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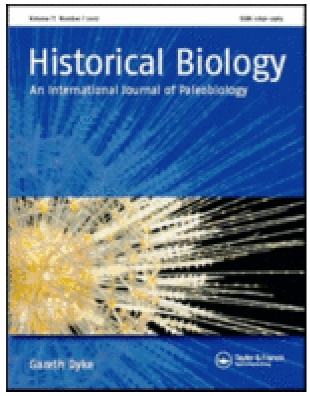

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Late Miocene rhinocerotids from the Balkan-Iranian province: ecological insights from dental microwear textures and enamel hypoplasia

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Abstract: The late Miocene is a period of increasing aridity and habitat openness in the south-eastern Mediterranean region. The impact of these changes has not been fully explored regarding rhinocerotids' ecology, although rhinoceroses were a major and diverse component of the Miocene mammalian faunas. Here we investigate the palaeoecology of rhinocerotid specimens coming from 12 localities throughout the Balkan-Iranian zoogeographic province, and covering a large part of the late Miocene (MN9 to MN13). Microwear textures confirmed the hypothesised niche partitioning between the two main rhinocerotid species – *Ceratotherium* [*Ce.*] *neumayri* (mixed-feeder including grasses) and *Dihoplus pikermiensis* (browser) – but highlighted dietary overlap between *Ce. neumayri* and the co-occurring chilothere species at Maragheh, Samos and Pentalophos-1. Although microwear did not reveal clear spatiotemporal differences, we found obvious discrepancies regarding hypoplasia prevalence: Vallesian rhinocerotid teeth displayed more defects (Xirochori and Pentalophos-1: 16.26 % of teeth affected) than Turolian specimens (all other localities: 9.72 %). Similarly, rhinocerotid teeth from eastern localities (Samos and Maragheh; supposedly more arid), had a higher hypoplasia prevalence (13.52 %) than their western counterparts (6.90 %). Insights from rhinocerotids' ecology thus challenged space and time homogeneity within Balkan-Iranian province, and the associated savanna habitat, at least regarding the sample studied here.

Keywords: Vallesian, Turolian, Balkans, Rhinocerotidae, dietary preferences, Pikermian Biome

Introduction

The Pikermian Biome (*sensu* Solounias et al. 1999) is a classical Turolian (late Miocene) mammalian assemblage, supposedly homogeneous over the so called Greco-Iranian biogeographical province (*sensu* de Bonis et al. 1979)*,* later specified as Balkano-Iranian province (*sensu* Geraads et al. 2001; Spassov et al. 2018), or the Sub-Paratethyan zoogeographic province (*sensu* Bernor 1984). Although very popular, these notions are debated and questioned. Indeed, faunal homogeneity has been challenged (Kostopoulos 2009; Athanassiou et al. 2014), the classic savanna-like environment is controverted – with reconstructions ranging from sclerophyllous evergreen woodlands (Athanassiou et al. 2014; Denk 2016; Denk et al. 2018) to a savanna mosaic (Tobien 1967; Solounias et al. 1999; Spassov 2002; Merceron et al. 2006, 2016a) – and the temporal range of the Pikermian Biome could be more restricted than previously thought (see Pikermian chronofauna *sensu* Eronen et al. 2009 and the Pikermian Event *sensu* Kostopoulos 2009, with an age of 7.3–7.1 Mya after Kostopoulos 2009 and 7.42–7.27 Mya after Spassov et al. 2017). In fact, many rich localities of the Balkans, Aegean region, or eastern Anatolia have been linked to the Pikermian Biome sensu lato, such as Hadjidimovo, Gorna Sushitsa, Karaslari, Kiro Kuchuk, Samos, or Maragheh (Bernor et al. 1996; Spassov 2002; Kostopoulos 2009; Geraads et al. 2011; Danowitz et al. 2016; Spassov et al. 2018, 2019). However, the dating of large number of Southern Balkans Turolian sites is unsure, as few localities (e.g, Pikermi, Gorna Sushitsa and Asmaka; Böhme et al. 2017, 2018) have radiometric ages. Besides, many localities of this area fall within the 7.42–7.25 Mya interval (MN12), but very few in the preceding 8.7–7.5 Mya interval (MN11; Kostopoulos 2009; Geraads et al. 2011).

All these localities yielded a typical species-rich large herbivore assemblages (e.g, ruminants and hipparionine equids) and several megaherbivores such as rhinocerotids, giraffids, and proboscideans (Solounias et al. 1999; Spassov 2002; Koufos et al. 2009a; Theodorou et al. 2010). The classic Turolian rhinocerotid assemblages are composed of one or two two-horned rhinocerotines (*Dihoplus* [*Dh.*] *pikermiensis* and / or *Ceratotherium* [*Ce.*] *neumayri*) and a similar number of aceratheriines either assigned to *Chilotherium*, *Acerorhinus*, or *Persiatherium* (Guérin 1980; Geraads 1988; Giaourtsakis 2003; Geraads and Spassov 2009; Athanassiou et al. 2014; Pandolfi 2016). In north-western Iran, Maragheh also yielded an elasmotheriine species (*Iranotherium morgani*) in addition to this classical rhinocerotine-aceratheriine fauna, making up to four distinct species and genera recognised at the same stratigraphic level (lower Maragheh biostratigraphic unit, ca. 9 Mya; Pandolfi 2016). Concerning rhinocerotids, in spite of widely homotaxic assemblages, obvious differences are visible in the distribution and relative abundance of the species across the Southeastern Mediterranean region, notably due to environmentally-controlled provincial differences (Giaourtsakis et al. 2006; Athanassiou et al. 2014). Indeed, from West to East there is a shift in the dominance of *Dh. pikermiensis* associated with *Acerorhinus* species, to that of *Ce. neumayri* associated with *Chilotherium* species, in parallel to clear climate disparities and a gradient towards more aridity and less trees towards East (Fortelius et al. 2002; Giaourtsakis et al. 2006; Strömberg et al. 2007; Eronen et al. 2009; Athanassiou et al. 2014).

Recently, the ecology of various large herbivores in several emblematic localities has raised an increasing interest (e.g, Pikermi, Samos, Maragheh, Hadjidimovo; Merceron et al. 2006; Solounias et al. 2010; Konidaris and Koufos 2013;

Danowitz et al. 2016; Orlandi-Oliveras et al. 2022). But, despite an abundant literature on the Pikermian Biome in general, their rhinocerotid component has always been under-investigated in this aspect (Giaourtsakis et al. 2006). Indeed, most works have widely focused on taxonomic issues (Giaourtsakis et al. 2006; Geraads and Spassov 2009; Giaourtsakis 2009; Athanassiou et al. 2014; Pandolfi 2016). As for ecological interpretation, dietary preferences of the two main rhinocerotid species (*Dh. pikermiensis* and *Ce. neumayri*) were classically hypothesised based on dental proportions (e.g, hypsodonty index) and similarity of occlusal pattern to modern rhinoceros species (Guérin 1980; Geraads and Koufos 1990; Geraads and Spassov 2009). In other words, independent proxies such as dental microwear, mesowear, or stable isotopy might provide original and useful palaeoecological inferences (Giaourtsakis et al. 2006). This is of particular concern, especially knowing that rhinocerotids were diverse and abundant large herbivores of the Pikermian fauna.

In this article we propose a large-scale insight into the palaeoecology of the rhinocerotids from the Balkan-Iranian province based on the combination of dental microwear textures (dietary proxy) and enamel hypoplasias (environmental stress proxy). A dozen of localities were included in this study throughout the late Miocene (MN9-MN13), and ranging from southern Bulgaria, northern and southern continental Greece as well as Samos Island, to north-western Iran. Those insights on rhinocerotids palaeoecology allowed us to discuss the supposed spatio-temporal homogeneity and the savanna biome of the region during late Miocene.

Materials and Methods

We studied the rhinocerotid remains from 12 late Miocene localities included in the Balkan-Iranian province (Figure 1; Table 1) and spanning the entire late Miocene interval (MN9–MN13; Tortonian and Messinian standard ages; Vallesian and Turolian European Land Mammal Ages). Details about the localities can be found in Supplementary S1. The material studied here is curated in various European institutions: the Naturhistorisches Museum Wien (NHMW), the Aristotle University of Thessaloniki (AUTh), the Naturhistorisches Museum Basel (NHMB), the National Museum of Natural History at the Bulgarian Academy of Sciences (NMNHS) and the Paleontological Museum "D. Kovachev", Asenovgrad (PMA) – branch of the NMNHS. For all details on the specimens included in this study see Supplementary S2. Due to the COVID-crisis and to the relocation of the collections of the Muséum National d'Histoire Naturelle of Paris, we were unable to include Turkish localities in this dataset.

[Figure 1 near here]

[Table 1 near here]

Dental Microwear Texture Analyses (DMTA)

Dental Microwear Texture Analysis (DMTA) is a short term proxy of diet (few days to few months), widely used in palaeontology (Calandra et al. 2008; Merceron et al. 2010; Jones and DeSantis 2017; Bethune et al. 2019; Hullot et al. 2021). Here we used the protocol based on Scott et al. (2005, 2006) with sensitive-scale fractal analyses.

DMT was studied on silicone (Regular Body President, ref. 6015 - ISO 4823, medium consistency, polyvinylsiloxane addition type; Coltene Whaledent) negative replicas from wear facets of well-preserved molars. We sampled one tooth per individual (preferentially second molars regardless of position and side) and focused on two facets from the same enamel band, one grinding (occlusal) and one shearing (lateral; if present), as the inclusion of both grinding and shearing facets in microwear studies may improve dietary discrimination (Louail et al. 2021; Merceron et al. 2021). Localisation of these facets on upper and lower molars is detailed in Figure 2.

[Figure 2 near here]

Silicone moulds were scanned with a Leica DCM8 confocal profilometer ("TRIDENT" profilometer housed at the PALEVOPRIM, CNRS, University of Poitiers) using white light confocal technology with a 100× objective (Leica Microsystems; Numerical aperture: 0.90; working distance: 0.9 mm). The produced scans (.plu files) were pre-treated with LeicaMap v.8.2. (Leica Microsystems). Pre-treatment included surface inversion (as scans were produced on negative replicas), replacement of the very few missing points (i.e, non-measured, less than 1%) by the mean of the neighbouring points, removal of aberrant peaks (automatic operators including a morphological filter see supplementary Information in (Merceron et al. 2016b), levelling of the surface, removal of form (polynomial of degree 8) and selection of a 200×200 µm area (1551 × 1551 pixels) saved as a digital elevation model (.sur) to be used for DMTA. The 200x200 µm surfaces were then analysed using the Scale-Sensitive Fractal Analysis with SFrax (Surfract, www.surfract.com) and LeicaMap.

Five texture variables are considered here:

- Anisotropy (exact proportion of length-scale anisotropy of relief; epLsar), which is an indication of the orientation concentration of surface roughness;
- Complexity (area-scale fractal complexity; Asfc), which measures the roughness at a given scale;
- Heterogeneity of the complexity (HAsfc) – here at two different scales 3x3 and 9x9 - reflecting the variation of complexity within the studied 200x200 µm zone;
- Fine textural fill volume (0.2 µm; FTfv) estimated by filling the surface with square cuboids of different volumes (see Scott et al. 2006 for details).

Additionally, we used an extant species dataset modified from that of Hullot et al. (2019), with two new specimens (one of *Rhinoceros unicornis* and one of *Rhinoceros sondaicus*), to facilitate the interpretation of dental microwear texture of the fossil material. It consists of 17 specimens of *Ceratotherium simum* (white rhinoceros) and 21 of *Diceros bicornis* (black rhinoceros) originated from Africa and the three Asian species with four specimens of *Dicerorhinus sumatrensis* (Sumatran rhinoceros), 15 of *R. sondaicus* (Javan rhinoceros), and five of *R. unicornis* (Indian rhinoceros).

Enamel hypoplasia

Enamel hypoplasia is a common marker of stress that is permanent, sensitive, but non-specific. Hypoplasia has been linked to many causes (more than a hundred in human; Small and Murray 1978), such as seasonality, birth, weaning or diseases (Goodman and Rose 1990; Bratlund 1999; Mead 1999; Rothschild et al. 2001; Franz-Odendaal et al.

2003; Niven et al. 2004; Upex and Dobney 2012). We studied enamel hypoplasia with the naked eye, as it provides a cheap, fast, and reliable insight (Hullot et al. 2021). We analysed all cheek teeth available, both deciduous and permanent, with the exception of damaged, much worn, or not properly identified teeth. This exclusion concerned 75 teeth and left a total of 894 teeth (288 milk molars and 606 permanent premolars and molars) from the 12 localities included in the hypoplasia-aimed analysis. No standard protocol is available for hypoplasia analysis, but most studies refer to the *Fédération Dentaire Internationale* (1982) to identify hypoplasia defects (linear enamel hypoplasia [LEH], pitted hypoplasia, and aplasia). After identification, we recorded qualitative data (tooth affected, position of the defect on the crown, severity) and took calliper measurements (distance of the defect from enamel-dentine junction, width if applicable). The different types of defects and associated calliper measurements are illustrated in Figure 3.

[Figure 3 near here]

Statistics and General Linear Mixed Models (GLMMs)

All statistics were conducted in R (https://www.R-project.org/), equipped with the following packages: reshape2 (Wickham 2007), dplyr (Wickham et al. 2019), lme4 (Bates et al. 2015), car (Fox et al. 2012), MASS (Venables and Ripley 2002). Figures were done using R package ggplot2 (Wickham 2011) as well as Inkscape v.0.91.

For GLMMs, we used the same bottom-up approach as in Hullot et al. (2021) based on a R code modified from Arman et al. (2019). An example of this code applied to DMTA variable epLsar (anisotropy) is given in Supplementary S3. For DMTA response variables were the five DMTA parameters (epLsar, Asfc, FTfv, HAsfc9, and HAsfc81), which were modelled using Gaussian family. The factors were: specimen (number of the specimen; random factor), locality, province, age (MN zones), genus, tooth (e.g, second molar and fourth milk molar), position (upper or lower), side (left or right), cusp (protocone, protoconid, or hypoconid), and facet (grinding or shearing). Hypoplasia response variables were Hypo (1 or 0 for presence or absence of hypoplasia) modelled with Binomial family, Defect (e.g, LEH, Pits, Aplasia; converted to numbers), Localisation (position of the defect on the crown; mostly labial or lingual), Multiple (number of defects), and Severity (from 0 to 4), for which we selected Poisson family. The factors tested were: specimen (number of the specimen; random factor), genus, province, locality, age (Vallesian or Turolian), tooth (e.g, first molar, fourth premolar), position (upper or lower), side (left or right), and wear (low, average, high). Additionally, Defect was converted and used as a factor for response variables Severity, Multiple, and Localisation.

The best model was selected using Akaike's Information Criterion score (AIC; lowest score), then tested for over-dispersion (estimated through the ratio of deviance and degrees of freedom) and corrected if necessary by using quasi-Poisson or quasi-Binomial laws from the MASS package (Venables and Ripley 2002) or by adjusting the coefficients table for Gaussian laws (multiply type error by square root of the dispersion factor and recalculate z and p values accordingly). In total, 300 models were compared across the 10 response variables (see electronic supplementary material, S3, S4, and S5).

Results

Dental microwear

The p-values associated with MANOVAs (Species/Genus x Facet x Province/Locality) on all five main DMTA parameters (epLsar, Asfc, FTfv, HAsfc9, HAsfc81) were the lowest for Facet, ranging between 0.027 (Genus x Facet x Locality) and 0.047 (Species x Facet x Locality). For all other parameters (Species, Genus, Province, Locality), p-values were above 0.1 in every formula. The ANOVAs conducted for each DMTA parameter revealed low p-values for several factors suggesting an effect in the differences observed for all parameters but HAsfc81, as detailed in Table 2. Both types of statistical tests suggested that the differences in DMT patterns observed were mainly due to facet.

[Table 2 near here]

Median, mean and standard deviation of the mean (SD) were calculated by species, facet and locality. Besides at Maragheh, the sampling was very restricted (n < 5), either due to low numbers of cranio-dental specimens available, or to the lack of well-preserved dental microwear texture on molars. The results are detailed in Table 3. We also plotted anisotropy against complexity for all specimens (Figure 4).

[Table 3 near here]

[Figure 4 near here]

The mean and median values of anisotropy for *Ceratotherium neumayri* were low (< 2.5 x 10^{-3}) at Pikermi, Pentalophos-1, and Strumyani, moderate (~ 3 x 10^{-3}) at Maragheh and Kalimantsi, and high (≥ 4.5 x 10^{-3}) at Ravin des Zouaves-5 and Samos on both facets (Table 3). For complexity, the values were moderate (> 1) for most sites on both facets, except for the shearing facet of Samos (0.68) and Ravin des Zouaves-5 (0.98), and much higher for the grinding facet at Strumyani-2 (1.98) and Samos (2.74). Only four specimens of *Ce. neumaryi* have anisotropy higher than the classic high anisotropy threshold of 5 x 10^{-3} on both facets: two from Maragheh, one from Samos, and one from Ravin des Zouaves-5 (Figure 4). Similarly, four specimens were above the high complexity cutpoint (Asfc = 2) but only on the grinding facets (none on the shearing ones): both specimens from Strumyani, one from Maragheh, and one from Pentalophos-1.

Mean and median of FTfv (in μm^3) for *Ce. neumayri* specimens were high (> 4 x 10^4) on both facets for all localities but Pikermi (2.2 x 10^4), and shearing facet at Maragheh (3.4 x 10^4). Mean and median of HAsfc9 and HAsfc81 for *Ce. neumayri* varied greatly depending on the locality (Table 3). On the grinding facet, both Hasfc were low (≤ 0.2 for HAsfc9 and ≤ 0.5 for HAsfc81) at Pentalophos-1 and Ravin des Zouaves-5, but high (> 0.3 and > 0.6) at Pikermi and Samos. Values for the grinding facet at Kalimantsi and Maragheh were high for HAsfc9 (0.3-0.4) but moderate for HAsfc81 (> 0.5). On the shearing facet, HAsfc9 was moderate at Pentalophos-1 (0.25) and Samos (0.22), and high at Maragheh (> 0.3) and Ravin des Zouaves-5 (0.46), while HAsfc81 was moderate (0.5-0.6) in Maragheh, Samos, and Ravin des Zouaves-5, but low at Pentalophos-1 (0.49).

Dihoplus pikermiensis dental microwear textures were studied from Hadjidimovo and Pikermi only. This rhinocerotid had low mean and median values of anisotropy (< 2 x 10^{-3}) at both sites and on both facets (Table 3). These statistics were high for complexity of the grinding facet (2.83) but low for the shearing facet (0.5) at Pikermi, and moderate (between 1 and 2) for both facets at Hadjidimovo. On Figure 4, we can see that all specimens of *Dh. pikermiensis* are below 2.5 x 10^{-3} for epLsar on both facets, and above 1 for Asfc on grinding facet. For both sites, FTfv was high on the grinding facet (~ 6.6 x 10^{4}) and low on the shearing one (Pikermi: 1.4 x 10^{4} and Hadjidimovo: 2.6 x 10^{4}). Mean and median of both HAsfc were moderate to high on the grinding facet for both localities, and low-moderate on the shearing facets (Table 3).

Chilotherium [*Ch.*] species from the different sites (Maragheh, Pentalophos-1, Samos, and Xirochori) had various dental microwear texture profiles. *Chilotherium persiae* had the lowest mean value of anisotropy on both facets (grinding: 2.28 x 10^{-3}; shearing: 3.07 x 10^{-3}), while *Ch. kiliasi* from Pentalophos-1 and *Ch.* sp. from Xirochori had similarly high mean values on both facets (grinding: ~ 4 x 10^{-3}; shearing: ~ 6 x 10^{-3}). *Chilotherium schlosseri* from Samos had very low mean complexity on both facets (grinding: 0.64; shearing: 0.38). On the shearing facet, *Ch. persiae* and *Ch. kiliasi* displayed complexity mean around 1, while *Chilotherium* sp. from Xirochori had a complexity of 2.36. On the grinding facet the median Asfc was high (around 2) for all species but *Ch. schlosseri*. On the grinding facet, only three specimens (all from Maragheh; *Ch. persiae*) have epLsar values above the high anisotropy threshold (5 x 10^{-3}), while about half the specimens from Maragheh and both from Pentalophos-1 (*Ch. kiliasi*) are above the high complexity cutpoint (2; Figure 4). On the shearing facet, five specimens display high epLsar values (3 from Maragheh, one from Pentalophos-1, and on from Xirochori) and three have high Asfc values (same one from Xirochori, and two from Maragheh; Figure 4). FTfv had high values (> 4 x 10^4) on the grinding facets of all *Chilotherium* species. On the shearing facet, FTfv was low for the specimen from Xirochori (1.5 x 10^4), moderate for *Ch. persiae* (Maragheh) and *Ch. kiliasi* (Pentalophos-1) with a mean around 3 x 10^4, and high for *Ch. schlosseri* (Samos; 5.7 x 10^4). HAsfc medians were high (> 0.3 for HAsfc9 and > 0.6 for HAsfc81) on the grinding facet all species but that at Xirochori (HAsfc9: 0.2; HAsfc81: 0.44). Hasfc medians on the shearing facet were low for *Ch. schlosseri* and moderate to high for all three other species.

Teeth of all representatives of *Acerorhinus* (from Gorna Sushitsa, Kocherinovo, and Kalimantsi) had low values of anisotropy, between 1 and 2 x 10^{-3} on both facets, except the shearing facet of the specimen from Gorna Sushitsa (6.6 x 10^{-3}). Values of complexity were moderate, between 1 and 1.5, on both facets, except for the grinding facet of the specimen of Kocherinovo (4.3). FTfv was high (> 4 x 10^4) on the grinding facet at Kalimantsi and Kocherinovo, and the shearing facet at Gorna Sushitsa, moderate otherwise (> 2.5 x 10^4; Table 3). Eventually, HAsfc9 was high (0.3–0.5) on the grinding facet at all sites and low to moderate on the shearing ones (Kocherinovo: 0.19; Gorna Sushitsa: 0.29), while HAsfc81 was moderate (0.5-0.6) for all but the shearing facets of the specimen of Gorna Sushitsa (> 1).

GLMM

The results observed with basic statistics (mean, median) were retrieved with GLMMs, confirming the reliability of this approach. For all response variables (epLsar, Asfc, FTfv, HAsfc9, and HAsfc81), model support increased (i.e, lower AIC) when intraspecific factors were included (e.g, Facet, Genus, Province). When Genus was not forced into the models, the final models contained two to five factors, including Specimen, the random factor, by default in all models. Genus was in the final models of epLsar and HAsfc81, Facet in that of epLsar, Asfc and FTfv, and Province in that of HAsfc9 and HAsfc81. Details and comparison of all models can be seen in electronic supplementary material S3 and S4.

GLMMs results revealed the impact of Facet, Genus, and Province on the dental microwear pattern. We found more differences in dental microwear with GLMM than with the classic MANOVA / ANOVAs approach. Between Genus (corresponding to a single species except for *Chilotherium*) few differences were noticed: *Ceratotherium* has higher anisotropy than *Dihoplus* ($df = 58$; $\alpha = 0.05$, t-value = -3.094), but lower complexity and HAsfc81 than *Chilotherium* and *Acerorhinus* ($df > 60$; $\alpha = 0.05$, t-values > 1.7). The choice of the studied facet also appears crucial as the shearing facet has higher values of anisotropy ($df = 58$; $\alpha = 0.05$, t-value = 2.14) but lower values of complexity and fine textural fill volume ($df > 60$; $\alpha = 0.05$, absolute of t-value > 1.7) than the grinding facet. Eventually, Western localities specimens have lower HAsfc9 and HAsfc81 than Eastern ones ($df > 60$, $\alpha = 0.95$, absolute of t-values > 1.7).

Besides the facet, the sampling site (tooth locus, position, side, cusp) had sometimes a confounding effect. Right teeth had lower complexity and HAsfc81 ($df > 60$, $\alpha = 0.95$, absolute of t-values > 1.7) than their left counterparts. Similarly, upper teeth display higher anisotropy than lower teeth ($df = 58$; $\alpha = 0.05$, t-value = 3.199), and the protocone has lower FTfv than the protoconid ($df = 63$, $\alpha = 0.95$, t-value = -2.24).

Eventually, second molars had higher epLsar values than third ones, but lower than first molars ($df > 60$, $\alpha = 0.95$, absolute of t-values > 1.7). Tuckey's contrasts also highlighted that M3 had lower epLsar than M1 (p-value < 0.001).

GLMM - Comparison to extant dataset

When compared to the extant dataset, all fossil species had lower values of anisotropy than the grazing *Ce. simum* and the folivore *Dc. sumatrensis* ($df = 165$, $\alpha = 0.05$, t-value threshold: ± 1.645). Moreover, *Dihoplus pikermiensis* had lower anisotropy than the browsing *Ds. bicornis* (t-value = - 1.71) and the variable grazer *R. unicornis* (t-value = - 2.18). Concerning complexity, *Ce. neumayri*, *Chilotherium*, and *Dihoplus pikermiensis* had lower complexity values than both extant browsing species, *Ds. bicornis* and *R. sondaicus* ($df = 165$, $\alpha = 0.05$, t-value threshold: ± 1.645). HAsfc81 values of *Ce. neumayri* were significantly lower than that of *Ce. simum* (t-value = - 2.33), *R. sondaicus* (t-value = - 2.77), and *Ds. bicornis* (t-value = - 1.87), while those of *Dh. pikermiensis* were significantly lower than the ones of only the extant grazing species *Ce. simum* (t-value = - 1.78), and the browser *R. sondaicus* (t-value = - 2.12). However, there were no critical differences in FTfv and HAsfc9 values between the extant and extinct rhinocerotids.

Hypoplasia

Out of the 894 rhinocerotid teeth studied throughout the Balkan-Iranian province, only 94 presented hypoplasia, corresponding to around 10.51 %. This relatively moderate prevalence is however very distinct depending on the species, tooth locus, and locality considered (Table 4). Overall, milk molars (38/288; 13.19 %) were more affected than permanent teeth (56/606; 9.24 %; Table 4). Similarly, upper teeth (47/508; 9.25 %) were less affected than their lower counterparts (47/386; 12.18 %; Table 4). When all species and localities are merged (Table 4; Figure 5), the most affected tooth locus is D4/d4 with 35.06 % (27/77 teeth being hypoplastic), while the least affected are D1/d1 (3/63; 4.76 %) and D3/d3 (3/79; 3.80 %). We also found a relatively high prevalence for M2/m2 (14/105; 13.33 %) and M3/m3 (14/84; 16.67 %).

[Table 4 near here]

Once all localities and teeth are merged, *Ch. kiliasi* and *Ch. schlosseri* were the most affected species with both 22.22 % of teeth bearing a defect (14/63 and 2/9 hypoplastic teeth respectively; Table 4), followed by *Ch. persiae* (39/337; 11.57 %). The least affected species were *I. morgani* and the *Dihoplus* species from Slatino with no teeth hypoplastic (Table 4; Figure 6). Both two-horned rhinocerotine species, *Ce. neumayri* and *Dh. pikermiensis*, have similarly low overall hypoplasia prevalence, around 8 % (21/248 and 11/134 hypoplastic teeth, respectively). All other species exhibit a similar prevalence, with around 7-9 % of teeth being hypoplastic. Only one tooth out of ten (10 %) is affected by hypoplasia for the *Chilotherium* sp. skull from Xirochori, and four teeth out of 60 (6.67 %) for the *Acerorhinus* sp. specimens. No permanent tooth (0/58) is affected for *D. pikermiensis* but 14.47 % (11/76) of milk teeth are hypoplastic.

Figure 5 highlighted prevalence differences between Eastern localities (Samos and Maragheh) and Western ones (all others), and between Vallesian sites (Pentalophos-1 and Xirochori) and Turolian ones (all others). The Eastern localities presented twice as more frequent hypoplastic teeth in total (66/488; 13.52 %) than the Western sites (28/406; 6.90 %). Although it may not be obvious visually, rhinocerotids from Vallesian localities had a prevalence 1.5 times higher (20/123; 16.26 %) than Turolian ones (74/761; 9.72 %). The rhinocerotids from Samos were the most prone to hypoplasia with 27.94 % (19/68) of their teeth bearing at least one defect. Hypoplasia was also frequent at Pentalophos-1 (19/123; 15.45 %) and Maragheh (47/420; 11.19 %). On the contrary, no hypoplasia was recorded in several localities having yielded only a few exploitable specimens, such as Gorna Sushista (two maxillaes, one skull), Kocherinovo (one mandible), Ravin des Zouaves (two skulls, one mandible), and Slatino (two maxillaes). The detail of hypoplasia counts and prevalence by species, locus, and locality is available in Supplementary S6.

[Figure 5 near here]

The previous results are based on counts on each tooth as if it were isolated, but many specimens were mandibles and maxillaes (i.e, associated teeth). This means that some events of hypoplasia might have been counted more than once, as hypoplasia is likely to affect all co-developing teeth in a given individual, which may somewhat bias the interpretation of hypoplasia prevalence. For instance, 16.67 % (2/12) of *Persiatherium rodleri* teeth present hypoplasia, but they all belong to the same skull, and both hypoplastic teeth (left and right M2) document the same hypoplasia event. Thus, Table 5 presents the results of hypoplasia prevalence when associated teeth are considered.

[Table 5 near here]

Overall, *Chilotherium* species seem to be particularly affected by hypoplasia. At Pentalophos-1, 66.67 % of the specimens of *Ch. kiliasi* presented hypoplasia, while at Maragheh 47.06 % of maxillaes and mandibles had at least one defect. Specimens of *Ce. neumayri* and *Dh. pikermiensis* at all localities seem less affected than the chilotheres. Nearly all dental material studied from Samos displayed hypoplasia, while at Kalimantsi only three remains, all of *Acerorhinus* sp, were affected (Table 5).

Clear phylogenetic differences are also evident on Figure 6. Although both restricted in specimens and species, the Elasmotheriina seem really spared by hypoplasia, a result also noted in other early to middle Miocene species (Hullot et al. 2022). On the contrary, Aceratheriina are very prone to having hypoplastic defects. Eventually, Rhinocerotina species are more or less affected depending on the locality. This could suggest that hypoplasia in this tribe reflects more the local conditions rather than a specific susceptibility to stress.

[Figure 6 near here]

GLMM

For all response variables (Hypo, Defect, Multiple, Localisation, and Severity), model support increased (lower AIC) when intraspecific factors (e.g, Tooth Loci, Genus) were included. When Genus was not forced into the models, the final models contained two to seven factors, including Specimen, the random factor, by default in all models. Defect (converted to a factor) was in the final models of all concerned variables (Multiple, Localisation, and Severity). Age and Province were in the final models of

Hypo and Defect, and Position was in that of Hypo and Localisation. Details and comparison of all models can be seen in electronic supplementary material S3 and S5.

Based on GLMMs results, we can investigate the influence of Province and Age on the hypoplasia pattern. Rhinocerotid teeth from Western localities are less affected by hypoplasia (p-value = 2.2×10^{-4}) than those from Eastern localities (Samos and Maragheh), but no significant differences in the nature of the defects were found. Vallesian rhinocerotids (from Pentalophos-1 and Xirochori) are more prone to hypoplastic defects on their teeth than Turolian ones (p-value = 1.03×10^{-3}), and the type of defects is also different (p-value = 9.21×10^{-3}). The only interspecific differences detected were between *Ce. neumayri* and *Dh. pikermiensis* (p-value = 0.036) or *Acerorhinus* (p-value = 0.052). Concerning tooth loci, all teeth but P4/p4 presented less hypoplastic defects than D4/d4 (p-values ≤ 0.001; except for M2/m2: p-value = 0.011 and M3/m3: p-value = 0.045).

Other effects were also observed. For instance, upper teeth tended to have less defects than their lower counterparts (47/508 and 47/386 teeth affected, respectively; p-value = 0.045), and the defects are less frequently observed on the labial side (p-value = 0.016). Besides between upper and lower teeth, no difference in defect localisation (labial vs. lingual) was observed (p-values > 0.3). Concerning defect type, LEHs were more frequently multiple than pits, aplasia and other types of defects. LEH were also more often severe than pits or other defects (p-values < 0.02). Concerning pits, this result might be due to the way pits are recorded in the first place (i.e, several pits identified as a single hypoplasia event) and their aetiology (less ameloblasts disrupted than for LEH or aplasia).

Discussion

Dietary preferences of the studied specimens

Regarding DMTA, seven rhinocerotid species belonging to four genera (*Ceratotherium*, *Dihoplus*, *Chilotherium*, *Acerorhinus*) were studied. The reconstructed dietary preferences are detailed by locality and by species in Table 6.

[Table 6 near here]

The dental microwear texture profile (Figure 4) of *Ceratotherium neumayri*, with few specimens displaying high values of anisotropy (> 5 x 10^{-3}; grinding: 4/16; shearing: 4/9) and complexity (> 2; grinding: 4/16; shearing: 0/9), suggests quite soft food items and excludes pure grazing for the concerned individuals (except for the specimen of Samos). The moderate to high mean values of HAsfc9 and HAsfc81 at all sites (Table 3) point towards a certain intra-individual dietary versatility, incompatible with a monotypic diet such as pure grazing and strict folivory (Scott 2012; Ramdarshan et al. 2016; Merceron et al. 2018; Hullot et al. 2019), two dietary behaviours also excluded regarding the differences with the extant grazer *Ceratotherium simum* highlighted by GLMMs. Our results are instead compatible with a mixed-feeding feeding behaviour. Such a diet is consistent with statements from the literature, as many authors stated that strict grazing similar to that of extant white rhinoceros (*Ceratotherium simum*) was very unlikely (Guérin 1980; Geraads and Koufos 1990; Giaourtsakis et al. 2006; Geraads and Spassov 2009) although this rhinoceros has adaptations to low-level vegetation (Geraads and Spassov 2009). The only other microwear (2D) study including this species (Solounias et al. 2010), suggested a grazing behaviour, contrary to our present specimen from Pikermi, but the study also included only one tooth from Pikermi (Figure 4).

Chilotherium species are also thought to be non-specialist grazers (Geraads and Koufos 1990; Geraads and Spassov 2009). Our results show a wide range of anisotropy values (Figure 4), and moderate to high Hasfc means (Table 3) for species assigned to this genus, recalling the microwear textures of *Ce. neumayri*. This suggests a similar mixed-feeding behaviour for *Chilotherium* spp. and *Ce. neumayri.* Therefore, competition for food resources may have occurred between these species around the localities where they co-occur (e.g, Samos, Maragheh, Pentalophos-1, and Gorna Sushitsa). However, several specimens of *Ch. persiae* (Maragheh; n = 6/13) and all of *Ch. kiliasi* (Pentalophos-1; n = 2/2) display high values of complexity (> 2) on the grinding facet, contrary to *Ce. neumayri*. This suggests the inclusion of harder browse items in the diet of these chilotheres, either due to competition (shift in the diet in harsh conditions) or to resource partitioning. In a previous study, the mesowear score of *Ch. persiae* (MS = 0.3; n = 12) even suggested browsing preferences for this quite high-crowned rhinocerotid (Jokela 2015).

Dihoplus pikermiensis has a browsing signature, with low values of anisotropy and moderate values of complexity (Figure 4), as expected based on the low-crowned cheek teeth of this rhinocerotine (Guérin 1980; Giaourtsakis et al. 2006; Geraads and Spassov 2009). The preliminary results (n = 3 from Pikermi) of 2D microwear from Solounias et al. (2010) pointed towards a grazing behaviour. This discrepancy can be explained by a sampling bias due to the restricted number of specimens in both studies. Thus, our results suggest that the main rhinocerotids of the Pikermian Biome, *Dihoplus pikermiensis* and *Ceratotherium neumayri*, had different dietary preferences and food niches, further reflected in their microwear textures, and as already proposed by previous studies (Spassov et al. 2006; Giaourtsakis et al. 2006; Geraads and Spassov 2009).

Our restricted pool of *Acerorhinus* sp. specimens points towards browsing or mixed-feeding behaviour. Browsing has already been proposed for some species of these genus based on dental morphology. Indeed, representatives of *Acerorhinus* have brachydont, non-prismatic crowns suggesting a diet based primarily on non-fibrous and non-abrasive food (i.e, browsing; Athanassiou et al. 2014). Moreover, the strong cingulum on the teeth might suggest the consumption of branches and thorns, as this structure has been proposed as gingiva protection during mastication of such hard objects (Heissig 2012). The consumption of hard objects should result in high values of complexity, as observed on the grinding facet of the specimen from Kocherinovo and one other from Kalimantsi. A browsing diet is also consistent with the reconstructed landscape at Kocherinovo, as dominated by open woodland and shrubland (Hristova et al. 2013).

