et al., 2009) to account for the heterogeneity of the variances between the factor levels. For this analysis, we applied the "gls" function from the "nlme" package (Pinheiro et al., 2017). The significance threshold was set at 0.05. We applied Bonferroni's correction in cases of multiple comparisons (Table 2). This entire statistical analysis was performed using R software version 3.4.4 (R Development Core Team, 2017). To plot some Euclidean distances between the samples and the reference collections, the Past 2.17c program (Hammer et al., 2001) was used.

Although the archaeological skeletal representation in the analyzed assemblages is mainly based on bones of the zeugopodium and autopodium, we obtained the CI for the majority of the bones of the postcranium to be applied in any South American paleontological, archaeological, or modern records. Confidence intervals were obtained for specimens of $\sim \geq 2$ years, where the dimensional variables can no longer be affected by bone maturation in cursorial animals (Davis 1996; Popkin et al., 2012; see also Table S2). In this way, this study enables us to compare measurements between individuals of ≥ 2 years of both species. We also obtained the CI for males and females of *O. bezoarticus* (Table S3) and, given that the ages of the deer specimens are known, a general fusion sequence of the skeletal elements for this species was developed (Table S4). For this, the bones were separated according to their fusion state: “not fused” (the epiphysis and diaphysis are completely separate; in the tables it is “NF”); “fusing” (the epiphysis and diaphysis are joined by bone splints in an incomplete fusion where the sutures are open; in the tables it is “HF”), and “fused” (the fusion is closed; in the tables it is “F”). It should be noted that the fusion stages depend on the nutritional and health status, genetic issues, the type of environment, and the competition (Carden & Hayden, 2006; Popkin et al., 2012). Given that this study is limited to the available sample of 24 individuals, differences may arise with bigger samples or with specimens recovered from other regions or subspecies. Also, some sexual variation may be expected in the bone fusion process in *O. bezoarticus*, as it has been observed that female deer with the telemetacarpalian condition tend to present an earlier fusion pattern, especially in bones with late fusion (Purdue, 1983); this also happens in other species (Walker 1987). However, the composition of the collection does not allow us to take this analysis of sexual variability in the fusion stages any further.

Once this contemporary basis for the morphometric data was obtained, the same measurements were taken and the fusion states were observed in the bones of medium-sized deer recovered from the archaeological sites listed in Table 1, and located as seen in Figure 3. These records were generated by complex hunter-gatherer groups that were adapted to the wetland environment, with settlements based on a centrally located foraging system, with medium to high residential stability. Their economy was based on freshwater fish, deer (medium-sized deer and *Blastocerus dichotomus*), small-to-medium-sized rodents and freshwater clams. Agroforestry of local palms and the development of more or less sporadic small gardens have also been postulated based on historical sources and some archaeological features (Acosta 2005; Loponte 2008). The techniques used for cooking the deer do not seem to have involved a roasting process, or at least not to such a degree that it affected the bones. Indeed, the number of bones showing evidence of burning is extremely low (average less than 1% of the bones) and there is practically no evidence of calcination. The bones in general terms are well-preserved (weathering stages average ≤ 2; cf. Behrensmeyer & Miller, 2012), including unfused bones (Acosta 2005; Buc & Loponte, 2016; Loponte 2008). However, they were mostly systematically fragmented in their fresh state down to sub-optimal sizes that were suitable for increasing the extraction of nutrients by boiling (cf. Church & Lyman, 2003). This processing explains to a great extent the large amount of pottery recovered from these sites and the underrepresentation of proximal ends compared to the distal ones of large bones (Acosta, 2005; Acosta et al., 2014; Loponte 2008).

For this study, we selected 213 bones (phalanxes, metacarpals, metatarsals, naviculo-cuboids, astragals, and calcaneus). Given the quantity of bones from medium-sized deer recovered when excavating the sites in this region (Acosta, 2005; Acosta & Mucciolo, 2014; Acosta et al., 2014; Arrizurieta et al., 2010; Bastourre, 2014; Cione et al., 1977; Loponte, 2008; Loponte & Acosta, 2008, 2015; Loponte et al., 2012; Mucciolo, 2013; Mucciolo & Musali, 2013), this sample is fairly representative of hunted individuals corresponding to this category.

The values of the confidence intervals allowed us to establish solid morphometric identifications in the archaeological collection, because they do not generally overlap, or do so marginally in some measures; in most of the cases, the CI of one species is outside the range of the other's simple variation. In a very few cases, some archaeological bones showed intermediate or overlapping values. These elements remained indeterminate. After the taxonomic assignment had been carried out, the age and sex of the bones identified as *O. bezoarticus* were evaluated. The age categories were assigned according to the fusion stage obtained in bones with secondary fusion patterns (phalanxes, metapodials, and calcaneus). Because all of the bones included in this study have early fusion stages, the age classes were identified within broader categories with no further precision. For bones with primary fusion patterns (*i.e.* naviculo-cuboids and astragalus), their ages were obtained according to their sizes.

Sex assignment was more complex, as most of the dimensions obtained in the post-skull bones overlapped between both sexes in *O. bezoarticus*. Moreover, the taphonomic, but cultural factors, which produced fractures, especially in phalanxes and metapodials, prevented us from taking all the necessary measures that would improve this identification. Thus, the sex assignment was done following the same security methodology, which means that the value must be exclusive to one of the sexes in the CI range, and this value must be outside the simple variation range for the other sex. Otherwise, they would have been identified as indeterminate. In a very few cases, some bones showed values typical of males, and some values typical of females. In these extremely rare cases, a sex was only assigned if more than 50% of the measures corresponded exclusively to one or the other; otherwise they remained indeterminate.

Results

Reference collection

The metric values obtained from the bones of both species overlapped in a few cases, but most were discontinuous, showing significant statistical differences. However, they had a small magnitude that required the use of formal measurements to support taxonomic identifications. These results are consistent with the small interspecific differences observed between the average sizes of adult individuals of both species. In general terms, it was observed that the upper limit of the CI of the bones of *M. gouazoubira* are lower than the lower endpoint of *O. bezoarticus*, and, in this way, the CI limits became a great analytical tool for differentiating between them. It is also significant that, in many cases, the simple dimensional ranges of one species did not overlap with the simple variation ranges of the other, but this did not happen in every case. For all these reasons, the *ad-hoc* determinations of *M. gouazoubira* carried out in the collections from the study area should be re-analyzed in the light of these data. It is important to note that not all of the measurements we selected here for each bone had the same discriminant capacity. Some measurements in certain bones were very similar or had a wide range of overlap, while other measurements of these same bones were significantly discriminating (see Table 2). Therefore, the taxonomic determination should present the more discriminatory and/or the largest number of measures that can be taken from each bone, which will strengthen the respective identifications.

The phalanxes deserve a special comment in this section. They are often one the most commonly recovered bones in local archaeological assemblages; they have the highest integrity, allowing every possible measure to be obtained, and they also have a high discriminatory capacity in taxonomic terms between both deer. In ungulates in general, the hindlimb phalanxes are longer and more robust than the forelimb ones. This tendency is very tenuous in *O. bezoarticus*, for which more current samples are required in order to be able to make progress in this matter. In the case of *M. gouazoubira*, this trend is evident (Table 2). Fortunately for the zooarchaeological analysis, the first hindlimb and forelimb phalanxes of *M. gouazoubira* are shorter (GL measurement) than the forelimb of *O. bezoarticus* (which, in time, is shorter than its hindlimb phalanxes). Therefore, they provide an adequate framework for a secure taxonomic assignment. Besides the GL measure, it should also be noted that the phalanxes of *O. bezoarticus* are more robust than the forelimb and hindlimb phalanxes of *M. gouazoubira* (Table 2). In the case of the second and third phalanxes, something similar happens to that observed with the first phalanxes, although with a slight decrease in the discriminatory capacity.

Archaeological analysis

Metapodials

The analyzed archaeological metapodials add up to a total of 85 elements, where 125 measurements were obtained, according to the possibilities that arise from the conservation of each specimen. With the exception of only two, the rest fall within the *O. bezoarticus* CI values (Table 3). Of the two metapodials excepted, one (metatarsus # 12) has a value in the Dd dimension, thus falling within the upper limit of the CI for *M. gouazoubira*, but also within the simple variation range of *O. bezoarticus*. Unfortunately, this bone is fractured, and no more dimensions can be obtained. Therefore, its taxonomic determination is ambiguous. The second exception (metacarpus # 33) is equivalent to the previous one. Only a single measurement can possible be taken, which falls near the lower limit of the CI and within the simple variability range of *O. bezoarticus*, and at the upper limit of *M. gouazoubira*; therefore, its assignment is doubtful. Excluding these two ambiguous samples, it is noteworthy that within the 85 measured metapodials, it has not been possible to identify with any certainty a single one of *M. gouazoubira*; on the contrary, 83 samples without a doubt belong to *O. bezoarticus*. When two measures are used to compare the archaeological samples against both reference subsets, they clearly cluster with *O. bezoarticus*, showing a significant Euclidean distance with *M. gouazoubira* (Figures S2 and S3).

All the analyzed metapodials are fused, with the exception of two specimens with unfused condyles. Since both the metatarsals and metacarpals are fully fused before two years after birth (Table S4), all the hunted specimens have ages equal to or more than 24 months, and only 2.3% of all the metapodials correspond to younger individuals. Nineteen metapodials (22.3%) have had their sex determined. Most of this subset (90%) can be assigned to males, and only 10% to females. These results would be related to sex-biased selection (Table 3). However, they cannot be interpreted so linearly, as is discussed in the final section of this paper.

Calcaneus

The analyzed calcaneus adds up to a total of 15 elements, from which 52 measurements were obtained (Table 4). As happened with the metapodials, most of the samples (14) fall within the CI ranges of *O. bezoarticus* (see also Figures S2 and S3), and only one calcaneus (specimen #4, Table 4) is ambiguous, as it has three measurements that fully correspond to *M. gouazoubira* (GBT, GDT and GB), one that fully corresponds to *O. bezoarticus* (GD), and the last measurement (GL) almost reaches the minimum value recorded in the reference collection of this species. These bones are exceptional, sharing exclusive values of each species at the same time. They could be related to the variability of a few individuals within the populations, and they are extremely interesting cases. This specimen should also be viewed in the light of a female from the reference collection of *O. bezoarticus*, where one calcaneus and astragalus have an atypical value for this species (Figure S2). This suggests that it is to be expected that some rare calcaneus and astragalus with intermediate values within the local archaeological contexts will have an assignment that is doubtful. On the other hand, the absence of a calcaneus that can undoubtedly be assigned to *M. gouazoubira* reinforces the results obtained from the metapodials. Regarding the sex-age distribution, the results do not allow gender to be identified with certainty, with the exception of a single piece that was assigned to a male. All the calcaneus belong to individuals equal to or older than two years of age, with the exception of one sample, which falls within the range of 12-24 months, due to the fusing stage of the proximal tuberosity (see Table S4).

Astragalus

In the astragals, 93 measurements were obtained corresponding to 26 elements. All the values fall within the CI of *O. bezarticus* (Table 5; see also Figures S2 and S3). There is only one exception, again with a bone with shared values of both species, corresponding to astragalus # 24. Its Bd is typical of *M. gouazoubira* and the LM dimension falls within the CI of *M. gouazoubira*, but this magnitude was also recorded within the simple range of *O. bezoarticus*.

Besides, the GLI value is exclusive to *O. bezoarticus*, which is outside the dimensional range of *M. gouazoubira*, and, thus, the Euclidean distance based on GLI – LM groups it with the *O. bezoarticus* cluster (Figure 7). This case is close to calcaneus #4 and atypical values were recorded for the same female individual of *O. bezoarticus* (Figure 6 and 7). Leaving aside this single doubtful case, as we have seen in the previous bone elements, the absence of an astragalus which certainly belongs to *M. gouazoubira* is absolute, and, on the contrary, it is remarkable that all these bones definitely correspond to *O. bezoarticus*.

Regarding the sexual assignment, several values in different measurements exceed the thresholds assigned to *O. bezoarticus* females, so they can be tentatively assigned to males. The obtained dimensions, in addition, indicate that the hunted individuals are all older than 9-12 months of age, given that this element has a value for adults from this early age range.

Naviculo-cuboids

The sample available for naviculo-cuboids corresponds to 32 elements, from which 62 measurements were obtained. All of them undoubtedly belong to *O. bezoarticus* (Table 6; see also Figures S2 and S3). They were basically recognized by their GD values, whose CIs are very good for discriminating between the two species (Table 2). The age ranges indicate ages older than 9-12 months, which is when this bone element reaches the final dimensional range. Sexual assignment based on this bone (especially the GB measurement) involves greater uncertainty, because both sexes present a small difference, and the reference sample may include bias that, at these small levels of differentiation, may mask the thresholds referred to for each sex.

Phalanxes

We analyzed 55 phalanxes (first + second) with 183 measurements obtained. All the phalanxes (first and second) can undoubtedly be assigned to *O. bezoarticus* (Table 7; see also Figures S2 and S3). These results are concordant with those obtained from the previously analyzed bones. Given that the proximal plate of the phalanx is completely fused at 18 months of age (Table S4), all of the hunted specimens are older than this. In this study, we did not sexually assign the *O. bezoarticus* phalanxes, as the current reference collection does not adequately differentiate between both sexes.

Discussion

The previous analysis shows that the medium-sized hunted deer was exclusively *O. bezoarticus*, at least in the collections of the 13 sites analyzed here. The metric analysis of 213 bones did not allow the presence of *M. gouazoubira* to be determined. In this sense, 209 bones were definitely assigned to *O. bezoarticus* and only four bones remained indeterminate.

The latter ones had intermediate and/or mixed values that did not allow an adequate identification. Considering these results, it is more likely that these bones represent a small part of *O. bezoarticus'* variability, as it was recorded in the reference collection. Concurrently, it should also be noted that many antler fragments were recovered from the same sites analyzed here. All which were identified at a species level, belonged to *O. bezoarticus* and/or to *Blastocerus dichotomus* (a larger deer that reaches 150 kg); none were identified as *M. gouazoubira* (Acosta, 2005, Buc, 2012; Buc & Coronel, 2013; Loponte, 2008). Regarding the determinations of *M. gouazoubira* according to the informal criteria in the archaeological records of the area, they cannot be taken into account until the metric values are published or an appropriate comparison is presented. Thus, if *M. gouazoubira* was present in the southern section of the Lower Parana wetland, its population density would have been extremely low or occasional.

The fusion stages of metapodials (83 of 85) and calcaneus (13 of 14), indicate the capture of animals older than two years of age. These results were reinforced with the fusion stages of the phalanxes, as in 51 cases (100% of the sample) all were fused (≥ 18 months approximately). There was also a remarkable preponderance of males. In fact, out of 42 sexed individuals, only two could definitely be assigned to females and 40 to males. However, this imbalance could have been related to a methodological bias, as it is easier to identify males because they differ in the CI upper thresholds, while males and females are indistinguishable in practically all of the remainder of their dimensional distribution. Notwithstanding this bias, a potentially greater hunting pressure on males has been analyzed in different studies. Among them is the return maximization model, which links acquired biomass and time spent foraging (Alvard, 1995; Stephen & Krebs, 1986). This model considers males to be preferable if their capture does not imply an additional risk, as they have greater muscle volume, a bonus of raw material related to their antlers, and greater prestige than capturing a female (Alvard 1995, Smith 2004). Other authors suggest that preferential capturing of males is related to a conservation strategy (*e.g*. "prudent predator", Slobodkin 1961, 1968). In this case, hunters avoid hunting females which could be pregnant as part of a conservation strategy for hunting resources, a behavior that is observed in both human and non-human predators (see different positions in Borge & Castillo, 1997; Caughley, 1977; Downing, 1980; Fitzgibbon, 1990; Hayne & Gwynn, 1977; Hornocker, 1970; Kruuk & Snell, 1981; Robinson & Redford, 1991; Sinclair et al., 2006; Smith & Wishnie, 2000). This concurrent selection scheme (maximization + conservation) acquires greater consistency in our record, as it also explains the absence of neonatal and juvenile individuals in the analyzed collection (cf. Robinson & Bennet, 2000). This avoidance of hunting females, or hunting them proportionally less, also increases the sustainable yield of the target population, thus reducing the possibility of a local extinction, ensuring a deferred pay-off, and ensuring the viability of hunting in the medium and long term. This has also been suggested for the study area as an explanation for the record of *Myocastor coypus*, a medium-sized rodent 5-6 kg in weight. This mammal provides excellent skins for making coats and sacks. Their age profiles show that almost exclusively adult individuals were captured (Loponte, 2008). Since this species has territorial behavior and establishes more or less stable colonies in the landscape, its exploitation seems to have taken place at the optimum moment of individuals' maturity, thus providing the largest skins and the largest amount of meat per individual. These global conservation behaviors only make sense in environments where the local population has control over access and exploitation (Hames, 1991; Nimachow et al., 2010), which was precisely postulated based on several lines of evidence for the study area (Loponte, 2008; Acosta & Loponte, 2013). This new information based on the age selection of hunted deer is concurrent data in the same sense. Finally, it should be noted that *O. bezoarticus* males tend to move more than females from one group to another (Aniano, 2015; Jackson & Langguth, 1987). Also, they develop a seasonal spatial segregation behavior, moving more in order to reach areas with better quality pastures (Cosse & González, 2013). This kind of behavior could also have contributed to increasing encounters with human hunters (see, in this sense, Holmer & Røskaft, 2006).

Conclusions and final remarks

The local hunter-gatherers selected adult specimens of *O. bezoarticus* for hunting, with a probable bias towards the males. This would have been part of a behavior with the aim of conserving this resource in the medium term. The analyses carried out so far have not allowed the presence of *M. gouazoubira* in the faunal assemblages to be identified with any degree of certainty. Therefore, its southernmost distribution range should be reconsidered.

This is the first approach to analyze the existence of a bias in the capture of medium-sized deer in the region. It is also the first attempt to build a morphometric frame of reference to differentiate between the post-cranium bones of the two species, as well as to identify the males and females of *O. bezoarticus* and their age of maturity at the time of hunting. The increase in the current and archaeological samples that are being recovered in different parts of the Paraná River basin, including Argentina, Uruguay, and Brazil, will allow these databases to be contrasted and increased in the short term.