Interestingly, all rhinocerotid species at Maragheh – *Ce. neumayri*, *Ch. persiae*, *I. morgani* (DMT not studied), and *P. rodleri* (DMT not studied) – are relatively hypsodont and adapted to open and dry environments (Pandolfi 2016). However, the link between hypsodonty and grazing is controverted. Indeed, hypsodonty might be either a way to compensate for the ingestion of more food due to poor nutritional quality, and/or a way to consume a greater diversity of resources, or even protect from excessive abrasion due to exogenous abrasive loads in open and dry environments (Semprebon and Rivals 2007; Damuth and Janis 2011; Jardine et al. 2012; Semprebon et al. 2019). A mixed-feeding diet has for instance been proposed for the subhypsodont elasmotheriines *Hispanotherium beonense* from Béon 1 (MN4; France) and *Hispanotherium* cf. *matritense* from Gračanica (MN5; Bosnia-Herzegovina), based on dental wear (micro- and meso- wear) data (Xafis et al. 2020; Hullot et al. 2021). Moreover, our DMTA results for *Ce. neumayri* and *Ch. persiae*, do not support a pure grazing diet for neither of them and suggest a potential niche partitioning or dietary shift due to competition.

Interactions with other mammalian herbivores

In addition to rhinocerotids, the fossil localities studied have yielded many other mammalian herbivores species such as other perissodactyls, artiodactyls and proboscideans (NOW Database, 2020 and citations therein), as well as micro-herbivores (rodents, lagomorphs) but very few is known about their palaeoecology. Faunal lists by locality are detailed in Supplementary S1. Although co-occurrence is not a good proxy for ecological interactions (Blanchet et al. 2020), it is possible that some of these herbivores were competing for or partitioning food resources with the rhinocerotids. Niche partitioning can take place through different strategies, such as resources partitioning, living in different habitats, having different body masses or different feeding heights (Hutchinson 1959; Schoener 1974; Arsenault and Owen-Smith 2008).

Most species of perissodactyls (beside rhinocerotids) found in the studied localities are hipparions (*Cremohipparion*, *Hipparion*, and *Hippotherium*), as tapirs are relatively rare (Koufos 2006) and chalicotheres limited in number (S1). Exploitation of C3 grasses (mixed-feeding and grazing) is suggested by microwear analyses of several hipparion species from Samos and Pikermi (Koufos et al. 2009b; Solounias et al. 2010), as well as from Hadjidimovo, Kalimantsi, and Strumyani (Clavel et al. 2012), although most species do not fully rely on this resource (mixed-feeders; Orlandi-Oliveras et al. 2022). Regarding chalicotheres, *Ancylotherium pentelicum* studied at Pikermi and Samos, but also present at Hadjidimovo, Kalimantsi and Maragheh, has a dental microwear indicating the inclusion of harder objects such as branches or bark (Semprebon et al. 2011). Thus, it appears that hipparions, chalicotheres, and rhinocerotids exploited quite different niches, suggesting little or no competition for resources.

Artiodactyl species are also very common at the localities studied, and this clade is often considered to be a competitor of perissodactyls (Janis 1976). Indeed, the microwear signature of most bovids species points towards browsing or mixed-feeding preferences (Merceron et al. 2006; Solounias et al. 2010; Clavel et al. 2012), similarly to what is found for rhinocerotids. However, some artiodactyls (e.g, some bovids and giraffids) from Greek localities (Samos, Pikermi, Axios Valley) seem to have been grazers, a feeding preference not occupied by the rhinocerotids studied here (Quade et al. 1994; Merceron et al. 2007, 2018; Solounias et al. 2010). In contrast, no strictly grazing bovid species are found at Hadjidimovo, nor at Kalimantsi according to dental microwear and enamel carbon stable isotopes composition (Merceron et al. 2006).

Concerning proboscideans, *Choerolophodon* is the most abundant genus in our localities (*C. anatolicus* at Pentalophos-1, *C. pentelici* at Ravin des Zouaves-5, Xirochori, Pikermi and Samos; S1). Other proboscidean species are also found in the region (e.g, *Mammut* sp, *Deinotherium giganteum*), but they are not included in former studies dealing with the relevant deposits (e.g, Solounias et al. 2010). The dental microwear texture of both *Choerolophodon* species from the Axios Valley supports the consumption of herbaceous monocotyledons, consistent with the arid climatic conditions and the absence of this genus in Central, Western and Northern Europe (Konidaris et al. 2016). In his master's thesis, Loponen (2020) also finds a grass preference for *C. pentelici* from Maragheh using the mesowear angle. Thus, it is unlikely that *Choerolophodon* and rhinocerotids were competing for food resources on a yearly base. Such a niche partitioning is observed today between the Asian elephant (*Elephas maximus*) and the sympatric Indian rhinoceros (*Rhinoceros unicornis*), but not between the African bush elephant (*Loxodonta Africana*) and the black rhinoceros (*Diceros bicornis*) competing for browse resources at the expenses of the rhinoceros (Landman et al. 2013).

Stress susceptibility

The prevalence of hypoplasia on late Miocene rhinocerotid teeth from the localities studied here is overall low (10.51 %). There are, however, great discrepancies depending on the locality, species, and tooth locus considered. Most localities had a null (Ravin des Zouaves-5, Gorna Sushitsa, Kocherinovo, Slatino) or very low (< 5 %; Hadjidimovo, Kalimantsi, Pikermi, Strumyani-2) prevalence of hypoplasia, contrasting with the higher prevalences at Xirochori (10 %), Maragheh (11.19 %), Pentalophos-1

(15.45 %), and Samos (27.94 %). In the literature, hypoplasia in rhinocerotids has been reported in several sites, mostly of Pleistocene age (Bratlund 1999; Fourvel et al. 2015; Bacon et al. 2018). The prevalence and loci affected vary greatly, from nearly no teeth affected (e.g, Siwalik rhinocerotids, middle and late Miocene of Pakistan; Antoine in press.) to more than 25 % being hypoplastic at Coc Muoi (Pleistocene, Vietnam; 26.8 % of rhinocerotid teeth affected and mostly permanent ones; Bacon et al. 2018), Béon 1 (late early Miocene, France; 25.96 %; Hullot et al. 2021) or Gračanica (early middle Miocene, Bosnia-Herzegovina; 48.39 %; Hullot et al. 2022).

The most affected loci were D4/d4 overall. These loci frequently bear hypoplasia at various localities (> 20 % at Pentalophos-1, Maragheh, Samos, Pikermi) and for several species (15 to 59 % of the D4/d4 of *Ce. neumayri*, *Dh. pikermiensis*, *Ch. persiae*). Hypoplasias on D4/d4 have already been noticed as frequent in rhinocerotids (Mead, 1999; Hullot et al. 2021), and correlated to birth related stresses. Hypoplasia was also common on second and third molars overall. However, hypoplasia on these loci was restricted to rhinocerotids from Maragheh (*Ch. persiae*, *Ce. neumayri*, and *P. rodleri*), *Ch. kiliasi* from Pentalophos-1, and *Acerorhinus* sp. from Kalimantsi (Supplementary S5). Enamel hypoplasia on second and third molars have been correlated with environmental stresses (and not pre-weaning or pre-birth stress as those teeth mostly mineralize after the weaning), like seasonality, in extant sheep (Upex and Dobney 2012) and in an extinct giraffid (Franz-Odendaal et al. 2003). Seasonality is also likely to induce hypoplasia at these loci in rhinoceroses, as these teeth are the last to develop in rhinocerotids and may thus record post-weaning stresses (Hitchins 1978; Hillman-Smith et al. 1986; Böhmer et al. 2016). At all three sites certain aridity and seasonality are mentioned (Merceron et al. 2006, 2007; Geraads and Spassov 2009;

Ataabadi et al. 2016) and could have been responsible of punctual stresses, such as food scarcity or drought.

Chilotherium species in general seem particularly susceptible to hypoplasia with 13.37 % of the teeth being affected (56/419), and more than 20 % for *Ch. schlosseri* at Samos (2/9; 22.22 %) and for *Ch. kiliasi* at Pentalophos-1 (14/63; 22.22 %). While at Samos, investigated rhinocerotid teeth seem to be particularly affected regardless of their taxonomic assignment, suggesting a particularly stressful environment in general, the situation is much more contrasted at Pentalophos-1 with *Ce. neumayri* relatively spared (5/60; 8.33 %). These discrepancies between rhinocerotids from the same locality may therefore highlight specific susceptibilities to hypoplasia. The dental loci affected at Pentalophos-1 suggest early life stresses only for *Ce. neumayri* (d4, p3, p4), while *Ch. kiliasi* teeth present both early life stresses and seasonality-related ones (m2/M2 and m3/M3). Interestingly, DMT patterns suggested a potential competition between these species, which may have led to a dietary shift in *Ch. kiliasi* during period of shortage. Such a competition could be the cause of some of the observed hypoplasias. As opposed to chilothere species, *Dh. pikermiensis* presents very few hypoplastic teeth with the notable exception of Samos (where 8/16 teeth are hypoplastic), and no permanent tooth affected (0/58). Our results point towards less susceptibility to stresses in the studied elasmotheriine (*Iranotherium*, no hypoplasia recorded), Rhinocerotini (*Ceratotherium* + *Dihoplus*), contrary to the Aceratheriini (*Chilotherium* + *Acerorhinus*).

Impact of spatial (longitude), temporal, and environmental variations

We found that Western localities rhinocerotids were less affected by hypoplasia than their Eastern counterparts (Samos and Maragheh). This could be linked to the increased aridity towards the East (Fortelius et al. 2002; Giaourtsakis et al. 2006; Strömberg et al. 2007; Eronen et al. 2009; Athanassiou et al. 2014), creating harsher and more stressful conditions for the fauna, with punctual resource shortage. These drier conditions are supported by the presence of more hypsodont and mesodont forms at Maragheh and Samos than at Pikermi, but a clear aridity gradient from West to East has been disputed (Ataabadi et al. 2013). Similarly, Vallesian rhinocerotids (from Pentalophos-1 and Xirochori) are more prone to hypoplastic defects (20/123; 16.26 %) than Turolian ones (74/761; 9.72 %). During the Vallesian, climatic conditions changed drastically from a washhouse episode (10.2 to 9.8 Mya) to a cooler and drier phase (9.7 to 9.5 Mya; Böhme et al. 2008). This event is known as the Vallesian crisis and resulted in a higher seasonality with cold winters and punctual unavailability of fruit resources, often associated with the extinction of hominoid species in Europe (Agustí et al. 2003), and resulted in more open environments (de Bonis et al. 1992a,b). Interestingly, both Vallesian sites from the Axios-Valley are roughly coeval with this crisis (Pentalophos-1, late MN9 and Xirochori ~ 9.6 Mya; Koufos 2006a).

Some authors, however, challenged the temporal homogeneity of this aridification event at the European scale, and suggested that Southeastern Mediterranean localities experienced it earlier, during the earliest late Miocene (11 Mya), and already had quite open and dry environments during the Vallesian interval (Koufos 2006), although aridity increased in the second half of the Turolian (Böhme et al. 2017). The high prevalence observed for enamel hypoplasia could thus only document relatively harsh conditions for rhinocerotids around these localities instead of the Vallesian crisis itself. The inclusion of more Vallesian localities from Southeastern Mediterranean region and the investigation of hypoplasia in other non-related taxa could help discriminate between these two hypotheses.

Concerning dietary preferences, no clear differences were observed neither between the species of both regions nor within species at different localities (Figure 4). This finding was surprising regarding previous studies and inferences. In Southern Bulgaria, a gradual aridification – notably between Hadjidimovo and Kalimantsi – is suggested by changes in dental microwear signals of bovids and by the presence of the open-habitat specialist *Ce. neumayri* in latter localities (Merceron et al. 2006; Geraads and Spassov 2009; Clavel et al. 2012). We did not observe such differences in the microwear textures of the studied rhinocerotids. Moreover, a series of adaptations are observed in the *Ce. neumayri* lineage (e.g, the gradual size growth, lengthening and lowering of the skull), linked with increasingly open and/or seasonal environments and their nutritionally inferior forage, indicating a probable progressive shift in the diet towards a coarser, mixed diet (Giaourtsakis 2009). Once again, we did not retrieve such a pattern in our DMTA results, but our sampling was restricted and DMTA unravel short-term insights of the diet.

Broader implications: palaeoenvironments, and the so-called "Pikermian Biome"

Although our results did not suggest drastic differences in the feeding strategies of the rhinocerotids studied here, either over time or space, the hypoplasia prevalence highlighted probable discrepancies in the local conditions. Thus a space and time continuum of the ecosystems throughout the Balkan-Iranian province as hypothesised by the “Pikermian Biome” *sensu* Solounias et al. (1999) is not supported.

The absence of true grazing rhinocerotids suggested by our DMT analyses is consistent with previous palaeoecological reconstructions based on tooth wear, carbon stable isotopes on enamel, phytoliths, and functional morphology that indicate very few C4-grasses in Turolian localities of the region (Strömberg et al. 2007). Similarly, a truly open savanna environment is very unlikely regarding our DMTA results, as most rhinocerotid species studied here must have greatly relied on browse resources. Due to Miocene climatic conditions (globally hot and wet) and low altitude, a C3 grassland is also doubtful (Solounias et al. 1999; Denk et al. 2018). These findings contradict the classical savanna biome proposed for the Pikermian fauna, as already tackled and discussed by several authors (Solounias et al. 1999; Athanassiou et al. 2014). The dietary preferences of the whole fauna are also way more diversified than in modern African savannas and they would more closely resemble modern Indian woodlands (Solounias et al. 1999, 2010). Despite the increased aridity and a tendency towards habitat openness, late Miocene terrestrial environments of the eastern Mediterranean were more likely dry woodlands or forests rather than grasslands (Strömberg et al. 2007; Clavel et al. 2012; Böhme et al. 2017, 2018; Spassov et al. 2018).

Conclusions

The study of the trophic palaeoecology of some late Miocene rhinocerotids from the Balkans (Greece and Bulgaria), Samos (Aegean region), and Maragheh (Iran) indicated clear spatio-temporal differences in the local conditions, as suggested by hypoplasia prevalence. The study of dietary preferences (dental microwear texture) confirmed the niche partitioning of the two most abundant species, i.e, *Ceratotherium neumayri* (mixed-feeder) and *Dihoplus pikermiensis* (browser). The combination of hypoplasia and DMT analyses highlighted potential competition between *Ce. neumayri* and associated chilothere species at the locality where they co-occur (Samos, Maragheh, Pentalophos-1). The dominance of rhinocerotid species depending on browse resources (leaves, branches, and fruits) seems to contradict the classical reconstitution of African savannah type environments in the area in question. Thus, the palaeoecological insights provided by the rhinocerotid sample studied here, allowed to somewhat challenge the concept of Pikermian Biome and Balkan-Iranian province, supposedly homogeneous over time and space.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Agustí J, De Siria AS, Garcés M. 2003. Explaining the end of the hominoid experiment in Europe. J Hum Evol. 45(2):145–153. doi: 10.1016/S0047- 2484(03)00091-5.

Antoine P-O. 2002. Phylogénie et évolution des Elasmotheriina (Mammalia, Rhinocerotidae). Mem Mus Natn Hist Nat. 188:1–359.

Antoine P-O. in press. Rhinocerotids from the Siwalik faunal sequence. In: Badgley C, Pilbeam D, Morgan M, editors. At the Foot of the Himalayas: Paleontology and Ecosystem Dynamics of the Siwalik Record of Pakistan.

Antoine P-O, Reyes MC, Amano N, Bautista AP, Chang C-H, Claude J, De Vos J, Ingicco T. 2022. A new rhinoceros clade from the Pleistocene of Asia sheds light on mammal dispersals to the Philippines. Zool J Linn Soc. 194(2): 416–430. doi: 10.1093/zoolinnean/zlab009.

Arman SD, Prowse TAA, Couzens AMC, Ungar PS, Prideaux G. J. 2019. Incorporating intraspecific variation into dental microwear texture analysis. J R Soc Interface. 16(153):20180957. doi: 10.1098/rsif.2018.0957.

Ataabadi MM, Bernor RL, Kostopoulos DS, Wolf D, Orak Z, Zare G, Nakaya H, Watabe M, Fortelius M. 2013. Recent advances in paleobiological research of the late Miocene Maragheh Fauna, Northwest Iran. In: Wang X, Flynn LJ, Fortelius M, editors. Fossil Mammals of Asia. Neogene Biostratigraphy and Chronology. New York: Columbia University Press; p. 546–565.

Ataabadi MM, Kaakinen A, Kunimatsu Y, Nakaya H, Orak Z, Paknia M, Sakai T, Salminen J, Sawada Y, Sen S. 2016. The late Miocene hominoid-bearing site in the Maragheh Formation, Northwest Iran. Palaeobio Palaeoenv. 96(3):349–371. doi: 10.1007/s12549-016-0241-4.

Athanassiou A, Roussiakis SJ, Giaourtsakis IX, Theodorou GE, Iliopoulos G. 2014. A new hornless rhinoceros of the genus *Acerorhinus* (Perissodactyla: Rhinocerotidae) from the Upper Miocene of Kerassiá (Euboea, Greece), with a revision of related forms. Palaeontogr Abt A. 303(1-3): 23–59.

Bacon A-M, Antoine P-O, Huong NTM, Westaway K, Tuan NA, Duringer P, Zhao J, Ponche J-L, Dung SC, Nghia TH, Minh TT, Son PT, Boyon M, Thuy NTK, Blin A, Demeter F. 2018. A rhinocerotid-dominated megafauna at the MIS6-5 transition: The late Middle Pleistocene Coc Muoi assemblage, Lang Son province, Vietnam. Quat Sci Rev. 186:123–141. doi: 10.1016/j.quascirev.2018.02.017.

Bates D, Mächler M, Bolker B, Walker S. 2015. Fitting linear mixed-effects models using lme4. J Stat Softw. 67:1–48. doi:10.18637/jss.v067.i01.

Bernor RL. 1984. A zoogeographic theater and biochronology play: the time/biofacies phenomena of Eurasian and African Miocene mammal provinces. Paléobiologie continentale. 14:121–142.

Bernor RL, Solounias N, Swisher CC III, van Couvering JA. 1996. The Correlation of Three Classical "Pikermian" Mammal Faunas–Maragheh, Samos, and Pikermi–with the European MN Unit System. In: Bernor RL, Fahlbusch V, Mittmann H-W, editors. The Evolution of Western Eurasian Neogene Mammal Faunas. New York: Columbia University Press; p. 124–136.

Bethune E, Kaiser TM, Schulz-Kornas E, Winkler DE. 2019. Multiproxy dietary trait reconstruction in Pleistocene Hippopotamidae from the Mediterranean islands. Palaeogeogr Palaeoclimatol Palaeoecol. 533:109210. doi: 10.1016/j.palaeo.2019.05.032.

Blanchet FG, Cazelles K, Gravel D. 2020. Co-occurrence is not evidence of ecological interactions. Ecol Lett. 23(7):1050–1063. doi: 10.1111/ele.13525.

Böhme M, Ilg A, Winklhofer M. 2008. Late Miocene "washhouse" climate in Europe. Earth Planet Sci Lett. 275(3-4):393–401. doi: 10.1016/j.epsl.2008.09.011.

Böhme M, Spassov N, Ebner M, Geraads D, Hristova L, Kirscher U, Kötter S, Linnemann U, Prieto J, Roussiakis S, Theodorou G, Uhlig G, Winklhofer M. 2017. Messinian age and savannah environment of the possible hominin *Graecopithecus* from Europe. PLOS ONE. 12(5):e0177347. doi: 10.1371/journal.pone.0177347.

Böhme M, van Baak CG, Prieto J, Winklhofer M, Spassov N. 2018. Late Miocene stratigraphy, palaeoclimate and evolution of the Sandanski Basin (Bulgaria) and the chronology of the Pikermian faunal changes. Glob Planet Change. 170: 1–19. doi: 10.1016/j.gloplacha.2018.07.019.

Böhmer C, Heissig K, Rössner GE. 2016. Dental Eruption Series and Replacement Pattern in Miocene *Prosantorhinus* (Rhinocerotidae) as Revealed by Macroscopy and X-ray: Implications for Ontogeny and Mortality Profile. J Mammal Evol. 23(3):265–279. doi: 10.1007/s10914-015-9313-x.

Bratlund B. 1999. Taubach revisited. Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz. 46:61–174. doi: 10.11588/jrgzm.1999.1.25776.

Calandra I, Göhlich UB, Merceron G. 2008. How could sympatric megaherbivores coexist? Example of niche partitioning within a proboscidean community from the Miocene of Europe. Naturwissenschaften. 95(9):831–838. doi: 10.1007/s00114-008-0391-y.

Clavel J, Merceron G, Hristova L, Spassov N, Kovachev D, Escarguel G. 2012. On *Mesopithecus* habitat: Insights from late Miocene fossil vertebrate localities of Bulgaria. J Hum Evol. 63(1):162–179. doi: 10.1016/j.jhevol.2012.04.007.

Damuth J, Janis CM. 2011. On the relationship between hypsodonty and feeding ecology in ungulate mammals, and its utility in palaeoecology. Bio Rev. 86(3):733–758. doi: 10.1111/j.1469-185X.2011.00176.x.

Danowitz M, Hou S, Mihlbachler M, Hastings V, Solounias N. 2016. A combined-mesowear analysis of late Miocene giraffids from North Chinese and Greek localities of the Pikermian Biome. Palaeogeogr Palaeoclimatol Palaeoecol. 449:194–204. doi: 10.1016/j.palaeo.2016.02.026.

de Bonis L, Bouvrain G, Geraads D. 1979. Artiodactyles du Miocène supérieur de Macédoine. In: Annales Géologiques Des Pays Helléniques. p. 167–175.

de Bonis L, Bouvrain G, Geraads D, Koufos G. 1992a. Diversity and paleoecology of Greek late Miocene mammalian faunas. Palaeogeogr Palaeoclimatol Palaeoecol. 91:99–121.

de Bonis L, Bouvrain G, Geraads D, Koufos G. 1992b. Multivariate study of late Cenozoic mammalian faunal compositions and paleoecology. Paleontologia i evolució. 24:93–101.

Denk T. 2016. Palaeoecological interpretation of the late Miocene landscapes and vegetation of northern Greece: A comment to Merceron et al, 2016 (Geobios 49, 135–146). Geobios. 49(6):423–431, doi: 10.1016/j.geobios.2016.06.009.

Denk T, Zohner CM, Grimm GW, Renner SS. 2018. Plant fossils reveal major biomes occupied by the late Miocene Old-World Pikermian fauna. Nat Ecol Evol. 2(12):1864–1870. doi: 10.1038/s41559-018-0695-z.

Eronen JT, Ataabadi MM, Micheels A, Karme A, Bernor RL, Fortelius M. 2009. Distribution history and climatic controls of the Late Miocene Pikermian chronofauna. PNAS. 106(29):11867–11871. doi: 10.1073/pnas.0902598106.

Fédération Dentaire Internationale. 1982. An epidemiological index of development defects of dental enamel (DDE index). Int Dent J. 42:411–426.

Fortelius M, Eronen J, Jernvall J, Liu L, Pushkina D, Rinne J, Tesakov A, Vislobokova I, Zhang Z, Zhou L. 2002. Fossil mammals resolve regional patterns of Eurasian climate change over 20 million years. Evol Ecol Res. 4(7):1005–1016.

Fourvel J-B, Fosse P, Fernandez P, Antoine P-O. 2015. Large mammals of Fouvent-Saint-Andoche (Haute-Saône, France): a glimpse into a Late Pleistocene hyena den. Geodiversitas. 37(2):237–266. doi: 10.5252/g2015n2a5.

Fox J, Weisberg S, Adler D, Bates D, Baud-Bovy G, Ellison S, Firth D, Friendly M, Gorjanc G, Graves S. 2012. Package 'car'. Vienna: R Foundation for Statistical Computing.

Franz-Odendaal TA, Lee-Thorp JA, Chinsamy A. 2003. Insights from stable light isotopes on enamel defects and weaning in Pliocene herbivores. J Biosci. 28(6):765–773. doi: 10.1007/BF02708437.

Geraads D. 1988. Révision des Rhinocerotinae (Mammalia) du Turolien de Pikermi: comparaison avec les formes voisines. Ann de Paléontol. 74(1):13–41.

Geraads D, Koufos G. 1990. Upper Miocene Rhinocerotidae (Mammalia) from Pentalophos-1, Macedonia, Greece. Palaeontogr Abt A. 210(4-6):151–168.

Geraads D, Spassov N. 2009. Rhinocerotidae (Mammalia) from the Late Miocene of Bulgaria. Palaeontogr Abt A. 287:99–122.

Geraads D, Spassov N, Kovachev D. 2001. New Chalicotheriidae (Perissodactyla, Mammalia) from the Late Miocene of Bulgaria. J Vert Paleontol. 21(3):596–606.

Geraads D, Spassov N, Hristova L, Markov GN, Tzankov T. 2011. Upper Miocene mammals from Strumyani, south-western Bulgaria. Geodiversitas. 33(3):451–484. doi: 10.5252/g2011n3a3.

Giaourtsakis IX, Theodorou G, Roussiakis S, Athanassiou A, Iliopoulos G. 2006. Late Miocene horned rhinoceroses (Rhinocerotinae, Mammlia) from Kerassia (Euboea, Greece). Neues Jahrb für Geol und Paläontol - Abh. 239(3):367–398. doi: 10.1127/njgpa/239/2006/367.

Giaourtsakis IX. 2003. Late Neogene Rhinocerotidae of Greece: distribution, diversity and stratigraphical range. Deinsea. 10:235–254.

Giaourtsakis IX. 2009. The Late Miocene Mammal Faunas of the Mytilinii Basin, Samos Island, Greece: New Collection. 9. Rhinocerotidae. Beiträge zur Paläontologie. 31:157–187.

Goodman AH, Rose JC. 1990. Assessment of systemic physiological perturbations from dental enamel hypoplasias and associated histological structures. Am J Phys Anthropol. 33(S11):59–110. doi: 10.1002/ajpa.1330330506.

Guérin C. 1980. Les rhinocéros (Mammalia, Perissodactyla) du Miocène terminal au Pleistocène supérieur en Europe occidentale: comparaison avec les espèces actuelles. Doc des Lab de Géol de Lyon. 79:1-1184.

Heissig K. 2012. Les Rhinocerotidae (Perissodactyla) de Sansan. In: Peigné S, Sen S, editors. Mammifères de Sansan. Paris: Mémoires du Muséum national d'Histoire naturelle. p. 317-485.

Hillman-Smith AKK, Owen-Smith NR, Anderson JL, Hall-Martin AJ, Selaladi JP. 1986. Age estimation of the white rhinoceros (*Ceratotherium simum*). J Zool. 210(3):355–377.

Hitchins PM. 1978. Age determination of the black rhinoceros (*Diceros bicornis* Linn.) in Zululand. S Afr Wildl Res. 8(2):71–80.

Hristova L, Geraads D, Markov GN, Spassov N. 2013. Late Miocene mammals from Kocherinovo, southwestern Bulgaria. Acta Zool Bulg. 65(4)517–529.

Hullot M, Antoine P-O, Ballatore M, Merceron G. 2019. Dental microwear textures and dietary preferences of extant rhinoceroses (Perissodactyla, Mammalia). Mamm Res. 64(3):397–409. doi: 10.1007/s13364-019-00427-4.

Hullot M, Laurent Y, Merceron G, Antoine P-O. 2021. Paleoecology of the Rhinocerotidae (Mammalia, Perissodactyla) from Béon 1, Montréal-du-Gers (late early Miocene, SW France): Insights from dental microwear texture analysis, mesowear, and enamel hypoplasia. Palaeontol Electron. 24(2):1–26. doi: 10.26879/1163.

Hullot M, Merceron G, Antoine P-O. 2022 preprint. Spatio-temporal diversity of dietary preferences and stress sensibilities of early and middle Miocene Rhinocerotidae from Eurasia: impact of climate changes. BioRxiv. doi: 10.1101/2022.05.06.490903

Janis C. 1976. The evolutionary strategy of the Equidae and the origins of rumen and cecal digestion. Evolution. 30(4):757–774.

Jardine PE, Janis CM, Sahney S, Benton MJ. 2012. Grit not grass: Concordant patterns of early origin of hypsodonty in Great Plains ungulates and Glires. Palaeogeogr Palaeoclimatol Palaeoecol. 365–366:1–10, doi: 10.1016/j.palaeo.2012.09.001.

Jokela T. 2015. The High, the Sharp and the Rounded: Paleodiet and Paleoecology of Late Miocene Herbivorous Mammals from Greece and Iran. Master Thesis. University of Helsinki. p. 67.

Jones DB, DeSantis LRG. 2017. Dietary ecology of ungulates from the La Brea tar pits in southern California: A multi-proxy approach. Palaeogeogr Palaeoclimatol Palaeoecol. 466:110–127, doi: 10.1016/j.palaeo.2016.11.019.

Konidaris GE, Koufos GD. 2013. Late Miocene Proboscidea (Mammalia) from Macedonia and Samos Island, Greece: preliminary results. Paläontol Z. 87(1):121–140. doi: 10.1007/s12542-012-0147-z.

Konidaris GE, Koufos GD, Kostopoulos DS, Merceron G. 2016. Taxonomy, biostratigraphy and palaeoecology of *Choerolophodon* (Proboscidea, Mammalia) in the Miocene of SE Europe-SW Asia: implications for phylogeny and biogeography. J Syst Palaeontolo. 14(1):1–27. doi: 10.1080/14772019.2014.985339.

Kostopoulos DS. 2009. The Pikermian Event: Temporal and spatial resolution of the Turolian large mammal fauna in SE Europe. Palaeogeogr Palaeoclimatol Palaeoecol. 274:82–95, doi: 10.1016/j.palaeo.2008.12.020.

Koufos GD. 2006. Palaeoecology and chronology of the Vallesian (late Miocene) in the Eastern Mediterranean region. Palaeogeogr Palaeoclimatol Palaeoecol. 234:127–145, doi: 10.1016/j.palaeo.2005.01.014.

Koufos GD, Kostopoulos DS, Vlachou TD. 2009a. The late Miocene mammal faunas of the Mytilinii basin, Samos Island, Greece: new collection. 16. Biochronology. Beiträge zur Paläontologie. 31:397–408.

Koufos GD, Kostopoulos DS, Merceron G. 2009b. The late Miocene mammal faunas of the Mytilinii Basin, Samos Island, Greece: new collection. 17. Palaeoecology-Palaeobiogeography. Beiträge zur Paläontologie. 31:409–430.

Landman M, Schoeman DS, Kerley GIH. 2013. Shift in Black Rhinoceros Diet in the Presence of Elephant: Evidence for Competition? *PLOS ONE*. 8(7):e69771. doi: 10.1371/journal.pone.0069771.

Loponen L. 2020. Diets of Miocene Proboscideans from Eurasia, and Their Connection to Environments and Vegetation. Master Thesis. University of Helsinki. p. 54.

Louail M, Ferchaud S, Souron A, Walker AEC, Merceron G. 2021. Dental microwear textures differ in pigs with overall similar diets but fed with different seeds. Palaeogeogr Palaeoclimatol Palaeoecol. 572:110415, doi: 10.1016/j.palaeo.2021.110415.

Mead AJ. 1999. Enamel hypoplasia in Miocene rhinoceroses (*Teleoceras*) from Nebraska: evidence of severe physiological stress. J Vert Paleontol. 19(2):391–397.

Merceron G, Zazzo A, Spassov N, Geraads D, Kovachev D. 2006. Bovid paleoecology and paleoenvironments from the Late Miocene of Bulgaria: Evidence from dental microwear and stable isotopes. Palaeogeogr Palaeoclimatol Palaeoecol. 241:637–654. doi: 10.1016/j.palaeo.2006.05.005.

Merceron G, Blondel C, Viriot L, Koufos GD, de Bonis L. 2007. Dental microwear analysis of bovids from the Vallesian (late Miocene) of Axios Valley in Greece: reconstruction of the habitat of *Ouranopithecus macedoniensis* (Primates, Hominoidea). Geodiversitas. 29(3):421–433.

Merceron G, Escarguel G, Angibault J-M, Verheyden-Tixier H. 2010. Can Dental Microwear Textures Record Inter-Individual Dietary Variations? PLOS ONE. 5(3):e9542. doi: 10.1371/journal.pone.0009542.

Merceron G, Novello A, Scott RS. 2016a. Paleoenvironments inferred from phytoliths and Dental Microwear Texture Analyses of meso-herbivores. Geobios. 49(1):135–146. doi: 10.1016/j.geobios.2016.01.004.

Merceron G, Ramdarshan A, Blondel C, Boisserie J-R, Brunetiere N, Francisco A, Gautier D, Milhet X, Novello A, Pret D. 2016b. Untangling the environmental from the dietary: dust does not matter. Proc R Soc B. 283(1838):20161032. doi: 10.1098/rspb.2016.1032.

Merceron G, Colyn M, Geraads D. 2018. Browsing and non-browsing extant and extinct giraffids: Evidence from dental microwear textural analysis. Palaeogeogr Palaeoclimatol Palaeoecol. 505:128–139. doi: 10.1016/j.palaeo.2018.05.036.

Merceron G, Kallend A, Francisco A, Louail M, Martin F, Plastiras C-A, Thiery G, Boisserie J-R. 2021. Further away with dental microwear analysis: Food resource partitioning among Plio-Pleistocene monkeys from the Shungura Formation, Ethiopia. Palaeogeogr Palaeoclimatol Palaeoecol. 572:110414. doi: 10.1016/j.palaeo.2021.110414.

Niven LB, Egeland CP, Todd LC. 2004. An inter-site comparison of enamel hypoplasia in bison: implications for paleoecology and modeling Late Plains Archaic subsistence. J Archaeol Sci. 31(12):1783–1794. doi: 10.1016/j.jas.2004.06.001.

NOW Database. 2020. New, Old Worlds Database of Fossil Mammals. https://nowdatabase.luomus.fi/

Orlandi-Oliveras G, Köhler M, Clavel J, Scott RS., Mayda S, Kaya T, Merceron G. 2022. Feeding strategies of circum-Mediterranean hipparionins during the late Miocene: Exploring dietary preferences related to size through dental microwear analysis. Palaeontol Electron. 25(1):a13. doi: 10.26879/990

Pandolfi L. 2016. *Persiatherium rodleri*, gen. et sp. nov. (Mammalia, Rhinocerotidae) from the upper Miocene of Maragheh (northwestern iran). J Vert Paleontol. 36(1):e1040118. doi: 10.1080/02724634.2015.1040118.

Pandolfi L, Antoine P-O, Bukhsianidze M, Lordkipanidze D, Rook L. 2021. Northern Eurasian rhinocerotines (Mammalia, Perissodactyla) by the Pliocene–Pleistocene transition: phylogeny and historical biogeography. J Syst Palaeontol. 19(15):1031–1057. doi: 10.1080/14772019.2021.1995907.

Quade J, Solounias N, Cerling TE. 1994. Stable isotopic evidence from paleosol carbonates and fossil teeth in Greece for forest or woodlands over the past 11 Ma. Palaeogeogr Palaeoclimatol Palaeoecol. 108:41–53.

Ramdarshan A, Blondel C, Brunetière N, Francisco A, Gautier D, Surault J, Merceron G. 2016. Seeds, browse, and tooth wear: a sheep perspective. Ecol Evol. 6(16):5559–5569. doi: 10.1002/ece3.2241.

Rothschild BM, Martin LD, Lev G, Bercovier H, Bar-Gal GK, Greenblatt C, Donoghue H, Spigelman M, Brittain D. 2001. *Mycobacterium tuberculosis* Complex DNA from an Extinct Bison Dated 17,000 Years before the Present. Clin Infect Dis. 33(3):305–311. doi: 10.1086/321886.

Scott JR. 2012. Dental microwear texture analysis of extant African Bovidae. Mammalia. 76(2):157–174. doi: 10.1515/mammalia-2011-0083.

Scott RS, Ungar PS, Bergstrom TS, Brown CA, Grine FE, Teaford MF, Walker A. 2005. Dental microwear texture analysis shows within-species diet variability in fossil hominins. Nature. 436(7051):693–695. doi: 10.1038/nature03822.

Scott RS, Ungar PS, Bergstrom TS, Brown CA, Childs BE, Teaford MF, Walker A. 2006. Dental microwear texture analysis: technical considerations. J Hum Evol. 51(4)339–349. doi: 10.1016/j.jhevol.2006.04.006.

Semprebon GM, Rivals F. 2007. Was grass more prevalent in the pronghorn past? An assessment of the dietary adaptations of Miocene to Recent Antilocapridae (Mammalia: Artiodactyla). Palaeogeogr Palaeoclimatol Palaeoecol. 253:332–347. doi: 10.1016/j.palaeo.2007.06.006.

Semprebon GM, Sise PJ, Coombs MC. 2011. Potential bark and fruit browsing as revealed by stereomicrowear analysis of the peculiar clawed herbivores known as chalicotheres (Perissodactyla, Chalicotherioidea). J Mammal Evol. 18(1):33–55. doi: 10.1007/s10914-010-9149-3.

Semprebon GM, Rivals F, Janis CM. 2019. The Role of Grass vs. Exogenous Abrasives in the Paleodietary Patterns of North American Ungulates. Front Ecol Evol. 7:1-23. doi: 10.3389/fevo.2019.00065.

Solounias N, Plavcan JM, Quade J, Witmer L. 1999. The paleoecology of the Pikermian biome and the savanna myth. In: Augusti, J, Rook, L, Andrews, P, editors. Hominoid Evolution and Climatic Change in Europe. Cambridge: University Press. p. 436–453.

Solounias N, Rivals F, Semprebon GM. 2010. Dietary interpretation and paleoecology of herbivores from Pikermi and Samos (late Miocene of Greece). Paleobiology. 36(1)113–136.

Spassov N. 2002. The Turolian Megafauna of West Bulgaria and the character of the Late Miocene" Pikermian biome". Bollettino-Societa Paleontologica Italiana. 41(1):69–82.

Spassov N, Tzankov T, Geraads D. 2006. Late Neogene stratigraphy, biochronology, faunal diversity and environments of South-West Bulgaria (Struma River Valley). Geodiversitas. 28(3):477–498.

Spassov N, Böhme M, Geraads D, Kötter S, van Baak C. 2017. Pikermian mammal event, post-Pikermian mammal turnover and appearance of *Graecopithecus*. In: Book of Abstracts of the 15 Th Congress of the RCMNS. p. 29.

Spassov N, Geraads D, Hristova L, Markov G, Garevska B, Garevski R. 2018. The late Miocene mammal faunas of the Republic of Macedonia (FYROM). Palaeontogr Abt A. 311(1-6):1–85. doi: 10.1127/pala/2018/0073

Spassov N, Geraads D, Hristova L, Markov G. 2019. The late Miocene mammal fauna from Gorna Sushitsa, southwestern Bulgaria, and the early/middle Turolian transition. Neues Jahrb für Geol und Paläontol - Abh. 291(3):317–350. doi: 10.1127/njgpa/2019/0804.

Strömberg CAE, Werdelin L, Friis EM, Saraç G. 2007. The spread of grass- dominated habitats in Turkey and surrounding areas during the Cenozoic: Phytolith evidence. Palaeogeogr Palaeoclimatol Palaeoecol. 250:18–49. doi: 10.1016/j.palaeo.2007.02.012.

Theodorou GE, Roussiakis SJ, Athanassiou A, Filippidi A. 2010. Mammalian remains from a new site near the classical locality of Pikermi (Attica, Greece). Scientific Annals, School of Geology, Aristotle University of Thessaloniki. 99: 109–120.

Tobien H. 1967. Subdivision of Pontian mammalian faunas. Giornale di Geologia. 35:1–5.

Upex B, Dobney K. 2012. Dental enamel hypoplasia as indicators of seasonal environmental and physiological impacts in modern sheep populations: a model for interpreting the zooarchaeological record. J Zool. 287(4):259–268. doi: 10.1111/j.1469-7998.2012.00912.x.

Venables WN, Ripley BD. 2002. Modern Applied Statistics with S. New York: Springer.

Wickham H. 2007. Reshaping data with the reshape package. J Stat Softw. 21(12):1–20.

Wickham H. 2011. ggplot2. Wiley Interdiscip Rev Comput Stat. 3(2):180–185.

Wickham H, François R, Henry L, Müller K. 2019. dplyr: A Grammar of Data Manipulation. R package version 0.8.3. 13:2020.

Xafis A, Saarinen J, Bastl K, Nagel D, Grímsson F. 2020. Palaeodietary traits of large mammals from the middle Miocene of Gračanica (Bugojno Basin, Bosnia-Herzegovina). Palaeobio Palaeoenv. 100(2):457–477. doi: 10.1007/s12549-020-00435-2

Tables with captions

Table 1. List of rhinocerotid species found in each locality of interest.

Grey background indicates species not included in our sample and thus not studied here.

Table 2. Factor showing an effect for each ANOVA formula on every DMTA parameters

epLsar: anisotropy, Asfc: complexity, FTfv: fine textural fill-volume, HAsfc: heterogeneity of the complexity. *: p-value < 0.05; **: p-value < 0.01; -: p-values > 0.05

Table 3. Number of specimens (N), median, mean, and standard deviation of the mean (SD) of the DMTA parameters by locality, species, and facet

FTfv: fine texturall fill-volume, HAsfc: heterogeneity of the complexity; Gr. – grinding; Sh. – shearing.

Table 4. Prevalence of hypoplasia by species and tooth locus

Lower case stands for lower teeth and upper case for upper ones. D/d: deciduous teeth, P/p: premolars, and M/m: molars. -: no tooth available

Table 5. Number of rhinocerotid specimens affected by hypoplasia per type (mandible + maxilla or isolated tooth), species, and locality

Localities with a null prevalence of hypoplasia not shown in this table. - stands for no material available.

Table 6. Dietary preferences as inferred from textural microwear (DMT) of the studied rhinocerotid specimens from different fossil localities of the Balkan-Iranian province

Colour/Abbreviation code: brown/B – browser, blue/M – mixed-feeder, green/G – grazer, no colour/x – not studied here

Figure captions

Figure 1. Localisation of the 12 late Miocene localities studied from the Balkan-Iranian province

A- Balkan-Iranian province and B- zoom on Bulgaria and Greece to precise the localisation of the continental localities.

1150 Eastern localities: Maragheh (9 to 7.4 Mya, MN10-MN12; Iran), Samos (7.8 to 6.7
1151 Mya, MN11-MN13; Greece). Western localities: PNT-1 - Pentalophos-1 (late MN9-
1152 MN10; Greece), XIR - Xirochori (~ 9.6 Mya MN10; Greece), RZO - Ravin des
1153 Zouaves-5 (~ 8.2 Mya MN11; Greece), KCH - Kocherinovo (early MN11; Bulgaria),
1154 KAL - Kalimantsi (material studied here: 7.42–7.27 Mya, MN12; Bulgaria), HD -
1155 Hadjidimovo (> 7.44 Mya, MN11; Bulgaria), Str - Struymani-2 (MN11-MN12;
1156 Bulgaria), GS - Gorna Sushitsa (MN11-MN12; Bulgaria), Pikermi (7.33 and 7.29 Mya,
1157 MN12; Greece), Sl - Slatino (early Turolian; Bulgaria; see stratigraphic details in
1158 Spassov et al. 2006).

1159 Figure 1 Alt Text: A- Map showing the Southeastern Mediterranean area with black
1160 dots indicating the localisation of the fossil localities. B- Zoomed map on Bulgaria and
1161 Northern Greece, where most sites are found.

1162

1163 Figure 2. Localisation of the dental facets on rhinocerotid molars.

1164 Position of the two dental facets (grinding and shearing) on the second upper molar
1165 (left) and second lower molar (right). Both facets are sampled on the same enamel band
1166 with (grinding) or without (shearing) Hunter-Schreger bands (HSB). Illustration after
1167 Hullot et al. (2019).

1168 Figure 2 Alt Text: Drawings of upper and lower rhinocerotid tooth rows (4th premolar to
1169 3rd molar) in occlusal view, with red squares on 2nd molars showing the localisation of
1170 the wear facets. Two zoomed drawings of the enamel band illustrating the grinding
1171 (with grey stripes showing the Hunter-Schreger bands) and shearing facets.

1172

1173 Figure 3. Different types of hypoplasia and associated measurements illustrated on
1174 rhinocerotid teeth.

Left: photos of the specimens, Right: associated interpretative drawings of the photos with hypoplasia defects in dark grey. Approximate scale given for each specimen.

A – Linear enamel hypoplasia (LEH) illustrated on the lower left teeth of the specimen PNT129 (*Ceratotherium neumayri* from Pentalophos-1; AUTh); B – Pits illustrated on the upper left teeth of the specimen 1911-0005-0041 (*Dihoplus pikermiensis* from Samos; NHMW); C – Aplasia on the upper right teeth of the specimen HD-597 (*Dh. pikermiensis* from Hadjidimovo; PMA)

Measurements: a- Distance of the defect to the enamel-dentine junction, b- width of the defect (when applicable).

Figure 3 Alt Text: Three photographs of rhinocerotid tooth rows with their associated interpretative drawings. A- Labial view of lower left p3-p4-m1 with linear hypoplasia (horizontal line marks on the enamel). B- Lingual view of upper right decidual molars D2-D3-D4 with pitted hypoplasia on the meta- and proto- lophs. C- Lingual view of upper left decidual molars D3-D4. The D4 displays aplasia (patches of missing enamel) on the lingual end of the proto- and meta- lophs.

Figure 4. Dental microwear results of rhinocerotids from the Balkan-Iranian province plotted on anisotropy against complexity by facet, genus, species and province

A – Mean and standard deviation of the mean by locality, facet and coloured by species

B – All specimens studied separated by facet and genus, and coloured by localities

Colour code detailed on the upper right of the figure. Abbreviations: PNT-1: Pentalophos-1, XIR: Xirochori, RZO: Ravin des Zouaves-5, KCH: Kocherinovo, Mar: Maragheh, KAL: Kalimantsi, HD: Hadjidimovo, GS: Gorna Sushitsa, Str: Strumyani-2

Figure 4 Alt Text: A- Multi-panel graphs plotting anisotropy against complexity by locality and facet coloured by species. Few specimens for the shearing facet and for both facets at some localities (one: XIR, KCH, GS; two: Samos and Pikermi). We see obvious differences for the two rhino species at PNT-1, and overlapping at Mar.

B- Multi-panel graphs plotting anisotropy against complexity by genus and facet coloured by locality and shaped by part of the province (East or West). No clear tendencies by time nor space. *Dihoplus* specimens plot in the browsing space, contrary to *Ceratotherium* ones.

Figure 5. Prevalence of hypoplasia affecting the rhinocerotids of the Balkan-Iranian Province.

A – Overall prevalence of hypoplasia (all specimens merged), in absolute numbers (left) and frequency (right)

B – Comparison of the prevalence of hypoplasia at Vallesian localities (Pentalophos-1 and Xirochori; left) and Turolian ones (right)

C – Comparison of the prevalence of hypoplasia at Eastern localities (Maragheh and Samos; left) and Western ones (right)

Dark grey: hypoplastic teeth; Light grey: normal teeth

Figure 5. Alt Text: A- Two stacked barplots showing the number or frequency of hypoplastic (dark grey) vs. normal (light grey) teeth by locus, all localities merged. D4/d4 exhibit the highest values (above 25%) for hypoplastic teeth, while d1, d2, and P4 have none. B- Two stacked barplots showing the number of hypoplastic (dark grey) vs. normal (light grey) teeth by locus for Vallesian or Turolian localities specimens. Turolian localities yielded more teeth with virtually all loci affected by hypoplasia but d1, d2, and P4, contrary to d4/D4 standing out. Fewer teeth were studied and less loci are affected by hypoplasia in Vallesian localities; p3, p4, and M1 at highest. C- Two stacked barplots showing the number of hypoplastic (dark grey) vs. normal (light grey)

teeth by locus for Eastern (Maragheh, Samos) or Western localities. Less teeth and loci affected for Western localities rhinocerotids, while for Eastern specimens virtually all loci affected by hypoplasia but d1, d2, p4 and P4, contrary to d4/D4 standing out as very hypoplastic.

Figure 6. Compared prevalence of hypoplasia on rhinocerotid teeth from the Balkan-Iranian province by locality, species and tooth locus plotted against phylogeny. Barplots coloured by subtribes: green for Rhinocerotina, yellow for Aceratheriina, and orange for Elasmotheriina; dark shades for hypoplastic teeth, light shades for teeth with no apparent hypoplasia

Phylogenetic relationships summarised from Antoine, 2002, Pandolfi, 2016, Antoine et al. 2021, and Pandolfi et al. 2021.

Figure 6 Alt Text: Barplots of the frequency of hypoplastic teeth by tooth locus for each species at every locality ordered chronologically plotted against the phylogeny. Barplots coloured by subtribes: green for Rhinocerotina, yellow for Aceratheriina, and orange for Elasmotheriina; dark shades for hypoplastic teeth, light shades for teeth with no apparent hypoplasia. Elasmotheres, represented by one species, do not present hypoplasia, while aceratheres (four *Chilotherium* species and one *Acerorhinus*) seem very touched. The prevalence of hypoplasia in rhinocerotines (*Ceratotherium* and *Dihoplus*) appear more locality than species dependent.

Word count: 12296

		Pentalophos-1 (late MN9-MN10)	Xirochori (MN10)	Maragheh (MN10-MN12)	Kocherinovo (MN11)	Ravin des Zouaves-5 (MN11)	Hadjidimovo (MN11)	Strumyani-2 (MN11-MN12)	Slatino (early Turolian)	Samos (MN11-MN13)	Kalimantsi (MN12)	Pikermi (MN12)	Gorna Sushita (MN12)
Rhinocerotinae													
Rhinocerotina													
	Ceratotherium neumayri	x		x		x		x		x	x	x	x
	Dihoplus pikermiensis						x	x		x	x	x	
	Dihoplus cf. *schleirmacheri*								x				
Aceratheriina													
	Chilotherium kilasi	x											
	Chilotherium samium									x			
	Chilotherium schlosseri									x			
	Chilotherium sp.		x										x
	Chilotherium persiae			x									
	Acerorhinus sp.				x				x		x		x
	Acerorhinus neleus											x	
	Persiatherium rodleri			x									
Teleoceraterina													
	Brachypotherium sp.										x		
Elasmotheriinae													
Elasmotheriina													
	Iranotherium morgani			x									
	Total	2	1	4	1	1	1	2	2	4	4	3	3

	epLsar	Asfc	FTfv	HAsfc9	HAsfc81
Species x Facet x Locality	Locality *	Facet **	Facet *	-	-
Species x Facet x Province	-	Facet **	Facet *	Province *	-
Genus x Facet x Locality	Genus:Locality *	Facet **	Facet *	-	-
Genus x Facet x Province	Genus:Province *	Facet **	Facet **	Province *	-

		N	Anisotropy (x 10^-3)			Complexity		
			Median	Mean	SD	Median	Mean	SD
Ceratotherium neumayri								
Pentalophos-1 (MN9-10)	Gr.	2	2.16	2.16	0.36	1.98	1.98	1.22
	Sh.	2	1.49	1.49	1.83	1.31	1.31	0.26
Maragheh (MN10-12)	Gr.	7	3.12	3.11	1.73	1.83	1.69	0.72
	Sh.	5	2.44	3.62	3.05	1.06	1.14	0.55
Ravin des Zouaves (MN11)	Gr.	2	4.46	4.46	1.05	1.14	1.14	0.39
	Sh.	1	5.06	5.06	NA	0.98	0.98	NA
Strumyani-2 (MN11-MN12)	Gr.	2	2.31	2.31	0.59	2.74	2.74	0.95
			0.00	0.00	0.00			
Samos (MN11-MN13)	Gr.	1	7.69	7.69	NA	1.28	1.28	NA
	Sh.	1	8.75	8.75	NA	0.69	0.69	NA
Kalimantsi (MN11-MN12)	Gr.	1	3.03	3.03	NA	1.37	1.37	NA
Pikermi (MN11-MN13)	Gr.	1	0.19	0.19	NA	1.04	1.04	NA
Dihoplus pikermiensis								
Hadjidimovo (MN11-MN12)	Gr.	4	1.88	1.85	0.75	1.66	1.84	0.72
	Sh.	2	1.60	1.60	0.44	1.08	1.08	0.44
Pikermi (MN11-MN13)	Gr.	1	1.51	1.51	NA	2.83	2.83	NA
	Sh.	1	1.69	1.69	NA	0.50	0.50	NA
Chilotherium kiliasi								
Pentalophos-1 (MN9-10)	Gr.	2	4.09	4.09	0.65	2.47	2.47	0.42
	Sh.	1	6.40	6.40	NA	0.82	0.82	NA
Chilotherium sp.								
Xirochori (MN10)	Gr.	1	4.55	4.55	NA	1.96	1.96	NA
	Sh.	1	6.27	6.27	NA	2.36	2.36	NA
Chilotherium persiae								
Maragheh (MN10-12)	Gr.	13	2.28	2.75	2.08	1.56	1.82	1.04
	Sh.	9	3.07	3.54	1.91	0.96	1.46	1.35
Chilotherium schlosseri								
Samos (MN11-MN13)	Gr.	1	3.88	3.88	NA	0.65	0.65	NA
	Sh.	1	3.14	3.14	NA	0.38	0.38	NA

Acerorhinus sp.								
Kocherinovo (MN11)	Gr.	1	1.47	1.47	NA	4.31	4.31	NA
	Sh.	1	1.65	1.65	NA	1.51	1.51	NA
Kalimantsi (MN11-MN12)	Gr.	4	1.94	2.25	1.91	1.42	1.73	0.84
Gorna Sushitsa (MN11-12)	Gr.	1	1.28	1.28	NA	1.17	1.17	NA
	Sh.	1	6.58	6.58	NA	1.23	1.23	NA

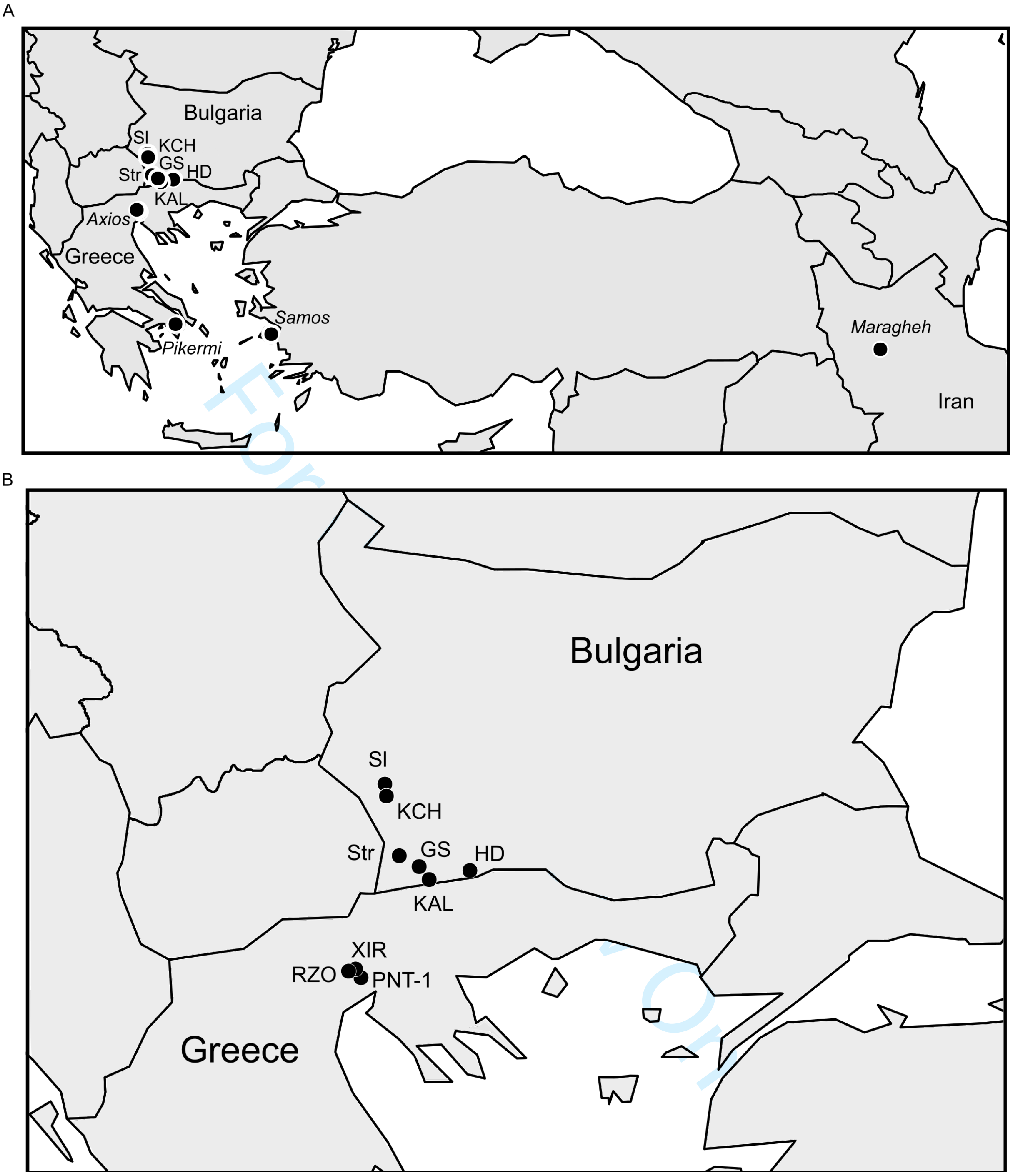
FTFV (x 10^4)			HAsfc9			HAsfc81		
Median	Mean	SD	Median	Mean	SD	Median	Mean	SD
5.60	5.60	0.63	0.20	0.20	0.02	0.45	0.45	0.07
4.85	4.85	0.50	0.25	0.25	0.01	0.49	0.49	0.07
5.75	5.82	2.61	0.32	0.42	0.20	0.51	0.62	0.22
3.42	4.63	3.24	0.35	0.32	0.06	0.55	0.54	0.10
5.91	5.91	2.46	0.19	0.19	0.00	0.39	0.39	0.04
2.20	2.20	NA	0.46	0.46	NA	0.57	0.57	NA
5.20	5.20	4.30	0.24	0.24	0.16	0.56	0.56	0.15
4.94	4.94	NA	0.83	0.83	NA	1.35	1.35	NA
4.01	4.01	NA	0.22	0.22	NA	0.52	0.52	NA
4.83	4.83	NA	0.32	0.32	NA	0.50	0.50	NA
2.27	2.27	NA	0.52	0.52	NA	0.68	0.68	NA
6.67	5.95	3.25	0.28	0.31	0.12	0.58	0.56	0.17
2.57	2.57	0.24	0.26	0.26	0.03	0.46	0.46	0.03
6.64	6.64	NA	0.35	0.35	NA	0.80	0.80	NA
1.43	1.43	NA	0.19	0.19	NA	0.43	0.43	NA
7.10	7.10	0.94	0.39	0.39	0.09	0.70	0.70	0.26
3.31	3.31	NA	0.38	0.38	NA	0.50	0.50	NA
8.28	8.28	NA	0.20	0.20	NA	0.44	0.44	NA
5.69	5.69	NA	0.19	0.19	NA	0.59	0.59	NA
4.57	4.84	1.91	0.38	0.40	0.13	0.71	0.70	0.20
3.06	4.16	2.66	0.31	0.48	0.40	0.60	0.79	0.55
7.08	7.08	NA	0.32	0.32	NA	0.65	0.65	NA
1.54	1.54	NA	0.12	0.12	NA	0.34	0.34	NA

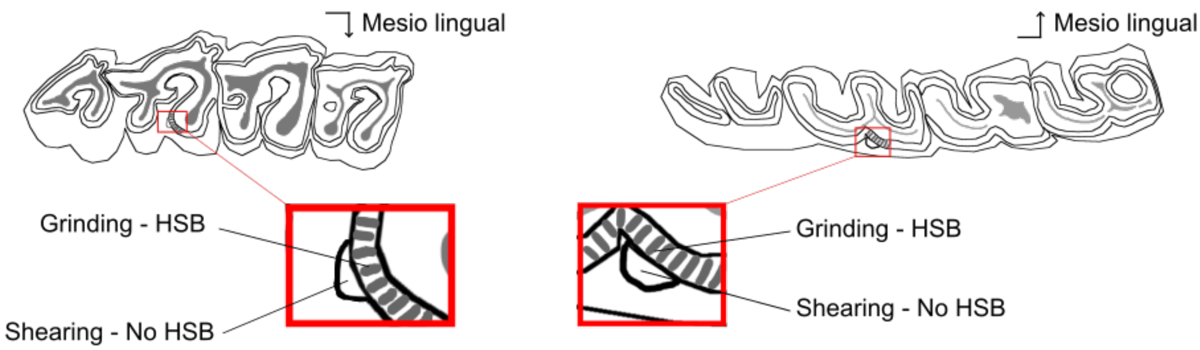
5.13	5.13	NA	0.45	0.45	NA	0.59	0.59	NA
2.99	2.99	NA	0.19	0.19	NA	0.49	0.49	NA
5.22	5.12	1.52	0.43	0.38	0.13	0.61	0.74	0.39
2.67	2.67	NA	0.37	0.37	NA	0.51	0.51	NA
5.70	5.70	NA	0.29	0.29	NA	1.08	1.08	NA

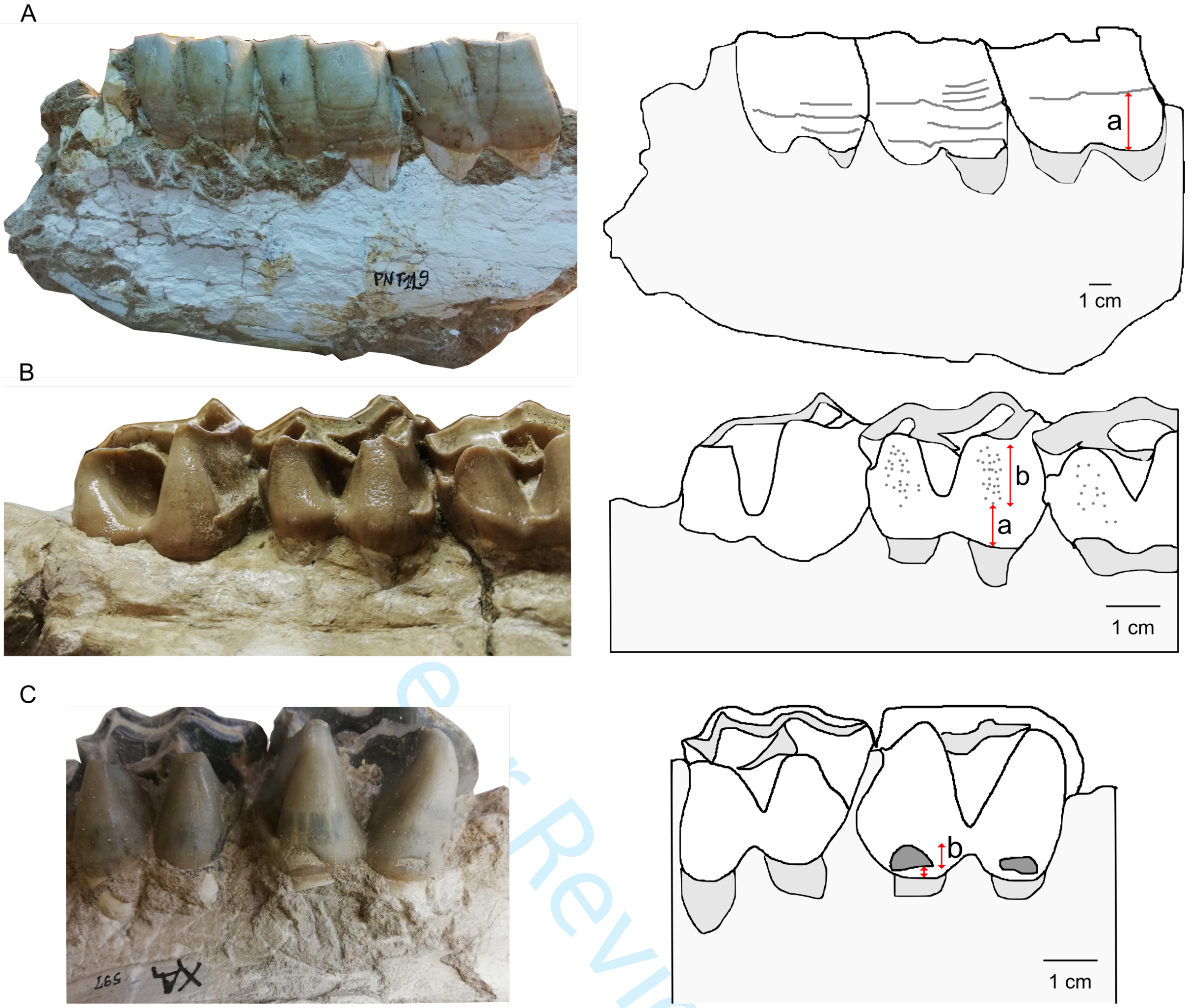
	Ceratotherium neumayri	*Dihoplus pikermiensis*	*Dihoplus cf. schleiermacheri*	*Chilotherium kiliasi*	*Chilotherium persiae*	*Chilotherium schlosseri*	*Chilotherium sp.*	*Acerorhinus sp.*	*Persiatherium rodleri*	*Iranotherium morgani*
d1	0/6	0/3	-	0/1	-	-	-	-	-	0/2
D1	0/10	3/15	-	0/2	0/18	-	-	0/2	0/1	0/3
d2	0/12	0/3	-	0/3	0/10	-	-	-	-	0/3
D2	0/10	3/15	-	0/3	2/9	-	-	0/1	-	-
d3	0/15	0/5	-	0/3	1/13	-	-	0/1	-	0/2
D3	0/11	2/15	-	0/3	0/8	-	0/2	0/1	-	-
d4	3/12	0/5	-	1/3	8/10	2/2	-	0/2	-	-
D4	2/8	3/15	-	1/3	7/12	-	0/2	0/1	0/2	-
Total Milk	5/84	11/76	-	2/21	18/80	2/2	0/4	0/8	0/3	0/10
p2	1/12	0/3	-	2/6	0/17	0/1	-	0/1	-	-
P2	2/12	0/6	0/1	0/2	0/27	-	0/2	0/5	0/3	-
p3	3/17	0/4	-	2/6	0/19	0/2	-	0/2	-	-
P3	2/12	0/6	0/1	1/2	0/25	-	-	2/8	0/2	0/1
p4	2/16	0/4	-	3/6	0/16	-	-	1/2	-	-
P4	0/11	0/5	0/1	0/2	0/26	-	-	0/5	-	-
m1	3/20	0/5	-	0/4	0/17	0/2	-	0/6	-	-
M1	0/17	0/5	0/1	0/2	3/30	-	1/2	0/4	0/2	0/1
m2	2/17	0/4	-	0/3	6/15	0/2	-	0/4	-	0/1
M2	0/10	0/6	0/1	1/3	3/29	-	0/2	0/5	2/2	0/1
m3	1/9	0/5	-	2/3	4/14	-	-	0/4	-	0/1
M3	0/11	0/5	-	1/3	5/22	-	-	1/6	-	0/1
Total Permanent	16/164	0/58	0/5	12/42	21/257	0/7	1/6	4/52	2/9	0/6
Total Lower	15/136	0/41	-	10/38	19/131	2/9	-	1/22	-	0/9
Total Upper	6/112	11/93	0/5	4/25	20/206	-	1/10	3/38	0/12	0/7
Total All	21/248	11/134	0/5	14/63	39/337	2/9	1/10	4/60	2/12	0/16

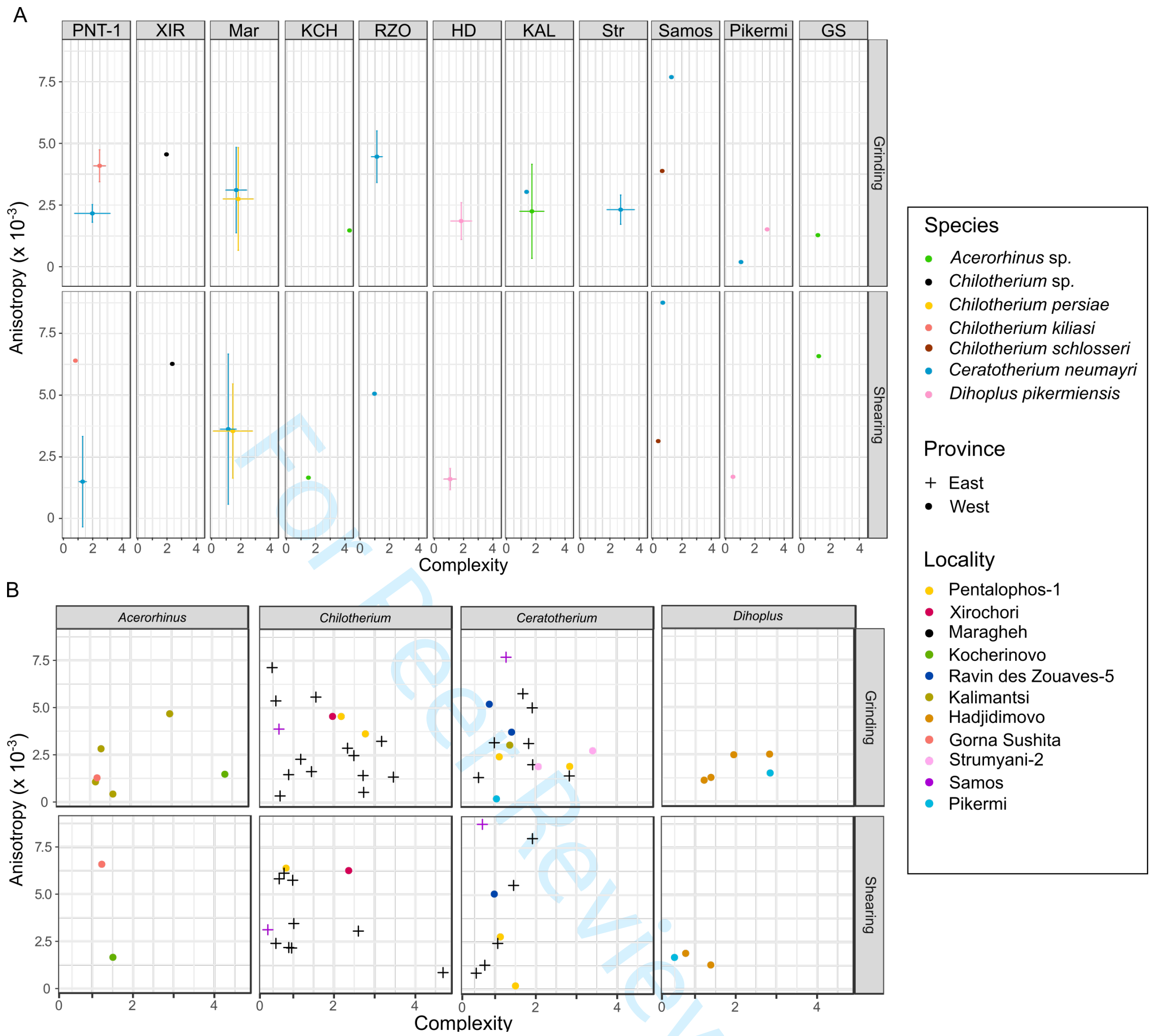
		Maxillaes and mandibles	Isolated teeth
Pentalophos-1			
	Ceratotherium neumayri	2/10	1/1
	Chilotherium kiliasi	6/9	-
Xirochori			
	***Chilotherium* sp.**	1/1	-
Maragheh			
	Ceratotherium neumayri	1/6	4/19
	Chilotherium persiae	16/34	8/54
	Iranotherium morgani	0/5	0/5
	Persiatherium rodleri	1/1	0/1
Hadjidimovo			
	Dihoplus pikermiensis	1/9	0/9
Strumyani-2			
	Ceratotherium neumayri	1/2	-
	Dihoplus pikermiensis	0/2	-
Samos			
	Ceratotherium neumayri	2/5	-
	Dihoplus pikermiensis	2/2	-
	Chilotherium schlosseri	1/1	-
Kalimantsi			
	***Acerorhinus* sp.**	3/7	0/3
	Ceratotherium neumayri	0/5	
	Dihoplus pikermiensis	0/4	0/5
Pikermi			
	Ceratotherium neumayri	-	0/5
	Dihoplus pikermiensis	1/2	0/1