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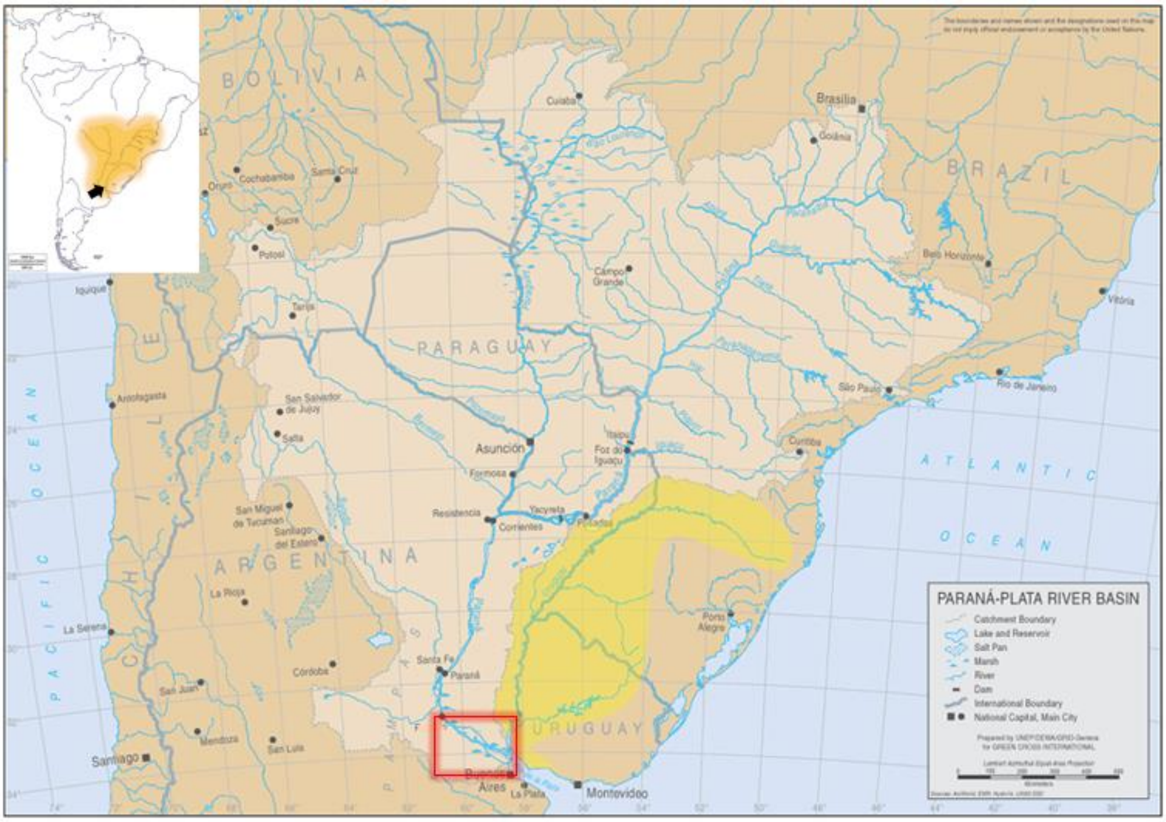


Figure 1. Location of the Lower Paraná wetland (red square) in the southern Paraná Basin (map taken and modified from United Nations Environmental Program).

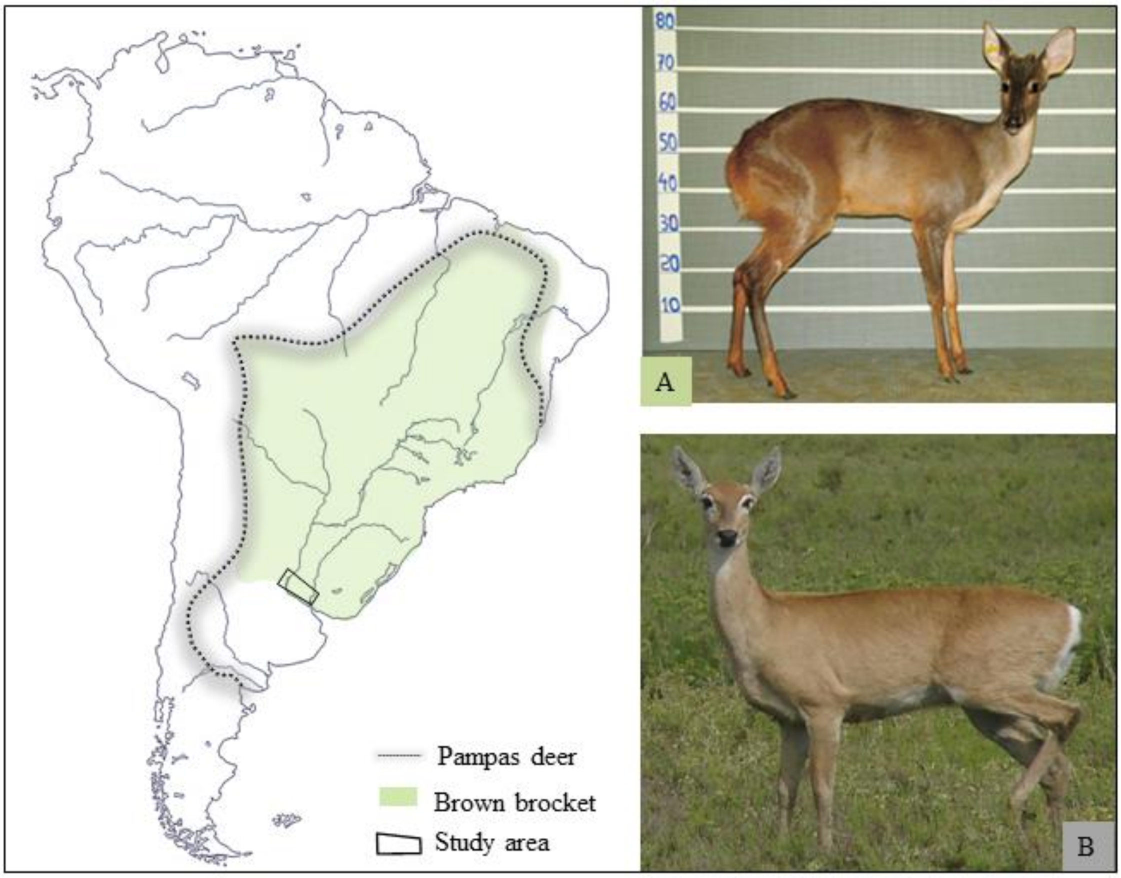


Figure 2. Distribution of both species during the Holocene pre-Columbian time based on Weber & González (2003), Black-Décima et al. (2010) and González et al. (2010). A: *M. gouazoubira* (brown brocket deer). B: *O. b. celer* (pampas deer). Image taken from Black-Décima et al. (2010).

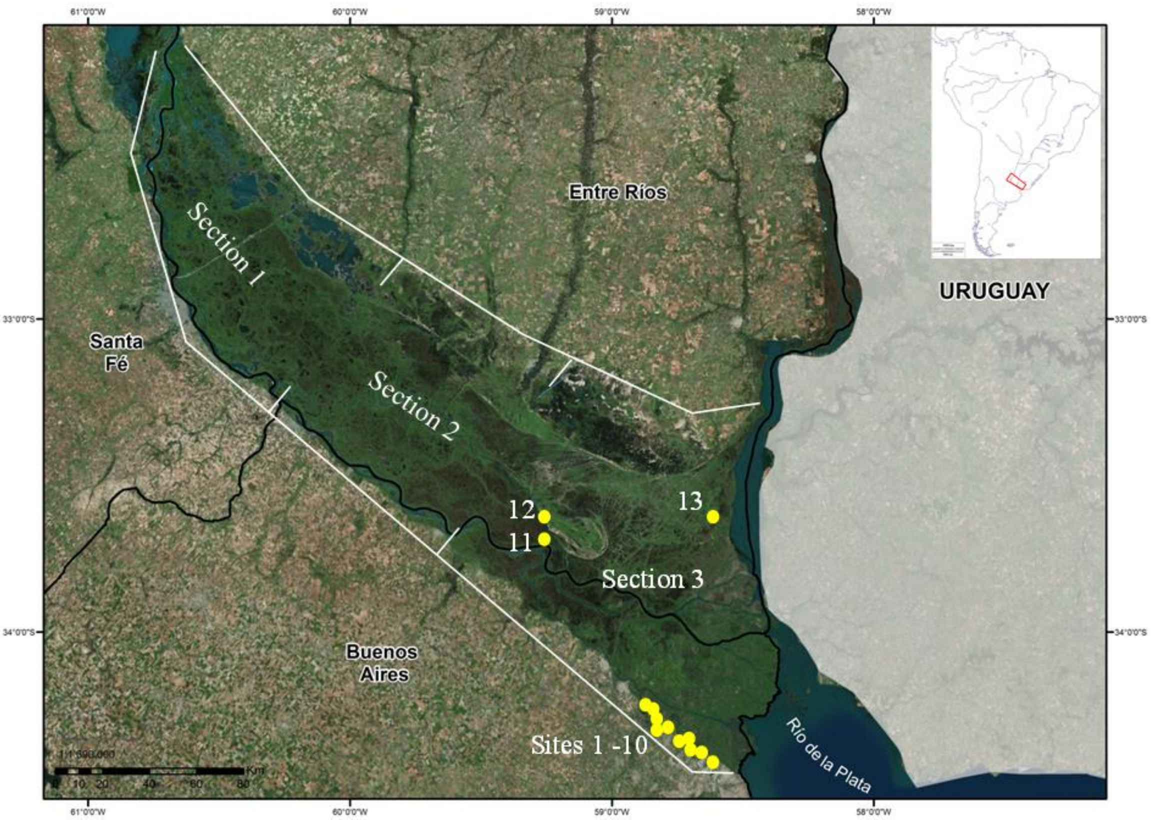


Figure 3. Locations of the sites analyzed in this study. Their names are listed in Table 1. The sections on this map (1, 2 and 3) are based on the informal criteria for this study. The base-map was developed by Mercedes Maison Baibiene (INAPL).

Table 1. Radiocarbon dates of the faunal collections analyzed here.

Sites	Site acronym	Site #	Lab. Code	14C years BP
Las Vizcacheras	LV	1	Beta 148237	1090 ± 40
			LP-1401	1070 ± 60
Túmulo de Campana 1	TCS1	2	AA100007	1754 ± 49
			AA108374	1670 ± 26
			AA108370	1669 ± 26
			AA108373	1656 ± 26
			AA108372	1633 ± 26
			AA108369	1551 ± 26
			AA108368	1334 ± 29
Túmulo de Campana 2	TCS2	3	Beta 172059	1640 ± 70
La Bellaca 2	LBS2	4	LP-1263	680 ± 80
Rancho Largo	Rancho L.	5	AA97459	1010 ± 45
Anahí	Anahí	6	Beta 147108	1020 ± 70
Garín	Garín	7	LP-240	1060 ± 60
			LP-3082	1360 ± 70
Guazunambí	Guazun.	8	Beta 147109	940 ± 60
Río Luján 2	RL2	9	AA97458	1692 ± 46
Punta Canal	PC	10	LP-1293	900 ± 80
Isla Lechiguanas 1 level IV	IL S1 (IV)	11	AA97467	2300 ± 43
	IL S1 (IV)		AA97467	2296 ± 34
	IL S1 (IV)		AA97461	2267 ± 34
Isla Lechiguanas 1 level II	IL S1 (II)		AA97462	408 ± 30
La Argentina	La Arg.	12	AA97463	1645 ± 34
			AA103642	979 ± 44
Cerro Lutz	Co. Lutz	13	AA103643	1116 ± 45
			AA77310	976 ± 42
			AA103648	953 ± 47
			AA77312	916 ± 42
			AA77311	795 ± 42
			LP 1711	730 ± 70

Table 2. Values of confidence intervals (95%) for *O.b. celer* and *M. gouazoubira* and the General Linear Model test.

	Ozotoceros bezoarticus mandible							*Mazama gouazoubira mandible*						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GLsm	14	42.02	1.77	37.72	44.9	41.0	43.05	3	35.17	2.64	32.72	37.96	28.62	41.72
GLsp	14	25.42	2.30	22.0	30.25	24.09	26.75	3	24.49	0.94	23.41	25.07	22.16	26.83
GLma	15	67.61	2.73	63.09	70.83	66.10	69.13	3	59.66	3.42	56.13	62.96	51.16	68.16
GL	13	174.18	4.08	168	180	171.72	176.65	3	130.76	5.85	124.39	135.89	116.23	145.29
GHR	12	88.56	4.18	81.96	94.79	85.91	91.22	3	66.53	1.86	64.53	68.22	61.9	71.16

	Ozotoceros bezoarticus atlasOzotoceros bezoarticus atlasOzotoceros bezoarticus atlas							*Mazama gouazoubira atlasMazama gouazoubira atlasMazama gouazoubira atlas*							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	13	49.61	3.28	45.88	57.77	47.11	51.6	4	37.48	0.95	36.81	38.84	35.97	38.98	140.4
GB	13	57.49	3.93	51.9	65.2	55.23	59.36	4	48.15	2.25	46.14	51.27	44.58	51.72	19.96

*CV p<0.025

	Ozotoceros bezoarticus axisOzotoceros bezoarticus axisOzotoceros bezoarticus axis							*Mazama gouazoubira axisMazama gouazoubira axisMazama gouazoubira axis*							
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
LCDe*	14	48.9	2.34	43.4	52.45	47.55	50.26	4	36.13	2.22	34.0	39.13	32.60	39.66	94.27
H	12	44.67	4.97	38.88	54.29	41.51	47.83	4	40.57	1.22	39.12	42.11	38.62	42.51	2.55
BFcr	14	37.12	1.73	34.15	39.69	36.11	38.12	4	31.63	1.70	29.72	33.42	28.93	34.34	31.3

*CV p<0.016

	Ozotoceros bezoarticus scapula Ozotoceros bezoarticus scapula Ozotoceros bezoarticus scapula							*Mazama gouazoubira scapulaMazama gouazoubira scapulaMazama gouazoubira scapula*							
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
HS	11	133.75	8.20	121.90	152.0	128.24	139.25	4	114.5	4.2	108.29	117.12	107.82	121.18	19.5
GLP	13	29.48	1.29	27.86	31.93	28.70	30.26	4	24.3	1.42	22.56	25.79	22.04	26.55	47.5
BG	12	21.15	1.34	19.33	23.22	20.29	22.0	4	17.26	1.06	15.91	18.39	15.57	18.95	27.3

*CV p<0.016

	Ozotoceros bezoarticus humerus Ozotoceros bezoarticus humerus							*Mazama gouazoubira humerus Mazama gouazoubira humerus*							
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	15	150.49	8.13	139.0	167.0	145.99	154.99	4	132.07	5.67	125.25	138.90	123.04	141.09	9.7
Bp	13	35.87	2.22	33.20	40.47	34.53	37.21	4	29.07	1.01	27.60	29.87	27.46	30.68	34.1
Dp	14	44.92	2.92	39.40	49.5	43.23	46.60	4	37.38	1.40	36.12	38.85	35.16	39.60	24.1
Bd	16	29.14	1.56	27.12	32.41	28.31	29.97	4	25.02	0.57	24.30	25.54	24.12	25.92	76.7
Dd	14	28.03	1.59	25.32	30.28	27.11	28.94	4	21.07	0.84	19.87	21.79	19.73	22.40	71.7

*CV p<0.01

	Ozotoceros bezoarticus ulna Ozotoceros bezoarticus ulna							*Mazama gouazoubira ulnaMazama gouazoubira ulna*							
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F

Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	14	193.44	8.52	181.80	208.0	188.52	198.36	4	151.85	6.91	141.86	157.53	140.85	162.85	79.2
Bp	15	25.21	1.26	23.33	27.38	24.51	25.91	4	21.23	1.46	19.54	23.06	18.90	23.55	29.7

*CV p<0.025

	Ozotoceros bezoarticus radiusOzotoceros bezoarticus radius							Mazama gouazoubira radius Mazama gouazoubira radius							
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	14	163.14	6.44	152.3	172.1	159.42	166.86	4	125.48	6.72	115.87	131.45	114.78	136.18	106.2
Bp	14	27.1	1.56	23.8	29.65	26.20	28.0	4	21.94	0.73	20.99	22.73	20.77	23.1	36.6
Dp	12	16.3	0.76	15.1	17.93	15.82	16.78	4	13.07	0.79	12.37	13.92	11.82	14.32	48.5
Bd	14	24.87	1.12	23.26	27.13	24.22	25.51	4	21.25	1.39	19.30	22.31	19.04	23.45	30.9
Dd	12	18.18	1.03	16.34	20.10	17.52	18.83	4	14.63	2.02	11.60	15.81	11.41	17.85	20.1

*CV p<0.01

	Ozotoceros bezoarticus pisiform							Mazama gouazoubira pisiform						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	2	13.87	0.42	13.57	14.17			2	10.12	0.78	9.56	10.67		

	Ozotoceros bezoarticus triquetral							Mazama gouazoubira triquetral						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	4	18.53	0.1	18.43	18.67	18.37	18.69	2	16.04	0.38	15.77	16.31		

	Ozotoceros bezoarticus lunate							Mazama gouazoubira lunate						
Measures	n	mean	SD	min	max.	LB	UB	n	mean	SD	min	max.	LB	UB
GD	4	14.47	1.14	13.55	16.13	13.55	16.13	3	11.98	0.6	11.45	12.63	10.49	13.47

	Ozotoceros bezoarticus capitate							Mazama gouazoubira capitate						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	5	13.15	0.73	12.0	13.91	12.25	14.06	3	11.98	0.6	11.45	12.63	10.49	13.47

	Ozotoceros bezoarticus hamate							*Mazama gouazoubira hamate*						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	3	12.04	0.13	11.91	12.16	11.73	12.35	3	9.91	0.62	9.2	10.34	8.37	11.45

	Ozotoceros bezoarticus scaphoid							*Mazama gouazoubira scaphoid*						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	5	16.11	1	15.25	17.8	14.86	17.36	3	12.88	0.46	12.45	13.36	11,74	14.02

	Ozotoceros bezoarticus metacarpus							*Mazama gouazoubira metacarpus*							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	13	155.61	5.80	147.63	166.0	150.84	158.61	4	109.81	4.72	103.06	114.30	102.30	117.32	162.4
Bp	13	21.39	1.0	20.06	23.67	20.60	22.04	4	18.4	0.96	17.05	19.33	16.86	19.93	28.0
Dp	11	15.35	1.0	14.26	17.78	14.62	16.12	4	12.46	1.15	11.53	14.08	10.63	14.29	24.7
Bd	13	21.38	0.99	18.84	22.64	20.66	22.11	4	17.63	1.21	15.95	18.53	15.71	19.55	35.7
Dd	12	14.42	0.81	13.01	15.56	13.84	14.98	4	11.36	0.60	10.50	11.89	10.39	12.32	51.1
Bdcm	11	9.89	0.56	8.69	10.71	9.54	10.34	4	8.14	0.59	7.33	8.65	7.19	9.08	29.6

Bdcl	11	9.7	0.51	8.70	10.30	9.42	10.11	4	8.03	0.61	7.31	8.61	7.06	8.99	29.4

*CV p<0.007

	Ozotoceros bezoarticus pelvis							Mazama gouazoubira pelvis						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GL	8	196.38	13.55	183.1	226.0	185.04	207.71	3	165.67	3.21	162	168	157.68	173.65

	Ozotoceros bezoarticus sacrum							Mazama gouazoubira sacrum						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GL	12	95.74	6.74	88.29	105.08	91.46	100.02	3	89.9	6.4	82.75	95.09	74	99.8
GB	12	75.42	4.54	68.47	81.74	72.53	78.31	3	59.55	1.44	57.91	60.63	55.96	63.14

	Ozotoceros bezoarticus femur							Mazama gouazoubira femur							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	13	191.81	7.61	184.9	209.2	187.21	196.40	4	165.5	4.80	161.10	171.20	157.87	173.13	41.6
Bp	14	46.61	2.10	42.40	49.10	45.40	47.82	4	37.03	3.15	32.70	40.20	32.01	42.04	52.4
DC	15	19.70	1.27	17.40	21.31	19.0	20.41	4	16.5	1.16	14.86	17.57	14.66	18.34	20.7
BH	15	18.22	0.96	16.97	20.11	17.69	18.75	4	14.64	0.92	13.28	15.32	13.17	16.11	44.7
Bd	15	40.12	1.72	37.30	43.31	39.17	41.07	4	33.97	2.12	31.46	36.63	30.59	37.34	37.1
Bdgt	14	21.78	1.46	19.68	24.27	20.94	22.62	4	17.66	1.74	15.39	19.60	14.89	20.44	23.0
Dd	14	51.85	1.88	48.70	54.71	50.76	52.93	4	42.8	2.17	40.33	45.60	39.34	46.26	67.7

*CV p<0.0007

	Ozotoceros bezoarticus patella							Mazama gouazoubira patella						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GL	8	29.65	2.10	26.92	33.72	27.90	31.41	3	28.66	2.16	26.20	30.21	23.31	34.02
GB	7	24.07	1.06	22.57	25.26	23.10	25.05	3	19.36	1.52	17.71	20.69	15.60	23.12

	Ozotoceros bezoarticus tibia							Mazama gouazoubira tibia							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	16	222.16	9.20	205.10	235.20	217.26	227.07	4	190.0	6.68	181	197	179.37	200.63	27.3
Bp	16	41.07	1.81	37.10	43.70	40.10	42.03	4	36.19	2.4	33.08	38.59	32.37	40.01	18.6
Dpcla	15	26.71	1.28	24.46	29.13	26.0	27.42	4	23.9	0.91	23.02	25.18	22.45	25.35	13.9
Bpcla	15	21.01	1.30	18.16	23.33	20.29	21.73	4	17.77	0.81	16.71	18.65	16.49	19.05	18.8
Dp	15	41.86	2.10	37.61	45.83	40.70	43.02	4	34.99	2.32	33.22	38.2	31.29	38.69	32.5
Dd	15	19.86	0.79	18.49	21.46	19.42	20.30	4	17.53	0.9	16.47	18.61	16.11	18.96	22.3
Bd	15	26.95	1.20	25.08	29.64	26.29	27.62	4	23.89	1.57	21.72	25.46	21.4	26.39	17.7

*CV p<0.0007

	Ozotoceros bezoarticus calcaneus							Mazama gouazoubira calcaneus						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GL	15	65.22	2.55	60.19	68.70	63.81	66.63	3	55.64	0.79	54.84	56.41	53.69	57.59
GBT	15	14.93	0.75	13.60	16.66	14.52	15.34	3	13.47	1.20	12.70	14.85	10.50	16.44
GDT	15	17.38	0.95	15.46	18.56	16.85	17.91	3	15.55	0.80	14.80	16.39	13.56	17.53

GD	15	22.84	1.25	21.12	25.35	22.15	23.53	3	20.43	0.27	20.12	20.59	19.77	21.09
GB	15	21.55	1.45	19.59	23.49	20.75	22.36	3	18.13	0.80	17.58	19.05	16.13	20.12

	Ozotoceros bezoarticus astragalus							Mazama gouazoubira astragalus							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GLI	14	29.36	1.39	26.59	31.79	28.62	30.10	4	25.86	1.19	24.11	26.81	23.96	27.76	22.9
Bd	14	19.22	0.7	18.07	20.61	18.84	19.60	4	16.72	1.46	14.65	17.90	14.39	18.05	27.9
Dm	14	16.57	0.8	15.26	18.17	16.14	17.0	4	14.40	0.69	13.78	15.03	13.31	15.49	24.1
LM	14	23.35	1.12	21.56	25.28	22.75	23.95	4	20.80	1.0	19.4	21.52	19.21	22.39	18.5

*CV p<0.01

	Ozotoceros bezoarticus naviculo cuboid							Mazama gouazoubira naviculo cuboid							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GD	14	23.89	1.43	21.01	25.77	23.07	24.72	4	17.44	1.12	16.33	18.99	15.66	19.21	68.8
GB	13	23.43	1.49	21.49	26.46	22.52	24.33	4	21.09	1.25	19.45	22.2	19.1	23.07	8

*CV p<0.016

	Ozotoceros bezoarticus lateral malleolus							Mazama gouazoubira lateral malleolus						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	2	13.96	1.22	13.09	14.82			2	13.26	1.8	11.98	14.53		

	Ozotoceros bezoarticus meanl cuneiform							Mazama gouazoubira meanl cuneiform						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GD	4	15.94	1.12	14.52	16.85	14.17	17.71	2	12.65	1.13	12.03	13.64		

	Ozotoceros bezoarticus metatarsus							Mazama gouazoubira metatarsus							Statistical analysis
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB	F
GL	16	178.62	6.79	166.8	188.0	175.0	182.24	4	139.75	7.46	129	146	127.89	151.61	79.0
Bp	16	20.20	1.07	18.09	21.80	19.62	20.77	4	17.78	0.87	16.48	18.36	16.39	19.16	18.1
Dp	15	21.23	1.09	19.63	23.16	20.62	21.83	4	18.15	0.77	17.03	18.8	16.91	19.38	28.3
Bd	17	22.65	0.78	20.35	23.84	22.25	23.05	4	18.99	1.27	17.4	20.03	16.96	21.01	58.7
Dd	16	15.74	0.81	14.0	16.90	15.31	16.17	4	13.27	0.69	12.35	14.02	12.17	14.37	33.4
Bdcm	14	10.46	0.54	9.40	11.18	10.14	10.77	4	8.77	0.64	8.01	9.33	7.75	9.8	29.0
Bdcl	13	10.19	0.51	9.19	11.01	9.88	10.50	4	8.75	0.6	7.95	9.38	7.8	9.7	23.7

*CV p<0.0007

	Ozotoceros bezoarticus 1° phalanx forelimb							*Mazama gouazoubira 1° phalanx forelimb*						
Measures	n	mean	SD	min.	max.	LB	UB	n	mean	SD	min.	max.	LB	UB
GL	14	34.20	2.20	31.05	38.1	32.93	35.47	9	24.87	1.08	22.19	25.77	24.03	25.7
Bp	14	10.35	0.44	9.60	10.95	10.09	10.60	9	9.32	0.46	8.93	10.17	8.97	9.68
Bd	14	9.27	0.32	8.47	9.61	9.08	9.45	9	7.94	0.45	7.40	8.59	7.60	8.29
Dd	14	8.36	0.51	7.50	9.40	8.07	8.66	9	7.46	0.37	6.89	7.90	7.17	7.75
Dp	14	13.51	0.75	12.13	15.02	13.07	13.94	9	10.8	0.26	10.44	11.14	10.61	11.0

Ozotoceros bezoarticus 1° phalanx hindlimb

Measures	n	mean	SD	min.	max.	LB	UB
GL	23	35.13	2.10	32.17	38.89	34.22	36.03
Bp	23	11.19	0.56	10.33	12.03	10.94	11.43
Bd	23	10.09	0.50	9.10	10.9	9.88	10.30
Dd	23	8.86	0.68	7.99	10.64	8.57	9.16
Dp	23	15.22	0.77	13.86	16.78	14.89	15.55

Mazama gouazoubira 1° phalanx hindlimb

n	mean	SD	min.	max.	LB	UB
8	27.62	1.16	24.86	28.44	26.64	28.59
8	10.04	0.45	9.20	10.52	9.66	10.42
8	8.65	0.50	7.76	9.13	8.23	9.06
8	8.12	0.52	7.26	8.69	7.69	8.56
8	12.8	0.36	12.33	13.25	12.5	13.10

Ozotoceros bezoarticus 2° phalanx forelimb

Measures	n	mean	SD	min.	max.	LB	UB
GL	9	24.49	1.88	22.92	28.68	23.05	25.94
Bp	9	9.57	0.54	8.71	10.30	9.16	9.98
Bd	9	8.21	0.45	7.49	9.04	7.86	8.55
Dd	9	11.04	0.52	10.37	12.16	10.64	11.44
Dp	9	13.81	0.66	12.86	15.14	13.30	14.32

Mazama gouazoubira 2° phalanx forelimb

n	mean	SD	min.	max.	LB	UB
8	19.2	1.32	16.4	20.44	18.09	20.3
8	8.48	0.55	7.81	9.40	8.02	8.94
8	6.33	0.32	5.85	6.82	6.07	6.60
8	9.09	0.40	8.37	9.48	8.75	9.42
8	11.29	0.81	9.55	11.99	10.61	11.96

Ozotoceros bezoarticus 2° phalanx hindlimb

Measures	n	mean	SD	min.	max.	LB	UB
GL	15	25.72	1.21	24.18	29.21	25.05	26.39
Bp	15	10.51	0.60	9.55	11.52	10.17	10.84
Bd	14	8.61	0.57	7.71	9.38	8.28	8.93
Dd	14	10.97	0.33	10.51	11.56	10.78	11.16
Dp	15	14.96	0.76	13.56	15.83	14.54	15.38

Mazama gouazoubira 2° phalanx hindlimb

n	mean	SD	min.	max.	LB	UB
9	21.4	0.92	20.08	22.38	20.69	22.11
9	9.42	0.38	8.75	9.96	9.13	9.71
9	7.09	0.49	6.69	8.25	6.72	7.47
9	9.47	0.32	8.84	9.87	9.22	9.71
9	13.32	0.67	12.25	14.21	12.81	13.84

Ozotoceros bezoarticus 3° phalanx forelimb

Measures	n	mean	SD	min	max.	LB	UB
GL	4	24.52	0.61	23.96	25.15	23.54	25.49
Bp	4	8.46	0.14	8.26	8.60	8.23	8.68
Dp	4	14.77	0.28	14.5	15.15	14.33	15.21

Mazama gouazoubira 3° phalanx forelimb

n	mean	SD	min.	max.	LB	UB
5	23.91	0.27	23.56	24.23	23.58	24.25
5	7.20	0.27	6.89	7.61	6.87	7.53
5	13.12	0.72	12.45	13.9	12.23	14.01

Ozotoceros bezoarticus 3° phalanx hindlimb

Measures	n	mean	SD	min.	max.	LB	UB
GL	2	24.39	1.29	23.48	25.30		
Bp	2	7.41	0.08	7.35	7.46		
Dp	2	14.0	0.06	13.95	14.04		

Mazama gouazoubira 3° phalanx hindlimb

n	mean	SD	min.	max.	LB	UB
6	23.44	1.65	21.98	25.68	21.71	25.18
6	7.12	0.59	6.06	7.67	6.50	7.74
6	12.2	0.72	11.22	13.31	11.45	12.95

Table 3. Dimensions, taxonomic, sex, and age assignment of metapodials recovered from archaeological sites in the lower Paraná wetland. F: fused. NF: not fused.

SITE	Metatarsus						Assignment		
	Measures						Taxa	Sex	Age
	#	Bp	Dp	Bd	Dd	FS			
Co. Lutz	1			22.55	15.97	F	*O.b.*	I	≥24 m
Co. Lutz	2			23.77	14.61	F	*O.b.*	I	≥24 m
Co. Lutz	3			21.53	15.68	F	*O.b.*	I	≥24 m
Co. Lutz	4			24.82	15.28	F	*O.b.*	M	≥24 m
Co. Lutz	5				17.72	F	*O.b.*	M	≥24 m
Co. Lutz	6				14.82	F	*O.b.*	I	≥24 m
Co. Lutz	7				16.4	F	*O.b.*	I	≥24 m
Co. Lutz	8				15.92	F	*O.b.*	I	≥24 m
Co. Lutz	9			21.64	14.46	F	*O.b.*	I	≥24 m
Co. Lutz	10			21.87	16.54	F	*O.b.*	I	≥24 m
Co. Lutz	11				15.57	F	*O.b.*	I	≥24 m
Co. Lutz	12				14.37	F	*O.b./M.g.*	I	≥24 m
Garín	13				17.05	F	*O.b.*	I	≥24 m
Garín	14				15.48	F	*O.b.*	I	≥24 m
Garín	15				16.88	F	*O.b.*	I	≥24 m
Garín	16				16.26	NF	*O.b.*	I	≤12 m
Garín	17				15.16	NF	*O.b.*	I	≤12 m
Garín	18	20.97				F	*O.b.*	I	≥24 m
Garín	19			22.66	15.68	F	*O.b.*	I	≥24 m
Garín	20			23.73	16.47	F	*O.b.*	I	≥24 m
Anahí	21			23.69	15.11	F	*O.b.*	I	≥24 m
Anahí	22			23.47	15.53	F	*O.b.*	I	≥24 m
Anahí	23			23.54		F	*O.b.*	I	≥24 m

SITE	Metarcapus						Assignment		
	Measures						Taxa	Sex	Age
	#	Bp	Dp	Bd	Dd	FS			
Co. Lutz	1			22.49	15	F	*O.b.*	M	≥24 m
Co. Lutz	2			22.08	14.86	F	*O.b.*	M	≥24 m
Co. Lutz	3			20.83	13.77	F	*O.b.*	I	≥24 m
Co. Lutz	4				13.34	F	*O.b.*	I	≥24 m
Co. Lutz	5				14.58	F	*O.b.*	I	≥24 m
Co. Lutz	6				14.24	F	*O.b.*	I	≥24 m
Garín	7		16.55			F	*O.b.*	M	≥24 m
Garín	8			21.18	13.83	F	*O.b.*	I	≥24 m
Garín	9			22.81	15.37	F	*O.b.*	M	≥24 m
Guazun.	10			20.22	13.78	F	*O.b.*	I	≥24 m
Guazun.	11			19.48		F	*O.b.*	F	≥24 m
ILS1 (II)	12				16.96	F	*O.b.*	M	≥24 m
ILS1 (II)	13	22.2	15.4			F	*O.b.*	M	≥24 m
ILS1 (II)	14			19.01	14.44	F	*O.b.*	I	≥24 m
ILS1 (II)	15				17.2	F	*O.b.*	M	≥24 m
La Arg.	16			23.78	15.86	F	*O.b.*	M	≥24 m
LBS2	17			21.55	15.62	F	*O.b.*	M	≥24 m
LBS2	18			21.46	15.11	F	*O.b.*	I	≥24 m
LBS2	19			22.07	14.76	F	*O.b.*	I	≥24 m
LBS2	20				13.83	F	*O.b.*	I	≥24 m
LBS2	21				13.79	F	*O.b.*	I	≥24 m
LBS2	22				14.19	F	*O.b.*	I	≥24 m
LBS2	23				13.83	F	*O.b.*	I	≥24 m

Anahí	24				15.25	F	*O.b.*	I	≥24 m
Anahí	25	22.82	23.25			F	*O.b.*	M	≥24 m
Anahí	26	18.24	20.27			F	*O.b.*	F	≥24 m
Anahí	27			23.81	16.46	F	*O.b.*	I	≥24 m
Anahí	28			22.93	15.11	F	*O.b.*	I	≥24 m
Anahí	29				14.8	F	*O.b.*	I	≥24 m
Anahí	30			22.9	15.4	F	*O.b.*	I	≥24 m
Garín	31				17.02	F	*O.b.*	I	≥24 m
Garín	32				16.31	F	*O.b.*	I	≥24 m
Guazun.	33				16.54	F	*O.b.*	I	≥24 m
ILSI (IV)	34			24.09	17.12	F	*O.b.*	M	≥24 m
ILSI (IV)	35			25.26	16.5	F	*O.b.*	M	≥24 m
La Arg.	36				15.98	F	*O.b.*	I	≥24 m
La Arg.	37				15.71	F	*O.b.*	I	≥24 m
La Arg.	38				15.81	F	*O.b.*	I	≥24 m
La Arg.	39			23.64	17.15	F	*O.b.*	I	≥24 m
LBS2	40			22.84	15.51	F	*O.b.*	I	≥24 m
LBS2	41			22.73	15.92	F	*O.b.*	I	≥24 m
LBS2	42				15.5	F	*O.b.*	I	≥24 m
LBS2	43				16.72	F	*O.b.*	I	≥24 m
LBS2	44				16.25	F	*O.b.*	I	≥24 m
LBS2	45				16.06	F	*O.b.*	I	≥24 m
LBS2	46				17.2	F	*O.b.*	I	≥24 m
RL 2	47	19.23				F	*O.b.*	I	≥24 m
RL 3	48			21.94	14.77	F	*O.b.*	I	≥24 m
PC	49			22.7	15.95	F	*O.b.*	I	≥24 m

LBS2	24				14.5	F	*O.b.*	I	≥24 m
LBS2	25				14.38	F	*O.b.*	I	≥24 m
LBS2	26				15.06	F	*O.b.*	I	≥24 m
LBS2	27				15.06	F	*O.b.*	I	≥24 m
LBS2	28				15.44	F	*O.b.*	I	≥24 m
LBS2	29				14.94	F	*O.b.*	I	≥24 m
LBS2	30			22.93	15.55	F	*O.b.*	M	≥24 m
LBS2	31			21.37	14.59	F	*O.b.*	I	≥24 m
Rancho L.	32			23.04	14.97	F	*O.b.*	M	≥24 m
RL2	33	19.9				F	*O.b./M.g.*	I	≥24 m
PC	34	22.7	16.32			F	*O.b.*	M	≥24 m
PC	35			21.88	13.97	F	*O.b.*	I	≥24 m
PC	36			21.75	14.92	F	*O.b.*	I	≥24 m

Table 4. Dimensions, taxonomic, sex, and age assignment of calcaneus recovered from archaeological sites in the lower Paraná wetland. F: fused. HF: fusing. NF: not fused. ND: no data.