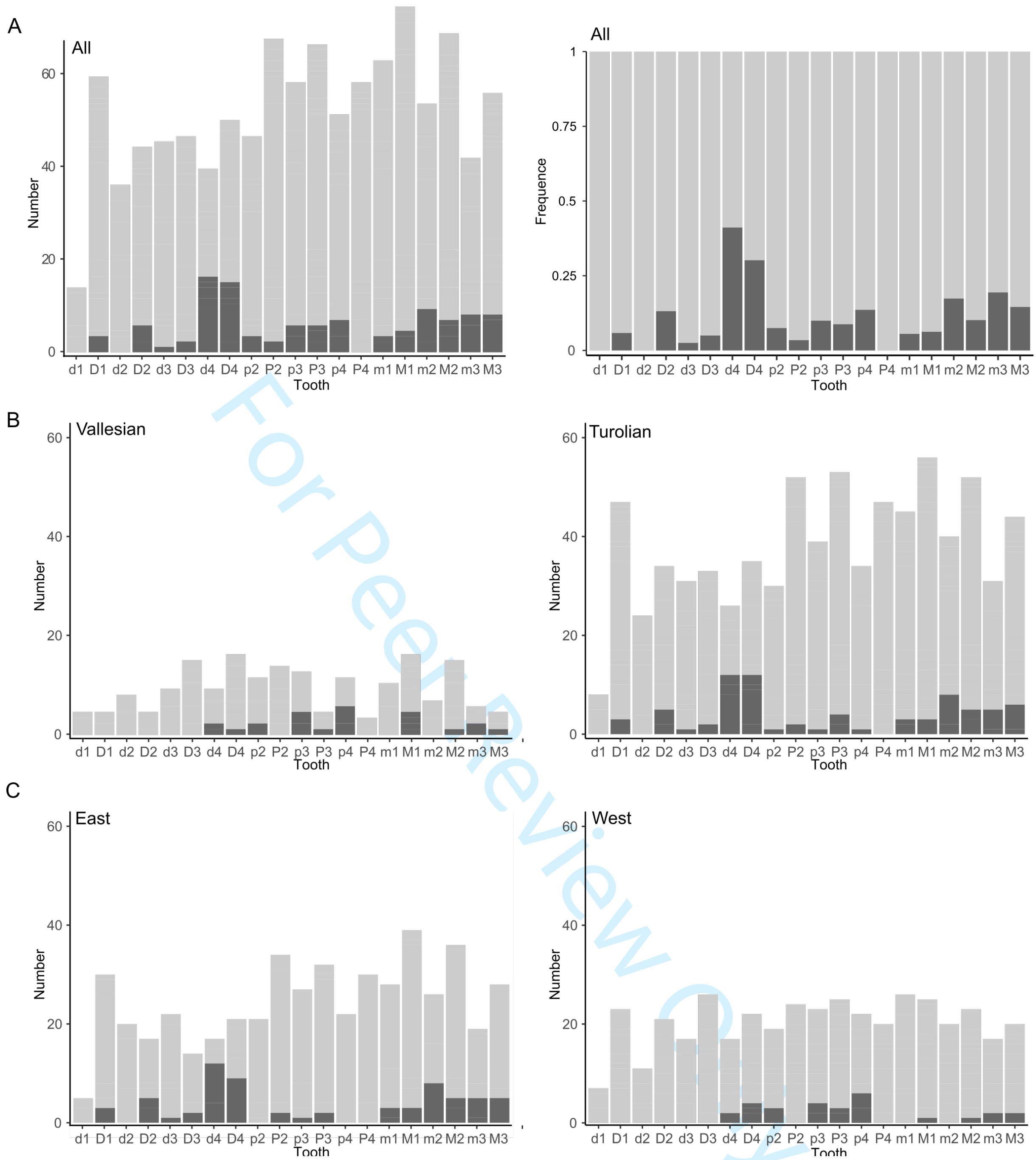
		Pentalophos-1	Xirochori	Maragha	Kocherinovo	Ravin des Zouaves 5	Hadjidimovo	Strumyani-2	Slatino	Samos	Kalimantsi	Pikermi	Gorna Sushitsa
Rhinocerotinae													
	Ceratotherium neumayri	B		M		M		B		G	M	B	x
	Dihoplus pikermiensis						B	B		B	B	B	
	Dihoplus cf. *schleiermacheri*								x				
	Chilotherium kiliasi	M											
	Chilotherium persiae			M									
	Chilotherium schlosseri									M			
	Chilotherium samium									x			
	Chilotherium sp.		M										x
	Acerorhinus sp.				B				x		x		B
	Acerorhinus neleus											x	
	Persiatherium rodleri			x									
	Brachypotherium sp.										x		
Elasmotheriinae													
	Iranotherium morgani			x									

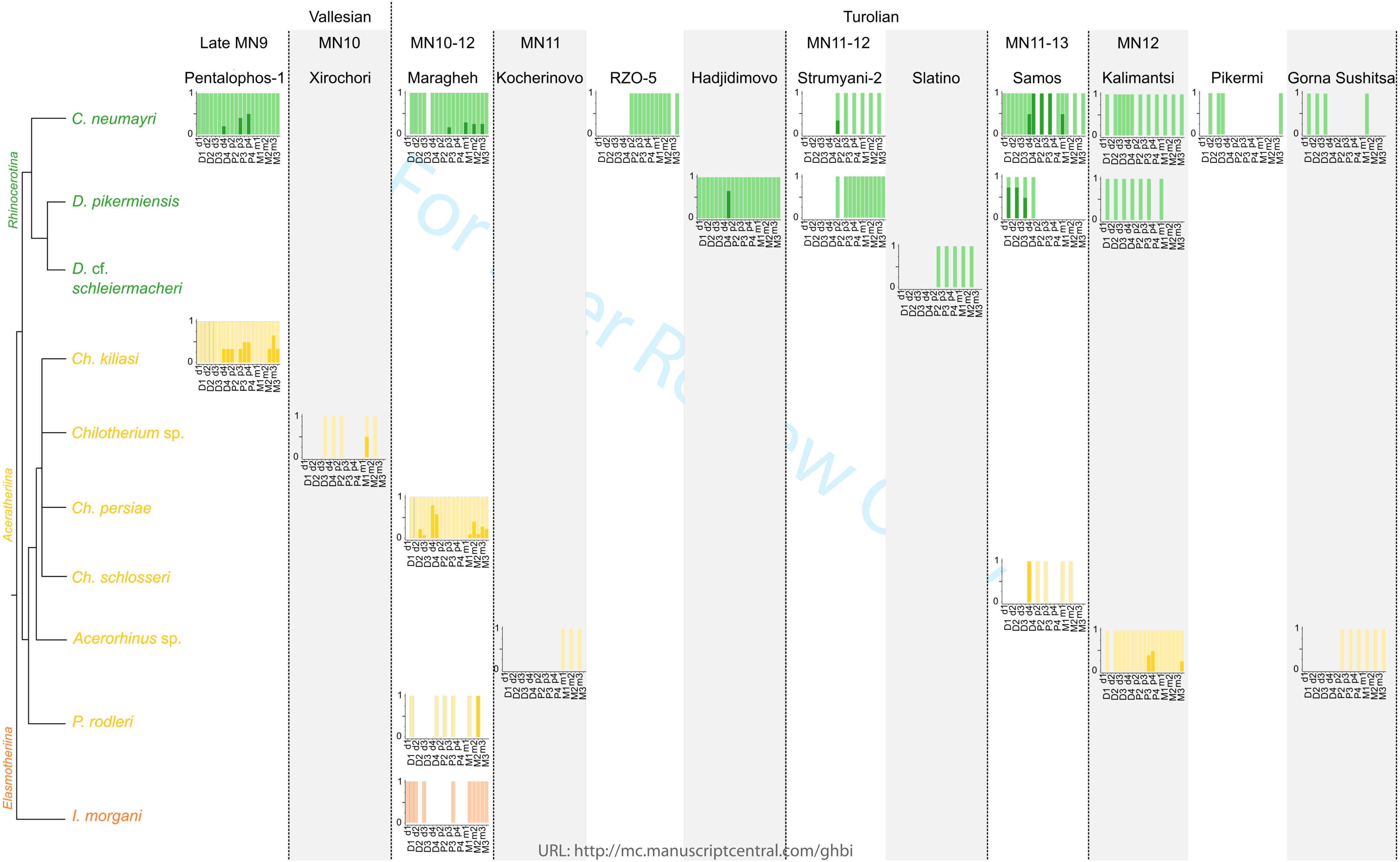

A
Bulgaria
SI
KCH
GS
Str
HD
KAL
Axios
Greece
Samos
Pikermi
Maragheh
Iran
B
Bulgaria
SI
KCH
Str
GS
HD
KAL
XIR
RZO
PNT-1
Greece


Mesio lingual
Grinding - HSB
Shearing - No HSB
Mesio lingual
Grinding - HSB
Shearing - No HSB


A
PNT119
a
1 cm
B
b
a
1 cm
C
597
XA
b
1 cm


A
PNT-1
XIR
Mar
KCH
RZO
HD
KAL
Str
Samos
Pikermi
GS
Grinding
Shearing
Anisotropy (x 10⁻³)
Complexity
B
Acerorhinus
Chilotherium
Ceratotherium
Dihoplus
Species
Acerorhinus sp.
Chilotherium sp.
Chilotherium persiae
Chilotherium kiliasi
Chilotherium schlosseri
Ceratotherium neumayri
Dihoplus pikermiensis
Province
East
West
Locality
Pentalophos-1
Xirochori
Maragheh
Kocherinovo
Ravin des Zouaves-5
Kalimantsi
Hadjidimovo
Gorna Sushita
Strumyani-2
Samos
Pikermi


A
All
Number
Tooth
All
Frequence
Tooth
B
Vallesian
Number
Tooth
Turolian
Number
Tooth
C
East
Number
Tooth
West
Number
Tooth
d1 D1 d2 D2 d3 D3 d4 D4 p2 P2 p3 P3 p4 P4 m1 M1 m2 M2 m3 M3



Vallesian
Turolian
Late MN9
MN10
MN10-12
MN11
MN11-12
MN11-13
MN12
Pentalophos-1
Xirochori
Maragheh
Kocherinovo
RZO-5
Hadjidimovo
Strumyani-2
Slatino
Samos
Kalimantsi
Pikermi
Gorna Sushitsa
Rhinocerotina
C. neumayri
D. pikermiensis
D. cf. schleiermacheri
Aceratheriina
Ch. kiliasi
Chilotherium sp.
Ch. persiae
Ch. schlosseri
Acerorhinus sp.
P. rodleri
Elasmotheriina
I. morgani
1
0
d1 d2 d3 d4 p2 p3 p4 m1 m2 m3
D1 D2 D3 D4 P2 P3 P4 M1 M2 M3

Supplementary – Late Miocene rhinos

Details on the localities studied

Pikermi is a very famous fossiliferous site, situated only few kilometers away from Athens (Greece). The classic locality has been known since the 19th century and dated to the MN12 (Koufos 2006a). It has yielded an abundant and diverse mammal fauna, though originating from two to three different levels separated by tens or even hundreds of thousands of years (Theodorou et al. 2010). More recently, new localities (Chromateri, Pikermi-Valley) have been discovered spanning from MN11 to MN13 (Theodorou et al. 2010), although the classical levels have been dated between 7.33 and 7.29 Mya (Böhme et al. 2017, 2018) corresponding to the MN12. Pikermi is considered as one of the most classical and famous fossil Neogene localities across the world, a reference for all coeval Turolian localities of the Eastern Mediterranean, and the origin of the so-called “Pikermian Biome”. The rhinocerotid assemblage is composed of the following associated species: *Dihoplus pikermiensis* (dominant), *Ceratotherium neumayri* and *Acerorhinus neleus*.

Samos encompasses several localities near Mytilini (Samos Island; Greece) with an imprecise stratigraphy and a temporal range from MN11 to MN13 (7.8 to 6.7 Mya; Koufos et al. 2009). The first excavations date back to the 19th century and yielded a non-homologous and non-isochronous fauna, forming four chronologically succeeding mammal assemblages over about 1 Myr (Koufos et al. 2009). The rhinocerotid assemblage is composed of *Ceratotherium neumayri* (dominant), *Dihoplus pikermiensis*, *Chilotherium samium*, and *Chilotherium schlosseri* (Giaourtsakis 2009) that are associated in the Intermediary and Dominant Mammal Assemblages of Samos (Koufos et al. 2009).

Maragheh is composed of several localities spanning over 1.6 Myr, dating from 9 to 7.4 Mya (MN10 to MN12), and forming three biostratigraphically-distinct intervals (Ataabadi et al. 2013). It has yielded one of the most diverse late Miocene assemblages of rhinocerotids, with four distinct species and genera in the same stratigraphical level (Ataabadi et al. 2013; Pandolfi 2016), similar to what is found in middle Miocene localities, such as Sansan (Heissig 2012; Pandolfi 2016): *Ceratotherium neumayri* (dominant), *Chilotherium persiae* (dominant), *Iranotherium morgani,* and *Persiatherium rodleri*.

Localities of the Axios Valley

Our dataset includes three localities from the Axios Valley (Macedonia, Greece), a few dozen kilometers North-East from Thessaloniki: **Pentalophos-1** (latest MN9 or early MN10) and **Xirochori** (~ 9.6 Mya, MN10) both Vallesian, and the more recent locality of **Ravins des Zouaves – 5** (RZO) dated to the Turolian (~ 8.2 Mya, MN11; Sen et al., 2000; Koufos and Vlachou, 2019). Pentalophos-1 has yielded two rhinocerotid species, *Ceratotherium neumayri* and *Chilotherium kiliasi*, forming half of the mammalian biomass according to Geraads and Koufos (1990). In the other two localities, only one rhinocerotid species is found: *Ce. neumayri* at RZO and *Chilotherium sp.* at Xirochori.

Hadjidimovo is one of the richest Bulgarian localities. It is composed of four localities from the Mesta River valley, near the Bulgarian-Greek frontier. Hadjidimovo has been dated to the second half or the end of MN11 (Spassov et al. 2018), and older than 7.44 Mya (Böhme et al. 2018). Only one rhinocerotid is found at this locality: *Dh. pikermiensis* (Geraads and Spassov 2009).

Kalimantsi also comprises several localities (more than 10) from the Struma River valley (Bulgaria), with the main locality Kalimantsi-1 dated to MN11 (older than 7.44 Mya according to Böhme et al., 2018), while others (material studied here) are Middle Turolian in age, or MN12, in the time interval 7.42–7.27 Mya (Böhme et al. 2018). It is the richest locality of the Struma basin and it has yielded the best-known late Miocene Bulgarian vertebrate assemblage. Four rhinocerotid species are found at Kalimantsi but probably not associated: *Ce. neumayri, Dh. pikermiensis, Brachypotherium* sp. (KAL-3 and 4), and *Acerorhinus* sp (KAL-1 and higher levels; Geraads and Spassov, 2009).

Gorna Sushitsa refers to several localities (16 levels identified; (Böhme et al. 2018; Spassov et al. 2019) with different ages within the Turolian stage (MN11-MN12). The material studied here come from the levels GS7 and GS8, that are probably closed in age to classical Pikermi levels, within MN12 (Böhme et al. 2018). Gorna Sushitsa is located in the Sandanski District, South-Western Bulgaria (41.555°N, 23.384°E), and it has yielded three species of rhinocerotids at different levels: *Ce. neumayri* (GS3, GS4, GS7, and GS8), *Chilotherium* sp. (GS3, GS4, and GS8), and *Acerorhinus* sp. (Spassov et al. 2019).

Slatino designates two independent rhinocerotine findings from unknown localities (probably distinct fossiliferous outcrops) near the Slatino village, Struma River Basin, Southwestern Bulgaria. Their age is uncertain, but the Slatino lithocomplex, to which they belong, is dated to the lower part of the late Miocene (Tortonian / Vallesian; (Spassov et al. 2006; Geraads and Spassov 2009). One specimen has been referred to as *Acerorhinus* sp. and the other one as *Dihoplus* cf. *schleiermacheri*.

Kocherinovo consists of three subcoeval localities from the Middle Struma basin, Southwestern Bulgaria (Hristova et al. 2013). The localities are estimated to the early Turolian (early MN11). The only rhinocerotid recognised is *Acerorhinus* sp.

Strumyani-2 is a locality near Sandanski, Struma River Valley, Southwestern Bulgaria. It has yielded a fauna similar to that of Pikermi but probably slightly older, dated to early–early middle Turolian times (MN11–12; Geraads et al., 2011). Both *Ce. neumayri* and *Dh. pikermiensis* are present and were found in the same spot suggesting a close association of these two species (Geraads and Spassov, 2009).

<u>Faunal lists (herbivore taxa)</u>

Table 1 : Faunal list and inferred dietary preferences of mammal herbivore taxa from the Southeastern Mediterranean Late Miocene localities studied

Colour code: brown – browser, blue – mixed-feeder, light green – folivore, dark green – grazer, red – frugivore, no colour – no data available

Dietary preferences were inferred based on the literature : Geraads & Koufos, 1990 ; Geraads et al., 2001 ; Giaourtsakis, 2003, 2009 ; Koufos, 2006b; Merceron et al., 2006 ; Geraads & Spassov, 2009 ; Koufos et al., 2009 ; Solounias et al., 2010 ; Clavel et al., 2012 ; Ataabadi et al., 2013 ; Hristova et al., 2013 ; Spassov et al., 2019 ; NOW Database, 2020.

Assemblages merged for Maragheh, Kalimantsi, Samos, and Pikermi.

		Pentalophos-1	Xirochori	Maragheh	Ravin des Zouaves 5	Kocherinovo	Strumyani-2	Slatino	Gorna Sushitsa	Kalimantsi	Hadjidimovo	Samos	Pikermi
Perissodacyla													
Chalicotheriidae	Chalicotheriidae indet				x								
	Ancylotherium pentelicum			x			x			x	x	x	x
	Ancylotherium sp.	x											
	Anisodon sp.								x				
	Metaschizotherium fraasi									x			
	Chalicotherium goldfussi										x		x
	Kalimantsia bulgarica									x			
Equidae	*Cremohipparion macedonicum*	x			x	cf.							
	Cremohipparion proboscideum				x							x	
	Cremohipparion moldavicum			aff.									
	Cremohipparion matthewi			aff.								x	
	Cremohipparion mediterraneum						x			x	x	aff.	x
	Cremohipparion nikosi											x	
	Hippotherium primigenium	x	ex. gr.										
	Hippotherium brachypus			x		x	cf.		x	x	x		
	Hippotherium giganteum											x	
	Hipparion sp.					x	x						
	Hipparion gettyi			x									
	Hipparion campbelli			x									
	Hipparion depereti	aff.											
	Hipparion dietrichi				x		x					aff.	
	Hipparion platigenis										x		
Rhinocerotidae	*Ceratotherium neumayri*	x		x	x		x		x	x		x	x
	Dihoplus pikermiensis						x			x	x	x	x
	Dihoplus cf. *schleiermacheri*							x					
	Chilotherium kiliasi	x											
	Chilotherium persiae			x									
	Chilotherium schlosseri											x	
	Chilotherium samium											x	
	Chilotherium sp.		x						x				
	Acerorhinus sp.					x		x	x	x			
	Acerorhinus neleus												x
	Persiatherium rodleri			x									
	Brachypotherium sp.									x			
	Iranotherium morgani			x									
Tapiridae	*Tapirus* sp.						x			x			
	Tapirus jeanpiveteaui										x		
Artiodactyla													
Suidae	cf. *Microstonyx* sp.					x							
	Microstonyx major			x	x		x			x			x
	Hippopotamodon major				x								
	Hippopotamodon erymanthius								x		x	x	
	Propotamochoerus sp.				x				x				
Traguildae	*Dorcatherium puyhauberti*						cf.						
Bovidae	*Gazella* sp.	x	x			x			x	x	x	3/4	x
	Gazella ancyrensis			cf.									
	Gazella capricornis			x	cf.		cf.		cf.			x	x
	Gazella pilgrimi				x							x	
	Demecquenemia rodleri			x									
	Prostrepsiceros axiosi				x								

		Pentalophos-1	Xirochori	Maragheh	Ravin des Zouaves 5	Kocherinovo	Strumyani-2	Slatino	Gorna Sushitsa	Kalimantsi	Hadjidimovo	Samos	Pikermi
	Prostrepsiceros houtumschindleri			x								x	
	Prostrepsiceros fraasi			x									
	Prostrepsiceros vinayaki			cf.									
	Protragelaphus skouzesi			x								x	x
	Helladorcas geraadsi	x											
	Helladorcas sp.		x										
	Ouzocerus pentalophosi	x	cf.										
	Protoryx sp.	x	x										
	Protoryx carolinae												x
	Protoryx crassicornis											x	
	Sporadotragus parvidens											x	x
	Sporadotragus vasili						x						
	Sporadotragus sp.									x			
	Pseudotragus capricornis											x	
	Tragoportax sp.					x	x						
	Tragoportax amalthea			cf.	x				x	x	x	x	x
	Tragoportax rugosifrons										x	x	x
	Skoufotragus laticeps			x					cf.			x	
	Miotragocerus valenciennesi						cf.		x	x	x	x	x
	Miotragocerus mauis			cf.									
	Miotragocerus sp.	x		x	x	x							
	Nisidorcas planicornis				x								
	Nisidorcas sp.			x									
	Palaeoreas lindermayeri				x	x	x			x	x	x	x
	Palaeoryx pallasi				cf.							x	x
	Palaeoryx sp.			x			x		x		x		
	Criotherium argalioides											x	
	Criotherium sp.									x			
	Urmiatherium polaki			x									
	Oioceros atropatenes			x									
	Oioceros rothi			x					x				x
	Oioceros wegneri											x	
	Oioceros sp.										x		
	Prosinotragus kuhlmanni											x	
	Samokeros minotaurus			x								x	
Giraffidae	*Paleogiraffa macedoniae*	x											
	Paleogiraffa pamiri		x										
	Palaeotragus coelophrys	x		x						x		x	x
	Palaeotragus rouenii				x		x		cf.		x	x	x
	Palaeotraginae indet				x								
	Helladotherium duvernoyi			x	x		x			x	x	x	x
	Helladotherium sp.								x				
	?Samotherium sp.					x							
	Samotherium neumayri			x									
	Samotherium boissieri											x	
	Samotherium major											x	
	Bohlinia attica			x			x		cf.	x	x	x	x
Cervidae	Pliocervus pentelici												x
	indet			x			x				x		
Rodentia													
Sciuridae	*Spermophlinus bredai*												
Glidridae	*Muscardinus* sp.												x
	Myomimus dehmi												x

		Pentalophos-1	Xirochori	Maragheh	Ravin des Zouaves 5	Kocherinovo	Strumyani-2	Slatino	Gorna Sushitsa	Kalimantsi	Hadjidimovo	Samos	Pikermi
Muridae	*Valerymys* sp.				x							x	
	Byzantina pikermiensis											x	x
	Karnimata provocator											x	x
	Kowalskia lavocati												x
	Parapodemus gaudryi												x
	Micromys bendai												x
	Occitanomys brailloni												x
	Pseudomeriones pythagorasi											x	
	Pliospalax sotirisi											x	
Hystricidae	*Hystrix primigenia*								x		x	x	x
	Hystrix sp.			x			x						
Lagomorpha													
Leptoridae	*Alilepus* sp.												x
Ochotonidae	*Prolagus crusafonti*												x
	Prolagus michauxi												x
Proboscidea													
Gomphotheriidae	*Choerolophodon anatolicus*	x											
	Choerolophodon pentelici		x	x	x					x		x	x
	Choerolophodon sp.					x							
	"Tetralophodon" atticus						x			x	x	x	x
Deinotheriidae	*Deinotherium gigantissimum*			x					x			x	
Mammutidae													
	"Mammut" sp.				x						x	x	

Interactions with other herbivores

In addition to rhinocerotids, the fossil localities studied have yielded other herbivores species such as other perissodactyls, artiodactyls and proboscids, as well as micro-herbivores (rodents, lagomorphs, insects). Species lists by locality are detailed in Table 1.

Concerning perissodactyls, tapirs are rather rare in the Southeastern Mediterranean region (Koufos 2006b) and very few is known about their paleoecology. Equids on the other hand, have been well studied. This taxa is generally considered to be adapted to open environments and abrasive grazing-type feeding (Janis 1976; Mihlbachler et al. 2011). Equids are mostly represented by hipparions (50-350 kg depending on species and period; Hippotherium spp., Cremohipparion; Shoemaker and Clauset, 2014) in the studied localities. The 2D microwear of five species from Samos and Pikermi reveals the exploitation of C3-type grasses (mixed feeders and grazers; Solounias et al., 2010). This grass consumption by different hipparion species is also proposed for Late Miocene localities in Bulgaria (Hadjidimovo, Kalimantsi, Strumyani; (Clavel et al. 2012). Thus, hipparions probably did not compete with rhinocerotids for food resources. Evetually, chalicotheres are present in most of the sites studied with relative taxonomic variety, but in fairly limited numbers (sampling biases are conceivable, however). Like rhinoceroses, they exhibit significant size and mass (Costeur et al. 2012; Guérin 2012). A recent study of the dental microwear of different species suggests significant fruit consumption in several species including *Metaschizotherium fraasi* from Petersbuch (MN 6; Germany), a species also present at Kalimantsi (Schulz et al. 2007; Semprebon et al. 2011). For the schizotherine species *Ancylotherium pentelicum* studied in Pikermi and Samos, but also present at Hadjidimovo, Kalimantsi and Maragha, dental microwear indicates the inclusion of harder objects such as branches or bark (Semprebon et al. 2011). Thus, it appears that chalicotheres and rhinocerotids exploited quite different niches, suggesting little or no competition for resources.

Artiodactyl species are also very common at the localities studied, and this clade is often considered to be a competitor of perissodactyls (Janis 1976). Indeed, most bovids from Samos and Pikermi are browsers or mixed-feeders (Solounias et al. 2010). Similarly at Hadjidimovo, where bovids are either mixed feeders (*Tragoportax rugosifrons*, *Gazella* sp. and *Palaeoreas lindermayeri*) or folivores (*Miotragocerus gaudryi* and *Palaeoreas lindermayeri*), and at Kalimantsi, where *Tragoportax* cf. *amalthea* appears as strict browser and *Palaeoreas lindermayeri* and *Gazella* sp. as mixed feeders (Merceron et al. 2006; Clavel et al. 2012). Thus, most artiodactyls present at the localities of interest are mixed feeders or browsers, and thus potentially in competition with associated rhinocerotids. However, some artiodactyls found at these localities seem to have been grazers, a feeding preference not occupied by the rhinocerotids studied here. At Samos and Pikermi, the 2D microwear reveals that five ruminant species exploited C3 grass resources, in addition to the aforementioned hipparions (Solounias et al. 2010). Similarly in Greece, where some Pentalophos-1 bovids have a grazing signal (microwear: Merceron et al., 2007), and it is likely that giraffids from the Axios Valley (*Palaeogiraffa macedoniae* and *P. major*; microwear: Merceron et al., 2018) and Samos (*Samotherium* cf. *boissieri*; isotopy: Quade et al., 1994) included monocotyledonous grasses in their diet. In contrast, no strictly grazing bovid species are found at Hadjidimovo, nor at Kalimantsi according to microwear and carbon isotopes (Merceron et al. 2006).

Concerning our localities of the Southeastern Mediterranean region, *Choerolophodon* is the most abundant proboscidean genus: *C. anatolicus* at Pentalophos-1, *C. pentelici* Ravin des Zouaves-5, Xirochori, Pikermi and Samos. The microwear of both species in the Axios Valley reveals the consumption of grasses, consistent with the arid climatic conditions and the absence of this genus in Central, Western and Northern Europe (Konidaris et al. 2016). In his master's thesis, Loponen (2020) finds a grass preference for *C. pentelici* from Maragheh using the mesowear angle. Other proboscidean species are also found in the region (e.g., *Mammut* sp., *Deinotherium gigantissimum*), but they are not included in the microwear studies on the relevant deposits (Solounias et al. 2010). Fossil forms of proboscideans are extremely diverse and the wide variety of dental morphologies suggests very different dietary specialisations (Shoshani, 1998; Loponen, 2020). They are megaherbivore species (>1000 kg) that can reach considerable size and mass (Göhlich, 1999; Larramendi, 2015). Indeed, *Deinotherium giganteum* and *D. gigantissimum* are among the largest Neogene mammals (up to 4 m at the withers: Göhlich, 1999; Larramendi, 2015) and probably fed more on the tops of trees. Thus, niche partitioning with rhinos could also be based on different feeding heights.

Glires (Rodentia + Lagomorpha) are small to medium-sized (a few grams to a few kilograms; Costeur et al., 2012) mostly herbivorous mammals that are highly abundant and diverse (Samuels 2009). Due to their small size and fragile bones, there is a sampling bias for this group. Furthermore, the study of rodent ecology per se is quite rare (Gomes Rodrigues et al. 2009; Coillot et al. 2013; Robinet et al. 2020), and is more often used to date the deposit or propose environmental conditions (Vianney-Liaud 1991; Legendre et al. 2005; Maridet and Sen 2012) than to propose dietary preferences (Samuels 2009). When mentioned, the diet of herbivorous rodents is not described on the classic grazer-grazer spectrum, but rather between folivore and graminivore (Gordon et al. 2019). Regarding lagomorphs, the study of non-rabbit taxa is even more rare.

In the fossil localities studied here, few rodents and even fewer lagomorphs were found, probably due to incomplete survey of the deposits (Koufos 2003). The species found are mainly Muridae, but *Hystrix primigenia* is also frequently present (NOW Database, 2020 and references therin). The interaction between ungulates and present-day rodents has been discussed very broadly in "The Ecology of the Browsing and Grazing I & II" (Gordon and Prins 2008; Gordon et al. 2019). The authors report a wide range of effects, both positive and negative, greatly dependent on the habitat and species involved. They agree, however, that high browsing pressure leads to a decrease in rodent diversity and abundance (Steen et al. 2005). A similar trend is noted for lagomorphs (Komonen et al. 2003).

<u>Interests and limits of GLMMs</u>

Generalised linear mixed-models are very interesting albeit complex tools, principally used in ecology. If correctly applied and carefully interpreted, they provide a good way to assess the impact of many factors at the same time. The results observed with basics statistics (mean, median) were retrieved with GLMMs, confirming the reliability of this approach. We found significant differences in microwear textures and hypoplasia patterns notably depending on species, locality, province, and age.

In this article, we chose to select the best candidate models using Akaike's Information Criterion (AIC). Other criteria exist and may lead to different results depending on their sensibilities. For instance, Bayesian Information Criterion (BIC) ranking only gave consistent results to AIC ranking for HAsfc9, Multiple and Severity (see S3, S4, and S5). For all other DMTA variables it gave the same final model: (1|Specimen) + Facet, suggesting a preponderant role of the facet in the observed microwear textures. For Hypo and Localisation, the final models were relatively similar but with less factors in the BIC ranking selection. Eventually the best BIC selected (1|Specimen) as the best candidate model for Defect, highlighting the individual character of hypoplasia. Besides biological aspects, these results can easily be explained by the risk of over-fitting when using AIC and under-fitting with BIC (Findley 1991).

Our final models sometimes included factors suggesting confounding effects (e.g., Tooth Loci, Side for DMTA; Position or Wear for hypoplasia). For DMTA variables the importance of such factors was not surprising, and some authors already discussed or adapted their sampling protocol (only one facet from one precise tooth locus; e.g., lower left m2) to limit this bias (Mihlbachler et al. 2012; Christensen 2014; Ramdarshan et al. 2017). The use of GLMMs might even help increasing sample size by controlling the effects of merging different teeth and/or facets, which would be of crucial importance for dietary reconstruction using microwear. Concerning hypoplasia, we found that averaged and very worn teeth had a higher hypoplasia prevalence than lesser worn teeth. This finding was imputed to sampling bias as no logical explanation could be provided. Moreover, upper teeth were less prone to hypoplasia than their lower counterparts. This finding is surprising regarding development as they have similar developmental timings, but such a pattern was also observed in great apes (Lukacs 1999), and for the rhinocerotids from Béon 1 (late early Miocene, Southwestern France; Hullot et al., 2021), suggesting that other factors may be responsible (e.g., genetic origin).

References

Ataabadi MM, Bernor RL, Kostopoulos DS, et al (2013) Recent advances in paleobiological research of the late Miocene Maragheh Fauna, Northwest Iran. In: Wang X, Flynn LJ, Fortelius M (eds) Fossil Mammals of Asia. Neogene Biostratigraphy and Chronology, Columbia University Press. New York, pp 546–565

Böhme M, Spassov N, Ebner M, et al (2017) Messinian age and savannah environment of the possible hominin *Graecopithecus* from Europe. PLOS ONE 12:e0177347. https://doi.org/10.1371/journal.pone.0177347

Böhme M, Van Baak CG, Prieto J, et al (2018) Late Miocene stratigraphy, palaeoclimate and evolution of the Sandanski Basin (Bulgaria) and the chronology of the Pikermian faunal changes. Glob Planet Change 170:1–19. https://doi.org/10.1016/j.gloplacha.2018.07.019

Christensen HB (2014) Similar associations of tooth microwear and morphology indicate similar diet across marsupial and placental mammals. PloS One 9:e102789–e102789. https://doi.org/10.1371/journal.pone.0102789

Clavel J, Merceron G, Hristova L, et al (2012) On *Mesopithecus* habitat: Insights from late Miocene fossil vertebrate localities of Bulgaria. J Hum Evol 63:162–179. https://doi.org/10.1016/j.jhevol.2012.04.007

Coillot T, Chaimanee Y, Charles C, et al (2013) Correlated Changes in Occlusal Pattern and Diet in Stem Murinae During the Onset of the Radiation of Old World Rats and Mice. Evolution 67:3323–3338. https://doi.org/10.1111/evo.12172

Costeur L, Guérin C, Maridet O (2012) Paléoécologie et paléoenvironnement du site miocène de Sansan. In: Peigné S, Sen S (eds) Mammifères de Sansan, Mémoires du Muséum national d'Histoire naturelle. Paris, pp 661–693

Findley DF (1991) Counterexamples to parsimony and BIC. Ann Inst Stat Math 43:505–514

Geraads D, Koufos G (1990) Upper Miocene Rhinocerotidae (Mammalia) from Pentalophos-1, Macedonia, Greece. Palaeontogr Abt Paläozool Stratigr 210:151–168

Geraads D, Spassov N (2009) Rhinocerotidae (Mammalia) from the Late Miocene of Bulgaria. Palaeontogr Abt Paläozool Stratigr 287:99–122

Geraads D, Spassov N, Hristova L, et al (2011) Upper Miocene mammals from Strumyani, south-western Bulgaria. Geodiversitas 33:451–484. https://doi.org/10.5252/g2011n3a3

Geraads D, Spassov N, Kovachev D (2001) New Chalicotheriidae (Perissodactyla, Mammalia) from the Late Miocene of Bulgaria. J Vertebr Paleontol 21:596–606

Giaourtsakis IX (2009) The Late Miocene Mammal Faunas of the Mytilinii Basin, Samos Island, Greece: New Collection. 9. Rhinocerotidae. Beitr Zur Paläontol 31:157–187

Giaourtsakis IX (2003) Late Neogene Rhinocerotidae of Greece: distribution, diversity and stratigraphical range. Deinsea 10:235–254

Gomes Rodrigues H, Merceron G, Viriot L (2009) Dental microwear patterns of extant and extinct Muridae (Rodentia, Mammalia): ecological implications. Naturwissenschaften 96:537–542. https://doi.org/10.1007/s00114-008-0501-x

Gordon IJ, Prins HHT (2008) The ecology of browsing and grazing. Springer

Gordon IJ, Prins HHT, Mallon J, et al (2019) The Ecology of Browsing and Grazing in Other Vertebrate Taxa. In: Gordon IJ, Prins HHT (eds) The Ecology of Browsing and Grazing II. Springer International Publishing, Cham, pp 339–404

Guérin C (2012) *Anisodon grande* (Perissodactyla, Chalicotheriidae) de Sansan. Mém Muséum Natl Hist Nat 1993 203:279–315

Heissig K (2012) Les Rhinocerotidae (Perissodactyla) de Sansan. In: Peigné S, Sen S (eds) Mammifères de Sansan. Mémoires du Muséum national d'Histoire naturelle, Paris, pp 317–485

Hristova L, Geraads D, Markov GN, Spassov N (2013) Late Miocene mammals from Kocherinovo, southwestern Bulgaria. Acta Zool Bulg 65:517–529

Hullot M, Laurent Y, Merceron G, Antoine P-O (2021) Paleoecology of the Rhinocerotidae (Mammalia, Perissodactyla) from Béon 1, Montréal-du-Gers (late early Miocene, SW France): Insights from dental microwear texture analysis, mesowear, and enamel hypoplasia. Palaeontol Electron 24:1–26. https://doi.org/10.26879/1163

Janis C (1976) The evolutionary strategy of the Equidae and the origins of rumen and cecal digestion. Evolution 30:757–774

Komonen M, Komonen A, Otgonsuren A (2003) Daurian pikas (*Ochotona daurica*) and grassland condition in eastern Mongolia. J Zool 259:281–288

Konidaris GE, Koufos GD, Kostopoulos DS, Merceron G (2016) Taxonomy, biostratigraphy and palaeoecology of *Choerolophodon* (Proboscidea, Mammalia) in the Miocene of SE Europe-SW Asia: implications for phylogeny and biogeography. J Syst Palaeontol 14:1–27. https://doi.org/10.1080/14772019.2014.985339

Koufos GD (2006a) The Neogene mammal localities of Greece: faunas, chronology and biostratigraphy. Hell J Geosci 41:183–214

Koufos GD (2006b) Palaeoecology and chronology of the Vallesian (late Miocene) in the Eastern Mediterranean region. Palaeogeogr Palaeoclimatol Palaeoecol 234:127–145. https://doi.org/10.1016/j.palaeo.2005.01.014

Koufos GD (2003) Late Miocene mammal events and biostratigraphy in the Eastern Mediterranean. Deinsea 10:343–372