SITE	Calcaneus							Assignment		
	Measures							Taxa	Sex	Age
	#	GL	GBT	GDT	GD	GB	FS			
Anahí	1	65.09	15.05	17.94	23.11	18.67	F	*O.b.*	I	≥24 m
Anahí	2		14.69	16.28			F	*O.b.*	I	≥24 m
Anahí	3	62.72	14.79	18.84		19.43	F	*O.b.*	I	≥24 m
Anahí	4	59.85	12.72	14.25	23.97	16.35	F	*M.g./O.b.*	I	≥24 m
Anahí	5	64.82	14.69	17.04	22.95	19.61	F	*O.b.*	I	≥24 m
Anahí	6		14.78	17.3			F	*O.b.*	I	≥24 m
Garín	7	73.48	14.29	19.19	23.12	19.42	F	*O.b.*	I	≥24 m
Garín	8	62.34	13.96	17.48	22.16	18.58	F	*O.b.*	I	≥24 m
Garín	9	62.47			23.2		F	*O.b.*	I	≥24 m
Guazunambí	10		16.58	18.04			F	*O.b.*	I	≥24 m
ILS1(IV)	11	67.77	16.75	18.62	24.38	20.89	F	*O.b.*	M	≥24 m
ILS1(II)	12				24.73		ND	*O.b.*	I	-
TCS2	13	64.06	15.03	17.72	22.35	20.41	HF	*O.b.*	I	12 - 24 m
La Bellaca 2	14		15.02	17.52			F	*O.b.*	I	≥24 m
Río Luján 2	15		15.27	18.9			F	*O.b.*	I	≥24 m

Table 5. Dimensions, taxonomic, sex, and age assignment of astragals recovered from archaeological sites in the lower Paraná wetland.

SITE	Astragalus					Assignment		
	Measures					Taxa	Sex	Age
	#	GLI	Bd	Dm	LM			
Anahí	1	27.81	19.25	15.38		*O.b.*	I	≥ 9-12 m
Anahí	2	30.81	19.27	16.77	24.67	*O.b.*	I	≥ 9-12 m
Anahí	3	30.41	19.32	15.88	24.09	*O.b.*	I	≥ 9-12 m
Anahí	4	31.19	20.95	17.76	24.23	*O.b.*	M	≥ 9-12 m
Anahí	5	32.71	20.28	17.28	26.25	*O.b.*	M	≥ 9-12 m
Garín	6	28.46	18.09	16.18	22.71	*O.b.*	I	≥ 9-12 m
Garín	7	31.31	19.66	17.08	25.5	*O.b.*	M	≥ 9-12 m
Garín	8	31.18	20.0	16.74	25.44	*O.b.*	M	≥ 9-12 m
Garín	9	30.28	20.76	16.99	24.72	*O.b.*	I	≥ 9-12 m
Garín	10	31.77	19.96	16.99	24.71	*O.b.*	I	≥ 9-12 m
Garín	11	28.98	18.18	14.52	22.87	*O.b.*	I	≥ 9-12 m
Guazunambí	12	31.49	19.95	17.09	25.32	*O.b.*	M	≥ 9-12 m
Guazunambí	13			15.51		*O.b.*	I	≥ 9-12 m
Guazunambí	14	30.35	20.54	17.74	24.69	*O.b.*	M	≥ 9-12 m
Guazunambí	15	30.14	18.24	16.36	24.62	*O.b.*	I	≥ 9-12 m
Guazunambí	16	30.61	19.5	16.47	24.57	*O.b.*	I	≥ 9-12 m
Guazunambí	17			15.96		*O.b.*	I	≥ 9-12 m
ILS1-IV	18	29.18	18.84	14.44	23.68	*O.b.*	I	≥ 9-12 m
La Argentina	19	32.07	18.96	16.75	25.25	*O.b.*	M	≥ 9-12 m
Rancho Largo	20	30.21	19.93	16.35	24.61	*O.b.*	I	≥ 9-12 m
Punta Canal	21	31.61	20.07	18.13	26.09	*O.b.*	M	≥ 9-12 m
Punta Canal	22	32.25	19.27	16.8	25.25	*O.b.*	M	≥ 9-12 m
Punta Canal	23	30.31	20.2	17.32	25.02	*O.b.*	M	≥ 9-12 m
Punta Canal	24	28.43	17.4		21.52	*O.b./M.g*	I	≥ 9-12 m
Punta Canal	25	29.49	19.81	15.54	23.83	*O.b.*	I	≥ 9-12 m
Punta Canal	26			16.74		*O.b.*	I	≥ 9-12 m

Table 6. Dimensions, taxonomic, sex, and age assignment of naviculo-cuboids recovered from archaeological sites in the lower Paraná wetland.

SITE	Naviculo-cuboid			Assignment		SITE	Naviculo-cuboid			Assignment	
	Measures			Taxa	Sex		Measures			Taxa	Sex
	#	GD	GB				#	GD	GB		
Anahí	1	20.73	23.11	*O.b.*	I	Guazun.	17	25.03	25.84	*O.b.*	M
Anahí	2	20.48	24.1	*O.b.*	I	Guazun.	18	20.63	23.73	*O.b.*	I
Anahí	3	23.04	24.11	*O.b.*	I	Guazun.	19	23.21	25.92	*O.b.*	M
Anahí	4	22.43	24.73	*O.b.*	I	Guazun.	20	22.35	23.62	*O.b.*	I
Anahí	5	22.8	24.94	*O.b.*	I	ILS1(II)	21	22.35	24.67	*O.b.*	I
Anahí	6	21.64	24.68	*O.b.*	I	ILS1(II)	22		23.68	*O.b.*	I
Co. Lutz	7	25.37	19.35	*O.b.*	I	LBS2	23	22.49	23.52	*O.b.*	I
Garín	8	22.73	24.83	*O.b.*	I	LBS2	24	22.7	24.52	*O.b.*	I
Garín	9	23.03	25.21	*O.b.*	M	LBS2	25	22.58	24.09	*O.b.*	I
Garín	10	23.54	26.38	*O.b.*	M	LV	26	23.64	24.71	*O.b.*	I
Garín	11	24.7	25.94	*O.b.*	M	PC	27	23.61	25.4	*O.b.*	M
Garín	12	21.73	23.24	*O.b.*	I	PC	28	24.45	26.43	*O.b.*	M
Garín	13	23.36	25.35	*O.b.*	M	PC	29	22.88		*O.b.*	I
Garín	14	23.71	25.18	*O.b.*	M	PC	30	23.98	25.85	*O.b.*	M
Garín	15	23.25	24.38	*O.b.*	I	PC	31	22.96	27.58	*O.b.*	M
Guazun.	16	24.57	24.78	*O.b.*	I	PC	32	24.91	26.09	*O.b.*	M

Table 7. Dimensions, taxonomic and age assignment of the phalanxes recovered from archaeological sites in the lower Paraná wetland. F: fused. ND: no data.

SITE	1° phalanx							Assignment	
	Measures							Taxa	Age
	#	GL	Bp	Dp	Bd	Dd	FS		
Anahí	1				10.99	9.35	nd	*O.b.*	≥ 18 m.
Anahí	2	37.93	12.70	14.31	12.14	11.14	F	*O.b.*	≥ 18 m.
Anahí	3				9.48	8.55	F	*O.b.*	≥ 18 m.
Anahí	4		11.33	14.05			F	*O.b.*	≥ 18 m.
Guazun.	5		10.51	13.04			F	*O.b.*	≥ 18 m.
Guazun.	6			9.54	10.40		nd	*O.b.*	
TCS2	7	39.77	11.48	15.12	9.29	9.02	F	*O.b.*	≥ 18 m.
TCS2	8	39.05	12.30	14.79	12.18	10.95	F	*O.b.*	≥ 18 m.
ILS1(II)	9	31.66	13.49	14.02	11.68	9.68	F	*O.b.*	≥ 18 m.
La Arg.	10	35.38	10.69	13.13	10.00	8.90	F	*O.b.*	≥ 18 m.
La Arg.	11	39.08	12.74	15.30	10.90	9.26	F	*O.b.*	≥ 18 m.
La Arg.	12		12.89	16.89			F	*O.b.*	≥ 18 m.
La Arg.	13	40.17	12.42	14.70	10.70	9.37	F	*O.b.*	≥ 18 m.
La Arg.	14		10.50	13.63			F	*O.b.*	≥ 18 m.
LBS2	15		10.51	14.26			F	*O.b.*	≥ 18 m.
LBS2	16		10.44	14.49			F	*O.b.*	≥ 18 m.
Rancho L.	17				10.37	9.14	ND	*O.b.*	
LV	18	33.11	10.76	13.10	9.29	8.99	F	*O.b.*	≥ 18 m.
PC	19	37.20	12.52	14.29	11.40	9.77	F	*O.b.*	≥ 18 m.
PC	20	36.18	12.42	16.77	11.26	9.76	F	*O.b.*	≥ 18 m.
PC	21	36.55	12.79	14.22	12.53	11.27	F	*O.b.*	≥ 18 m.
PC	22	33.66	10.66	13.76	8.96	8.59	F	*O.b.*	≥ 18 m.
PC	23	34.20	10.80		9.81	8.76	F	*O.b.*	≥ 18 m.
PC	24		12.05	15.71			F	*O.b.*	≥ 18 m.
PC	25		11.68	15.30			F	*O.b.*	≥ 18 m.
PC	26		10.62	13.71			F	*O.b.*	≥ 18 m.
PC	27		11.48	15.50			F	*O.b.*	≥ 18 m.
PC	28		10.90	14.60			F	*O.b.*	≥ 18 m.
PC	29	31.78	10.49	14.03	8.80	8.14	F	*O.b.*	≥ 18 m.
PC	30		12.41	15.49			F	*O.b.*	≥ 18 m.

SITE	2° phalanx							Assignment	
	Measures							Taxa	Age
	#	GL	Bp	Dp	Bd	Dd	FS		
Anahí	1	25.4	9.54	14.21	7.84	11.53	F	*O.b.*	≥ 18 m.
Guazun.	2	25.18	10.0	14.66	8.44	10.93	F	*O.b.*	≥ 18 m.
Guazun.	3	22.57	9.25	12.59	7.97	11.15	F	*O.b.*	≥ 18 m.
Guazun.	4		10.97	15.65			F	*O.b.*	≥ 18 m.
Guazun.	5	25.2	10.30	14.35	7.64	10.43	F	*O.b.*	≥ 18 m.
Guazun.	6		9.95	13.37			F	*O.b.*	≥ 18 m.
Guazun.	7		10.32	14.69			ND	*O.b.*	
Guazun.	8				8.83	11.97	ND	*O.b.*	
Guazun.	9			12.25	8.82		F	*O.b.*	≥ 18 m.
La Arg.	10				9.93	13.67	F	*O.b.*	≥ 18 m.
La Arg.	11				8.89	11.39	F	*O.b.*	≥ 18 m.
La Arg.	12				9.67	12.64	F	*O.b.*	≥ 18 m.
LBS2	13		9.33	14.03			F	*O.b.*	≥ 18 m.
Rancho L.	14	26.22	10.53	13.92	8.17	11.84	F	*O.b.*	≥ 18 m.
PC	15	26.87	11.17	16.1	8.84	12.48	F	*O.b.*	≥ 18 m.
PC	16	24.85	10.9	14.7	8.54	11.4	F	*O.b.*	≥ 18 m.
PC	17	25.6	11.46	16.1	11.55	12.56	ND	*O.b.*	≥ 18 m.
PC	18				8.1	10.7	F	*O.b.*	≥ 18 m.
PC	19	24.96	9.85	14.42	8.22	10.49	F	*O.b.*	≥ 18 m.
PC	20		11.1		9.12	10.85	F	*O.b.*	≥ 18 m.
PC	21	23.85	10.1	13.38	8.05	11.16	F	*O.b.*	≥ 18 m.
PC	22		11.31	15.07			F	*O.b.*	≥ 18 m.
PC	23		10.5	15.14			F	*O.b.*	≥ 18 m.
PC	24		9.59	13.9			ND	*O.b.*	≥ 18 m.
PC	25				8.27	11.16	ND	*O.b.*	≥ 18 m.

Supplemental Data. Table S1.

TABLE S1. DEER COLLECTION				
Species	**Institution**	**Sex**	**Code**	**Age**
O. bezoarticus	FCNyM/LP	Female	MLP.20.XII.001	< 6 weeks
O. bezoarticus	FCNyM/LP	Female	MLP.23.VI.97.1	6 - 10 weeks
O. bezoarticus	FCNyM/LP	Indet.	MLP 30.XII.02.16	6 - 8 months
O. bezoarticus	FCNyM/LP	Female	MLP.23.VIII.96.2	6 - 10 months
O. bezoarticus	FCNyM/LP	Female	MLP 30.XII.03.14	9 - 12 months
O. bezoarticus	FCNyM/LP	Female	MLP.23.VIII.96.5	~2 years
O. bezoarticus	FCNyM/LP	Indet.	MLP.31.VIII.98.5	2 - 3 years
O. bezoarticus	MACN	Female	MACN 24709	2 - 3 years
O. bezoarticus	MACN	Male	MACN 27650	2 - 3 years
O. bezoarticus	FCNyM/LP	Female	MLP.5.VI.97.2	3 - 4 years
O. bezoarticus	INAPL	Male	CLA.50.86.1	3 - 4 years
O. bezoarticus	MACN	Male	MACN 27664	3 - 4 years
O. bezoarticus	MACN	Indet.	MACN 24630	4 - 6 years
O. bezoarticus	MACN	Male	MACN 24523	4 - 6 years
O. bezoarticus	MACN	Female	MACN 24507	4 - 6 years
O. bezoarticus	FCNyM/LP	Female	MLP.23.VIII.96.6	4 - 6 years
O. bezoarticus	FCNyM/LP	Female	MLP.5.VI.97.4	4 - 6 years
O. bezoarticus	FCNyM/LP	Female	MLP.23.VIII.96.3	4 - 6 years
O. bezoarticus	FCNyM/LP	Indet.	MLP.28.VIII.98.2	4 - 6 years
O. bezoarticus	FCNyM/LP	Female	MLP.5.VI.97.3	6 - 8 years
O. bezoarticus	FCNyM/LP	Female	MLP.22.6.99.10	6 - 8 years
O. bezoarticus	FCNyM/LP	Indet.	MLP.28.VIII.98.1	6 - 8 years
O. bezoarticus	MACN	Male	MACN 24749	6 - 8 years
O. bezoarticus	MACN	Female	MACN 24720	≥8 years
M. gouazoubira	INAPL	Male	CLA.70.13.1	~2 years
M. gouazoubira	FFA/UM	Male	CFA S/N	> 2 years
M. gouazoubira	FFA/UM	Male	CFA 12857	> 2 years
M. gouazoubira	FCNyM/LP	Male	MLP 4.VIII.98.1	> 2 years

FCNyM/LP: Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata
INAPL: Instituto Nacional de Antropología y Pensamiento Latinoamericano
MACN: Museo Argentino de Ciencias Naturales
FFA/UM: Fundación Félix Azara. Universidad Maimónides

Supplemental Data. Table S2.

		Statistical analysis		Age Category in years*				
Bone	Measure	F	p	0-1	2-3	3-4	4-6	6-8
Metatarsus	GL	25.5	<0.0001	a	b	b	b	b
Metacarpus	GL	13.7	<0.001	a	b	b	b	b
Humerus	GL	16.0	<0.001	a	b	b	b	b
Astragalus	GL	1.6	0.222					

*Different letters indicate significant differences ammong age category at the p<0.05.

Supplemental Data. Table S3.

SEXUAL DIMORPHISM IN PAMPAS DEER

Ozotoceros bezoarticus male mandible								*Ozotoceros bezoarticus* female mandible							Stadistical analysis	
Measures	n	mean	DS	min.	max.	LI	LS	n	mean	DS	min	max.	LI	LS	F	p*
GLsm	4	42.78	1.93	40.30	44.9	39.72	45.85	9	42.16	1.05	40.52	43.13	41.36	42.97	0.58	0.461
GLsp	4	26.40	1.32	24.9	27.60	24.31	28.50	9	24.44	1.87	22.0	28.0	23.0	25.88	3.52	0.087
GLma	4	69.19	2.67	65.2	70.83	64.93	73.44	9	66.52	2.57	63.09	70.68	64.55	68.5	1.90	0.193
GL	3	178.8	2.08	176.40	180.0	173.6	184	9	173	3.61	168.0	180.0	170.2	175.8		
GHR	4	89.47	4.42	83.60	93.91	82.43	96.51	8	87.33	4.83	81.8	94.79	83.29	91.36	0.26	0.619

*CV: p<0,012

Ozotoceros bezoarticus male atlas								*Ozotoceros bezoarticus* female atlas								
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GL	4	53.18	3.77	48.55	57.77	47.17	59.18	8	47.8	1.13	45.88	49.23	46.85	48.74	1.50	**0.003**
GB	4	60.28	6.28	51.9	65.2	50.28	70.27	8	56.28	1.78	53.90	58.70	54.80	57.77	1.55	0.241

*CV: p<0,025

Ozotoceros bezoarticus male axis								*Ozotoceros bezoarticus* female axis								
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
LCDe*	4	49.48	4.08	43.40	52.2	42.98	55.97	7	48.15	0.74	47.08	49.43	47.47	48.83	0.75	0.408
H	3	49.26	4.86	44.60	54.29	37.20	61.32	6	41.46	1.89	38.88	44.20	39.47	43.44		
BFcr	4	38.56	1.12	37.11	39.69	36.77	40.35	7	35.83	1.03	34.15	37.20	34.87	36.79	16.77	**0.003**

*CV: p<0,025

Ozotoceros bezoarticus male scapulae								*Ozotoceros bezoarticus* female scapulae						
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS
HS	1	135.0	0	135.0	135.0			8	131	6.14	122.0	138.0	125.9	136.1
GLP	2	30.82	1.58	29.70	31.93			9	28.87	0.89	27.86	30.70	28.18	29.55
BG	2	22.09	1.39	21.11	23.07			8	20.56	1.10	19.33	22.2	19.64	21.47

Ozotoceros bezoarticus male humerus								*Ozotoceros bezoarticus* female humerus						
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS
GL	3	155.8	4.63	152.3	161.0	144.3	167.3	8	147.6	7.03	139	160	141.7	153.5
Bp	3	36.46	3.41	33.20	40.01	27.98	44.94	8	35.14	1.13	33.88	36.64	34.2	36.09
Dp	3	44.94	2.94	42.20	48.05	37.63	52.25	8	44.79	2.35	41.02	48.89	42.82	46.76
Bd	3	30.23	2.04	28.37	32.41	25.16	35.29	8	28.56	1.41	27.12	30.58	27.37	29.74
Dd	3	28.33	1.43	27.10	29.90	24.78	31.88	8	27.55	1.59	25.32	29.33	26.22	28.88

Ozotoceros bezoarticus male ulna								*Ozotoceros bezoarticus* female ulna								
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p
Gl	3	200.70	3.16	197.10	203.0	192.9	208.5	9	189.3	7.09	181.8	202.3	183.9	194.80		
Bp	4	24.51	1.43	23.60	26.63	22.23	26.79	9	25.52	1.27	23.33	27.38	24.55	26.50	1.64	0.226

Ozotoceros bezoarticus male metacarpus								*Ozotoceros bezoarticus* female metacarpus								
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p
GL	4	159	7.44	149.1	166.0	147.2	170.8	7	153.3	4.68	147.6	160	148.9	157.6	3.36	0.096
Bp	4	21.50	0.38	21.00	21.89	20.90	22.10	7	20.86	0.74	20.06	22.1	20.17	21.54	3.20	0.104
Dp	3	16.00	1.54	15.10	17.78	12.16	19.83	6	14.9	0.4	14.26	15.4	14.48	15.32		
Bd	4	21.58	0.56	20.9	22.06	20.69	22.46	7	20.94	1.05	18.84	22.3	19.97	21.91	1.86	0.202
Dd	4	14.61	0.71	13.84	15.56	13.48	15.74	6	14.04	0.85	13.01	15.01	13.15	14.93	1.26	0.290
Bdcm	4	9.94	0.46	9.40	10.38	9.21	10.68	6	9.72	0.57	8.69	10.3	9.12	10.32	0.58	0.466
Bdcl	4	9.77	0.55	9.00	10.30	8.89	10.65	6	9.55	0.48	8.7	10.19	9.04	10.05	0.73	0.417

*CV: p<0,008

Ozotoceros bezoarticus male femur								*Ozotoceros bezoarticus* female femur								
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GL	3	191.2	3.95	187.10	195.0	181.3	201	7	189.6	7.35	185	205	182.8	196.4		
Bp	3	46.11	3.22	42.40	48.23	38.10	54.12	8	46.65	1.95	42.7	48.3	45.02	48.28		
DC	4	18.97	1.75	17.40	21.14	16.18	21.76	8	19.74	1.12	18	21.31	18.8	20.68	0.86	0.371
BH	4	18.68	0.89	17.68	19.7	17.26	20.11	8	17.69	0.69	16.97	18.86	17.11	18.27	4.57	0.058
Bd	4	40.17	2.33	37.70	43.31	36.46	43.87	8	39.74	1.58	37.3	42.38	38.41	41.06	0.15	0.711
Bdgt	4	21.75	1.96	20.0	24.27	18.63	24.88	7	21.6	1.26	19.68	23.33	20.44	22.76	0.03	0.877
Dd	4	52.06	2.60	48.70	54.71	47.93	56.19	7	51.15	1.6	49.1	53.13	49.67	52.63	0.53	0.484

*CV: p<0,01

Ozotoceros bezoarticus male tibia								*Ozotoceros bezoarticus* female tibia								
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GL	5	226.5	7.78	213.80	235.0	216.9	236.2	8	217.5	8.86	205.0	231.1	210.1	224.9	3.48	0.089
Bp	5	40.25	2.34	37.1	43.7	37.34	43.16	8	40.86	1.31	38.42	42.55	39.77	41.95	0.37	0.556
Dpcla	4	26.73	1.14	25.45	28.18	24.92	28.54	8	26.03	0.86	24.46	26.99	25.31	26.75	1.45	0.256
Bpcla	4	21.18	0.93	20.02	22.28	19.70	22.65	8	20.71	1.48	18.16	23.33	19.48	21.94	0.32	0.582
Dp	4	42.99	1.79	41.62	45.50	40.14	45.83	8	41.01	1.84	37.61	43.31	39.47	42.55	3.12	0.108
Dd	4	20.0	0.98	19.44	21.46	18.45	21.55	8	19.84	0.91	18.49	21.27	19.08	20.61	0.08	0.790
Bd	4	27.38	1.6	26.10	29.64	24.83	29.93	8	26.53	0.78	25.08	27.4	25.87	27.18	1.62	0.232

*CV: p<0,007

Ozotoceros bezoarticus male calcaneus								*Ozotoceros bezoarticus* female calcaneus								
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GL	4	65.09	2.15	63.20	68.18	61.67	68.52	8	64.05	2.18	60.19	67.29	62.23	65.88	0.61	0.453
GBT	4	15.17	1.27	13.60	16.66	13.15	17.19	8	14.6	0.32	14.26	15.23	14.33	14.86	0.79	0.395
GDT	4	16.95	0.98	15.90	17.86	15.40	18.50	8	17.31	1.01	15.46	18.56	16.47	18.16	0.34	0.571
GD	4	23.43	1.53	21.80	25.35	20.99	25.87	8	22.27	1.09	21.12	24.58	21.36	23.18	2.32	0.159
GB	4	21.84	1.25	20.6	23.26	19.85	23.84	8	20.96	1.52	19.59	22.83	19.69	22.23	1.00	0.340

*CV: p<0,01

Ozotoceros bezoarticus male astragalus								*Ozotoceros bezoarticus* female astragalus								
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GLl	4	30.04	1.30	28.70	31.79	27.97	32.10	9	28.68	1.24	26.59	30.25	27.73	29.64	3.99	0.074
Bd	4	19.47	0.78	18.88	20.61	18.24	20.71	9	19.01	0.55	18.07	19.71	18.59	19.44	1.83	0.206
Dm	4	16.40	1.18	15.64	18.17	14.52	18.29	9	16.34	0.73	15.26	17.47	15.78	16.9	0.00	0.993
LM	4	23.73	1.33	22.10	25.28	21.62	25.84	9	22.9	0.84	21.56	24.01	22.25	23.55	2.41	0.151

*CV: p<0,007

Ozotoceros bezoarticus male naviculo cuboid								*Ozotoceros bezoarticus* female naviculo cuboid								
Measures	n	media	DS	min.	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GD	4	23.94	1.26	22.50	25.55	21.94	25.93	6	22.98	1.35	21.01	24.30	21.56	24.40	1.26	0.294
GB	4	24.28	1.73	22.80	26.46	21.54	27.03	5	22.62	1.14	21.49	24.42	21.2	24.04	3.03	0.125

*CV: p<0,025

Ozotoceros bezoarticus male metatarsus								*Ozotoceros bezoarticus* female metatarsus								
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS	F	p*
GL	3	185.7	2.46	183.10	188.0	165.6	196.4	8	176.3	5.34	168	181	171.8	180.7		
Bp	4	20.25	0.80	19.58	21.40	18.97	21.52	8	19.93	1.12	18.09	21.4	19.0	20.87	0.24	0.634
Dp	4	21.87	0.68	21.10	22.73	20.79	22.96	7	20.59	0.57	19.82	21.51	20.06	21.11	11.44	**0.007**
Bd	5	22.67	0.58	22.10	23.49	21.95	23.39	8	22.47	0.92	20.35	23.25	21.7	23.24	0.19	0.671
Dd	5	15.71	0.79	14.92	16.90	14.74	16.69	7	15.62	1.01	14.0	16.56	14.69	16.55	0.03	0.871
Bdcm	5	10.46	0.67	9.40	11.12	9.62	11.3	6	10.34	0.51	9.5	11.07	9.8	10.88	0.11	0.748
Bdcl	4	10.12	0.56	9.60	10.77	9.22	11.01	6	10.09	0.53	9.19	10.63	9.53	10.64	0.01	0.941

*CV: p<0,008

Ozotoceros bezoarticus male 1 phalanx forelimb								*Ozotoceros bezoarticus* female 1 phalanx forelimb						
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS
GL	11	34.9	1.92	32.64	38.10	33.61	36.19	6	31.67	0.85	31.05	32.64	29.55	33.79
Bp	11	10.51	0.32	9.90	10.95	10.29	10.73	6	9.86	0.38	9.6	10.29	8.92	10.79
Bd	11	9.40	0.15	9.17	9.61	9.30	9.51	6	8.84	0.38	8.47	9.23	7.89	9.78
Dd	11	8.53	0.42	8.11	9.40	8.25	8.82	6	7.76	0.31	7.5	8.11	6.98	8.54
Dp	11	13.73	0.61	12.98	15.02	13.32	14.15	6	12.96	1.2	12.13	14.34	9.97	15.95

Ozotoceros bezoarticus male 1 phalanx hindlimb								*Ozotoceros bezoarticus* female 1 phalanx hindlimb						
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS
GL	19	34.99	2.29	32.17	38.89	33.89	36.09	8	33.21	1.02	32.17	34.29	32.36	34.06
Bp	19	11.02	0.46	10.33	11.83	10.79	11.24	8	10.74	0.32	10.33	11.27	10.47	11.01
Bd	19	10.01	0.49	9.10	10.62	9.77	10.24	8	9.73	0.59	9.1	10.42	9.24	10.22
Dd	19	8.85	0.75	7.99	10.64	8.49	9.21	8	8.36	0.29	7.99	8.77	8.12	8.60
Dp	19	15.20	0.84	13.86	16.78	14.79	15.60	8	14.67	0.75	13.86	15.49	14.04	15.30

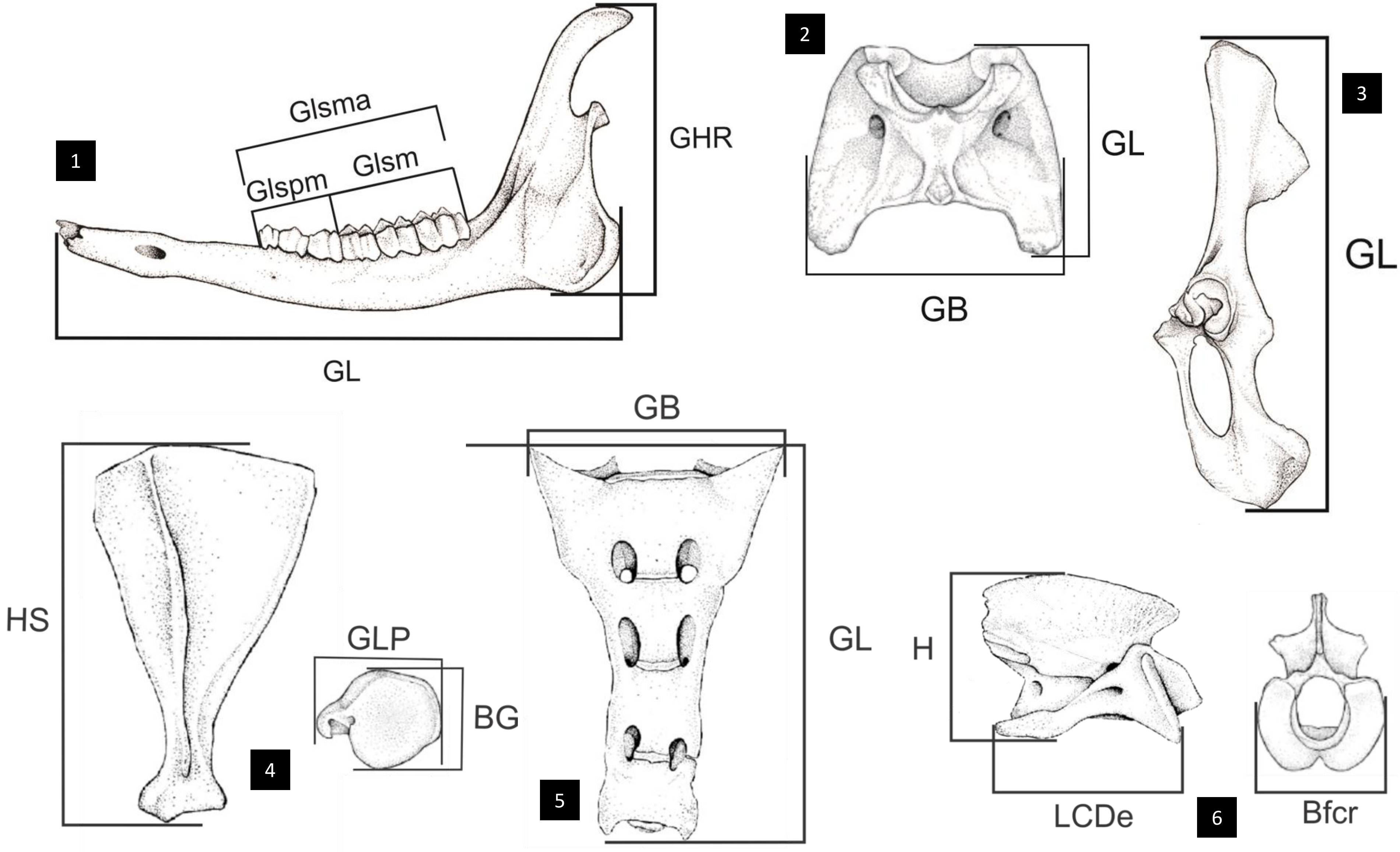
Ozotoceros bezoarticus male 2 phalanx hindlimb								*Ozotoceros bezoarticus* female 2 phalanx hindlimb						
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS
GL	5	25.68	1.76	24.09	28.68	23.50	27.87	4	23.01	0.12	22.92	23.17	22.82	23.19
Bp	5	9.96	0.22	9.73	10.30	9.69	10.24	4	9.08	0.35	8.71	9.47	8.52	9.64
Bd	5	8.4	0.39	8.04	9.04	7.92	8.88	4	7.96	0.43	7.49	8.41	7.27	8.65
Dd	5	11.36	0.47	11.01	12.16	10.78	11.93	4	10.65	0.25	10.37	10.86	10.25	11.05
Dp	5	14.2	0.53	13.87	15.14	13.54	14.86	4	13.32	0.46	12.86	13.85	12.59	14.05

Ozotoceros bezoarticus male 2 phalanx forelimb								*Ozotoceros bezoarticus* female 2 phalanx forelimb						
Measures	n	media	DS	min	max.	LI	LS	n	media	DS	min	max.	LI	LS
GL	5	26.46	1.55	25.53	29.21	24.54	28.38	6	24.84	0.54	24.18	25.46	24.27	25.4
Bp	5	10.71	0.17	10.46	10.86	10.50	10.92	6	9.96	0.37	9.55	10.63	9.57	10.35
Bd	4	8.47	0.18	8.32	8.72	8.18	8.76	6	8.26	0.55	7.71	8.80	7.68	8.84
Dd	4	11.08	0.07	11.02	11.16	10.97	11.18	6	10.67	0.16	10.51	10.97	10.50	10.84
Dp	5	15.24	0.13	15.13	15.45	15.09	15.40	6	14.4	0.84	13.56	15.36	13.52	15.28

Supplemental Data. Table S4.

BONE FUSION SEQUENCE OF PAMPAS DEER

Elements	Fusing (months)	Fused (months)
Scapulae (coracoid)	6 - 10	9 - 12
Px. radius	6 - 10	12 - 24
1° phalanx	6 - 12	≤18
2° phalanx	6 - 12	≤18
Ds. humerus	6 - 12	≤24
Ds. Metacarpal, condile	12- 24	≤24
Ds. Metatarsal, condile	12- 24	≤24
Ds. tibia	12- 24	≤24
Calcaneum, tuberosity	12- 24	≤24
Ds. ulna	12- 24	≤24
Px. Ulna	12- 24	≤24
Atlas, dorsal suture	12 - 24	≤ 36
Ds. radius	24 - 36	≤ 36
Sacrum, 1 vert.	24 - 36	≤ 36
Px. femur	24 - 36	≤ 36
Ds. femur	24 - 36	≤ 36
Px.humerus	24 - 36	≤ 36
Px. tibia	24 - 36	≤ 36
Pelvis, synphysis	24 - 36	≤ 36
Illiac crest	> 24	≤ 36
Sacrum, 2 and 3 vert.	> 24	≤ 36



1: Mandible. 2: Atlas. 3: Pelvis. 4: Scapula. 5: Sacrum. 6: Axis.