Koufos GD, Kostopoulos DS, Vlachou TD (2009) The late Miocene mammal faunas of the Mytilinii basin, Samos Island, Greece: new collection. 16. Biochronology. Beitr Zur Paläontol 31:397–408

Koufos GD, Vlachou TD (2019) New material and revision of hipparions from the upper Miocene locality Ravin des Zouaves-5, RZO of Axios Valley (Macedonia, Greece). Geobios 57:33–52

Legendre S, Montuire S, Maridet O, Escarguel G (2005) Rodents and climate: A new model for estimating past temperatures. Earth Planet Sci Lett 235:408–420. https://doi.org/10.1016/j.epsl.2005.04.018

Loponen L (2020) Diets of Miocene proboscideans from Eurasia, and their connection to environments and vegetation. Master Thesis, University of Helsinki

Lukacs JR (1999) Enamel hypoplasia in deciduous teeth of great apes: Do differences in defect prevalence imply differential levels of physiological stress? Am J Phys Anthropol 110:351–363. https://doi.org/10.1002/(SICI)1096-8644(199911)110:3<351::AID-AJPA7>3.0.CO;2-2

Maridet O, Sen S (2012) Les Cricetidae (Rodentia) de Sansan. In: Mammifères de Sansan. Mémoires du Muséum Paris, pp 29–65

Merceron G, Blondel C, Viriot L, et al (2007) Dental microwear analysis of bovids from the Vallesian (late Miocene) of Axios Valley in Greece: reconstruction of the habitat of *Ouranopithecus macedoniensis* (Primates, Hominoidea). Geodiversitas 29:421–433

Merceron G, Colyn M, Geraads D (2018) Browsing and non-browsing extant and extinct giraffids: Evidence from dental microwear textural analysis. Palaeogeogr Palaeoclimatol Palaeoecol 505:128–139. https://doi.org/10.1016/j.palaeo.2018.05.036

Merceron G, Zazzo A, Spassov N, et al (2006) Bovid paleoecology and paleoenvironments from the Late Miocene of Bulgaria: Evidence from dental microwear and stable isotopes. Palaeogeogr Palaeoclimatol Palaeoecol 241:637–654. https://doi.org/10.1016/j.palaeo.2006.05.005

Mihlbachler MC, Beatty BL, Caldera-Siu A, et al (2012) Error rates in dental microwear analysis using light microscopy. Palaeontol Electron 15:12A

Mihlbachler MC, Rivals F, Solounias N, Semprebon GM (2011) Dietary change and evolution of horses in North America. Science 331:1178–1181. https://doi.org/10.1126/science.1196166

NOW Database (2020) New & Old Worlds Database of Fossil Mammals. Version CC BY 4.0URL https://nowdatabase.luomus.fi/

Pandolfi L (2016) *Persiatherium rodleri*, gen. et sp. nov. (Mammalia, Rhinocerotidae) from the upper Miocene of Maragheh (northwestern iran). J Vertebr Paleontol 36:e1040118. https://doi.org/10.1080/02724634.2015.1040118

Quade J, Solounias N, Cerling TE (1994) Stable isotopic evidence from paleosol carbonates and fossil teeth in Greece for forest or woodlands over the past 11 Ma. Palaeogeogr Palaeoclimatol Palaeoecol 108:41–53

Ramdarshan A, Blondel C, Gautier D, et al (2017) Overcoming sampling issues in dental tribology: Insights from an experimentation on sheep. Palaeontol Electron 20:1–19

Robinet C, Merceron G, Candela AM, Marivaux L (2020) Dental microwear texture analysis and diet in caviomorphs (Rodentia) from the Serra do Mar Atlantic forest (Brazil). J Mammal 101:386–402

Samuels JX (2009) Cranial morphology and dietary habits of rodents. Zool J Linn Soc 156:864–888. https://doi.org/10.1111/j.1096-3642.2009.00502.x

Schulz E, Fahlke JM, Merceron G, Kaiser TM (2007) Feeding ecology of the Chalicotheriidae (Mammalia, Perissodactyla, Ancylopoda). Results from dental micro-and mesowear analyses. Verhandlungen Naturwissenschaftlichen Ver Hambg 43:5–31

Semprebon GM, Sise PJ, Coombs MC (2011) Potential bark and fruit browsing as revealed by stereomicrowear analysis of the peculiar clawed herbivores known as chalicotheres (Perissodactyla, Chalicotherioidea). J Mamm Evol 18:33–55. https://doi.org/10.1007/s10914-010-9149-3

Sen S, Koufos GD, Kondopoulou D, De Bonis L (2000) Magnetostratigraphy of the late Miocene continental deposits of the lower Axios valley, Macedonia, Greece. Geol Soc Greece Spec Publ 9:197–206

Shoemaker L, Clauset A (2014) Body mass evolution and diversification within horses (family Equidae). Ecol Lett 17:211–220. https://doi.org/10.1111/ele.12221

Solounias N, Rivals F, Semprebon GM (2010) Dietary interpretation and paleoecology of herbivores from Pikermi and Samos (late Miocene of Greece). Paleobiology 36:113–136

Spassov N, Geraads D, Hristova L, et al (2018) The late Miocene mammal faunas of the Republic of Macedonia (FYROM). Palaeontogr Abt Paläozool Stratigr 311:1–85. https://doi.org/10.1127/pala/2018/0073

Spassov N, Geraads D, Hristova L, Markov G (2019) The late Miocene mammal fauna from Gorna Sushitsa, southwestern Bulgaria, and the early/middle Turolian transition. Neues Jahrb Für Geol Paläontol-Abh 291:317–350. https://doi.org/10.1127/njgpa/2019/0804

Spassov N, Tzankov T, Geraads D (2006) Late Neogene stratigraphy, biochronology, faunal diversity and environments of South-West Bulgaria (Struma River Valley). Geodiversitas 28:477–498

Steen H, Mysterud A, Austrheim G (2005) Sheep grazing and rodent populations: evidence of negative interactions from a landscape scale experiment. Oecologia 143:357–364

Theodorou GE, Roussiakis SJ, Athanassiou A, Filippidi A (2010) Mammalian remains from a new site near the classical locality of Pikermi (Attica, Greece). Sci Ann Sch Geol Aristotle Univ Thessalon 99:109–20

Vianney-Liaud M (1991) Les rongeurs de l'Eocène terminal et de l'Oligocène d'Europe comme indicateurs de leur environnement. Palaeogeogr Palaeoclimatol Palaeoecol 85:15–28

Supplementary S2 - Material List

Pentalophos-1 (fin MN9 ou début MN10 ; Grèce)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
AUTh	PNT-135	*Chilotherium kiliasi*	Hémi-crâne gauche avec D1, P2-M3	DMTA, Hypo
AUTh	PNT142	*Chilotherium kiliasi*	Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
AUTh	PNT129	*Ceratotherium neumayri*	Mandibule avec p3-m1 gauches et p2-p4 droites	DMTA
AUTh	PNT34	*Ceratotherium neumayri*	Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
AUTh	PNT?	*Ceratotherium neumayri*	Hémi-mandibule droite avec d1-d4, m1	Hypo
AUTh	PNT?	*Ceratotherium neumayri*	Hémi-mandibule droite avec p2-p3, d4, m1-m2	Hypo
AUTh	PNT13	*Ceratotherium neumayri*	Hémi-mandibule gauche avec d1-d2	Hypo
AUTh	PNT14	*Ceratotherium neumayri*	Hémi-mandibule gauche avec d3-d4	Hypo
AUTh	PNT143	*Ceratotherium neumayri*	Crâne avec D1, P2-M3 gauches et P2-P3, D4, M1-M2 droites	Hypo
AUTh	PNT144	*Ceratotherium neumayri*	Crâne avec D3-D4, M1 gauches et D1-D4, M1 droites	Hypo
AUTh	PNT26	*Ceratotherium neumayri*	d3 droite	Hypo
AUTh	PNT34	*Ceratotherium neumayri*	Mandibule avec p2-m3 gauches et droites	Hypo
AUTh	PNT48	*Ceratotherium neumayri*	Hémi-mandibule droite avec d2-d4	Hypo
AUTh	PNT89	*Ceratotherium neumayri*	Hémi-mandibule droite avec d1-d4	Hypo
AUTh	PNT?	*Chilotherium kiliasi*	Mandibule avec p2-m3 gauches et p2-p4 droites	Hypo
AUTh	PNT12	*Chilotherium kiliasi*	Mandibule avec p2-p4 gauches et p2-m1 droites	Hypo
AUTh	PNT122	*Chilotherium kiliasi*	Maxillaire droit avec M2-M3	Hypo
AUTh	PNT3	*Chilotherium kiliasi*	Hémi-mandibule droite avec d2-d4	Hypo
AUTh	PNT32	*Chilotherium kiliasi*	Hémi-crâne gauche avec P2-M3	Hypo
AUTh	PNT56	*Chilotherium kiliasi*	Maxillaire droit avec D2-D4	Hypo
AUTh	PNT95	*Chilotherium kiliasi*	Crâne avec D1-D4 gauches et D2-D4 droites Mandibule avec d2-d4 gauches et d1-d4 droites	Hypo

Xirochori (MN10 ; Grèce)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
AUTh	XIR ?	*Chilotherium* sp.	Crâne avec P2, D3-D4, M1-M2 gauches et droites	DMTA, Hypo

Maragha (MN10-12 ; Iran)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NHMW	Mar1949	*Ceratotherium neumayri*	Hémi-mandibule droite avec m2-m3	Hypo
NHMW	Mar1959	*Ceratotherium neumayri*	m1 droite	DMTA, Hypo
NHMW	Mar2035	*Ceratotherium neumayri*	m2 droite	Hypo
NHMW	Mar2057	*Ceratotherium neumayri*	D4 droite	Hypo
NHMW	Mar2058	*Ceratotherium neumayri*	D2 droite	Hypo
NHMW	Mar2110	*Ceratotherium neumayri*	M3 gauche	Hypo
NHMW	Mar2117	*Ceratotherium neumayri*	Hémi-mandibule droite avec p2-m1	Hypo
NHMW	Mar2142	*Ceratotherium neumayri*	m2 gauche	DMTA, Hypo
NHMW	Mar2143	*Ceratotherium neumayri*	m1 gauche	DMTA, Hypo
NHMW	Mar2144	*Ceratotherium neumayri*	m1 gauche	DMTA, Hypo
NHMW	Mar2145	*Ceratotherium neumayri*	p4 gauche	Hypo
NHMW	Mar2166	*Ceratotherium neumayri*	p3 droite	Hypo
NHMW	Mar2168	*Ceratotherium neumayri*	d2 gauche	Hypo
NHMW	Mar2169	*Ceratotherium neumayri*	Hémi-mandibule droite avec d3-d4	Hypo
NHMW	Mar2173	*Ceratotherium neumayri*	m2 gauche	DMTA, Hypo
NHMW	Mar2176	*Ceratotherium neumayri*	p3-p4 gauches	Hypo
NHMW	Mar2177	*Ceratotherium neumayri*	m2 gauche	Hypo
NHMW	Mar2178	*Ceratotherium neumayri*	p4 droite	Hypo
NHMW	Mar2179	*Ceratotherium neumayri*	p3 droite	Hypo
NHMW	Mar2199	*Ceratotherium neumayri*	D1 droite	Hypo
NHMW	Mar2200	*Ceratotherium neumayri*	D1 gauche	Hypo
NHMW	Mar2272	*Ceratotherium neumayri*	m3 droite	Hypo
NHMW	Mar2320	*Ceratotherium neumayri*	D2 gauche	Hypo
NHMW	2014-0424-0001	*Ceratotherium neumayri*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	Mar0385	*Ceratotherium neumayri*	Hémi-mandibule gauche avec m1-m3	DMTA, Hypo
NHMW	Mar1948	*Chilotherium persiae*	Hémi-mandibule avec d2-d4, m1	Hypo
NHMW	Mar1960	*Chilotherium persiae*	p3 gauche	Hypo
NHMW	Mar1962	*Chilotherium persiae*	Hémi-mandibule droite avec p3-p4	Hypo
NHMW	Mar1965	*Chilotherium persiae*	p2 droite	Hypo
NHMW	Mar1969	*Chilotherium persiae*	m2 droite	DMTA, Hypo
NHMW	Mar1970	*Chilotherium persiae*	p4 gauche	Hypo
NHMW	Mar1971	*Chilotherium persiae*	m1 droite	Hypo
NHMW	Mar1972	*Chilotherium persiae*	p3 droite	Hypo
NHMW	Mar2032	*Chilotherium persiae*	Hémi-mandibule gauche avec d2-d4	Hypo
NHMW	Mar2033	*Chilotherium persiae*	Hémi-mandibule droite avec d2-d4	Hypo
NHMW	Mar2034	*Chilotherium persiae*	Crâne avec D2-D4, M1 gauches et D2, D4 droites	Hypo
NHMW	Mar2069	*Chilotherium persiae*	d3 droite	Hypo
NHMW	Mar2070	*Chilotherium persiae*	d2 droite	Hypo
NHMW	Mar2071	*Chilotherium persiae*	d2 gauche	Hypo
NHMW	Mar2072	*Chilotherium persiae*	p2 gauche	Hypo
NHMW	Mar2118	*Chilotherium persiae*	Mandibule avec p2-p3 gauches et droites	Hypo
NHMW	Mar2119	*Chilotherium persiae*	Mandibule avec d2-d4 gauches et droites	Hypo
NHMW	Mar2121	*Chilotherium persiae*		DMTA, Hypo
NHMW	Mar2123	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et droites	DMTA, Hypo
NHMW	Mar2124	*Chilotherium persiae*	Crâne avec P2-P3, D4, M1-M2 gauches et droites + D1 gauche	Hypo
NHMW	Mar2125	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et P3-M3 droites	Hypo

NHMW	Mar2127	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et D1, P3-M3 droites	Hypo
NHMW	Mar2128	*Chilotherium persiae*	Mandibule avec d2-d4, m1 gauches et d3-d4, m1 droites	DMTA, Hypo
NHMW	Mar2131	*Chilotherium persiae*	Hémi-mandibule droite avec p4-m3	DMTA, Hypo
NHMW	Mar2132	*Chilotherium persiae*	Crâne avec D1-D4, M1 gauches et D2-D4, M1 droites Mandibule avec d2-d4, m1 gauches et d3 droite	Hypo
NHMW	Mar2133	*Chilotherium persiae*	Mandibule avec p2-m3 gauches et droites	Hypo
NHMW	Mar2134	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMW	Mar2135	*Chilotherium persiae*	Mandibule avec d2-d4, m1 gauches et d3-d4, m1-m2 droites	Hypo
NHMW	Mar2138	*Chilotherium persiae*	D2 droite	Hypo
NHMW	Mar2139	*Chilotherium persiae*	D2 gauche	Hypo
NHMW	Mar2140	*Chilotherium persiae*	D3 gauche	Hypo
NHMW	Mar2172	*Chilotherium persiae*	p3 gauche	Hypo
NHMW	Mar2174	*Chilotherium persiae*	M2 gauche	Hypo
NHMW	Mar2196	*Chilotherium persiae*	M3 droite	Hypo
NHMW	Mar2197	*Chilotherium persiae*	M2 droite	Hypo
NHMW	Mar2198	*Chilotherium persiae*	P2 droite	Hypo
NHMW	Mar2202	*Chilotherium persiae*	Maxillaire droit avec P3-P4	Hypo
NHMW	Mar2203	*Chilotherium persiae*	Maxillaire gauche avec P3-M1	Hypo
NHMW	Mar2205	*Chilotherium persiae*	P2 gauche	Hypo
NHMW	Mar2206	*Chilotherium persiae*	P2 gauche	Hypo
NHMW	Mar2221	*Chilotherium persiae*	M1 droite	Hypo
NHMW	Mar2273	*Chilotherium persiae*	M3 droite	Hypo
NHMW	Mar2279	*Chilotherium persiae*	d3 droite	Hypo
NHMW	Mar2283	*Chilotherium persiae*	M3 gauche	Hypo
NHMW	Mar2284	*Chilotherium persiae*	M2 gauche	Hypo
NHMW	Mar2286	*Chilotherium persiae*	D4 gauche	Hypo
NHMW	Mar2288	*Chilotherium persiae*	M3 droite	Hypo
NHMW	Mar2289	*Chilotherium persiae*	P2 gauche	Hypo
NHMW	Mar2312	*Chilotherium persiae*	M3 droite	DMTA, Hypo
NHMW	Mar2313	*Chilotherium persiae*	M2 droite	Hypo
NHMW	Mar2314	*Chilotherium persiae*	M2 droite	Hypo
NHMW	Mar2315	*Chilotherium persiae*	M3 gauche	DMTA, Hypo
NHMW	Mar2316	*Chilotherium persiae*	M2 droite	Hypo
NHMW	Mar2317	*Chilotherium persiae*	M1 droite	DMTA, Hypo
NHMW	Mar2318	*Chilotherium persiae*	M1 droite	DMTA, Hypo
NHMW	Mar2319	*Chilotherium persiae*	D4 gauche	Hypo
NHMW	Mar2321	*Chilotherium persiae*	P2 droite	Hypo
NHMW	Mar2322	*Chilotherium persiae*	D1 gauche	Hypo
NHMW	Mar2323	*Chilotherium persiae*	P4 droite	Hypo
NHMW	Mar2324	*Chilotherium persiae*	P3 droite	Hypo
NHMW	Mar2325	*Chilotherium persiae*	P2 droite	Hypo
NHMW	Mar2326	*Chilotherium persiae*	P2 gauche	Hypo
NHMW	Mar2327	*Chilotherium persiae*	P2 gauche	Hypo
NHMW	Mar2331	*Chilotherium persiae*	P2 droite	Hypo
NHMW	Mar2334	*Chilotherium persiae*	P4 droite	Hypo
NHMW	Mar2337	*Chilotherium persiae*	M3 gauche	Hypo
NHMW	Mar2340	*Chilotherium persiae*	D4 gauche	Hypo
NHMW	Mar2341	*Chilotherium persiae*	P2 droite	Hypo
NHMW	Mar2343	*Chilotherium persiae*	p2 droite	Hypo

NHMW	Mar2344	*Chilotherium persiae*	M1 droite	DMTA, Hypo
NHMW	Mar2348	*Chilotherium persiae*	D3 droite	Hypo
NHMW	Mar2353	*Chilotherium persiae*	Maxillaire gauche avec P3-P4	Hypo
NHMW	Mar4111	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et D1, P2-M2 droites	Hypo
NHMW	Mar ?	*Chilotherium persiae*	Mandibule avec p2-m3 gauches et p3-m3 droites	DMTA, Hypo
NHMW	Mar0382	*Chilotherium persiae*	Crâne avec P3-M3 gauches et D1, P2-M3 droites Mandibule p2-m3 gauches et droites	Hypo
NHMW	Mar0383	*Chilotherium persiae*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMW	Mar0384	*Chilotherium persiae*	Crâne avec P4-M3 gauches et droites	Hypo
NHMW	Mar0386	*Chilotherium persiae*	Crâne avec D1-D4, M1 gauches et droites	Hypo
NHMW	Mar0387	*Chilotherium persiae*	Crâne avec P2-M2 gauches et P2-M3 droites Hémi-mandibule droite avec p2-m3	DMTA, Hypo
NHMW	Mar0388	*Chilotherium persiae*	p2-m3 gauches et droites	DMTA, Hypo
NHMW	Mar0390	*Chilotherium persiae*	Maxillaire gauche avec P2-M1	Hypo
NHMW	Mar0391	*Chilotherium persiae*	M1 gauche	Hypo
NHMW	Mar0393	*Chilotherium persiae*	Maxillaire droit avec M1-M3	Hypo
NHMW	Mar0394	*Chilotherium persiae*	Maxillaire gauche avec M2-M3	Hypo
NHMW	Mar0399	*Chilotherium persiae*	Maxillaire droit avec D1-D4	Hypo
NHMW	Mar2307-08	*Chilotherium persiae*	Maxillaire gauche avec P3-M1	Hypo
NHMB	Mgh2	*Chilotherium persiae*	Maxillaire droit avec P2-M2	DMTA, Hypo
NHMW	Mar2175	*Iranotherium morgani*	P3 gauche	Hypo
NHMW	Mar2208	*Iranotherium morgani*	D1 gauche	Hypo
NHMW	Mar2209	*Iranotherium morgani*	Hémi-mandibule gauche avec d1-d4	Hypo
NHMW	Mar2210	*Iranotherium morgani*	Hémi-mandibule droite avec d1-d4	Hypo
NHMW	Mar2215	*Iranotherium morgani*	D1 gauche	Hypo
NHMW	Mar2217	*Iranotherium morgani*	D1 droite	Hypo
NHMW	Mar2224	*Iranotherium morgani*	d2 droite	Hypo
NHMW	Mar2227	*Iranotherium morgani*	Hémi-mandibule gauche avec m2-m3	Hypo
NHMW	2014/0425/0001 Mar0392	*Iranotherium morgani*	Maxillaire gauche avec M1-M3	Hypo
NHMW	Mar2345	*Persiatherium rodleri*	P2 gauche	Hypo
NHMW	2014/0426/0001 Mar2126	*Persiatherium rodleri*	Crâne avec P2-P3, D4, M1-M2 gauches et droites + D1 gauche	Hypo

Ravin des Zouaves-5 (MN11 ; Grèce)

Lieu de stockage	**Numéro d'inventaire**	**Espèce**	**Nature du spécimen**	**Méthodes utilisées**
AUTh	RZO?	*Ceratotherium neumayri*	Crâne avec P2-M1 gauches et P2-P4 droites	Hypo
AUTh	RZO?	*Ceratotherium neumayri*	Mandibule avec p2-m2 gauches et droites	DMTA, Hypo
AUTh	RZO26	*Ceratotherium neumayri*	Crâne avec P2-M3 gauches et droites	DMTA, Hypo

Kocherinovo (MN11 ; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHS	KCH3-FM2959	*Acerorhinus* sp.	Mandibule avec m1-m3 gauches et droites	DMTA, Hypo

Kalimantsi (MN11-12 ; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHA	K-1050	*Acerorhinus* sp.	P3 gauche	Hypo
NMNHA	K595 / K694	*Acerorhinus* sp.	D1 gauche Crâne avec P2-M3 gauches et droites	DMTA, Hypo
NMNHA	K600	*Acerorhinus* sp.	Maxillaire gauche avec M2-M3	DMTA, Hypo
NMNHA	K608	*Acerorhinus* sp.	Mandibule avec p3-m3 gauches et p2-m3 droites	DMTA, Hypo
NMNHA	K609	*Acerorhinus* sp.	Hémi-mandibule gauche avec d3-m1	Hypo
NMNHA	K610	*Acerorhinus* sp.	Hémi-mandibule droite avec d4-m1	Hypo
NMNHA	K697	*Acerorhinus* sp.	Maxillaire gauche avec D2-D4	Hypo
NMNHA	K699 / K700	*Acerorhinus* sp.	Maxillaire gauche avec P3-P4	Hypo
NMNHA	K701	*Acerorhinus* sp.	M3 gauche	DMTA, Hypo
NMNHA	K702	*Acerorhinus* sp.	P3 droite	Hypo
NMNHA	K593	*Ceratotherium neumayri*	Crâne avec D1-D4 gauches et droites	Hypo
NMNHA	K594	*Ceratotherium neumayri*		DMTA, Hypo
NMNHA	K603	*Ceratotherium neumayri*	Maxillaire droit avec D1-D3	Hypo
NMNHA	K604	*Ceratotherium neumayri*	Maxillaire droit avec D2-D4	Hypo
NMNHA	K688 / K689	*Ceratotherium neumayri*	Maxillaire gauche avec D3-D4	Hypo
NMNHA	K690	*Ceratotherium neumayri*	D4 droite	Hypo
NMNHA	K692	*Ceratotherium neumayri*	m1 gauche	Hypo
NMNHA	K695	*Ceratotherium neumayri*	P2 gauche	Hypo
NMNHA	K696	*Ceratotherium neumayri*	P2 droite	Hypo
NMNHA	K703	*Ceratotherium neumayri*	P3 gauche	Hypo

Hadjidimovo (limite MN11-MN12 ; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHA	HD597	*Dihoplus pikermiensis*	Crâne avec D1-D4 gauches et droites	Hypo
NMNHA	HD598	*Dihoplus pikermiensis*	Crâne avec P2-M3 gauches et droites	DMTA, Hypo
NMNHA	HD605	*Dihoplus pikermiensis*	Maxillaire droit avec P3-M3	DMTA, Hypo
NMNHA	HD606	*Dihoplus pikermiensis*	Maxillaire gauche avec M1-M3	DMTA, Hypo
NMNHA	HD607	*Dihoplus pikermiensis*	Maxillaire gauche avec D1-D4	Hypo
NMNHA	HD615	*Dihoplus pikermiensis*	Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NMNHA	HD616	*Dihoplus pikermiensis*	Mandibule avec d1-d4 gauches et droites	Hypo
NMNHA	HD617	*Dihoplus pikermiensis*	Hémi-mandibule gauche avec d1-d4	Hypo
NMNHA	HD618	*Dihoplus pikermiensis*	Hémi-mandibule droite avec d3-d4	Hypo
NMNHA	HD671	*Dihoplus pikermiensis*	P4 gauche	Hypo
NMNHA	HD672	*Dihoplus pikermiensis*	P2 gauche	Hypo
NMNHA	HD673	*Dihoplus pikermiensis*	P2 droite	Hypo
NMNHA	HD674	*Dihoplus pikermiensis*	P3 gauche	Hypo
NMNHA	HD676	*Dihoplus pikermiensis*	D1 droite	Hypo
NMNHA	HD677	*Dihoplus pikermiensis*	D1 droite	Hypo
NMNHA	HD678	*Dihoplus pikermiensis*	D2 gauche	Hypo
NMNHA	HD1054	*Dihoplus pikermiensis*	D2 gauche	Hypo

Slatino (Turolien ; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHS	Slatino-2 sans numéro	*Dihoplus* cf. *schleiermacheri*	Maxillaire droit avec P2-M2	Hypo
NMNHS	Slatino-1 sans numéro	*Acerorhinus* sp.	Maxillaire droit D1, P2-P3	Hypo

Gorna Sushitsa (MN11-12; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHS	GS7-FM3142	*Acerorhinus* sp.	Crâne avec P2-M3 gauches et droites	DMTA, Hypo
NMNHS	GS8-2837	*Ceratotherium neumayri*	Crâne avec D3-M1 gauches et M1 droite	Hypo
NMNHS	GS8-2912	*Ceratotherium neumayri*	Maxillaire droit avec D1-D3	Hypo

Strumyani-2 (MN11-12; Bulgarie)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NMNHS	FM2468	*Ceratotherium neumayri*	Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NMNHS	FM2800	*Ceratotherium neumayri*	Mandibule p2-m3 gauches et p3-m2	DMTA, Hypo
NMNHS	FM-2469	*Dihoplus pikermiensis*	Maxillaire droit avec P3-M3	Hypo
NMNHS	FM-2470	*Dihoplus pikermiensis*	Mandibule avec p3-m3 gauches et p2-m3 droites	Hypo

Samos (MN11-13; Grèce)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NHMW	1911/0005/0040	*Ceratotherium neumayri*	Hémi-mandibule droite avec d1-d4	Hypo
NHMW	1911/0005/0043	*Ceratotherium neumayri*	Hémi-mandibule droite avec d2-d4	Hypo
NHMW	1911/0005/0044	*Ceratotherium neumayri*	Mandibule avec d1-d4, m1 gauches et droites	Hypo
NHMW	1911/0005/0045	*Ceratotherium neumayri*	Crâne avec D1-D4, M1-M2 gauches et D1-D4, M1 droites	Hypo
NHMW	1911/0005/0439	*Ceratotherium neumayri*	Mandibule avec d1-d4, m1 gauches et d2-d4, m1 droites	Hypo
NHMB	SAM1	*Ceratotherium neumayri*	Crâne avec P2-M3 gauches et droites	DMTA, Hypo
NHMW	1911-0005-0033	*Chilotherium schlosseri*	Mandibule avec p2-p3, d4, m1-m2 gauches et p3, d4, m1-m2 droites	DMTA, Hypo
NHMW	1911/0005/0030	*Dihoplus pikermiensis*	Crâne avec D1-D4 gauches et droites	Hypo
NHMW	1911/0005/0041	*Dihoplus pikermiensis*	Crâne avec D1-D4 gauches et droites	Hypo

Pikermi (MN11-13; Grèce)

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
NHMW	1854/0003/0008	*Ceratotherium neumayri*	d2 gauche	Hypo
NHMW	1854/0003/0009	*Ceratotherium neumayri*	d3 droite	Hypo
NHMW	1854/0003/0010a	*Ceratotherium neumayri*	D3 gauche	Hypo
NHMW	1853/0003/0010b	*Ceratotherium neumayri*	M3 gauche	DMTA, Hypo
NHMW	1854/0003/0010c	*Ceratotherium neumayri*	d3 gauche	Hypo
NHMW	1863/0001/0018	*Dihoplus pikermiensis*	Crâne avec D1-D4, M1 gauches et droites	Hypo
NHMW	1863/0001/0019	*Dihoplus pikermiensis*	M2 gauche	DMTA, Hypo
NHMW	1860/0032/0059	*Dihoplus pikermiensis*	Hémi-mandibule gauche avec d3-d4	Hypo
NHMW	1973/1613/11	*Dihoplus pikermiensis*	Crâne avec D1-D4 gauches et droites	Hypo

SPECIMENS ACTUELS

Lieu de stockage	Numéro d'inventaire	Espèce	Nature du spécimen	Méthodes utilisées
MNHN	1928-310	*Ceratotherium simum*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	1944-278	*Ceratotherium simum*	Crâne avec P2-M3 gauches et M1-M3 droites Mandibule avec p2-m3 gauches et p3-m3 droites	Hypo
MNHN	1983-955	*Ceratotherium simum*	Crâne avec D2, P3-M3 gauches et droites	DMTA, Hypo
MNHN	2017-1202	*Ceratotherium simum*	Crâne avec P2-M3 gauches et droites Mandibule avec m2-m3 gauches et droites	DMTA
MNHN	A2274	*Ceratotherium simum*	Crâne avec D1-D4 gauches et droites Mandibule avec d1-d4 gauches et droites	Hypo
MRAC	3880	*Ceratotherium simum*	Crâne avec P3-M3 gauches et P2-M3 droites Mandibule avec p2-m3 gauches et droites	DMTA
MRAC	3881	*Ceratotherium simum*	Crâne avec M2-M3 gauches et P4-M3 droites Manidibule avec p3-m3 gauches et droites	DMTA
MRAC	5919	*Ceratotherium simum*	Crâne avec P2-M3 gauches et M2-M3 droites Manidibule avec p3-m3 gauches et droites	DMTA
MRAC	5920	*Ceratotherium simum*	Mandibule avec p3-m3 gauches et p2-m3 droites	DMTA
MRAC	5921	*Ceratotherium simum*	Crâne avec D2-D3, M1-M2 gauches et D2-D4, M1-M2 droites Mandibule avec d2-d4, m1-m2 gauches et droites	DMTA
MRAC	5923	*Ceratotherium simum*	Crâne avec D2-D4, M1-M3 gauches et droites Mandibule avec d3-d4, m1-m2 gauches et droites	DMTA
MRAC	5925	*Ceratotherium simum*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
MRAC	5926	*Ceratotherium simum*	Crâne avec P2-M2 gauches et droites + D1 gauche Mandibule avec p2-m3 gauches et droites	DMTA
MRAC	8655	*Ceratotherium simum*	Crâne avec M2-M3 gauches et P4-M3 droites Manidibule avec p4-m3 gauches et m1-m3 droites	DMTA
MRAC	8656	*Ceratotherium simum*	Crâne avec P3, D4, M1-M2 gauches et droites Mandibule avec p2, d3-d4, m1-m2 gauches et droites	DMTA
MRAC	36511	*Ceratotherium simum*	Crâne avec P3-M3 gauches et P2-M3 droites Mandibule avec p3-m3 gauches et droites	DMTA

MRAC	36512	*Ceratotherium simum*	Crâne avec fragments dentaires Mandibule avec p3-m3 gauches et droites	DMTA
NHMB	5093	*Ceratotherium simum*	Crâne avec M2-M3 Mandibule avec m2-m3	Hypo
NHMB	C150	*Ceratotherium simum*	Crâne avec P2-M3 gauches et P3-M3 droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMB	C151	*Ceratotherium simum*	Crâne avec D2-D4, M1-M2 gauches et droites Mandibule avec d2-d4, m1-m2 gauches et droites	Hypo
NHMW	3086	*Ceratotherium simum*	Crâne avec P2-P3, M1-M2 gauches et droites + D1 droite Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	4281	*Ceratotherium simum*	Crâne avec P2-M3 gauches et P2-P3, M1-M3 droites	DMTA
NHMW	21030	*Ceratotherium simum*	Crâne avec D1-D4, M1 gauches et droites Mandibule avec d1-d4, m1 gauches et droites	Hypo
MCL	5000-2042	*Dicerorhinus sumatrensis*	Crâne avec P2-M2 gauches et P2, M1-M2 droites Mandibule avec p2-m3 gauches et droites	DMTA
NHMB	10529	*Dicerorhinus sumatrensis*	Maxillaire droit avec P2-M3 Hémi-mandibule droite avec p2-m3	Hypo
NHMW	1500	*Dicerorhinus sumatrensis*	Crâne avec D1, P3-M3 gauches et P2-M3 droites Mandibule avec p2-m3 gauches et p2-m2 droites	Hypo
NHMW	3082	*Dicerorhinus sumatrensis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites + d1 droite	Hypo
NHMW	4294	*Dicerorhinus sumatrensis*	Crâne avec D1-D4, M1-M3 gauches et D1-D2, P3, D4, M1-M3 droites Mandibule avec p2-p3, d4, m1-m3 gauches et droites + d1 droite	Hypo
NHMW	7529	*Dicerorhinus sumatrensis*	Crâne avec P2-M3 gauche et P2, P4-M3 droites Mandibule avec p2-m3 gauches et droites	Hypo
UMZC	H6381	*Dicerorhinus sumatrensis*	Crâne avec D1-D4, M1-M2 gauches et droites Mandibule avec d1-d4, m1 gauches et droites	DMTA
UMZC	H6384	*Dicerorhinus sumatrensis*	Crâne avec M2-M3 gaauches et droites Mandibule avec p3-m3 gauches et p4-m3 droites	DMTA
UMZC	H6385	*Dicerorhinus sumatrensis*	Maxillaire droit avec P2-M3 Hémi-mandibule droite avec p2-m3	DMTA
MCL	5000-2040	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
MCL	5000-2044	*Diceros bicornis*	Crâne avec P2-M2 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
MCL	5000-2045	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites	DMTA
MCL	5000-2046	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites	DMTA
MCL	5000-2047	*Diceros bicornis*	Crâne avec M2 gauche et M1-M3 droites Mandibule avec p2-m3 gauches et droites	DMTA
MHNT	OST.1996-154	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites + D1 gauche Mandibule avec p3-m3 gauches et p2-m3 droites	Hypo
MNHN	1931-581	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites	DMTA, Hypo
MNHN	1931-581 bis	*Diceros bicornis*	Mandibule avec d1-d4, m1 gauches et droites	Hypo
MNHN	1961-195	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo

MNHN	1965-1127	*Diceros bicornis*	Crâne sans dents Mandibule avec p3-m3 gauches et droites	DMTA
MNHN	1965-1128	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	1965-1129	*Diceros bicornis*	Crâne avec M3 gauches et droites	DMTA
MNHN	1974-124	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec d1, p2-m3 gauches et droites	Hypo
MNHN	1985-158	*Diceros bicornis*	Mandibule avec p4-m3 gauches et p3-m3 droites	DMTA, Hypo
MNHN	1985-242	*Diceros bicornis*	Mandibule avec d1-d4, m1 gauches et droites	Hypo
MNHN	1996-2520	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	2001-2116	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites + D1 gauche Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MRAC	829	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites + D1 gauche	DMTA
MRAC	7349	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p4-m3 gauches et d1, p2-m3 droites	DMTA, Hypo
MRAC	7987	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMB	10594	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites	Hypo
NHMB	C149	*Diceros bicornis*	Crâne avec P2-M3 gauches et P3-M3 droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMB	nN082	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMW	4279	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	4280	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	4291	*Diceros bicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	4292	*Diceros bicornis*	Crâne avec D1, P2-P3, D4, M1-M3 gauches et D1, P2-M3 droites Mandibule avec d1, p2-m3 gauches et droites	DMTA, Hypo
NHMW	55210	*Diceros bicornis*	Crâne avec P2-M3 gauches et droites + D1 gauche Mandibule avec p2-m3 gauches et droites	Hypo
UMZC	H6201	*Diceros bicornis*	M1-M2 droites	DMTA
UMZC	H6483	*Diceros bicornis*	Crâne avec D1-D4, M1-M2 gauches et droites Mandibule avec d1-d4, m1-m2 gauches et droites	DMTA
MCL	5000-2041	*Rhinoceros sondaicus*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
MCL	5000-2043	*Rhinoceros sondaicus*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
MHNT	OST.1996-50	*Rhinoceros sondaicus*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
MNHN	1896-2003	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	1932-42	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec d1, p2-m3 gauches et droites	DMTA, Hypo
MNHN	1932-48	*Rhinoceros sondaicus*	Crâne avec P2-M3 gauches et P2-P3, M3 droites	DMTA, Hypo
MNHN	1985-159	*Rhinoceros sondaicus*	Crâne avec D1, P2-P3, M3 gauches et D1, P2-M1, M3 droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo

MNHN	1985-160	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et D1, P2-P3, M1-M3 droites Mandibule avec p2-m3 gauches et droites	Hypo
MNHN	A2277	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	A7970	*Rhinoceros sondaicus*	Crâne avec P2, M1-M3 gauches et P3 droite Mandibule avec p3-m3 gauches et p2-m3 droites	DMTA, Hypo
MNHN	A7971	*Rhinoceros sondaicus*	Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MRAC	5591	*Rhinoceros sondaicus*	Crâne avec D1, P2-P3, D4, M1 gauches et D1, P2-P3, D4, M1-M2 droites Mandibule avec p3, d4, m1-m2 gauches et droites	DMTA
NHMB	1268	*Rhinoceros sondaicus*	Crâne avec D1-D4, M1 gauches et droites Mandibule avec d2-d4, m1 gauches et droites	Hypo
NHMB	10885	*Rhinoceros sondaicus*	Crâne avec P2-M3 gauches et droites Mandibule avec p4-m3 gauches et p3-m3 droites	DMTA
NHMB	C2775	*Rhinoceros sondaicus*	Crâne avec D1-D4, M1-M2 gauches et droites Mandibule d1-d4, m1-m2 gauches et droites	Hypo
NHMW	4296	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et D1, P2-M3, D4, M1-M3droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
NHMW	7066	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
UM	428N	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
UM	785V	*Rhinoceros sondaicus*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	1932-49	*Rhinoceros unicornis*	Crâne avec D1, P2-P3, D4, M1-M3 gauches et droites Mandibule avec d2, p3-m3 gauches gauche et d2, p3, d4, m1-m3 droites	DMTA, Hypo
MNHN	1933-316	*Rhinoceros unicornis*	Mandibule avec p2-m3 gauches et droites	Hypo
MNHN	1967-101	*Rhinoceros unicornis*	Crâne avec P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
MNHN	1985-161	*Rhinoceros unicornis*	Crâne avec D1-D4 gauches et droites Mandibule avec d1-d4, m1 gauches et droites	Hypo
MNHN	2009-400	*Rhinoceros unicornis*	Crâne avec D1, P2, P4-M3 gauches et D1, P2-M3 droites Mandibules avec p2-m3 gauches et droites	DMTA, Hypo
MNHN	A10866	*Rhinoceros unicornis*	Hémi-mandibule droite avec d2, p3, d4, m1-m3	DMTA, Hypo
NHMB	7351	*Rhinoceros unicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	DMTA
NHMB	11098	*Rhinoceros unicornis*	Crâne avec D1-D4, M1 gauches et droites Mandibule avec d1-d4, m1 gauches et droites	Hypo
NHMB	C1798	*Rhinoceros unicornis*	Crâne avec P4-M3 gauches et M1-M3 droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMB	nN007	*Rhinoceros unicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMB	nN009	*Rhinoceros unicornis*	Crâne avec D1, P2-M3 gauches et droites Mandibule avec p2-m3 gauches et droites	Hypo
NHMW	37591	*Rhinoceros unicornis*	?	DMTA
UMZC	H6301	*Rhinoceros unicornis*	Crâne avec D1, P2-P3, D4, M1-M2 gauches et droites Mandibule avec p2-p3, d4, m1-m2 gauches et droites	DMTA

Sum up GLMM – Balkans

Example of R code for GLMM applied to response variable Anisotropy

Gaussian law; Adapted from Aman et al., 2019

```
#Import dataset
setwd("C:/Users/manon.hullot/Desktop/Thèse 2020/Articles/En cours/Balkans/Bases/Microwear")
Balkans <- read.table("Balkans.txt",sep="\t",dec='.',header=T)

#Load required packages
library(lme4)
library(ggplot2)
library(car)
library(MASS)

#Force numerical factors to be analysed as categorical variables, change levels
Balkans$Tooth <- factor(Balkans$Tooth,levels = c("M2","M1","M3"))
Balkans$Cusp <- factor(Balkans$Cusp, levels = c("Protoconid","Protocone","Hypoconid"))
Balkans$Genus <- factor(Balkans$Genus,levels =
c("Ceratotherium","Chilotherium","Dihoplus","Acerorhinus"))
Balkans$Locality <- factor(Balkans$Locality,levels = c("Maragheh","Samos","Pentalophos-
1","Kalimantsi","Hadjidimovo","OtherB","OtherG"))
 #Balkans$Locality <- factor(Balkans$Locality,levels =
c("Maragheh","Pikermi","Samos","Xirochori","Pentalophos-
1","Kalimantsi","Hadjidimovo","Kocherinovo","Ravins des Zouaves-5","Gorna Sushitsa","Strumyani-
2"))


#Define family distribution, random effects
Mod1 <- lmer(Anisotropy~(1|Specimen) + Genus + Age,data=Balkans, REML = F)
summary(Mod1)

(nPar <- extractAIC(Mod1)[1]) # number of parameters
(aic <- extractAIC(Mod1)[2]) #AIC
(R2 <- 1-((sum((Balkans$Anisotropy-fitted(Mod1))^2))/sum((Balkans$Anisotropy-
mean(Balkans$Anisotropy))^2)))
(D <- -2*as.numeric(logLik(Mod1))) # deviance
(disp <- D/df.residual(Mod1))


# get row ids for each species
(species.nms <- unique(Balkans$Genus))
nSpecies <- length(species.nms)
species.ids <- sapply(species.nms, function(x) as.numeric(rownames(subset(Balkans,Genus==x))))
names(species.ids) <- species.nms

nFolds <- 5 # number of folds
oos.list <- vector('list',nFolds) # list to hold row indices for out-of-sample sets
for (i in 1:nFolds) oos.list[[i]] <- vector('list',nSpecies)
for (i in 1:nSpecies) {
  oos.inds <- species.ids[[i]]
  starting.n <- length(oos.inds)
  mylist <- vector('list',nFolds)
  for (j in 1:nFolds) {
    if (j < nFolds) {
      set.seed(i*1000+(j))
```

```
      fold.sample <- sample(1:length(oos.inds),round(((1/nFolds)*starting.n)),replace=F)
      oos.list[[j]][[i]] <- oos.inds[fold.sample]
      oos.inds <- oos.inds[-fold.sample]
    } else {
      oos.list[[j]][[i]] <- oos.inds
    }
  }
}
oos <- lapply(oos.list, unlist)
sum(duplicated(unlist(oos))) # no duplicated row ids, which is what we want
training <- lapply(oos, function(x) Balkans[-x,]) # list of training data frames
test <- lapply(oos, function(x) Balkans[x,]) # list of test data frames
sapply(training, dim); sapply(test, dim) # dimensions OK



#Function to run full model, and perfrom cross-validation, for all models in the candidate set, for any
response variable
fit.func <- function(models, response) {

  # set up data frame for storing results
  res <-
data.frame(model=character(),nPar=numeric(),D=numeric(),aic=numeric(),bic=numeric(),R2=numeric()
,cv.R2=numeric())
  fits <- vector('list',length(models))

  for (i in 1:length(models)) {

    model <- models[i]
    model.formula <- paste(response,model,sep=' ~ ')
    fit <- lmer(model.formula, data=Balkans, REML = F) # fit to full dataset
    nPar <- extractAIC(fit)[1] # number of parameters
    D <- -2*as.numeric(logLik(fit)) # deviance
    aic <- extractAIC(fit)[2]
    bic <- D + nPar*(log(nrow(Balkans)))
    R2 <- 1-((sum((Balkans[,response]-fitted(fit))^2))/sum((Balkans[,response]-
mean(Balkans[,response]))^2))

    # cross.validation
    R2.vec <- rep(NA, nFolds) # storage vector for cross-validation R2 for each fold
    for (j in 1:nFolds) {
      fold.Balkans <- training[[j]]
      test.Balkans <- test[[j]]
      fold.fit <- lmer(model.formula, data=fold.Balkans, REML = F) # fit to full dataset
      fold.preds <- predict(fold.fit,newdata=test.Balkans,re.form=NA)
      fold.R2 <- 1-((sum((test.Balkans[,response]-fold.preds)^2))/sum((test.Balkans[,response]-
mean(test.Balkans[,response]))^2))
      R2.vec[j] <- fold.R2
    }
    cv.R2 <- mean(R2.vec)

    # store results
    res <- rbind(res,data.frame(model=model,nPar=nPar,D=D,aic=aic,bic=bic,R2=R2,cv.R2=cv.R2))
    fits[[i]] <- fit

    print(paste('Model',i,'is done'))

  }

  # sort by aic
```

```
  res <- res[order(res$aic),]

  ## calculate dAIC and wAIC
  res$d.aic <- res$aic-res$aic[1]
  exp.d.aic <- exp(-res$d.aic/2)
  res$w.aic <- exp.d.aic/sum(exp.d.aic)
  res <- res[,c("model","nPar","D","aic","d.aic","w.aic","bic","R2","cv.R2")]

  # name model list
  names(fits) <- models

  ## combine into list and return
  return(list(res=res,fits=fits))
}



# create a candidate model set - adjust this as necessary
models<-c('(1|Specimen)',
        'Genus + (1|Specimen)',
        'Genus + (1|Specimen) + Locality',
        'Genus + (1|Specimen) + Province',
        'Genus + (1|Specimen) + Age',
        'Genus + (1|Specimen) + Tooth',
        'Genus + (1|Specimen) + Position',
        'Genus + (1|Specimen) + Side',
        'Genus + (1|Specimen) + Cusp',
        'Genus + (1|Specimen) + Facet')


# run function
res <- fit.func(models=models, response='Anisotropy')

## model selection table
res$res

########## refine model list above until final model selected

#Look at results for the top one
summary(res$fits$'Facet * Tooth + Position + Genus + (1|Specimen)')

#Test for overdispersion
(D <- -2*as.numeric(logLik(res$fits$'Facet * Tooth + Position + Genus + (1|Specimen)'))) # deviance
(disp <- D/df.residual(res$fits$'Facet * Tooth + Position + Genus + (1|Specimen)')) #overdispersion if
disp >1


#Over dispersion correction if needed
Mod1 <- lmer(Complexity~(1|Specimen) + Facet + Side,data=Balkans, REML = F)
cc <- coef(summary(Mod1))

  #Function to estimate over dispersion (over dispersion if p-value < 0.05)
overdisp_fun <- function(model) {
  rdf <- df.residual(model)
  rp <- residuals(model,type="pearson")
  Pearson.chisq <- sum(rp^2)
  prat <- Pearson.chisq/rdf
  pval <- pchisq(Pearson.chisq, df=rdf, lower.tail=FALSE)
  c(chisq=Pearson.chisq,ratio=prat,rdf=rdf,p=pval)
}
```

```
phi <- overdisp_fun(Mod1)["ratio"]
cc <-within(as.data.frame(cc),
        {   `Std. Error` <- `Std. Error`*sqrt(phi)
        `z value` <- Estimate/`Std. Error`
        `Pr(>|z|)` <- 2*pnorm(abs(`z value`), lower.tail=FALSE)
        })
printCoefmat(cc,digits=3)


Mod1 <- lmer(Anisotropy ~ Facet * Tooth + Position + Genus + (1|Specimen),data=Balkans)
summary(Mod1)

#Pairwise comparison for Species, Tooth, Locality
library(multcomp)
mc_tukey <- glht(Mod1, linfct=mcp(Tooth="Tukey"))
summary(mc_tukey) ## ## Simultaneous Tests for General Linear Hypotheses ## ## Multiple Comparisons of Means: Tukey Contrasts ## ##
```

Microwear

Concerning microwear, we conducted generalized linear mixed models (GLMMs) for five response variables, corresponding to the classic DMTA parameters: Anisotropy (epLsar), Complexity (Asfc), FTfv (fine textural fill-volume), HAsfc9 and HAsfc81 (heterogeneities of the complexity).

Models were built using a modified version of the script from Arman et al. (2019). We selected Gaussian family to study our response variables. Model construction followed a bottom-up approach as described in the main text, and model selection is based on the lowest AIC score (Akaike's Information Criterion). This resulted in 158 models (103 with genus forced in the models) were compared across the five response variables (see electronic supplementary material, S4).

Law used = Gaussian

- Variables tested: Anisotropy (epLsar), Complexity (Asfc), Heterogeneities of complexity (HAsfc9, HAsfc81), and Fine Textural fill-volume (FTfv)
- Factors: 1|Specimen (random effect), Genus, Locality, Province (West/East), Age (Vallesian vs Turolian), Tooth, Position (Upper/Lower), Side (Left/Right), Facet

References for factors:

- Genus = *Ceratotherium* because present in most localities and potentially grazing preferences
- Locality = Maragheh (most abundant)
- Country = East, province of Maragheh
- Age = MN11-13
- Tooth = M2

<u>Anisotropy</u>

No over-dispersion
Formula: Facet * Tooth + Position + Genus + (1|Specimen)
df = 58; α = 0.05 → t-value threshold ± 1.684

	Estimate	Std. Error	t value
(Intercept)	0.0024741	0.0004605	**5.373**
FacetShearing	0.0008416	0.0003933	**2.140**
ToothM1	0.0016762	0.0005982	**2.802**
ToothM3	-0.0016643	0.0007432	**-2.239**
PositionUpper	0.0016467	0.0005148	**3.199**
GenusChilotherium	-0.0005264	0.0005388	-0.977
GenusDihoplus	-0.0025655	0.0008293	**-3.094**
GenusAcerorhinus	-0.0007705	0.0007726	-0.997
FacetShearing:ToothM1	-0.0010525	0.0007497	-1.404
FacetShearing:ToothM3	0.0036870	0.0015677	**2.352**

Genus: *Ceratotherium* has higher epLsar than *Dihoplus* but no differences from *Chilotherium* and *Accerorhinus*
Pairwise comparison (Tukey Contrasts) suggested a nearly difference between *Chilotherium* (higher epLsar) and *Dihoplus* (p-value = 0.07)
Facet: Shearing higher anisotropy than grinding
Tooth: M1 higher epLsar than M2; M3 lower epLsar than M2
Pairwise comparisons showed than M3 had lower epLsar than M1 (p-value < 0.001)
Position: upper teeth display higher epLsar than lower teeth

Facet*Tooth interaction

Complexity

Over dispersion

Formula: Facet + Side + (1|Specimen)
df = 65; α = 0.05 → t-value threshold ± 1.671

	Estimate	Std. Error	t value
(Intercept)	2.0730	0.1732	**11.966**
FacetShearing	-0.6295	0.1862	**-3.381**
SideRight	-0.4610	0.2269	**-2.032**

Facet: shearing has lower Asfc
Side: Right side has lower Asfc

Correction for over-dispersion
Formula: Facet + Side + (1|Specimen)
df = 65; α = 0.05 → t-value threshold ± 1.671

	Estimate	Std. Error	t value	Pr(>|z|)	z value
(Intercept)	2.07e+00	1.12e-01	1.20e+01	1.12e-76	**18.53**
FacetShearing	-6.30e-01	1.20e-01	-3.38e+00	1.63e-07	**-5.24**
SideRight	-4.61e-01	1.46e-01	-2.03e+00	1.65e-03	**-3.15**

With Genus in the model
Formula: Genus + (1|Specimen) + Facet + Side + Position
df = 61; α = 0.05 → t-value threshold ± 1.671

	Estimate	Std. Error	t value
(Intercept)	2.0414	0.2099	**9.727**
GenusChilotherium	0.6102	0.2707	**2.254**
GenusDihoplus	0.3479	0.3767	0.924
GenusAcerorhinus	0.6760	0.3696	**1.829**
FacetShearing	-0.6247	0.1830	**-3.414**
SideRight	-0.6765	0.2300	**-2.941**
PositionUpper	-0.4767	0.2283	**-2.088**

Genus: *Chilotherium* and *Acerorhinus* have higher Asfc than *Ceratotherium*
No other differences highlighted by Tukey Contrasts
Facet: shearing has lower Asfc
Side: Right side has lower Asfc
Position: Upper teeth have lower Asfc

FTFV

Very important over-dispersion

Formula: Facet + Cusp + Position + (1|Specimen)
df = 63; α = 0.05 → t-value threshold ± 1.671

Estimate Std. Error t value

(Intercept)	59883	4462	**13.422**
FacetShearing	-14584	5045	**-2.891**
CuspProtocone	-11914	5329	**-2.236**
CuspHypoconid	-11401	7338	-1.554
AgeVallesian	11363	7278	1.561

Facet: Shearing has lower FTFV
Cusp: Protocone has lower FTFV than Protoconid
No other differences highlighted by Tukey Contrasts
Position: No differences
Age: No differences

Correction for over-dispersion

	Estimate	Std. Error	t value
(Intercept)	5.99e+04	9.55e+07	**13.4**
FacetShearing	-1.46e+04	1.08e+08	**-2.89**
CuspProtocone	-1.19e+04	1.14e+08	**-2.24**
CuspHypoconid	-1.14e+04	1.57e+08	-1.55
AgeVallesian	1.14e+04	1.56e+08	1.56

With Genus in the models, best candidate is (1|Specimen) alone

<u>HAsfc9</u>

No over-dispersion

Formula: Province + (1|Specimen)
df = 66; α = 0.05 → t-value threshold ± 1.671

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.40809	0.03094	**13.191**
ProvinceWest	-0.10393	0.04576	**-2.271**

Country: Western localities specimens have lower HAsfc9 than Eastern ones

With Genus in the models, best candidate is (1|Specimen) alone

<u>HAsfc81</u>

No over-dispersion

Formula: Province + Side + Genus + (1|Specimen)
df = 62; α = 0.05 → t-value threshold ± 1.671

	Estimate	Std. Error	t value
(Intercept)	0.69694	0.06608	**10.547**
ProvinceWest	-0.13617	0.08011	**-1.700**
SideRight	-0.18201	0.06726	**-2.706**
GenusChilotherium	0.15233	0.07815	**1.949**
GenusDihoplus	0.03340	0.11373	0.294
GenusAcerorhinus	0.25780	0.11558	**2.231**

Province: Western localities specimens have lower HAsfc81 than Eastern ones
Genus: *Ceratotherium* has lower HAsfc81 than *Chilotherium* and *Acerorhinus*
No other differences highlighted by Tukey Contrasts
Side: Right has lower HAsfc81 than left

BIC ranking differences

Without Genus forced:

- Anisotropy: best model is Facet + (1|Specimen)
- Complexity: best model is Facet + (1|Specimen)
- FTFV: best model is Facet + (1|Specimen)
- HAsfc9: same results
- HAsfc81: best model is (1|Specimen)

With Genus forced in the models:
Best model is (1|Specimen) for all variables

Hypoplasia

Concerning hypoplasia, we conducted generalized linear mixed models (GLMMs) for five response variables: Hypo (presence or absence of the defect), Defect (type of defect encountered), Localisation, Severity, Multiple

Models were built using a modified version of the script from Arman et al. (2019). We selected Poisson family to study our response variables except for Hypo, for which we selected Binomial law. Model construction followed a bottom-up approach as described in the main text, and model selection is based on the lowest AIC score (Akaike's Information Criterion). This resulted in 142 models (107 with genus forced) were compared across the five response variables (see electronic supplementary material, S6).

Law used = Binomial or Poisson

- Variables tested: Hypo, Defect, Localisation, Multiple, Severity
- Factors: 1|Specimen (random effect), Genus, Locality, Country, Age, Tooth, Position (Upper/Lower), Side (Left/Right), Wear, Defect (converted to factor for Localisation, Multiple and Severity models)

References for factors:

- Genus = *Ceratotherium* because present in most localities
- Locality = Maragheh (most abundant)
- Country = East, province of Maragheh
- Age = Turolian
- Tooth = D4, most commonly affected teeth in rhinos
- Wear = Average
- Defect = LEH (code 1)

<u>Hypo</u>

No over-dispersion

```
Formula: Hypo ~ (1 | Specimen) + Tooth * Province + Age + Wear + Position +
Genus
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)           0.6327     0.6318   1.001 0.316606
ToothD1              -2.9410     0.8677  -3.389 0.000700 ***
ToothD2              -2.7185     0.7457  -3.645 0.000267 ***
ToothD3              -3.5177     0.8518  -4.130 3.63e-05 ***
ToothP4             -20.2914  3158.1645  -0.006 0.994874
ToothP2              -3.8540     0.9866  -3.906 9.38e-05 ***
ToothP3              -3.3197     0.8431  -3.938 8.23e-05 ***
ToothM1              -2.8122     0.6800  -4.136 3.54e-05 ***
ToothM2              -1.5375     0.6071  -2.532 0.011326 *
ToothM3              -1.3579     0.6783  -2.002 0.045288 *
ProvinceWest         -4.9860     1.3493  -3.695 0.000220 ***
AgeVallesian          4.1876     1.2753   3.284 0.001025 **
WearOther           -19.0478 18434.1020  -0.001 0.999176
WearUnder            -1.3801     0.5590  -2.469 0.013551 *
WearUpper            -0.8572     0.4426  -1.937 0.052781 .
PositionUpper        -0.8472     0.4217  -2.009 0.044543 *
GenusAcerorhinus      2.8134     1.4481   1.943 0.052039 .
GenusDihoplus         2.3479     1.1188   2.099 0.035859 *
GenusChilotherium     0.2331     0.5452   0.427 0.669035
GenusIranotherium   -17.7946  5885.6952  -0.003 0.997588
GenusPersiatherium    0.4825     1.7281   0.279 0.780086
```

```
ToothD1:ProvinceWest   -15.3445  4337.6526  -0.004 0.997177
ToothD2:ProvinceWest    -8.3271    75.3082  -0.111 0.911955
ToothD3:ProvinceWest   -17.1334  8555.8341  -0.002 0.998402
ToothP4:ProvinceWest    20.1581  3158.1647   0.006 0.994907
ToothP2:ProvinceWest     2.7502     1.4651   1.877 0.060508 .
ToothP3:ProvinceWest     3.4216     1.2690   2.696 0.007012 **
ToothM1:ProvinceWest     0.1303     1.5923   0.082 0.934773
ToothM2:ProvinceWest    -0.6454     1.5498  -0.416 0.677111
ToothM3:ProvinceWest     1.1015     1.2238   0.900 0.368108
```

Tooth: D1, D2, D3,P2, P3, M1,M2, and M3 present less hypoplasic defects than D4
Pairwise comparisons (Tukey Contrasts) did not highlighted any other differences
Province: Rhinocerotids from Western localities are less affected by hypoplasia
Age: Vallesian rhinocerotids are more prone to hypoplasic defects than Turolian ones
Wear: Teeth less worn present less hypoplasia than averaged-worn ones
Pairwise comparisons (Tukey Contrasts) did not highlighted any other differences
Position: Upper teeth present less hypoplasia than lower ones
Genus: *Dihoplus* is more affected by hypoplasia than *Ceratotherium*
Pairwise comparisons (Tukey Contrasts) did not highlighted any other differences
Interaction Tooth*Province

<u>Defect</u>

Over-dispersion

```
Formula: Defect ~ (1 | Specimen) + Age + Province
             Estimate Std. Error z value Pr(>|z|)
(Intercept)   0.23674    0.05380   4.400 1.08e-05 ***
AgeVallesian  0.32465    0.12467   2.604  0.00921 **
ProvinceWest -0.16836    0.09104  -1.849  0.06441 .
```

Age: Vallesian rhinocerotids have more defects (or different pattern) than Turolian ones
Province: No differences

Correction for over-dispersion

```
Fixed effects: Defect ~ Age + Province
                  Value  Std.Error  DF   t-value p-value
(Intercept)   0.2351753 0.04749398 694  4.951687  0.0000
AgeVallesian  0.2841342 0.11759197 197  2.416272  0.0166
ProvinceWest -0.1412696 0.08064881 197 -1.751664  0.0814
```

With Genus forced in the models, best candidate is (1|Specimen) alone

<u>Localisation</u>

No over-dispersion

```
Formula: Localisation ~ (1 | Specimen) + Defect + Position
                Estimate Std. Error z value Pr(>|z|)
(Intercept)    1.603e-01  1.407e-01   1.139   0.2547
Defect1       -3.235e+01  3.024e+05   0.000   0.9999
```

```
Defect3        1.020e-01  3.774e-01   0.270   0.7869
Defect4        8.224e-02  2.860e-01   0.288   0.7737
Defect9        2.005e-01  2.705e-01   0.741   0.4585
Defect10       8.679e-02  2.962e-01   0.293   0.7695
PositionUpper  4.308e-01  1.779e-01   2.422   0.0155 *
```

```
Defect: No differences between defect types Localisation
Position: upper teeth have more defects or more frequently lingual or all
crown (labial+lingual) defects than lower ones
```

With Genus forced in the models

```
Formula: Localisation ~ Genus + (1 | Specimen) + Defect + Position
                      Estimate Std. Error z value Pr(>|z|)
(Intercept)          1.946e-01  2.003e-01   0.972   0.3311
GenusAcerorhinus     1.036e-01  4.206e-01   0.246   0.8054
GenusDihoplus       -3.472e-01  3.592e-01  -0.967   0.3337
GenusChilotherium   -7.395e-02  2.154e-01  -0.343   0.7313
GenusIranotherium   -1.998e+00  1.662e+07   0.000   1.0000
GenusPersiatherium   3.034e-02  5.465e-01   0.056   0.9557
Defect1             -3.466e+01  9.747e+05   0.000   1.0000
Defect3              2.444e-01  4.441e-01   0.550   0.5820
Defect4              1.864e-01  2.992e-01   0.623   0.5333
Defect9              2.460e-01  2.853e-01   0.862   0.3886
Defect10             1.183e-01  2.983e-01   0.396   0.6917
PositionUpper        4.682e-01  1.890e-01   2.477   0.0132 *
```

Pairwise comparisons (Tukey Contrasts) did not highlighted any other differences neither between Defects nor Genus

__**Multiple**__

Over-dispersion

```
Formula: Multiple ~ (1 | Specimen) + Defect
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  0.85605    0.08084  10.589   <2e-16 ***
Defect1     -0.85605    0.08824  -9.702   <2e-16 ***
Defect3     -0.16290    0.36268  -0.449    0.653
Defect4     -0.16290    0.26275  -0.620    0.535
Defect9     -0.10884    0.24324  -0.447    0.655
Defect10     0.10903    0.23271   0.469    0.639
```

Defect: Absence of defect is different from LEH in multiplicity
No differences in the multiplicity of other defects (pits, aplasia)

Correction for over-dispersion

```
                Value  Std.Error  DF   t-value p-value
(Intercept)  0.8392992 0.01204305 689  69.69156  0.0000
Defect1     -0.8437084 0.01215650 689 -69.40391  0.0000
Defect3     -0.1251806 0.05157607 689  -2.42711  0.0155
Defect4     -0.1756239 0.03674829 689  -4.77910  0.0000
Defect9     -0.1018346 0.03177872 689  -3.20449  0.0014
Defect10     0.1021998 0.03421943 689   2.98660  0.0029
```

Defect: LEH is more frequently multiple than pits, aplasia and other types of defects
Defect 10 (LEH + Other) = always multiple by definition
Pairwise comparisons highlighted the following differences:

- Absence of defect less multiple than pits (p-value < 0.001), aplasia (p-value < 0.001), Other defects (p-value < 0.001) and LEH + Other (p-value < 0.001)
- Pits less multiple than LEH + Other (p-value = 0.002)
- LEH + Other (Defect10) more multiple than aplasia (p-value < 0.001), Other defects (p-value < 0.001)

With Genus forced in the models (corrected for over-dispersion)

```
Fixed effects: Multiple ~ Genus + Defect
                         Value  Std.Error  DF    t-value p-value
(Intercept)          0.8529220 0.01565088 686   54.49675  0.0000
GenusAcerorhinus    -0.0224328 0.02638622 686   -0.85017  0.3955
GenusDihoplus       -0.0099350 0.01908625 686   -0.52053  0.6029
GenusChilotherium   -0.0193102 0.01462391 686   -1.32046  0.1871
GenusIranotherium   -0.0081313 0.03861491 197   -0.21057  0.8334
GenusPersiatherium  -0.0482706 0.05889122 197   -0.81966  0.4134
Defect1             -0.8447907 0.01228850 686  -68.74643  0.0000
Defect3             -0.1259240 0.05195059 686   -2.42392  0.0156
Defect4             -0.1746340 0.03689736 686   -4.73297  0.0000
Defect9             -0.1018948 0.03191280 686   -3.19291  0.0015
Defect10             0.1007951 0.03428047 686    2.94031  0.0034
```

Pairwise comparisons (Tukey Contrasts) did not highlighted differences between Genus

Severity

Over-dispersion

```
Formula: Severity ~ (1 | Specimen) + Defect
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  1.21011    0.06773  17.867   <2e-16 ***
Defect1     -1.21011    0.07640 -15.839   <2e-16 ***
Defect3     -0.11150    0.29651  -0.376    0.707
Defect4      0.23681    0.18439   1.284    0.199
Defect9     -0.07513    0.20075  -0.374    0.708
Defect10     0.14444    0.19195   0.752    0.452
```

Defect: Absence of defect is less severe than LEH
No differences in the severity of other defects (pits, aplasia)

Correction for over-dispersion

```
                 Value  Std.Error  DF     t-value p-value
(Intercept)  1.1995502 0.01042456 689   115.06966   0e+00
Defect1     -1.1979514 0.00935307 689  -128.08103   0e+00
Defect3     -0.1404784 0.03679561 689    -3.81780   1e-04
Defect4      0.1276596 0.02464820 689     5.17926   0e+00
Defect9     -0.0971834 0.02233648 689    -4.35088   0e+00
Defect10     0.1024334 0.02617083 689     3.91403   1e-04
```

Defect: LEH is more severe than absence, pits or other defects, but less severe than aplasia and defect 10 (LEH + Other)
Pairwise comparisons highlighted the following differences:

- Absence of defect (Defect1) less severe than pits (p-value < 0.001), aplasia (p-value < 0.001), Other defects (p-value < 0.001) and LEH + Other (p-value < 0.001)
- Pits less severe than aplasia (p-value < 0.001), LEH + Other (p-value < 0.001)
- Aplasia (Defect4) more severe than Other defects (Defect9; p-value < 0.001)
- LEH + Other (Defect10) more severe than Other Defect (p-value < 0.001)

With Genus forced in the models (corrected for over-dispersion)

	Value	Std.Error	DF	t-value	p-value
(Intercept)	1.1877620	0.01497940	686	79.29301	**0.0000**
GenusAcerorhinus	0.0035681	0.02876367	686	0.12405	0.9013
GenusDihoplus	0.0211249	0.02074184	686	1.01847	0.3088
GenusChilotherium	0.0199442	0.01576317	686	1.26524	0.2062
GenusIranotherium	0.0103606	0.03942586	197	0.26279	0.7930
GenusPersiatherium	-0.1205961	0.06905309	197	-1.74643	0.0823
Defect1	-1.1981226	0.00941386	686	-127.27222	**0.0000**
Defect3	-0.1408996	0.03696010	686	-3.81221	**0.0002**
Defect4	0.1270740	0.02470447	686	5.14376	**0.0000**
Defect9	-0.0971721	0.02242346	686	-4.33350	**0.0000**
Defect10	0.1022624	0.02618609	686	3.90522	**0.0001**

Persiatherium has less severe defects than *Ceratotherium* (nearly significant, p-value = 0.08)
Pairwise comparisons (Tukey Contrasts) did not highlighted differences between Genus

BIC ranking differences

Without Genus forced:

- Hypo: less factors in best candidate model (AIC = (1|Specimen) + Tooth * Province + Age + Wear + Position + Genus / BIC = (1|Specimen) + Tooth + Province)
- Defect: best model is (1|Specimen)
- Localisation: less factors in best candidate model (AIC = (1|Specimen) + Defect + Position / BIC = (1|Specimen) + Defect)
- Multiple: same best candidate model
- Severity: same best candidate model

With Genus forced in the models

- Hypo: best model is (1|Specimen)
- Defect: best model is (1|Specimen)
- Localisation: less factors in best candidate model (AIC = Genus + (1|Specimen) + Defect + Position / BIC = Genus + (1|Specimen) + Defect)
- Multiple: same best candidate model
- Severity: same best candidate model

Supplementary S4 – Detailed results of GLMM for DMTA

RDATA

Specimen	Locality	Age	Province	Genus	Species	Tooth	Position	Side	Cusp	Facet	Anisotropy	Complexity	H9	H81	FTFV
PNT135	Pentalophos-1	Vallesian	West	*Chilotherium*	*kilasi*	M2	Upper	Left	Protocone	Grinding	0.004552235	2.176813045	0.323944244	0.5190139	64430.85887
PNT135	Pentalophos-1	Vallesian	West	*Chilotherium*	*kilasi*	M2	Upper	Left	Protocone	Shearing	0.006400873	0.821827313	0.379414769	0.500790753	33073.18793
PNT142	Pentalophos-1	Vallesian	West	*Chilotherium*	*kilasi*	M2	Lower	Left	Protoconid	Grinding	0.003631969	2.771750954	0.454488004	0.885932503	77657.76049
PNT129	Pentalophos-1	Vallesian	West	*Ceratotherium*	*neumayri*	M1	Lower	Left	Protoconid	Grinding	0.00241528	1.111767177	0.188531682	0.492323804	60438.98283
PNT129	Pentalophos-1	Vallesian	West	*Ceratotherium*	*neumayri*	M1	Lower	Left	Protoconid	Shearing	0.000196164	1.500193392	0.255392277	0.536015485	51993.36077
PNT34	Pentalophos-1	Vallesian	West	*Ceratotherium*	*neumayri*	M2	Lower	Right	Hypoconid	Shearing	0.002790825	1.128135802	0.235490925	0.435643019	44966.3393
PNT34	Pentalophos-1	Vallesian	West	*Ceratotherium*	*neumayri*	M3	Lower	Right	Protoconid	Grinding	0.001905895	2.843446464	0.219759194	0.397875105	51514.99546
XIR ?	OtherG	Vallesian	West	*Chilotherium*	sp.	M1	Upper	Right	Protocone	Grinding	0.004554819	1.964794007	0.196776632	0.440815873	82837.06301
XIR ?	OtherG	Vallesian	West	*Chilotherium*	sp.	M1	Upper	Right	Protocone	Shearing	0.006270101	2.361349297	0.185214905	0.591389976	56908.97673
2014-0424-0001	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Protoconid	Grinding	0.00311704	1.834582984	0.197511368	0.431038883	46929.28661
Mar1959	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M1	Lower	Right	Protoconid	Grinding	0.003159905	0.990720893	0.31979934	0.433385789	85839.45685
Mar1959	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M1	Lower	Right	Protoconid	Shearing	0.000870014	0.535373768	0.277570631	0.435429057	25419.34294
Mar2142	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Hypoconid	Grinding	0.00140217	2.834281626	0.306977272	0.512082412	51580.97688
Mar2142	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Hypoconid	Shearing	0.002444605	1.063975522	0.228463357	0.44366924	34194.87211
Mar2143	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M1	Lower	Left	Protoconid	Grinding	0.005756548	1.692548819	0.666307225	0.780127662	92654.05357
Mar2144	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M1	Lower	Left	Protoconid	Grinding	0.005008436	1.922573209	0.556637691	0.861059277	58954.40082
Mar2144	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M1	Lower	Left	Protoconid	Shearing	0.007994329	1.917102463	0.352786668	0.659071296	26953.41101
Mar2173	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Right	Protoconid	Grinding	0.001314915	0.603393519	0.228614198	0.417959083	13839.60333
2014-0424-0001	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Protoconid	Shearing	0.005517448	1.453770075	0.353434861	0.545116444	103067.2505
Mar0385	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Protoconid	Grinding	0.001996624	1.934070396	0.654560303	0.921411259	57469.92065
Mar0385	Maragheh	Turolian	East	*Ceratotherium*	*neumayri*	M2	Lower	Left	Protoconid	Shearing	0.001290292	0.746019235	0.38313031	0.638053731	41865.21245
Mar1969	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Protoconid	Grinding	0.002871272	2.332836876	0.675446375	0.885339248	46417.93059
Mar2121	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M1	Upper	Right	Protocone	Shearing	0.005757745	0.984957127	0.397503573	0.51752072	14466.42684
Mar2123	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Left	Protocone	Grinding	0.00134119	3.460468193	0.485878759	0.828162511	67020.6297
Mar2123	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Left	Protocone	Shearing	0.000868102	4.680511337	0.841130876	1.800888095	66737.8351