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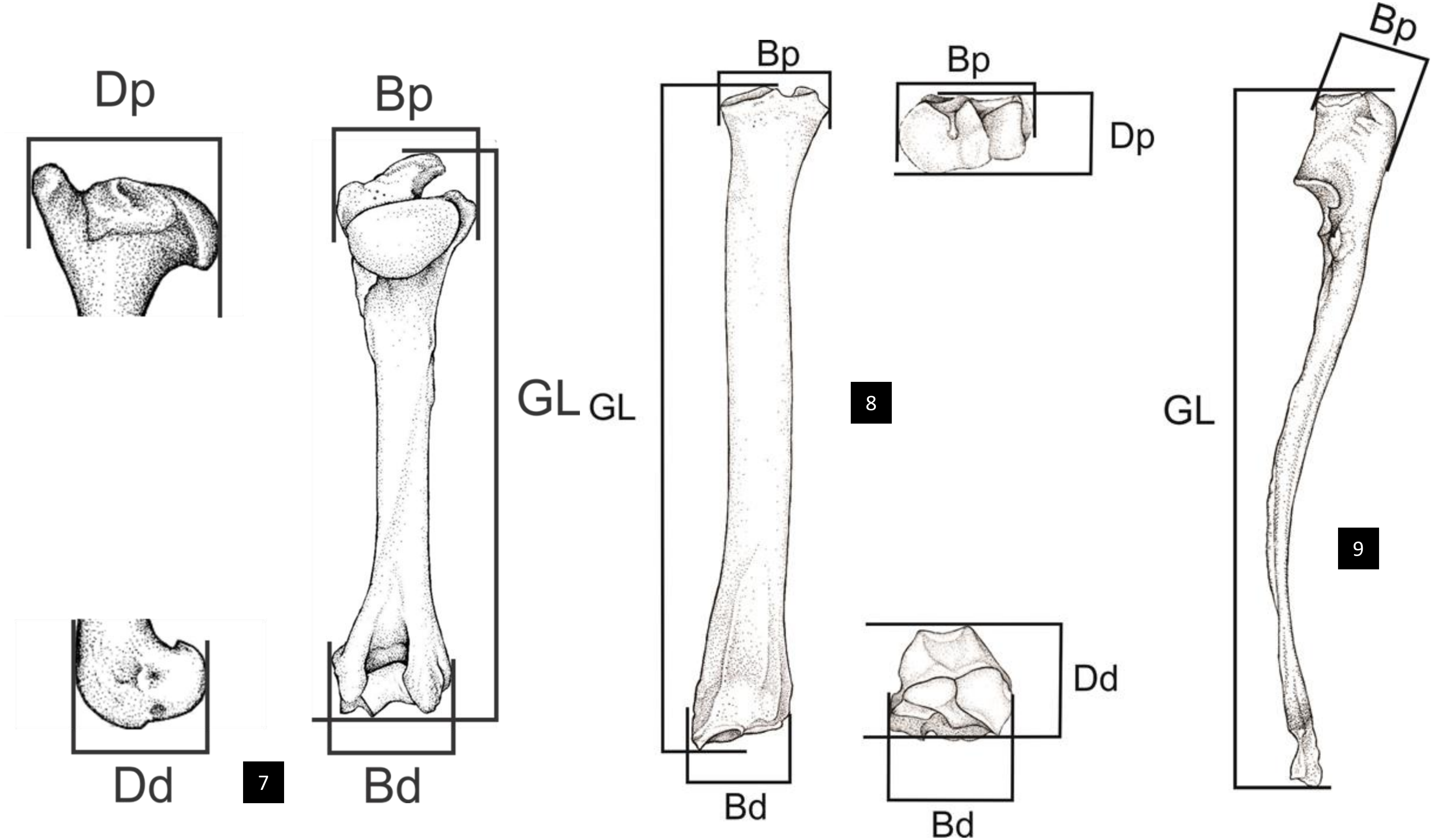

7: Humerus. 8: Radius. 9: Ulna

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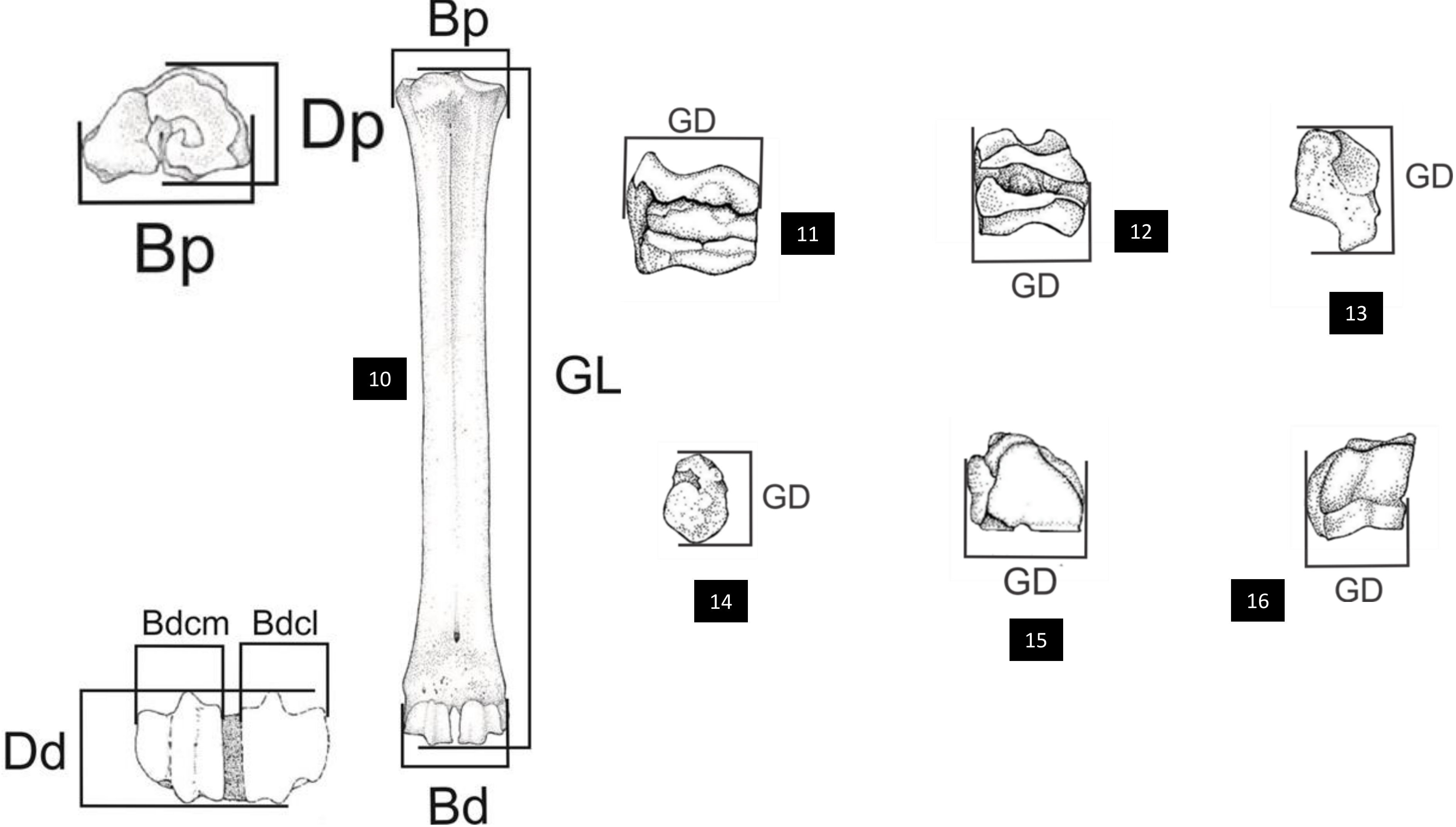
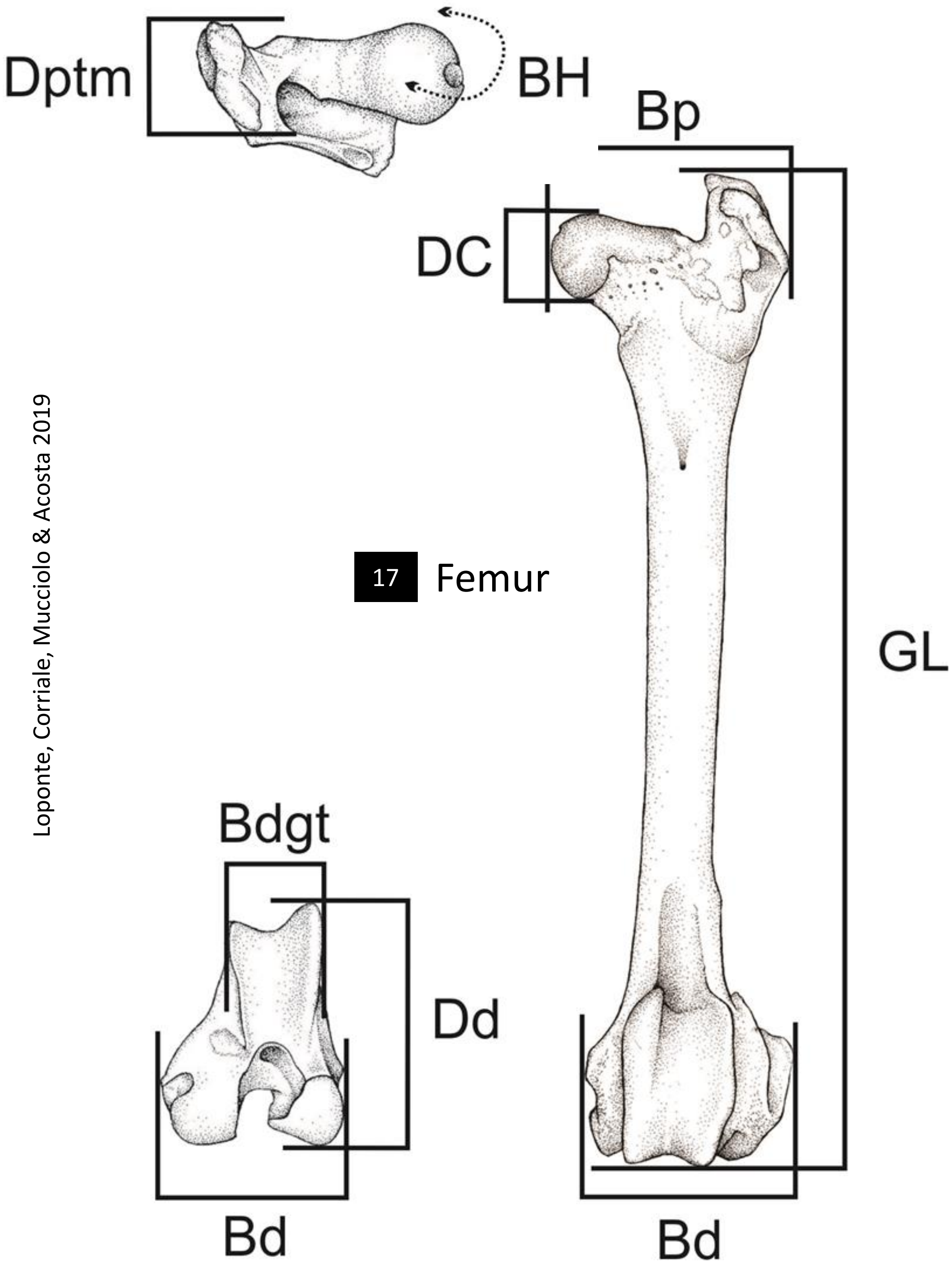


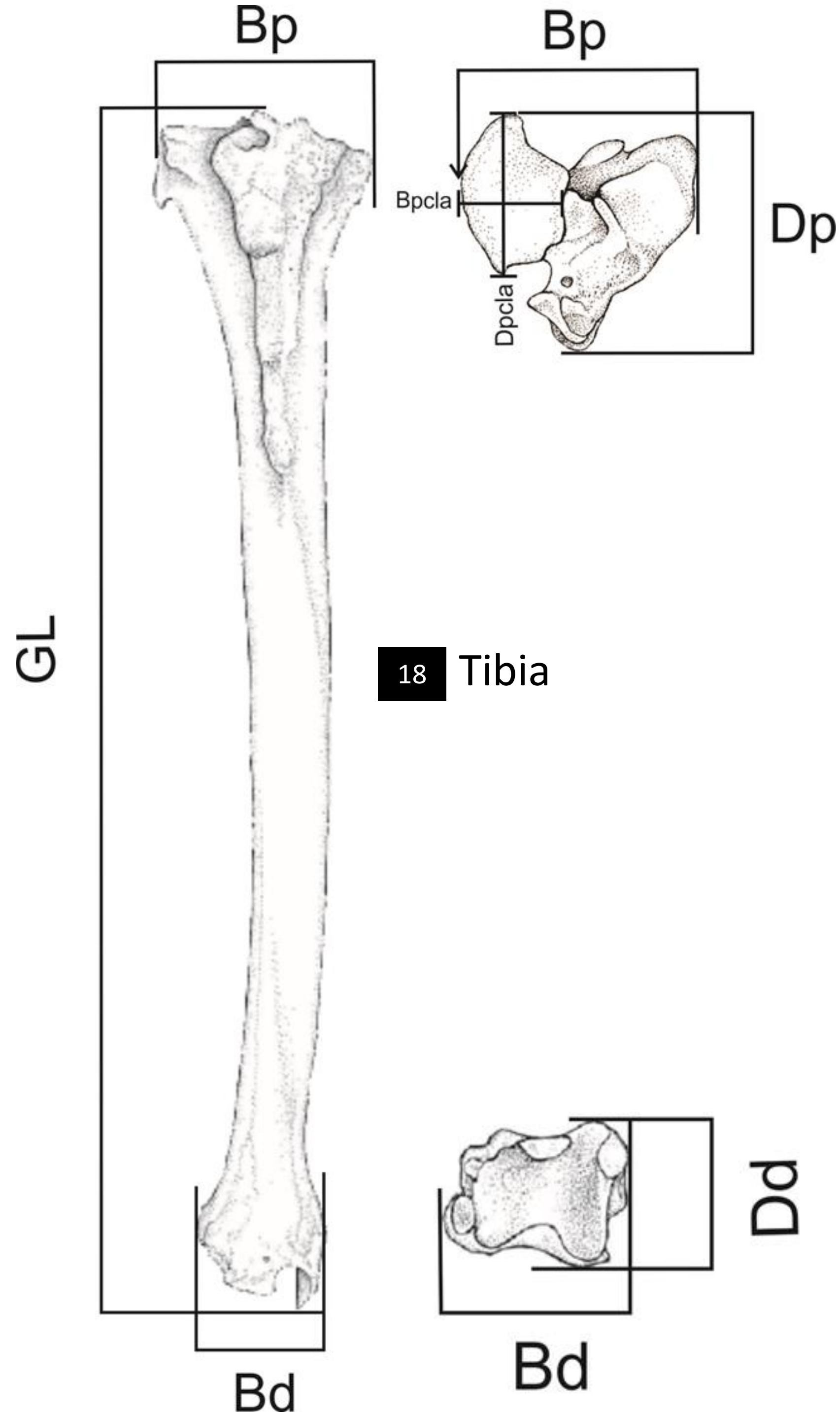
10: Metacarpal. 11: Scaphoid. 12: Lunate. 13: Triquetal. 14: Pisiform. 15: Hamate. 16: Capitate

Loponte, Corriale, Mucciolo & Acosta 2019

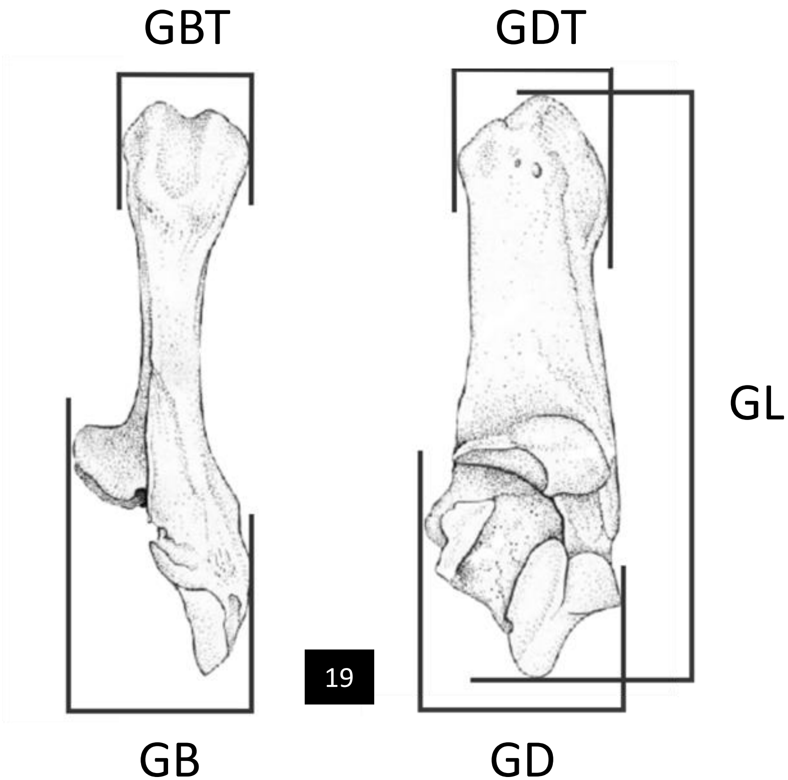
Loponte, Corriale, Mucciolo & Acosta 2019

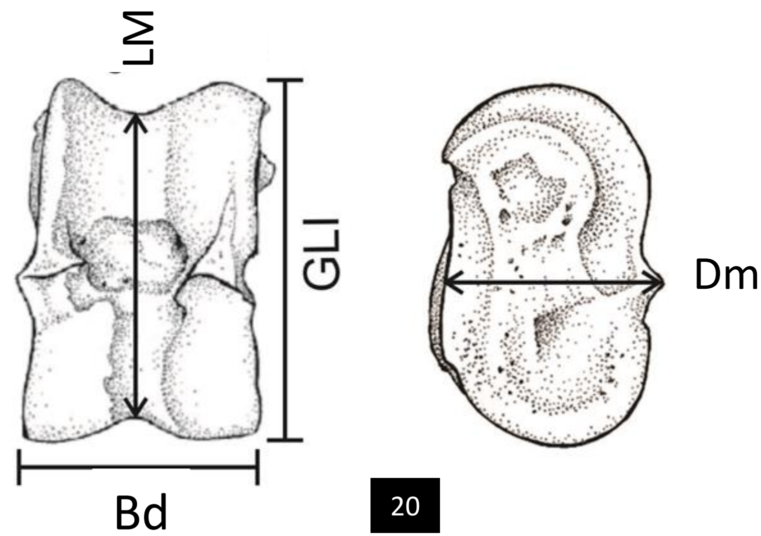


17 Femur



18 Tibia





19. Calcaneus. 20: Astragalus

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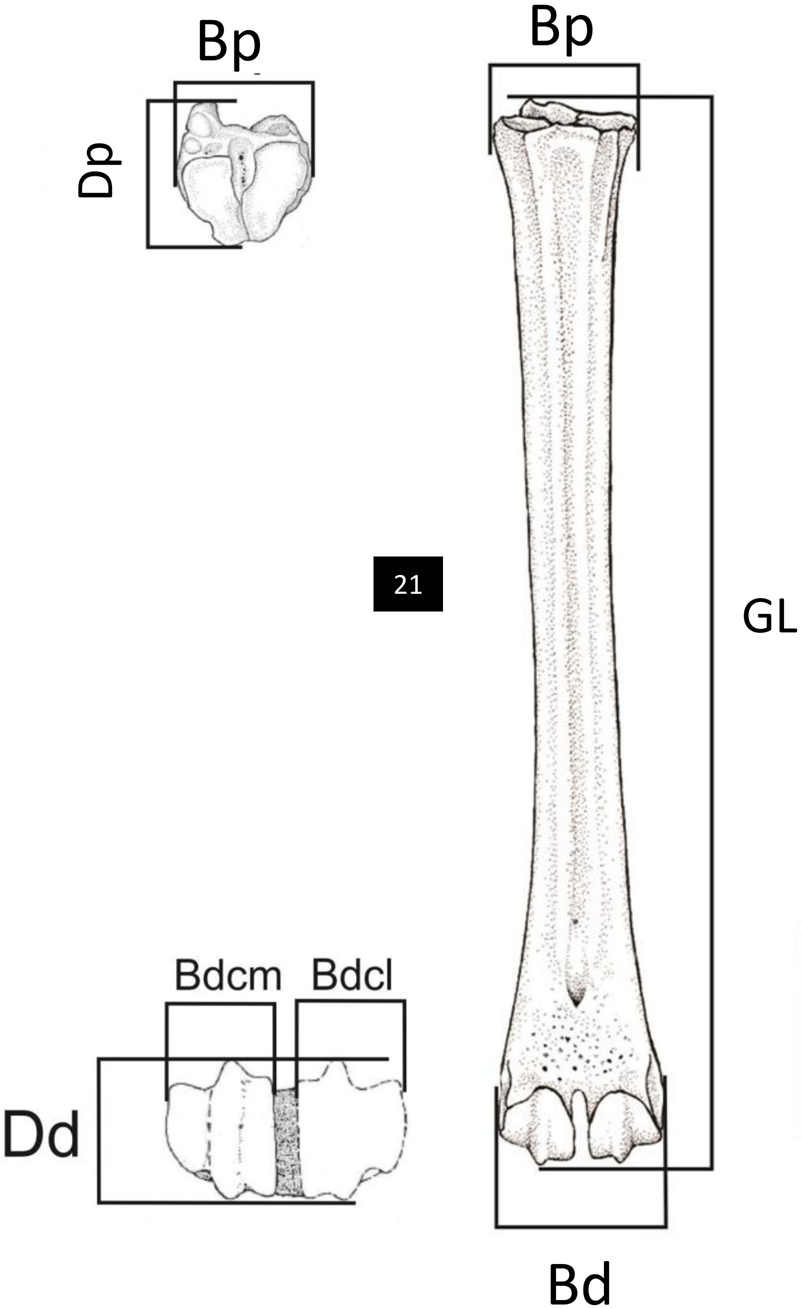
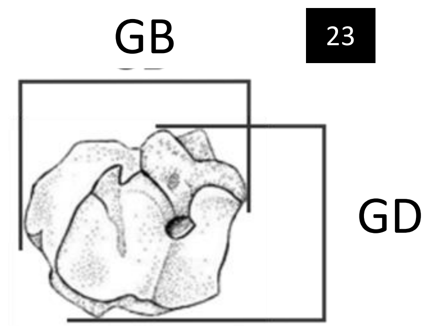
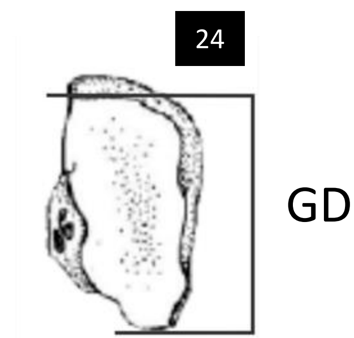
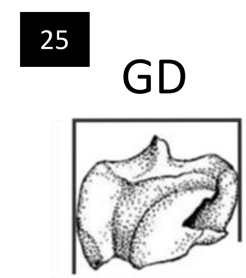




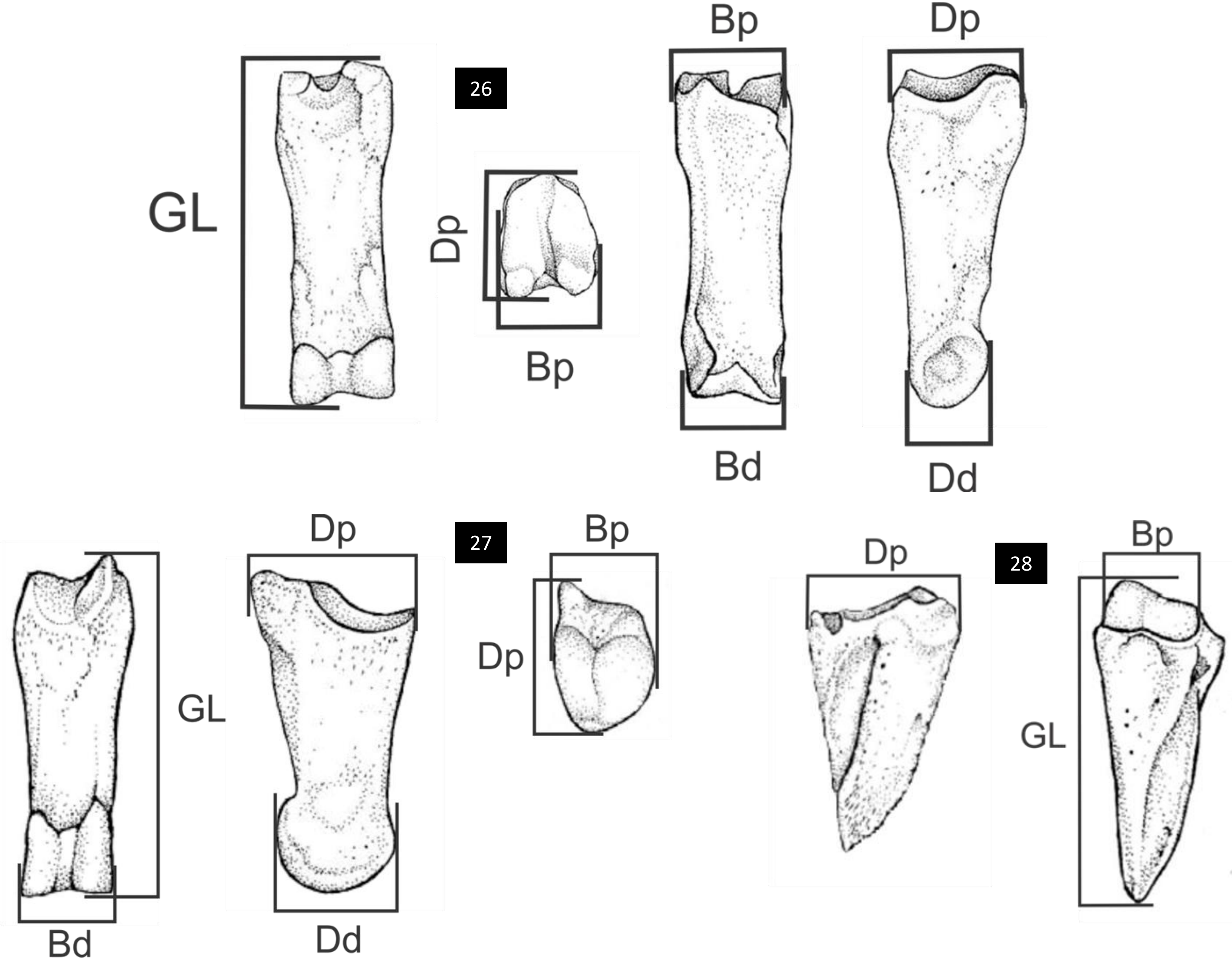




21: Metatarsal. 22: Patella.
23: Cuboid. 24: Cuneiform.
25: Maleolar

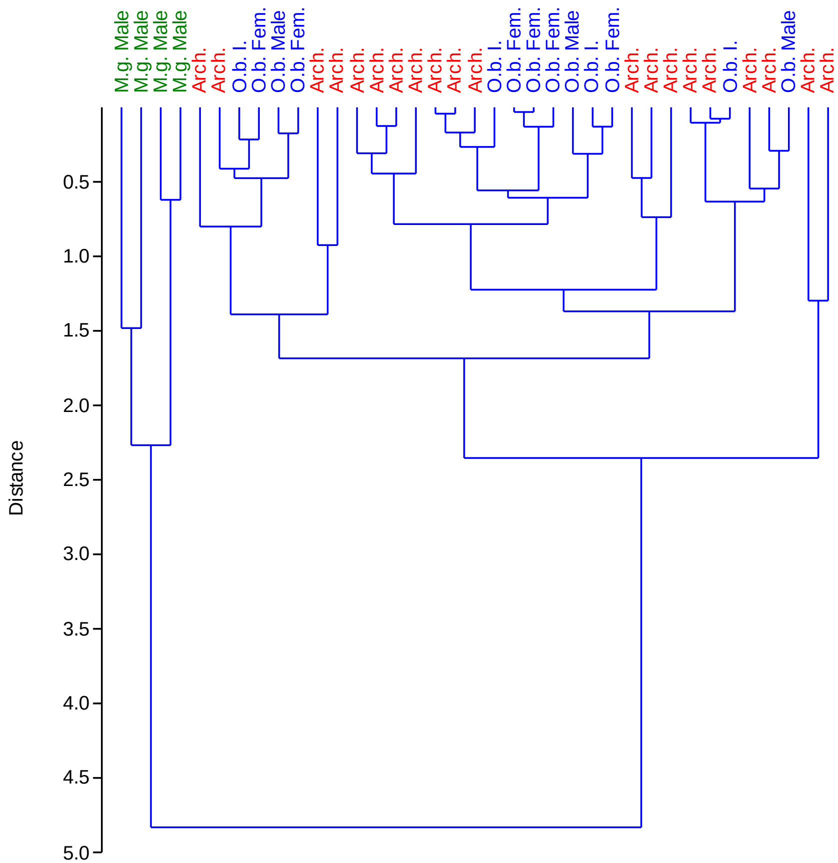
Loponte, Corriale, Mucciolo & Acosta 2019

Loponte, Corriale, Mucciolo & Acosta 2019

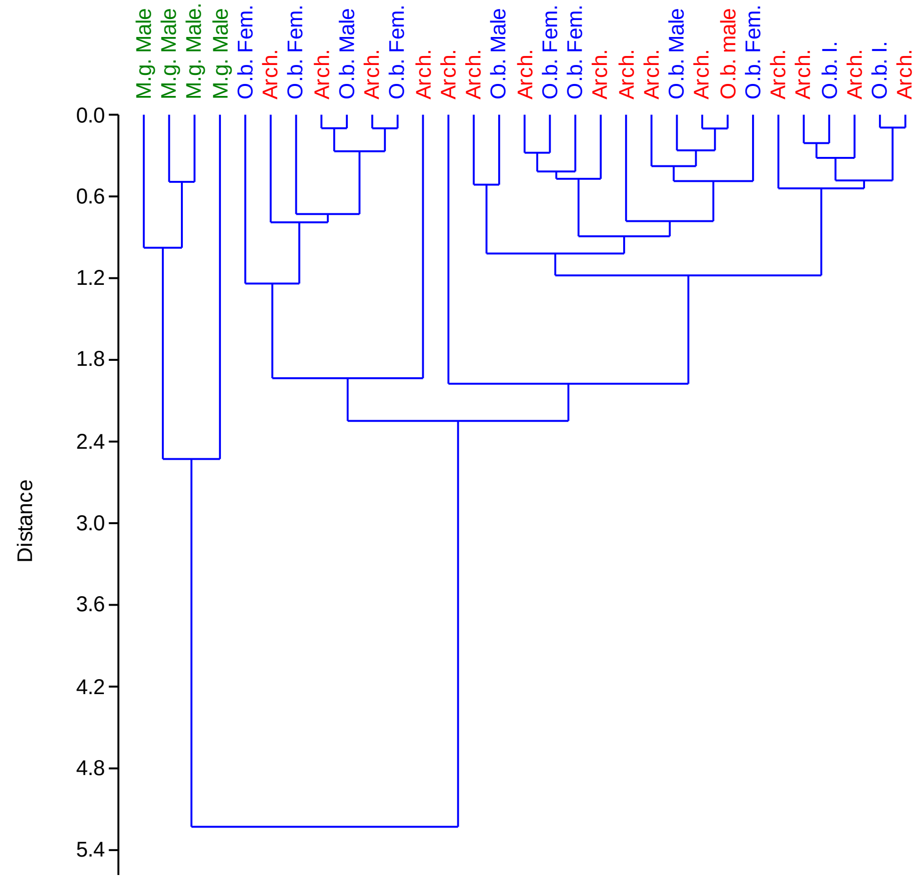


26: First phalanx. 27: Second phalanx. 28: Third phalanx

Figure S2. Euclidean distances

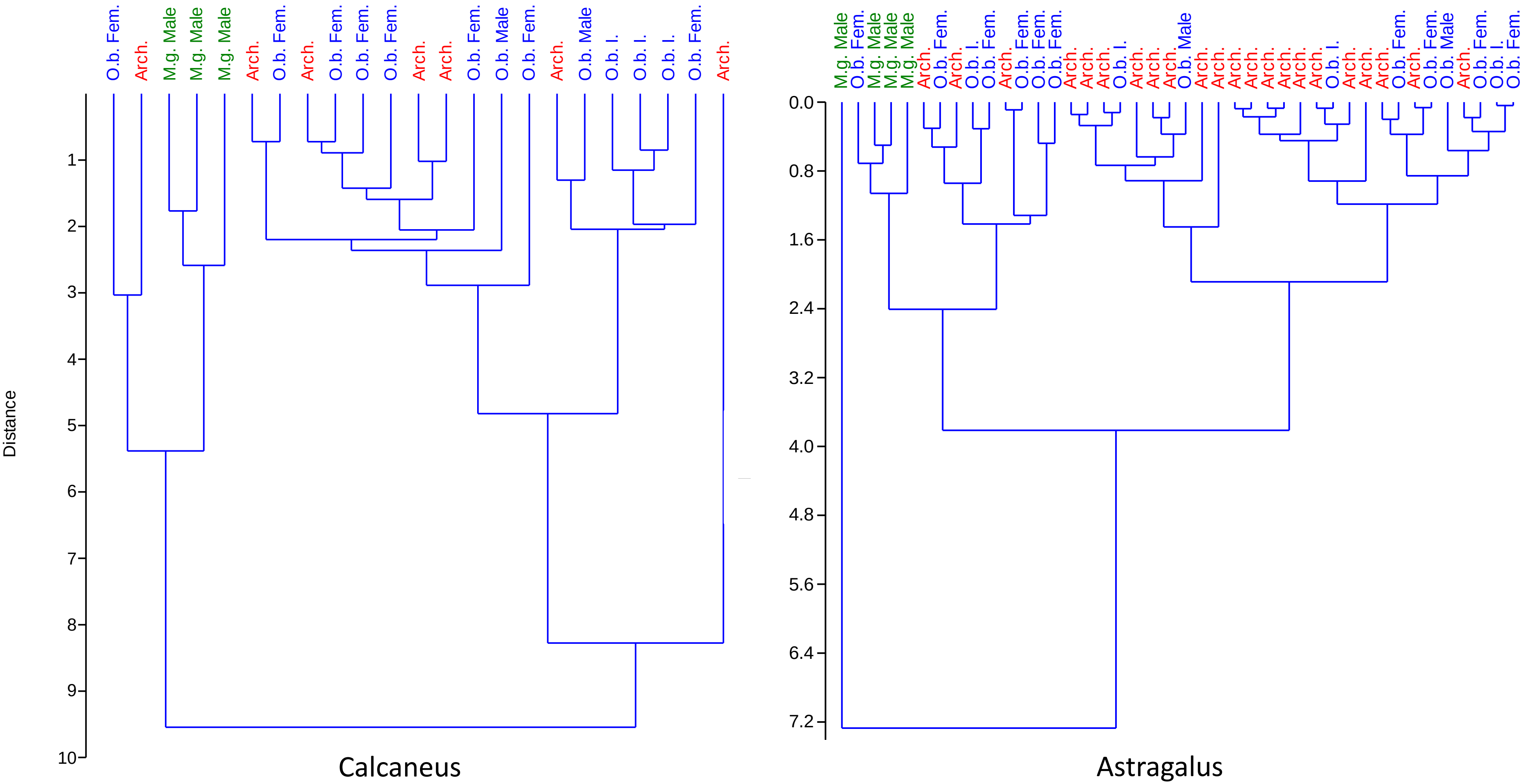


Metatarsus

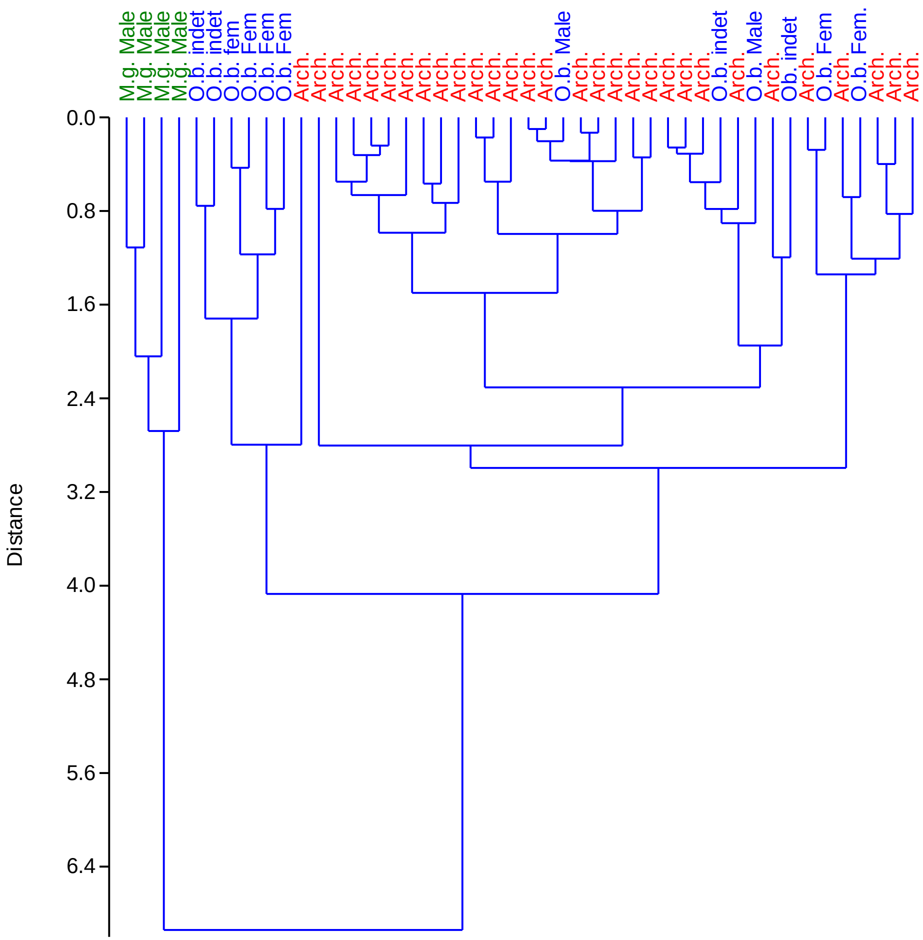


Metarcarpus.