Mar2128	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M1	Lower	Right	Protoconid	Grinding	0.003235765	3.170489213	0.433644504	0.709437962	44471.47863
Mar2128	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M1	Lower	Right	Protoconid	Shearing	0.003464975	1.012270428	0.234376348	0.612233796	23934.76094
Mar2131	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Protoconid	Grinding	0.005577939	1.555411508	0.304363186	0.577796856	76604.43129
Mar2131	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Protoconid	Shearing	0.003066723	2.599476103	1.405907485	1.699631008	96007.35787
Mar2312	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M3	Upper	Right	Protocone	Grinding	0.001630924	1.446600706	0.450087261	0.613928138	75565.22389
Mar2315	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M3	Upper	Left	Protocone	Grinding	0.000533304	2.728762238	0.357870786	0.743364548	38879.55309
Mar2315	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M3	Upper	Left	Protocone	Shearing	0.005834383	0.654476436	0.448025706	0.600610268	19068.63104
Mar2317	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M1	Upper	Right	Protocone	Grinding	0.00713883	0.479837719	0.383178444	0.782169367	45692.13494
Mar2318	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M1	Upper	Right	Protocone	Grinding	0.005375762	0.571625935	0.314477551	0.654072283	27629.72059
Mar2344	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Right	Protocone	Grinding	0.001469423	0.885914896	0.172350354	0.309769022	35778.42624
Mar2344	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Right	Protocone	Shearing	0.002170692	0.959247227	0.307207894	0.627459509	30631.8753
Mar ?	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Left	Protoconid	Grinding	0.002478321	2.488788445	0.374416133	1.11792466	62797.81867
Mar0387	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Hypoconid	Grinding	0.001422162	2.715081021	0.489744342	0.628607496	59333.794
Mar0387	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Hypoconid	Shearing	0.002194476	0.888590557	0.285979602	0.513015251	49040.69212
Mar0388	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Hypoconid	Grinding	0.000342657	0.675243746	0.23584705	0.494698957	11711.70246
Mar0388	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Lower	Right	Hypoconid	Shearing	0.002413554	0.572927925	0.220530385	0.432795221	49782.98312
Mgh2	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Right	Protocone	Grinding	0.002284484	1.182589727	0.528491745	0.707660932	36735.15686
Mgh2	Maragheh	Turolian	East	*Chilotherium*	*persiae*	M2	Upper	Right	Protocone	Shearing	0.006133321	0.772853846	0.1426491	0.338482342	25105.93118
K594	Kalimantsi	Turolian	West	*Ceratotherium*	*neumayri*	M3	Upper	Left	Protocone	Grinding	0.003034493	1.370141281	0.324098295	0.50399604	48265.41041
K595	Kalimantsi	Turolian	West	*Acerorhinus*	sp.	M2	Upper	Left	Protocone	Grinding	0.002820132	1.272499038	0.19144302	0.469721626	31704.07341
K600	Kalimantsi	Turolian	West	*Acerorhinus*	sp.	M3	Upper	Left	Protocone	Grinding	0.000420902	1.562851195	0.427344985	0.45417712	54517.15017
K608	Kalimantsi	Turolian	West	*Acerorhinus*	sp.	M2	Lower	Right	Hypoconid	Grinding	0.001067115	1.135169435	0.466805693	0.750275578	68571.19312
K701	Kalimantsi	Turolian	West	*Acerorhinus*	sp.	M3	Upper	Left	Protocone	Grinding	0.004673197	2.95935054	0.427184584	1.292862626	49929.06776
KCH3-FM2959	OtherB	Turolian	West	*Acerorhinus*	sp.	M2	Lower	Right	Protoconid	Grinding	0.001469725	4.314831231	0.447682415	0.593583156	51284.06048
KCH3-FM2959	OtherB	Turolian	West	*Acerorhinus*	sp.	M2	Lower	Right	Protoconid	Shearing	0.001654549	1.507286194	0.19062163	0.487022938	29922.57501
1853-0003-0010b	OtherG	Turolian	West	*Ceratotherium*	*neumayri*	M3	Upper	Left	Protocone	Grinding	0.000188962	1.043342988	0.520769259	0.677507711	22714.10463
1863-0001-0019	OtherG	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Protocone	Grinding	0.00151365	2.832297366	0.346305223	0.803907289	66358.44192
1863-0001-0019	OtherG	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Protocone	Shearing	0.001689262	0.49500627	0.185221015	0.432325356	14284.97793
RZO ?	OtherG	Turolian	West	*Ceratotherium*	*neumayri*	M1	Lower	Right	Protoconid	Grinding	0.003721166	1.415159378	0.194701723	0.418983484	76500.71204
RZO26	OtherG	Turolian	West	*Ceratotherium*	*neumayri*	M2	Upper	Right	Protocone	Grinding	0.005202054	0.867852663	0.19121934	0.364445005	41716.75425
RZO26	OtherG	Turolian	West	*Ceratotherium*	*neumayri*	M2	Upper	Right	Protocone	Shearing	0.005059654	0.979050403	0.464335689	0.574678458	22004.80434

GS7-FM3142	OtherB	Turolian	West	*Acerorhinus*	sp.	M2	Upper	Right	Protocone	Grinding	0.001278651	1.173900713	0.370547585	0.513190253	26672.98996
GS7-FM3142	OtherB	Turolian	West	*Acerorhinus*	sp.	M2	Upper	Right	Protocone	Shearing	0.006583742	1.233576825	0.286893186	1.07771675	56958.4628
HD598	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Upper	Right	Protocone	Grinding	0.001281305	1.377921043	0.479367591	0.631451333	88365.61981
HD605	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M1	Upper	Right	Protocone	Grinding	0.002480774	1.937923163	0.311250207	0.525124963	79948.24135
HD606	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Protocone	Grinding	0.001133368	1.210011483	0.223401347	0.337790308	16033.48562
HD606	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Protocone	Shearing	0.001905845	0.769559042	0.23903014	0.441475355	23967.75165
HD615	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Lower	Left	Hypoconid	Grinding	0.002513036	2.817907531	0.244773624	0.7389251	53489.69101
HD615	Hadjidimovo	Turolian	West	*Dihoplus*	*pikermiensis*	M2	Lower	Left	Hypoconid	Shearing	0.001289968	1.386575649	0.27481504	0.478331723	27415.28097
STR2-FM2468	OtherB	Turolian	West	*Ceratotherium*	*neumayri*	M2	Lower	Left	Hypoconid	Grinding	0.001894284	2.069661443	0.356406802	0.669118189	21659.56205
STR2-FM2800	OtherB	Turolian	West	*Ceratotherium*	*neumayri*	M2	Lower	Left	Protoconid	Grinding	0.002732548	3.407601877	0.129978947	0.451383989	82417.79757
SAM1	Samos	Turolian	East	*Ceratotherium*	*neumayri*	M2	Upper	Left	Protocone	Grinding	0.007689934	1.27893171	0.834082712	1.349332387	49352.29268
SAM1	Samos	Turolian	East	*Ceratotherium*	*neumayri*	M2	Upper	Left	Protocone	Shearing	0.008752523	0.687189387	0.217341749	0.51988679	40083.71405
1911-0005-0033	Samos	Turolian	East	*Chilotherium*	*schlosseri*	M1	Lower	Right	Protoconid	Grinding	0.003882446	0.648104791	0.319738584	0.648982246	70798.06613
1911-0005-0033	Samos	Turolian	East	*Chilotherium*	*schlosseri*	M1	Lower	Right	Protoconid	Shearing	0.003137342	0.375334595	0.12138446	0.34319561	15406.66211

GLMM Anisotropy

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	Facet + (1|Specimen)	4	-677.9682	-669.9682	0	0.31415114	-660.9742	0.7169289	-0.1657559
6	Tooth + (1|Specimen)	5	-679.7603	-669.7603	0.2078894	0.28313662	-658.5179	0.6661355	-0.2324735
9	Cusp + (1|Specimen)	5	-677.2493	-667.2493	2.7189438	0.08067287	-656.0068	0.6150384	-0.1074475
5	Province + (1|Specimen)	4	-675.0376	-667.0376	2.9306164	0.07257105	-658.0436	0.6557318	-0.1853978
1	(1|Specimen)	3	-672.9613	-666.9613	3.0069227	0.06985439	-660.2158	0.6504532	-0.1858861
7	Position + (1|Specimen)	4	-674.9447	-666.9447	3.0235013	0.06927774	-657.9507	0.6391837	-0.1701112
2	Genus + (1|Specimen)	6	-677.6635	-665.6635	4.3046985	0.03650776	-652.1726	0.6409183	-0.234478
4	Age + (1|Specimen)	4	-673.4275	-665.4275	4.5407688	0.03244317	-656.4335	0.6489746	-0.2016044
8	Side + (1|Specimen)	4	-673.0176	-665.0176	4.9506179	0.02643173	-656.0236	0.6510269	-0.1951712
3	Locality + (1|Specimen)	9	-681.8784	-663.8784	6.0898521	0.01495354	-643.6419	0.6136089	-0.41544

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
20	Facet * Tooth + (1|Specimen)	8	-692.1223	-676.1223	0	0.69804868	-658.1343	0.8030111	-0.2559251
15	Facet + Tooth + (1|Specimen)	6	-684.3899	-672.3899	3.732403	0.107995278	-658.8989	0.7248925	-0.2328896
18	Facet + Cusp + (1|Specimen)	6	-683.0161	-671.0161	5.106137	0.054337805	-657.5252	0.6935752	-0.0721306
16	Facet + Position + (1|Specimen)	5	-680.0182	-670.0182	6.104116	0.032990862	-658.7757	0.7082006	-0.1627966
10	Facet + (1|Specimen)	4	-677.9682	-669.9682	6.154041	0.032177535	-660.9742	0.7169289	-0.1657559
14	Facet + Province + (1|Specimen)	5	-679.6008	-669.6008	6.521462	0.026777387	-658.3583	0.7197223	-0.1724059
11	Facet + Genus + (1|Specimen)	7	-682.3884	-668.3884	7.73392	0.014604487	-652.6489	0.7088177	-0.1865821
13	Facet + Age + (1|Specimen)	5	-678.311	-668.311	7.811277	0.014050395	-657.0685	0.7159495	-0.1802593
17	Facet + Side + (1|Specimen)	5	-677.9997	-667.9997	8.122618	0.012024903	-656.7572	0.717201	-0.1739466
12	Facet + Locality + (1|Specimen)	10	-685.7317	-665.7317	10.390618	0.003868937	-643.2467	0.6888295	-0.4179209
19	Facet * Genus + (1|Specimen)	10	-685.3038	-665.3038	10.818521	0.003123732	-642.8188	0.7555674	-0.4347533

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	0	0.345189257	-657.8986	0.7921074	-0.1870565
27	Facet * Tooth + Cusp + (1|Specimen)	10	-697.9344	-677.9344	0.2006361	0.312240831	-655.4495	0.7941423	-0.1544636
20	Facet * Tooth + (1|Specimen)	8	-692.1223	-676.1223	2.0128107	0.126177228	-658.1343	0.8030111	-0.2559251
24	Facet * Tooth + Province + (1|Specimen)	9	-692.6157	-674.6157	3.5193756	0.059406582	-654.3792	0.8034137	-0.27973
26	Facet * Tooth + Side + (1|Specimen)	9	-692.3941	-674.3941	3.7409839	0.053175666	-654.1576	0.8030504	-0.2595179
23	Facet * Tooth + Age + (1|Specimen)	9	-692.305	-674.305	3.8301213	0.050857733	-654.0685	0.8028147	-0.2567307
21	Facet * Tooth + Genus + (1|Specimen)	11	-695.8681	-673.8681	4.2670237	0.04087755	-649.1346	0.7983311	-0.3179985
22	Facet * Tooth + Locality + (1|Specimen)	14	-699.3473	-671.3473	6.787794	0.011590616	-639.8684	0.7885989	-0.7394325
28	Facet * Tooth * Genus + (1|Specimen)	19	-702.9978	-664.9978	13.137304	0.000484538	-622.2764	0.8292151	-0.801039

SET 4

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
29	Facet * Tooth + Position + Genus + (1|Specimen)	12	-704.8894	-680.8894	0	0.35872486	-653.9075	0.7746465	-0.1677195
35	Facet * Tooth + Position * Genus + (1|Specimen)	15	-710.5377	-680.5377	0.3517445	0.30087155	-646.8103	0.752299	-0.2522494
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	2.7543593	0.09050237	-657.8986	0.7921074	-0.1870565
34	Facet * Tooth + Position + Cusp + (1|Specimen)	10	-697.9344	-677.9344	2.9549954	0.08186389	-655.4495	0.7941423	-0.1544636
32	Facet * Tooth + Position + Province + (1|Specimen)	10	-697.3823	-677.3823	3.5070911	0.06211641	-654.8974	0.7909638	-0.209283
33	Facet * Tooth + Position + Side + (1|Specimen)	10	-696.5388	-676.5388	4.350631	0.04074121	-654.0539	0.7922966	-0.2257354
31	Facet * Tooth + Position + Age + (1|Specimen)	10	-696.4008	-676.4008	4.4886242	0.03802499	-653.9159	0.7921385	-0.1862027
30	Facet * Tooth + Position + Locality + (1|Specimen)	15	-705.7274	-675.7274	5.1620093	0.02715472	-642	0.7786392	-0.4820995

SET 5

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
29	Facet * Tooth + Position + Genus + (1|Specimen)	12	-704.8894	-680.8894	0.000000	0.345685348	-653.9075	0.7746465	-0.1677195
40	Facet * Tooth + Position + Genus + Cusp + (1|Specimen)	13	-705.9008	-679.9008	0.988628	0.210864297	-650.6704	0.7807762	-0.1809644
39	Facet * Tooth + Position + Genus + Side + (1|Specimen)	13	-705.5409	-679.5409	1.348585	0.176132528	-650.3104	0.7746187	-0.1850913
38	Facet * Tooth + Position + Genus + Province + (1|Specimen)	13	-704.9358	-678.9358	1.953687	0.130149717	-649.7053	0.7746919	-0.1735726
37	Facet * Tooth + Position + Genus + Age + (1|Specimen)	13	-704.9189	-678.9189	1.9705261	0.129058516	-649.6885	0.7748596	-0.1866501
36	Facet * Tooth + Position + Genus + Locality + (1|Specimen)	18	-709.3845	-673.3845	7.5049622	0.008109595	-632.9116	0.7616493	-0.5083802

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
29	Facet * Tooth + Position + Genus + (1|Specimen)	12	-704.8894	-680.8894	0	0.35872486	-653.9075	0.7746465	-0.1677195
35	Facet * Tooth + Position * Genus + (1|Specimen)	15	-710.5377	-680.5377	0.3517	0.30087155	-646.8103	0.752299	-0.2522494
40	Facet * Tooth + Position + Genus + Cusp + (1|Specimen)	13	-705.9008	-679.9008	0.9886	0.210864297	-650.6704	0.7807762	-0.1809644
39	Facet * Tooth + Position + Genus + Side + (1|Specimen)	13	-705.5409	-679.5409	1.3485	0.176132528	-650.3104	0.7746187	-0.1850913
38	Facet * Tooth + Position + Genus + Province + (1|Specimen)	13	-704.9358	-678.9358	1.9536	0.130149717	-649.7053	0.7746919	-0.1735726
37	Facet * Tooth + Position + Genus + Age + (1|Specimen)	13	-704.9189	-678.9189	1.9705	0.129058516	-649.6885	0.7748596	-0.1866501
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	2.7543	0.345189257	-657.8986	0.7921074	-0.1870565
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	2.7543	0.09050237	-657.8986	0.7921074	-0.1870565
27	Facet * Tooth + Cusp + (1|Specimen)	10	-697.9344	-677.9344	2.955	0.312240831	-655.4495	0.7941423	-0.1544636
34	Facet * Tooth + Position + Cusp + (1|Specimen)	10	-697.9344	-677.9344	2.955	0.08186389	-655.4495	0.7941423	-0.1544636
32	Facet * Tooth + Position + Province + (1|Specimen)	10	-697.3823	-677.3823	3.5071	0.06211641	-654.8974	0.7909638	-0.209283
33	Facet * Tooth + Position + Side + (1|Specimen)	10	-696.5388	-676.5388	4.3506	0.04074121	-654.0539	0.7922966	-0.2257354
31	Facet * Tooth + Position + Age + (1|Specimen)	10	-696.4008	-676.4008	4.4886	0.03802499	-653.9159	0.7921385	-0.1862027
20	Facet * Tooth + (1|Specimen)	8	-692.1223	-676.1223	4.7671	0.69804868	-658.1343	0.8030111	-0.2559251
30	Facet * Tooth + Position + Locality + (1|Specimen)	15	-705.7274	-675.7274	5.162	0.02715472	-642	0.7786392	-0.4820995
24	Facet * Tooth + Province + (1|Specimen)	9	-692.6157	-674.6157	6.2737	0.059406582	-654.3792	0.8034137	-0.27973
26	Facet * Tooth + Side + (1|Specimen)	9	-692.3941	-674.3941	6.4953	0.053175666	-654.1576	0.8030504	-0.2595179
23	Facet * Tooth + Age + (1|Specimen)	9	-692.305	-674.305	6.5844	0.050857733	-654.0685	0.8028147	-0.2567307
21	Facet * Tooth + Genus + (1|Specimen)	11	-695.8681	-673.8681	7.0213	0.04087755	-649.1346	0.7983311	-0.3179985
36	Facet * Tooth + Position + Genus + Locality + (1|Specimen)	18	-709.3845	-673.3845	7.5049	0.008109595	-632.9116	0.7616493	-0.5083802
15	Facet + Tooth + (1|Specimen)	6	-684.3899	-672.3899	8.4995	0.107995278	-658.8989	0.7248925	-0.2328896
22	Facet * Tooth + Locality + (1|Specimen)	14	-699.3473	-671.3473	9.5421	0.011590616	-639.8684	0.7885989	-0.7394325
18	Facet + Cusp + (1|Specimen)	6	-683.0161	-671.0161	9.8733	0.054337805	-657.5252	0.6935752	-0.0721306
16	Facet + Position + (1|Specimen)	5	-680.0182	-670.0182	10.8712	0.032990862	-658.7757	0.7082006	-0.1627966
10	Facet + (1|Specimen)	4	-677.9682	-669.9682	10.9212	0.31415114	-660.9742	0.7169289	-0.1657559
6	Tooth + (1|Specimen)	5	-679.7603	-669.7603	11.1291	0.28313662	-658.5179	0.6661355	-0.2324735
14	Facet + Province + (1|Specimen)	5	-679.6008	-669.6008	11.2886	0.026777387	-658.3583	0.7197223	-0.1724059
11	Facet + Genus + (1|Specimen)	7	-682.3884	-668.3884	12.501	0.014604487	-652.6489	0.7088177	-0.1865821
13	Facet + Age + (1|Specimen)	5	-678.311	-668.311	12.5784	0.014050395	-657.0685	0.7159495	-0.1802593
17	Facet + Side + (1|Specimen)	5	-677.9997	-667.9997	12.8897	0.012024903	-656.7572	0.717201	-0.1739466
9	Cusp + (1|Specimen)	5	-677.2493	-667.2493	13.6401	0.08067287	-656.0068	0.6150384	-0.1074475
5	Province + (1|Specimen)	4	-675.0376	-667.0376	13.8518	0.07257105	-658.0436	0.6557318	-0.1853978
1	(1|Specimen)	3	-672.9613	-666.9613	13.9281	0.06985439	-660.2158	0.6504532	-0.1858861
7	Position + (1|Specimen)	4	-674.9447	-666.9447	13.9447	0.06927774	-657.9507	0.6391837	-0.1701112
12	Facet + Locality + (1|Specimen)	10	-685.7317	-665.7317	15.1577	0.003868937	-643.2467	0.6888295	-0.4179209
2	Genus + (1|Specimen)	6	-677.6635	-665.6635	15.2259	0.03650776	-652.1726	0.6409183	-0.234478
4	Age + (1|Specimen)	4	-673.4275	-665.4275	15.4619	0.03244317	-656.4335	0.6489746	-0.2016044
19	Facet * Genus + (1|Specimen)	10	-685.3038	-665.3038	15.5856	0.003123732	-642.8188	0.7555674	-0.4347533
8	Side + (1|Specimen)	4	-673.0176	-665.0176	15.8718	0.02643173	-656.0236	0.6510269	-0.1951712
28	Facet * Tooth * Genus + (1|Specimen)	19	-702.9978	-664.9978	15.8916	0.000484538	-622.2764	0.8292151	-0.801039
3	Locality + (1|Specimen)	9	-681.8784	-663.8784	17.011	0.01495354	-643.6419	0.6136089	-0.41544

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	Facet + (1|Specimen)	4	-677.9682	-669.9682	0	0.31415114	-660.9742	0.7169289	-0.1657559
1	(1|Specimen)	3	-672.9613	-666.9613	3.0069	0.06985439	-660.2158	0.6504532	-0.1858861
15	Facet + Tooth + (1|Specimen)	6	-684.3899	-672.3899	-2.4217	0.107995278	-658.8989	0.7248925	-0.2328896
16	Facet + Position + (1|Specimen)	5	-680.0182	-670.0182	-0.05	0.032990862	-658.7757	0.7082006	-0.1627966
6	Tooth + (1|Specimen)	5	-679.7603	-669.7603	0.2079	0.28313662	-658.5179	0.6661355	-0.2324735
14	Facet + Province + (1|Specimen)	5	-679.6008	-669.6008	0.3674	0.026777387	-658.3583	0.7197223	-0.1724059
20	Facet * Tooth + (1|Specimen)	8	-692.1223	-676.1223	-6.1541	0.69804868	-658.1343	0.8030111	-0.2559251
5	Province + (1|Specimen)	4	-675.0376	-667.0376	2.9306	0.07257105	-658.0436	0.6557318	-0.1853978
7	Position + (1|Specimen)	4	-674.9447	-666.9447	3.0235	0.06927774	-657.9507	0.6391837	-0.1701112
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	-8.1669	0.345189257	-657.8986	0.7921074	-0.1870565
25	Facet * Tooth + Position + (1|Specimen)	9	-696.1351	-678.1351	-8.1669	0.09050237	-657.8986	0.7921074	-0.1870565
18	Facet + Cusp + (1|Specimen)	6	-683.0161	-671.0161	-1.0479	0.054337805	-657.5252	0.6935752	-0.0721306
13	Facet + Age + (1|Specimen)	5	-678.311	-668.311	1.6572	0.014050395	-657.0685	0.7159495	-0.1802593
17	Facet + Side + (1|Specimen)	5	-677.9997	-667.9997	1.9685	0.012024903	-656.7572	0.717201	-0.1739466
4	Age + (1|Specimen)	4	-673.4275	-665.4275	4.5407	0.03244317	-656.4335	0.6489746	-0.2016044
8	Side + (1|Specimen)	4	-673.0176	-665.0176	4.9506	0.02643173	-656.0236	0.6510269	-0.1951712
9	Cusp + (1|Specimen)	5	-677.2493	-667.2493	2.7189	0.08067287	-656.0068	0.6150384	-0.1074475
27	Facet * Tooth + Cusp + (1|Specimen)	10	-697.9344	-677.9344	-7.9662	0.312240831	-655.4495	0.7941423	-0.1544636
34	Facet * Tooth + Position + Cusp + (1|Specimen)	10	-697.9344	-677.9344	-7.9662	0.08186389	-655.4495	0.7941423	-0.1544636
32	Facet * Tooth + Position + Province + (1|Specimen)	10	-697.3823	-677.3823	-7.4141	0.06211641	-654.8974	0.7909638	-0.209283
24	Facet * Tooth + Province + (1|Specimen)	9	-692.6157	-674.6157	-4.6475	0.059406582	-654.3792	0.8034137	-0.27973
26	Facet * Tooth + Side + (1|Specimen)	9	-692.3941	-674.3941	-4.4259	0.053175666	-654.1576	0.8030504	-0.2595179
23	Facet * Tooth + Age + (1|Specimen)	9	-692.305	-674.305	-4.3368	0.050857733	-654.0685	0.8028147	-0.2567307
33	Facet * Tooth + Position + Side + (1|Specimen)	10	-696.5388	-676.5388	-6.5706	0.04074121	-654.0539	0.7922966	-0.2257354
31	Facet * Tooth + Position + Age + (1|Specimen)	10	-696.4008	-676.4008	-6.4326	0.03802499	-653.9159	0.7921385	-0.1862027
29	Facet * Tooth + Position + Genus + (1|Specimen)	12	-704.8894	-680.8894	-10.9212	0.35872486	-653.9075	0.7746465	-0.1677195
11	Facet + Genus + (1|Specimen)	7	-682.3884	-668.3884	1.5798	0.014604487	-652.6489	0.7088177	-0.1865821
2	Genus + (1|Specimen)	6	-677.6635	-665.6635	4.3047	0.03650776	-652.1726	0.6409183	-0.234478
40	Facet * Tooth + Position + Genus + Cusp + (1|Specimen)	13	-705.9008	-679.9008	-9.9326	0.210864297	-650.6704	0.7807762	-0.1809644

39	Facet * Tooth + Position + Genus + Side + (1|Specimen)	13	-705.5409	-679.5409	-9.5727	0.176132528	-650.3104	0.7746187	-0.1850913
38	Facet * Tooth + Position + Genus + Province + (1|Specimen)	13	-704.9358	-678.9358	-8.9676	0.130149717	-649.7053	0.7746919	-0.1735726
37	Facet * Tooth + Position + Genus + Age + (1|Specimen)	13	-704.9189	-678.9189	-8.9507	0.129058516	-649.6885	0.7748596	-0.1866501
21	Facet * Tooth + Genus + (1|Specimen)	11	-695.8681	-673.8681	-3.8999	0.04087755	-649.1346	0.7983311	-0.3179985
35	Facet * Tooth + Position * Genus + (1|Specimen)	15	-710.5377	-680.5377	-10.5695	0.30087155	-646.8103	0.752299	-0.2522494
3	Locality + (1|Specimen)	9	-681.8784	-663.8784	6.0898	0.01495354	-643.6419	0.6136089	-0.41544
12	Facet + Locality + (1|Specimen)	10	-685.7317	-665.7317	4.2365	0.003868937	-643.2467	0.6888295	-0.4179209
19	Facet * Genus + (1|Specimen)	10	-685.3038	-665.3038	4.6644	0.003123732	-642.8188	0.7555674	-0.4347533
30	Facet * Tooth + Position + Locality + (1|Specimen)	15	-705.7274	-675.7274	-5.7592	0.02715472	-642	0.7786392	-0.4820995
22	Facet * Tooth + Locality + (1|Specimen)	14	-699.3473	-671.3473	-1.3791	0.011590616	-639.8684	0.7885989	-0.7394325
36	Facet * Tooth + Position + Genus + Locality + (1|Specimen)	18	-709.3845	-673.3845	-3.4163	0.008109595	-632.9116	0.7616493	-0.5083802
28	Facet * Tooth * Genus + (1|Specimen)	19	-702.9978	-664.9978	4.9704	0.000484538	-622.2764	0.8292151	-0.801039

GLMM Complexity

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	Facet + (1|Specimen)	4	179.9106	187.9106	0	0.87678379	196.9046	0.5609396	0.00183364
8	Side + (1|Specimen)	4	185.4619	193.4619	5.551272	0.05463224	202.4558	0.2925542	-0.15687684
1	(1|Specimen)	3	189.588	195.588	7.677368	0.01887006	202.3334	0.2756068	-0.17656736
7	Position + (1|Specimen)	4	188.4269	196.4269	8.516354	0.0124048	205.4209	0.289098	-0.1467839
5	Province + (1|Specimen)	4	188.4901	196.4901	8.57954	0.01201902	205.4841	0.2847493	-0.15539439
4	Age + (1|Specimen)	4	188.9402	196.9402	9.029607	0.00959706	205.9342	0.2798172	-0.19547345
6	Tooth + (1|Specimen)	5	187.6707	197.6707	9.760087	0.00666065	208.9132	0.2956629	-0.3008503
9	Cusp + (1|Specimen)	5	187.8301	197.8301	9.919464	0.00615047	209.0725	0.3166039	-0.15609949
2	Genus + (1|Specimen)	6	188.5667	200.5667	12.656104	0.00156551	214.0577	0.2575424	-0.33688473
3	Locality + (1|Specimen)	9	182.9133	200.9133	13.002703	0.00131641	221.1498	0.2636311	-0.24375028

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
17	Facet + Side + (1|Specimen)	5	175.9169	185.9169	0	0.41504706	197.1594	0.564058	0.00039529
10	Facet + (1|Specimen)	4	179.9106	187.9106	1.993667	0.15317156	196.9046	0.5609396	0.00183364
16	Facet + Position + (1|Specimen)	5	178.4893	188.4893	2.572419	0.11468422	199.7318	0.5674797	0.03189492
13	Facet + Age + (1|Specimen)	5	178.8634	188.8634	2.946457	0.09512231	200.1059	0.5647521	0.01466967
14	Facet + Province + (1|Specimen)	5	179.3164	189.3164	3.399484	0.07584181	200.5589	0.5613674	0.00439174
18	Facet + Cusp + (1|Specimen)	6	178.0553	190.0553	4.138353	0.05241617	203.5463	0.5786615	0.01007371
15	Facet + Tooth + (1|Specimen)	6	178.2104	190.2104	4.293522	0.04850327	203.7014	0.5635709	-0.12018194
20	Facet * Tooth + (1|Specimen)	8	175.6465	191.6465	5.729616	0.02365522	209.6345	0.6189871	-0.10769029
11	Facet + Genus + (1|Specimen)	7	179.134	193.134	7.217035	0.01124445	208.8734	0.5523981	-0.15376605
12	Facet + Locality + (1|Specimen)	10	173.5928	193.5928	7.675847	0.0089394	216.0777	0.5491782	-0.02606815
19	Facet * Genus + (1|Specimen)	10	177.3375	197.3375	11.420554	0.00137453	219.8224	0.6077926	-0.31683375

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
17	Facet + Side + (1|Specimen)	5	175.9169	185.9169	0	0.23082247	197.1594	0.564058	0.00039529
26	Facet + Side + Position + (1|Specimen)	6	174.1765	186.1765	0.2595345	0.20273134	199.6674	0.5697726	0.04631869
23	Facet + Side + Age + (1|Specimen)	6	175.0598	187.0598	1.1429022	0.13034669	200.5508	0.5666886	-0.00371713
28	Facet * Side + (1|Specimen)	6	175.2032	187.2032	1.2862574	0.12133073	200.6942	0.5688015	0.01166782
24	Facet + Side + Province + (1|Specimen)	6	175.689	187.689	1.7721145	0.09516304	201.18	0.5627659	0.00145996
27	Facet + Side + Cusp + (1|Specimen)	7	173.7488	187.7488	1.8319081	0.09236008	203.4883	0.5801597	0.0296231
21	Facet + Side + Genus + (1|Specimen)	8	172.8279	188.8279	2.911008	0.0538469	206.8159	0.5416511	-0.33784482
25	Facet + Side + Tooth + (1|Specimen)	7	175.1192	189.1192	3.2022773	0.04654922	204.8587	0.5619226	-0.10887323
22	Facet + Side + Locality + (1|Specimen)	11	168.2197	190.2197	4.3028012	0.02684953	214.9532	0.5368355	-0.02028245

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
17	Facet + Side + (1|Specimen)	5	175.9169	185.9169	0	0.41504706	197.1594	0.564058	0.000395286
26	Facet + Side + Position + (1|Specimen)	6	174.1765	186.1765	0.2596	0.20273134	199.6674	0.5697726	0.04631869
23	Facet + Side + Age + (1|Specimen)	6	175.0598	187.0598	1.1429	0.13034669	200.5508	0.5666886	-0.003717134
28	Facet * Side + (1|Specimen)	6	175.2032	187.2032	1.2863	0.12133073	200.6942	0.5688015	0.011667815
24	Facet + Side + Province + (1|Specimen)	6	175.689	187.689	1.7721	0.09516304	201.18	0.5627659	0.001459963
27	Facet + Side + Cusp + (1|Specimen)	7	173.7488	187.7488	1.8319	0.09236008	203.4883	0.5801597	0.029623097
10	Facet + (1|Specimen)	4	179.9106	187.9106	1.9937	0.876783785	196.9046	0.5609396	0.001833638
16	Facet + Position + (1|Specimen)	5	178.4893	188.4893	2.5724	0.114684223	199.7318	0.5674797	0.031894919
21	Facet + Side + Genus + (1|Specimen)	8	172.8279	188.8279	2.911	0.0538469	206.8159	0.5416511	-0.337844819
13	Facet + Age + (1|Specimen)	5	178.8634	188.8634	2.9465	0.095122306	200.1059	0.5647521	0.014669673
25	Facet + Side + Tooth + (1|Specimen)	7	175.1192	189.1192	3.2023	0.04654922	204.8587	0.5619226	-0.10887323
14	Facet + Province + (1|Specimen)	5	179.3164	189.3164	3.3995	0.075841811	200.5589	0.5613674	0.004391741
18	Facet + Cusp + (1|Specimen)	6	178.0553	190.0553	4.1384	0.052416172	203.5463	0.5786615	0.010073706
15	Facet + Tooth + (1|Specimen)	6	178.2104	190.2104	4.2935	0.048503267	203.7014	0.5635709	-0.120181938

22	Facet + Side + Locality + (1|Specimen)	11	168.2197	190.2197	4.3028	0.02684953	214.9532	0.5368355	-0.020282446
20	Facet * Tooth + (1|Specimen)	8	175.6465	191.6465	5.7296	0.023655219	209.6345	0.6189871	-0.107690294
11	Facet + Genus + (1|Specimen)	7	179.134	193.134	7.2171	0.011244449	208.8734	0.5523981	-0.153766051
8	Side + (1|Specimen)	4	185.4619	193.4619	7.545	0.054632243	202.4558	0.2925542	-0.156876842
12	Facet + Locality + (1|Specimen)	10	173.5928	193.5928	7.6759	0.008939398	216.0777	0.5491782	-0.026068146
1	(1|Specimen)	3	189.588	195.588	9.6711	0.018870062	202.3334	0.2756068	-0.176567358
7	Position + (1|Specimen)	4	188.4269	196.4269	10.51	0.012404797	205.4209	0.289098	-0.146783898
5	Province + (1|Specimen)	4	188.4901	196.4901	10.5732	0.012019019	205.4841	0.2847493	-0.155394394
4	Age + (1|Specimen)	4	188.9402	196.9402	11.0233	0.009597061	205.9342	0.2798172	-0.19547345
19	Facet * Genus + (1|Specimen)	10	177.3375	197.3375	11.4206	0.001374534	219.8224	0.6077926	-0.316833749
6	Tooth + (1|Specimen)	5	187.6707	197.6707	11.7538	0.006660648	208.9132	0.2956629	-0.300850299
9	Cusp + (1|Specimen)	5	187.8301	197.8301	11.9132	0.006150469	209.0725	0.3166039	-0.156099494
2	Genus + (1|Specimen)	6	188.5667	200.5667	14.6498	0.001565505	214.0577	0.2575424	-0.336884729
3	Locality + (1|Specimen)	9	182.9133	200.9133	14.9964	0.001316411	221.1498	0.2636311	-0.243750281