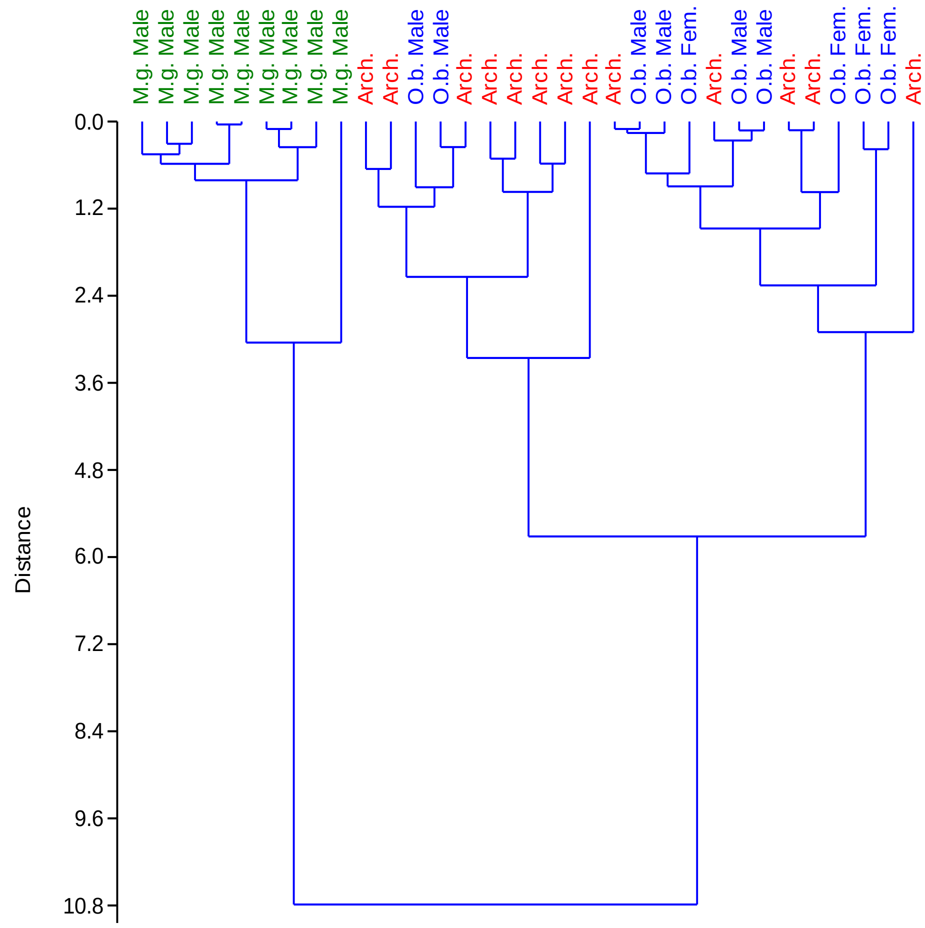
Euclidean distances matrix (measure of association or similarity) based on Bd-Dd measurements.



Euclidean distances matrix (measure of association or similarity) based on GL, GD, GBT and GDT measurements for the calcaneus, and based on GLI and LM for the astraglus.



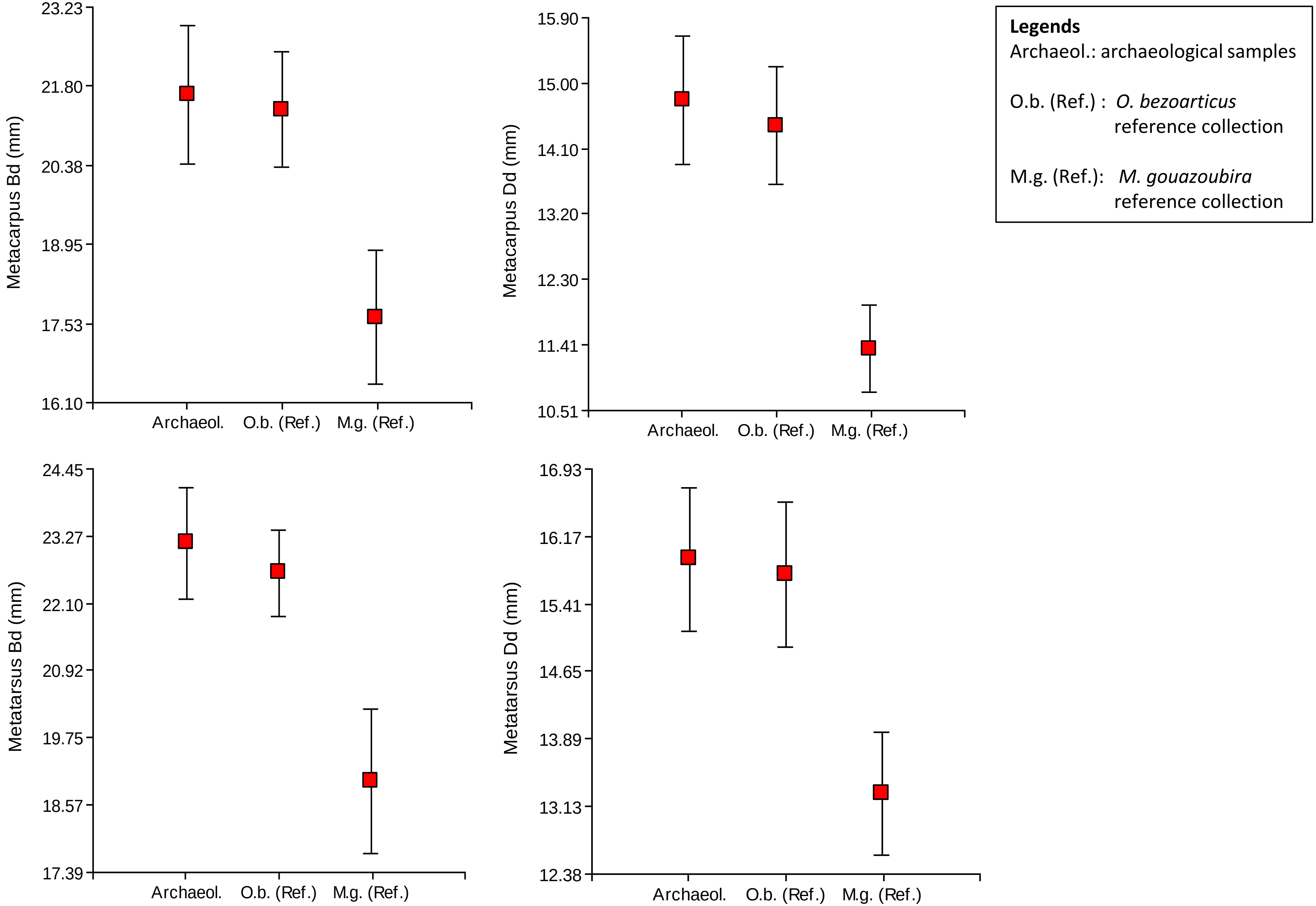
Naviculo-cuboid



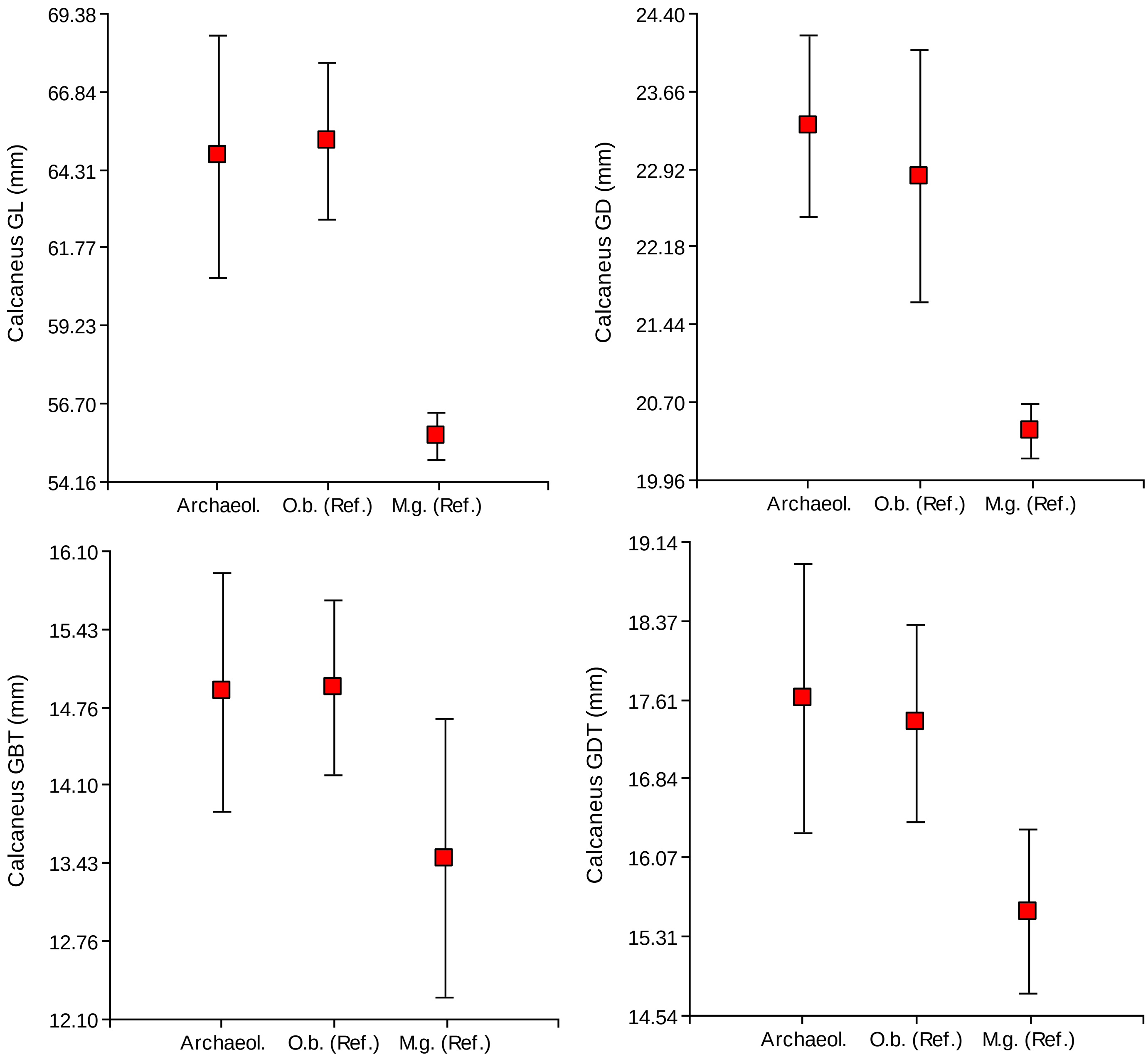
First phalanx

Euclidean distances matrix (measure of association or similarity) based on GD - GB measurements for the Naviculo-cuboid and based on GL and Dp for the first phalanx.

Figure S3. Metapodials. Bd and Dd measurements



Calcaneus. GL and GD measurements

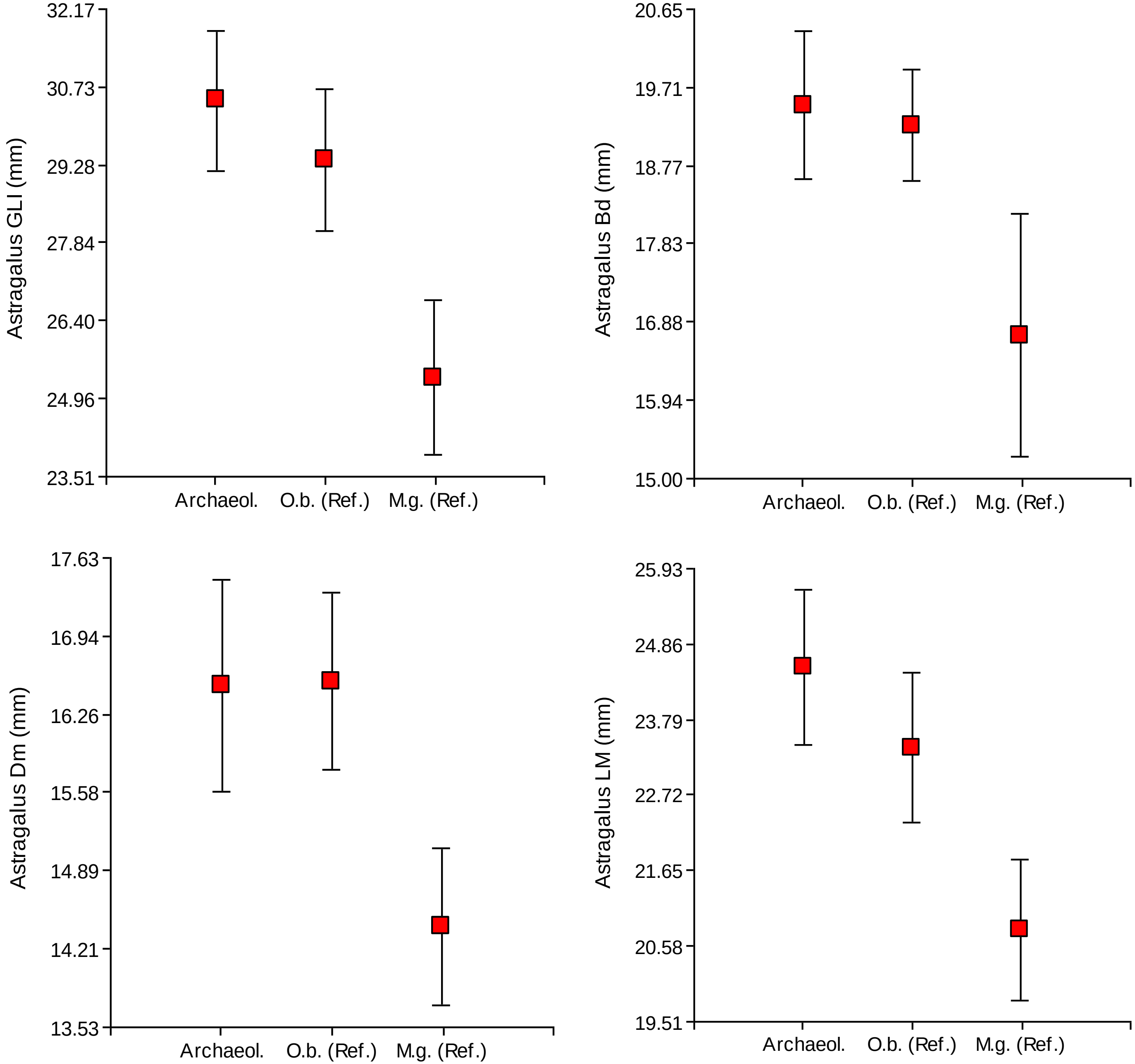


Legends
Archaeol.: archaeological samples

O.b. (Ref.) : *O. bezoarticus* reference collection

M.g. (Ref.): *M. gouazoubira* reference collection

Astragalus. GLI, Bd, Dm and LM measurements

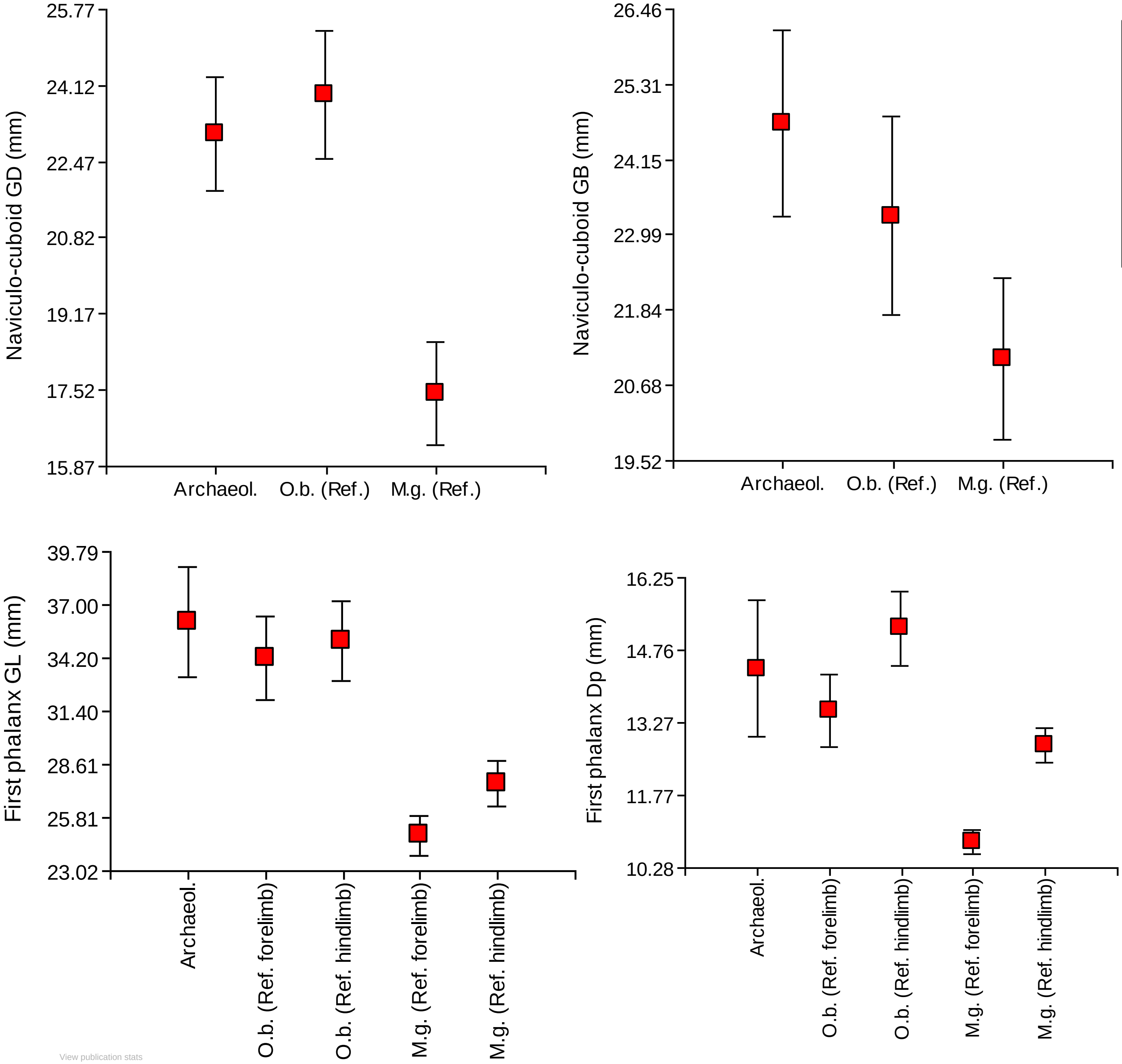


Legends
Archaeol.: archaeological samples

O.b. (Ref.) : *O. bezoarticus* reference collection

M.g. (Ref.): *M. gouazoubira* reference collection

Naviculo – cuboid and first phalanx



Legends

Archaeol.: archaeological samples

O.b. (Ref.) : *O. bezoarticus* reference collection

M.g. (Ref.): *M. gouazoubira* reference collection