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	Facet + (1|Specimen)	4	179.9106	187.9106	0	0.876783785	196.9046	0.5609396	0.001833638
17	Facet + Side + (1|Specimen)	5	175.9169	185.9169	-1.9937	0.41504706	197.1594	0.564058	0.000395286
26	Facet + Side + Position + (1|Specimen)	6	174.1765	186.1765	-1.7341	0.20273134	199.6674	0.5697726	0.04631869
16	Facet + Position + (1|Specimen)	5	178.4893	188.4893	0.5787	0.114684223	199.7318	0.5674797	0.031894919
13	Facet + Age + (1|Specimen)	5	178.8634	188.8634	0.9528	0.095122306	200.1059	0.5647521	0.014669673
23	Facet + Side + Age + (1|Specimen)	6	175.0598	187.0598	-0.8508	0.13034669	200.5508	0.5666886	-0.003717134
14	Facet + Province + (1|Specimen)	5	179.3164	189.3164	1.4058	0.075841811	200.5589	0.5613674	0.004391741
28	Facet * Side + (1|Specimen)	6	175.2032	187.2032	-0.7074	0.12133073	200.6942	0.5688015	0.011667815
24	Facet + Side + Province + (1|Specimen)	6	175.689	187.689	-0.2216	0.09516304	201.18	0.5627659	0.001459963
1	(1|Specimen)	3	189.588	195.588	7.6774	0.018870062	202.3334	0.2756068	-0.176567358
8	Side + (1|Specimen)	4	185.4619	193.4619	5.5513	0.054632243	202.4558	0.2925542	-0.156876842
27	Facet + Side + Cusp + (1|Specimen)	7	173.7488	187.7488	-0.1618	0.09236008	203.4883	0.5801597	0.029623097
18	Facet + Cusp + (1|Specimen)	6	178.0553	190.0553	2.1447	0.052416172	203.5463	0.5786615	0.010073706
15	Facet + Tooth + (1|Specimen)	6	178.2104	190.2104	2.2998	0.048503267	203.7014	0.5635709	-0.120181938
25	Facet + Side + Tooth + (1|Specimen)	7	175.1192	189.1192	1.2086	0.04654922	204.8587	0.5619226	-0.10887323
7	Position + (1|Specimen)	4	188.4269	196.4269	8.5163	0.012404797	205.4209	0.289098	-0.146783898
5	Province + (1|Specimen)	4	188.4901	196.4901	8.5795	0.012019019	205.4841	0.2847493	-0.155394394
4	Age + (1|Specimen)	4	188.9402	196.9402	9.0296	0.009597061	205.9342	0.2798172	-0.19547345
21	Facet + Side + Genus + (1|Specimen)	8	172.8279	188.8279	0.9173	0.0538469	206.8159	0.5416511	-0.337844819
11	Facet + Genus + (1|Specimen)	7	179.134	193.134	5.2234	0.011244449	208.8734	0.5523981	-0.153766051
6	Tooth + (1|Specimen)	5	187.6707	197.6707	9.7601	0.006660648	208.9132	0.2956629	-0.300850299
9	Cusp + (1|Specimen)	5	187.8301	197.8301	9.9195	0.006150469	209.0725	0.3166039	-0.156099494
20	Facet * Tooth + (1|Specimen)	8	175.6465	191.6465	3.7359	0.023655219	209.6345	0.6189871	-0.107690294
2	Genus + (1|Specimen)	6	188.5667	200.5667	12.6561	0.001565505	214.0577	0.2575424	-0.336884729
22	Facet + Side + Locality + (1|Specimen)	11	168.2197	190.2197	2.3091	0.02684953	214.9532	0.5368355	-0.020282446
12	Facet + Locality + (1|Specimen)	10	173.5928	193.5928	5.6822	0.008939398	216.0777	0.5491782	-0.026068146
19	Facet * Genus + (1|Specimen)	10	177.3375	197.3375	9.4269	0.001374534	219.8224	0.6077926	-0.316833749
3	Locality + (1|Specimen)	9	182.9133	200.9133	13.0027	0.001316411	221.1498	0.2636311	-0.243750281

GLMM FTfv

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	Facet + (1|Specimen)	4	1594.718	1602.718	0	0.71497903	1611.712	0.3282245	0.03427861
9	Cusp + (1|Specimen)	5	1596.789	1606.789	4.070305	0.09341955	1618.031	0.07550246	-0.02098141
7	Position + (1|Specimen)	4	1599.785	1607.785	5.066836	0.05676019	1616.779	0.07331006	-0.04949746
1	(1|Specimen)	3	1602.212	1608.212	5.494029	0.04584375	1614.958	0.11632573	-0.03541571
4	Age + (1|Specimen)	4	1600.353	1608.353	5.63488	0.04272624	1617.347	0.07055046	-0.02940672
5	Province + (1|Specimen)	4	1602.116	1610.116	7.398024	0.01769427	1619.11	0.13168005	-0.0518552
8	Side + (1|Specimen)	4	1602.205	1610.205	7.486319	0.01693011	1619.199	0.11640032	-0.1097383
6	Tooth + (1|Specimen)	5	1601.493	1611.493	8.774725	0.00888968	1622.736	0.09142527	-0.06552388
2	Genus + (1|Specimen)	6	1601.969	1613.969	11.250814	0.00257757	1627.46	0.07886869	-0.19244462
3	Locality + (1|Specimen)	9	1601.297	1619.297	16.578344	0.00017962	1639.533	0.11286898	-0.3511821

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
18	Facet + Cusp + (1|Specimen)	6	1589.552	1601.552	0	0.22422739	1615.043	0.2472313	0.01315291
11	Facet * Tooth + (1|Specimen)	8	1585.969	1601.969	0.4162087	0.18210007	1619.957	0.5315755	0.05007402
16	Facet + Position + (1|Specimen)	5	1592.023	1602.023	0.4706382	0.17721109	1613.266	0.2946061	0.03255427
13	Facet + Age + (1|Specimen)	5	1592.288	1602.288	0.7357013	0.15521481	1613.531	0.2928547	0.05581638

10	Facet + (1|Specimen)	4	1594.718	1602.718	1.165964	0.12517073	1611.712	0.3282245	0.03427861
14	Facet + Province + (1|Specimen)	5	1594.715	1604.715	3.1622307	0.04613378	1615.957	0.3302523	0.02073896
17	Facet + Side + (1|Specimen)	5	1594.718	1604.718	3.1658349	0.04605071	1615.961	0.3282322	-0.06395297
15	Facet + Tooth + (1|Specimen)	6	1593.318	1605.318	3.7661064	0.03411058	1618.809	0.305065	0.01489904
11	Facet + Genus + (1|Specimen)	7	1594.347	1608.347	6.7944947	0.00750383	1624.086	0.3046343	-0.10305343
19	Facet * Genus + (1|Specimen)	10	1591.292	1611.292	9.7395917	0.00172093	1633.777	0.3203135	-0.21368225
12	Facet + Locality + (1|Specimen)	10	1593.551	1613.551	11.9990064	0.00055608	1636.036	0.3237868	-0.23923576

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
22	Facet + Cusp + Age + (1|Specimen)	7	1587.208	1601.208	0	0.28107624	1616.948	0.1937563	0.02355286
18	Facet + Cusp + (1|Specimen)	6	1589.552	1601.552	0.3442341	0.23663264	1615.043	0.2472313	0.01315291
25	Facet + Cusp + Position + (1|Specimen)	6	1589.552	1601.552	0.3442341	0.23663264	1615.043	0.2472313	0.01315291
23	Facet + Cusp + Province + (1|Specimen)	7	1589.201	1603.201	1.992403	0.10379569	1618.94	0.268134	0.0092068
26	Facet + Cusp + Side + (1|Specimen)	7	1589.546	1603.546	2.3383424	0.08730911	1619.286	0.246513	-0.06414247
24	Facet + Cusp + Tooth + (1|Specimen)	8	1589.202	1605.202	3.9942354	0.03814933	1623.19	0.2412199	-0.04659754
20	Facet + Cusp + Genus + (1|Specimen)	9	1589.049	1607.049	5.8404981	0.0151557	1627.285	0.2655354	-0.09268046
21	Facet + Cusp + Locality + (1|Specimen)	12	1588.041	1612.041	10.833133	0.00124865	1639.023	0.2752093	-0.24623603

SET 4

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
22	Facet + Cusp + Age + (1|Specimen)	7	1587.208	1601.208	0	0.33435095	1616.948	0.1937563	0.02355286
31	Facet + Cusp + Age + Position + (1|Specimen)	7	1587.208	1601.208	0	0.33435095	1616.948	0.1937563	0.02355286
29	Facet + Cusp + Age + Province + (1|Specimen)	8	1587.186	1603.186	1.977798	0.12437391	1621.174	0.194012	0.0081149
32	Facet + Cusp + Age + Side + (1|Specimen)	8	1587.208	1603.208	1.999984	0.12300183	1621.196	0.1937565	-0.05450297
30	Facet + Cusp + Age + Tooth + (1|Specimen)	9	1586.74	1604.74	3.53158	0.05719126	1624.976	0.1991334	-0.02820617
27	Facet + Cusp + Age + Genus + (1|Specimen)	10	1586.627	1606.627	5.419206	0.02225548	1629.112	0.2304834	-0.07646253
28	Facet + Cusp + Age + Locality + (1|Specimen)	13	1583.835	1609.835	8.627092	0.00447562	1639.066	0.2316836	-0.18514466

SET 5

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
31	Facet + Cusp + Age + Position + (1|Specimen)	7	1587.208	1601.208	0	0.50229314	1616.948	0.1937563	0.02355286
35	Facet + Cusp + Age + Position + Province + (1|Specimen)	8	1587.186	1603.186	1.977798	0.18684607	1621.174	0.194012	0.0081149
37	Facet + Cusp + Age + Position + Side + (1|Specimen)	8	1587.208	1603.208	1.999984	0.1847848	1621.196	0.1937565	-0.05450297
36	Facet + Cusp + Age + Position + Tooth + (1|Specimen)	9	1586.74	1604.74	3.53158	0.08591804	1624.976	0.1991334	-0.02820617
33	Facet + Cusp + Age + Position + Genus + (1|Specimen)	10	1586.627	1606.627	5.419206	0.03343425	1629.112	0.2304834	-0.07646253
34	Facet + Cusp + Age + Position + Locality + (1|Specimen)	13	1583.835	1609.835	8.627092	0.0067237	1639.066	0.2316836	-0.18514466

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
22	Facet + Cusp + Age + (1|Specimen)	7	1587.208	1601.208	0	0.28107624	1616.948	0.1937563	0.02355286
31	Facet + Cusp + Age + Position + (1|Specimen)	7	1587.208	1601.208	0	0.33435095	1616.948	0.1937563	0.02355286
18	Facet + Cusp + (1|Specimen)	6	1589.552	1601.552	0.344	0.22422739	1615.043	0.2472313	0.01315291
25	Facet + Cusp + Position + (1|Specimen)	6	1589.552	1601.552	0.344	0.23663264	1615.043	0.2472313	0.01315291
11	Facet * Tooth + (1|Specimen)	8	1585.969	1601.969	0.761	0.18210007	1619.957	0.5315755	0.05007402
16	Facet + Position + (1|Specimen)	5	1592.023	1602.023	0.815	0.17721109	1613.266	0.2946061	0.03255427
13	Facet + Age + (1|Specimen)	5	1592.288	1602.288	1.08	0.15521481	1613.531	0.2928547	0.05581638
10	Facet + (1|Specimen)	4	1594.718	1602.718	1.51	0.71497903	1611.712	0.3282245	0.03427861
29	Facet + Cusp + Age + Province + (1|Specimen)	8	1587.186	1603.186	1.978	0.12437391	1621.174	0.194012	0.0081149
35	Facet + Cusp + Age + Position + Province + (1|Specimen)	8	1587.186	1603.186	1.978	0.18684607	1621.174	0.194012	0.0081149
23	Facet + Cusp + Province + (1|Specimen)	7	1589.201	1603.201	1.993	0.10379569	1618.94	0.268134	0.0092068
32	Facet + Cusp + Age + Side + (1|Specimen)	8	1587.208	1603.208	2	0.12300183	1621.196	0.1937565	-0.05450297
37	Facet + Cusp + Age + Position + Side + (1|Specimen)	8	1587.208	1603.208	2	0.1847848	1621.196	0.1937565	-0.05450297
26	Facet + Cusp + Side + (1|Specimen)	7	1589.546	1603.546	2.338	0.08730911	1619.286	0.246513	-0.06414247
14	Facet + Province + (1|Specimen)	5	1594.715	1604.715	3.507	0.04613378	1615.957	0.3302523	0.02073896
17	Facet + Side + (1|Specimen)	5	1594.718	1604.718	3.51	0.04605071	1615.961	0.3282322	-0.06395297
30	Facet + Cusp + Age + Tooth + (1|Specimen)	9	1586.74	1604.74	3.532	0.05719126	1624.976	0.1991334	-0.02820617
36	Facet + Cusp + Age + Position + Tooth + (1|Specimen)	9	1586.74	1604.74	3.532	0.08591804	1624.976	0.1991334	-0.02820617
24	Facet + Cusp + Tooth + (1|Specimen)	8	1589.202	1605.202	3.994	0.03814933	1623.19	0.2412199	-0.04659754
15	Facet + Tooth + (1|Specimen)	6	1593.318	1605.318	4.11	0.03411058	1618.809	0.305065	0.01489904
27	Facet + Cusp + Age + Genus + (1|Specimen)	10	1586.627	1606.627	5.419	0.02225548	1629.112	0.2304834	-0.07646253
33	Facet + Cusp + Age + Position + Genus + (1|Specimen)	10	1586.627	1606.627	5.419	0.03343425	1629.112	0.2304834	-0.07646253
9	Cusp + (1|Specimen)	5	1596.789	1606.789	5.581	0.09341955	1618.031	0.07550246	-0.02098141
20	Facet + Cusp + Genus + (1|Specimen)	9	1589.049	1607.049	5.841	0.0151557	1627.285	0.2655354	-0.09268046
7	Position + (1|Specimen)	4	1599.785	1607.785	6.577	0.05676019	1616.779	0.07331006	-0.04949746
1	(1|Specimen)	3	1602.212	1608.212	7.004	0.04584375	1614.958	0.11632573	-0.03541571
11	Facet + Genus + (1|Specimen)	7	1594.347	1608.347	7.139	0.00750383	1624.086	0.3046343	-0.10305343
4	Age + (1|Specimen)	4	1600.353	1608.353	7.145	0.04272624	1617.347	0.07055046	-0.02940672

28	Facet + Cusp + Age + Locality + (1|Specimen)	13	1583.835	1609.835	8.627	0.00447562	1639.066	0.2316836	-0.18514466
34	Facet + Cusp + Age + Position + Locality + (1|Specimen)	13	1583.835	1609.835	8.627	0.0067237	1639.066	0.2316836	-0.18514466
5	Province + (1|Specimen)	4	1602.116	1610.116	8.908	0.01769427	1619.11	0.13168005	-0.0518552
8	Side + (1|Specimen)	4	1602.205	1610.205	8.997	0.01693011	1619.199	0.11640032	-0.1097383
19	Facet * Genus + (1|Specimen)	10	1591.292	1611.292	10.084	0.00172093	1633.777	0.3203135	-0.21368225
6	Tooth + (1|Specimen)	5	1601.493	1611.493	10.285	0.00888968	1622.736	0.09142527	-0.06552388
21	Facet + Cusp + Locality + (1|Specimen)	12	1588.041	1612.041	10.833	0.00124865	1639.023	0.2752093	-0.24623603
12	Facet + Locality + (1|Specimen)	10	1593.551	1613.551	12.343	0.00055608	1636.036	0.3237868	-0.23923576
2	Genus + (1|Specimen)	6	1601.969	1613.969	12.761	0.00257757	1627.46	0.07886869	-0.19244462
3	Locality + (1|Specimen)	9	1601.297	1619.297	18.089	0.00017962	1639.533	0.11286898	-0.3511821

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	Facet + (1|Specimen)	4	1594.718	1602.718	0	0.71497903	1611.712	0.3282245	0.03427861
16	Facet + Position + (1|Specimen)	5	1592.023	1602.023	-0.695	0.17721109	1613.266	0.2946061	0.03255427
13	Facet + Age + (1|Specimen)	5	1592.288	1602.288	-0.43	0.15521481	1613.531	0.2928547	0.05581638
1	(1|Specimen)	3	1602.212	1608.212	5.494	0.04584375	1614.958	0.11632573	-0.03541571
18	Facet + Cusp + (1|Specimen)	6	1589.552	1601.552	-1.166	0.22422739	1615.043	0.2472313	0.01315291
25	Facet + Cusp + Position + (1|Specimen)	6	1589.552	1601.552	-1.166	0.23663264	1615.043	0.2472313	0.01315291
14	Facet + Province + (1|Specimen)	5	1594.715	1604.715	1.997	0.04613378	1615.957	0.3302523	0.02073896
17	Facet + Side + (1|Specimen)	5	1594.718	1604.718	2	0.04605071	1615.961	0.3282322	-0.06395297
7	Position + (1|Specimen)	4	1599.785	1607.785	5.067	0.05676019	1616.779	0.07331006	-0.04949746
22	Facet + Cusp + Age + (1|Specimen)	7	1587.208	1601.208	-1.51	0.28107624	1616.948	0.1937563	0.02355286
31	Facet + Cusp + Age + Position + (1|Specimen)	7	1587.208	1601.208	-1.51	0.33435095	1616.948	0.1937563	0.02355286
4	Age + (1|Specimen)	4	1600.353	1608.353	5.635	0.04272624	1617.347	0.07055046	-0.02940672
9	Cusp + (1|Specimen)	5	1596.789	1606.789	4.071	0.09341955	1618.031	0.07550246	-0.02098141
15	Facet + Tooth + (1|Specimen)	6	1593.318	1605.318	2.6	0.03411058	1618.809	0.305065	0.01489904
23	Facet + Cusp + Province + (1|Specimen)	7	1589.201	1603.201	0.483	0.10379569	1618.94	0.268134	0.0092068
5	Province + (1|Specimen)	4	1602.116	1610.116	7.398	0.01769427	1619.11	0.13168005	-0.0518552
8	Side + (1|Specimen)	4	1602.205	1610.205	7.487	0.01693011	1619.199	0.11640032	-0.1097383
26	Facet + Cusp + Side + (1|Specimen)	7	1589.546	1603.546	0.828	0.08730911	1619.286	0.246513	-0.06414247
11	Facet * Tooth + (1|Specimen)	8	1585.969	1601.969	-0.749	0.18210007	1619.957	0.5315755	0.05007402
29	Facet + Cusp + Age + Province + (1|Specimen)	8	1587.186	1603.186	0.468	0.12437391	1621.174	0.194012	0.0081149
35	Facet + Cusp + Age + Position + Province + (1|Specimen)	8	1587.186	1603.186	0.468	0.18684607	1621.174	0.194012	0.0081149
32	Facet + Cusp + Age + Side + (1|Specimen)	8	1587.208	1603.208	0.49	0.12300183	1621.196	0.1937565	-0.05450297
37	Facet + Cusp + Age + Position + Side + (1|Specimen)	8	1587.208	1603.208	0.49	0.1847848	1621.196	0.1937565	-0.05450297
6	Tooth + (1|Specimen)	5	1601.493	1611.493	8.775	0.00888968	1622.736	0.09142527	-0.06552388
24	Facet + Cusp + Tooth + (1|Specimen)	8	1589.202	1605.202	2.484	0.03814933	1623.19	0.2412199	-0.04659754
11	Facet + Genus + (1|Specimen)	7	1594.347	1608.347	5.629	0.00750383	1624.086	0.3046343	-0.10305343
30	Facet + Cusp + Age + Tooth + (1|Specimen)	9	1586.74	1604.74	2.022	0.05719126	1624.976	0.1991334	-0.02820617
36	Facet + Cusp + Age + Position + Tooth + (1|Specimen)	9	1586.74	1604.74	2.022	0.08591804	1624.976	0.1991334	-0.02820617
20	Facet + Cusp + Genus + (1|Specimen)	9	1589.049	1607.049	4.331	0.0151557	1627.285	0.2655354	-0.09268046
2	Genus + (1|Specimen)	6	1601.969	1613.969	11.251	0.00257757	1627.46	0.07886869	-0.19244462
27	Facet + Cusp + Age + Genus + (1|Specimen)	10	1586.627	1606.627	3.909	0.02225548	1629.112	0.2304834	-0.07646253
33	Facet + Cusp + Age + Position + Genus + (1|Specimen)	10	1586.627	1606.627	3.909	0.03343425	1629.112	0.2304834	-0.07646253
19	Facet * Genus + (1|Specimen)	10	1591.292	1611.292	8.574	0.00172093	1633.777	0.3203135	-0.21368225
12	Facet + Locality + (1|Specimen)	10	1593.551	1613.551	10.833	0.00055608	1636.036	0.3237868	-0.23923576
21	Facet + Cusp + Locality + (1|Specimen)	12	1588.041	1612.041	9.323	0.00124865	1639.023	0.2752093	-0.24623603
28	Facet + Cusp + Age + Locality + (1|Specimen)	13	1583.835	1609.835	7.117	0.00447562	1639.066	0.2316836	-0.18514466
34	Facet + Cusp + Age + Position + Locality + (1|Specimen)	13	1583.835	1609.835	7.117	0.0067237	1639.066	0.2316836	-0.18514466
3	Locality + (1|Specimen)	9	1601.297	1619.297	16.579	0.00017962	1639.533	0.11286898	-0.3511821

GLMM HAsfc9

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
5	Province + (1|Specimen)	4	-33.32655	-25.32655	0	0.52415229	-16.332566	6.86E-02	-0.10268085
4	Age + (1|Specimen)	4	-30.50412	-22.50412	2.822423	0.1278133	-13.510142	3.03E-02	-0.17617827
1	(1|Specimen)	3	-28.34909	-22.34909	2.977453	0.11828013	-15.603608	0.00E+00	-0.06396844
8	Side + (1|Specimen)	4	-28.70355	-20.70355	4.623001	0.05194999	-11.709564	5.05E-03	-0.08497554
10	Facet + (1|Specimen)	4	-28.68324	-20.68324	4.643306	0.05142524	-11.689259	4.76E-03	-0.07890955
7	Position + (1|Specimen)	4	-28.35351	-20.35351	4.973033	0.0436091	-11.359533	6.31E-05	-0.10927369
6	Tooth + (1|Specimen)	5	-29.63929	-19.63929	5.687258	0.03051301	-8.396812	1.83E-02	-0.13822512
9	Cusp + (1|Specimen)	5	-29.57369	-19.57369	5.752857	0.02952844	-8.331214	1.73E-02	-0.17416997
2	Genus + (1|Specimen)	6	-30.51618	-18.51618	6.810366	0.01740225	-5.02521	3.05E-02	-0.06585039
3	Locality + (1|Specimen)	9	-34.14828	-16.14828	9.178269	0.00532625	4.088179	7.95E-02	-0.38286647

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
5	Province + (1|Specimen)	4	-33.32655	-25.32655	0	0.23398295	-16.3325657	0.06863728	-0.1026808
16	Province + Side + (1|Specimen)	5	-34.22682	-24.22682	1.099723	0.13501514	-12.9843478	0.08053893	-0.1709669
18	Province + Facet + (1|Specimen)	5	-34.06634	-24.06634	1.260208	0.12460441	-12.823862	0.07842851	-0.0879206

14	Province + Tooth + (1|Specimen)	6	-35.85784	-23.85784	1.46871	0.11226847	-10.3668649	0.10171488	-0.1584847
13	Province + Age + (1|Specimen)	5	-33.70616	-23.70616	1.620382	0.10406932	-12.4636884	0.07367449	-0.1768797
20	Province * Age + (1|Specimen)	5	-33.70616	-23.70616	1.620382	0.10406932	-12.4636884	0.07367449	-0.1768797
15	Province + Position + (1|Specimen)	5	-33.6813	-23.6813	1.645245	0.1027836	-12.4388255	0.07334542	-0.150427
17	Province + Cusp + (1|Specimen)	6	-34.51536	-22.51536	2.811187	0.05737763	-9.0243878	0.08432109	-0.2126831
11	Province + Genus + (1|Specimen)	7	-34.09649	-20.09649	5.230056	0.01711954	-4.357024	0.07882539	-0.1844484
19	Province * Genus + (1|Specimen)	8	-34.10727	-18.10727	7.219272	0.00633198	-0.1193127	0.07896729	-0.2248446
12	Province + Locality + (1|Specimen)	9	-34.14828	-16.14828	9.178269	0.00237765	4.0881793	0.07950664	-0.3828665

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
5	Province + (1|Specimen)	4	-33.32655	-25.32655	0	0.52415229	-16.332566	6.86E-02	-0.10268085
16	Province + Side + (1|Specimen)	5	-34.22682	-24.22682	1.09973	0.13501514	-12.9843478	0.08053893	-0.1709669
18	Province + Facet + (1|Specimen)	5	-34.06634	-24.06634	1.26021	0.12460441	-12.823862	0.07842851	-0.0879206
14	Province + Tooth + (1|Specimen)	6	-35.85784	-23.85784	1.46871	0.11226847	-10.3668649	0.10171488	-0.1584847
13	Province + Age + (1|Specimen)	5	-33.70616	-23.70616	1.62039	0.10406932	-12.4636884	0.07367449	-0.1768797
20	Province * Age + (1|Specimen)	5	-33.70616	-23.70616	1.62039	0.10406932	-12.4636884	0.07367449	-0.1768797
15	Province + Position + (1|Specimen)	5	-33.6813	-23.6813	1.64525	0.1027836	-12.4388255	0.07334542	-0.150427
17	Province + Cusp + (1|Specimen)	6	-34.51536	-22.51536	2.81119	0.05737763	-9.0243878	0.08432109	-0.2126831
4	Age + (1|Specimen)	4	-30.50412	-22.50412	2.82243	0.1278133	-13.510142	3.03E-02	-0.17617827
1	(1|Specimen)	3	-28.34909	-22.34909	2.97746	0.11828013	-15.603608	0.00E+00	-0.06396844
8	Side + (1|Specimen)	4	-28.70355	-20.70355	4.623	0.05194999	-11.709564	5.05E-03	-0.08497554
10	Facet + (1|Specimen)	4	-28.68324	-20.68324	4.64331	0.05142524	-11.689259	4.76E-03	-0.07890955
7	Position + (1|Specimen)	4	-28.35351	-20.35351	4.97304	0.0436091	-11.359533	6.31E-05	-0.10927369
11	Province + Genus + (1|Specimen)	7	-34.09649	-20.09649	5.23006	0.01711954	-4.357024	0.07882539	-0.1844484
6	Tooth + (1|Specimen)	5	-29.63929	-19.63929	5.68726	0.03051301	-8.396812	1.83E-02	-0.13822512
9	Cusp + (1|Specimen)	5	-29.57369	-19.57369	5.75286	0.02952844	-8.331214	1.73E-02	-0.17416997
2	Genus + (1|Specimen)	6	-30.51618	-18.51618	6.81037	0.01740225	-5.02521	3.05E-02	-0.06585039
19	Province * Genus + (1|Specimen)	8	-34.10727	-18.10727	7.21928	0.00633198	-0.1193127	0.07896729	-0.2248446
3	Locality + (1|Specimen)	9	-34.14828	-16.14828	9.17827	0.00532625	4.088179	7.95E-02	-0.38286647
12	Province + Locality + (1|Specimen)	9	-34.14828	-16.14828	9.17827	0.00237765	4.0881793	0.07950664	-0.3828665

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
5	Province + (1|Specimen)	4	-33.32655	-25.32655	0	0.52415229	-16.332566	6.86E-02	-0.10268085
16	Province + Side + (1|Specimen)	5	-34.22682	-24.22682	1.09973	0.13501514	-12.9843478	0.08053893	-0.1709669
18	Province + Facet + (1|Specimen)	5	-34.06634	-24.06634	1.26021	0.12460441	-12.823862	0.07842851	-0.0879206
14	Province + Tooth + (1|Specimen)	6	-35.85784	-23.85784	1.46871	0.11226847	-10.3668649	0.10171488	-0.1584847
13	Province + Age + (1|Specimen)	5	-33.70616	-23.70616	1.62039	0.10406932	-12.4636884	0.07367449	-0.1768797
20	Province * Age + (1|Specimen)	5	-33.70616	-23.70616	1.62039	0.10406932	-12.4636884	0.07367449	-0.1768797
15	Province + Position + (1|Specimen)	5	-33.6813	-23.6813	1.64525	0.1027836	-12.4388255	0.07334542	-0.150427
17	Province + Cusp + (1|Specimen)	6	-34.51536	-22.51536	2.81119	0.05737763	-9.0243878	0.08432109	-0.2126831
4	Age + (1|Specimen)	4	-30.50412	-22.50412	2.82243	0.1278133	-13.510142	3.03E-02	-0.17617827
1	(1|Specimen)	3	-28.34909	-22.34909	2.97746	0.11828013	-15.603608	0.00E+00	-0.06396844
8	Side + (1|Specimen)	4	-28.70355	-20.70355	4.623	0.05194999	-11.709564	5.05E-03	-0.08497554
10	Facet + (1|Specimen)	4	-28.68324	-20.68324	4.64331	0.05142524	-11.689259	4.76E-03	-0.07890955
7	Position + (1|Specimen)	4	-28.35351	-20.35351	4.97304	0.0436091	-11.359533	6.31E-05	-0.10927369
11	Province + Genus + (1|Specimen)	7	-34.09649	-20.09649	5.23006	0.01711954	-4.357024	0.07882539	-0.1844484
6	Tooth + (1|Specimen)	5	-29.63929	-19.63929	5.68726	0.03051301	-8.396812	1.83E-02	-0.13822512
9	Cusp + (1|Specimen)	5	-29.57369	-19.57369	5.75286	0.02952844	-8.331214	1.73E-02	-0.17416997
2	Genus + (1|Specimen)	6	-30.51618	-18.51618	6.81037	0.01740225	-5.02521	3.05E-02	-0.06585039
19	Province * Genus + (1|Specimen)	8	-34.10727	-18.10727	7.21928	0.00633198	-0.1193127	0.07896729	-0.2248446
3	Locality + (1|Specimen)	9	-34.14828	-16.14828	9.17827	0.00532625	4.088179	7.95E-02	-0.38286647
12	Province + Locality + (1|Specimen)	9	-34.14828	-16.14828	9.17827	0.00237765	4.0881793	0.07950664	-0.3828665

GLMM HAsfc81

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
5	Province + (1|Specimen)	4	18.71871	26.71871	0	0.2304488	35.71269	0.1367503	-0.07393859
8	Side + (1|Specimen)	4	19.06478	27.06478	0.3460769	0.1938317	36.05876	0.1637596	-0.04745298
1	(1|Specimen)	3	21.224	27.224	0.5052943	0.17899925	33.96949	0.1740587	-0.07446819
4	Age + (1|Specimen)	4	19.95302	27.95302	1.2343118	0.12432173	36.947	0.1395636	-0.10406087
7	Position + (1|Specimen)	4	21.07128	29.07128	2.3525721	0.0710755	38.06526	0.1667659	-0.15154371
10	Facet + (1|Specimen)	4	21.17458	29.17458	2.4558712	0.06749767	38.16856	0.1701926	-0.10832614
2	Genus + (1|Specimen)	6	17.74088	29.74088	3.0221749	0.05085311	43.23185	0.1808906	-0.18328771
9	Cusp + (1|Specimen)	5	20.20551	30.20551	3.4868043	0.04031109	41.44799	0.1465462	-0.15313085

6	Tooth + (1|Specimen)	5	20.26528	30.26528	3.5465743	0.03912422	41.50776	0.1695391	-0.09367774
3	Locality + (1|Specimen)	9	17.07224	35.07224	8.3535331	0.00353694	55.3087	0.1206543	-0.39689218

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
16	Province + Side + (1|Specimen)	5	15.56096	25.56096	0	0.32506215	36.80343	0.12919877	-0.03912558
5	Province + (1|Specimen)	4	18.71871	26.71871	1.15775	0.18220662	35.71269	0.13675033	-0.07393859
15	Province + Position + (1|Specimen)	5	18.07249	28.07249	2.511535	0.09259628	39.31497	0.11086667	-0.15728798
13	Province + Age + (1|Specimen)	5	18.42025	28.42025	2.859289	0.07781794	39.66272	0.12651077	-0.10674359
20	Province * Age + (1|Specimen)	5	18.42025	28.42025	2.859289	0.07781794	39.66272	0.12651077	-0.10674359
18	Province + Facet + (1|Specimen)	5	18.53871	28.53871	2.977753	0.07334247	39.78119	0.12661994	-0.10459894
14	Province + Tooth + (1|Specimen)	6	17.0645	29.0645	3.503544	0.05638733	42.55547	0.13300246	-0.11602883
11	Province + Genus + (1|Specimen)	7	15.41248	29.41248	3.851527	0.04738249	45.15195	0.13518242	-0.18224066
17	Province + Cusp + (1|Specimen)	6	17.42298	29.42298	3.862021	0.04713454	42.91395	0.09001869	-0.15977962
19	Province * Genus + (1|Specimen)	8	15.40965	31.40965	5.848697	0.01745573	49.39762	0.13555318	-0.20816167
12	Province + Locality + (1|Specimen)	9	17.07224	35.07224	9.511283	0.00279652	55.3087	0.12065428	-0.39689218

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
21	Province + Side + Genus + (1|Specimen)	8	8.475592	24.47559	0	0.39445994	42.46355	0.1697818	-0.19596837
16	Province + Side + (1|Specimen)	5	15.560956	25.56096	1.085365	0.22925505	36.80343	0.1291988	-0.03912558
25	Province + Side + Position + (1|Specimen)	6	14.922826	26.92283	2.447234	0.11603598	40.4138	0.1077919	-0.10334301
23	Province + Side + Age + (1|Specimen)	6	15.246222	27.24622	2.77063	0.09871159	40.73719	0.1191187	-0.05210574
26	Province + Side + Cusp + (1|Specimen)	7	14.273694	28.27369	3.798103	0.05905482	44.01316	0.0980865	-0.10724688
27	Province + Side + Facet + (1|Specimen)	6	15.393716	27.39372	2.918124	0.08816989	40.88469	0.120068	-0.08876378
24	Province + Side + Tooth + (1|Specimen)	7	14.731763	28.73176	4.256172	0.04696636	44.47123	0.1223738	-0.10299129
22	Province + Side + Locality + (1|Specimen)	10	13.765707	33.76571	9.290115	0.00379036	56.25066	0.104608	-0.32771347

SET 4

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
21	Province + Side + Genus + (1|Specimen)	8	8.475592	24.47559	0	0.38615016	42.46355	0.1697818	-0.1959684
29	Province + Side + Genus + Age + (1|Specimen)	9	8.134258	26.13426	1.658667	0.16849278	46.37072	0.1738202	-0.1960579
33	Province + Side + Genus + Facet + (1|Specimen)	9	8.345113	26.34511	1.869521	0.15163337	46.58157	0.1713279	-0.2544998
31	Province + Side + Genus + Position + (1|Specimen)	9	8.460348	26.46035	1.984756	0.14314358	46.6968	0.1699626	-0.246713
32	Province + Side + Genus + Cusp + (1|Specimen)	10	7.475006	27.47501	2.999415	0.08618696	49.95996	0.1815646	-0.2503349
30	Province + Side + Genus + Tooth + (1|Specimen)	10	8.17792	28.17792	3.702329	0.06064651	50.66287	0.1733048	-0.2470612
28	Province + Side + Genus + Locality + (1|Specimen)	13	7.746324	33.74632	9.270732	0.00374664	62.97676	0.1783862	-0.4697886

Ranking of all models by AIC

	Model	**nPar**	**D**	**AIC**	**ΔAIC**	**w.aic**	**bic**	**r2**	**crv2**
21	Province + Side + Genus + (1|Specimen)	8	8.475592	24.47559	0	0.39445994	42.46355	0.1697818	-0.19596837
16	Province + Side + (1|Specimen)	5	15.56096	25.56096	1.08537	0.32506215	36.80343	0.12919877	-0.03912558
29	Province + Side + Genus + Age + (1|Specimen)	9	8.134258	26.13426	1.65867	0.16849278	46.37072	0.1738202	-0.1960579
33	Province + Side + Genus + Facet + (1|Specimen)	9	8.345113	26.34511	1.86952	0.15163337	46.58157	0.1713279	-0.2544998
31	Province + Side + Genus + Position + (1|Specimen)	9	8.460348	26.46035	1.98476	0.14314358	46.6968	0.1699626	-0.246713
5	Province + (1|Specimen)	4	18.71871	26.71871	2.24312	0.2304488	35.71269	0.1367503	-0.07393859
25	Province + Side + Position + (1|Specimen)	6	14.922826	26.92283	2.44724	0.11603598	40.4138	0.1077919	-0.10334301
8	Side + (1|Specimen)	4	19.06478	27.06478	2.58919	0.1938317	36.05876	0.1637596	-0.04745298
1	(1|Specimen)	3	21.224	27.224	2.74841	0.17899925	33.96949	0.1740587	-0.07446819
23	Province + Side + Age + (1|Specimen)	6	15.246222	27.24622	2.77063	0.09871159	40.73719	0.1191187	-0.05210574
27	Province + Side + Facet + (1|Specimen)	6	15.393716	27.39372	2.91813	0.08816989	40.88469	0.120068	-0.08876378
32	Province + Side + Genus + Cusp + (1|Specimen)	10	7.475006	27.47501	2.99942	0.08618696	49.95996	0.1815646	-0.2503349
4	Age + (1|Specimen)	4	19.95302	27.95302	3.47743	0.12432173	36.947	0.1395636	-0.10406087
15	Province + Position + (1|Specimen)	5	18.07249	28.07249	3.5969	0.09259628	39.31497	0.11086667	-0.15728798
30	Province + Side + Genus + Tooth + (1|Specimen)	10	8.17792	28.17792	3.70233	0.06064651	50.66287	0.1733048	-0.2470612
26	Province + Side + Cusp + (1|Specimen)	7	14.273694	28.27369	3.7981	0.05905482	44.01316	0.0980865	-0.10724688
13	Province + Age + (1|Specimen)	5	18.42025	28.42025	3.94466	0.07781794	39.66272	0.12651077	-0.10674359
20	Province * Age + (1|Specimen)	5	18.42025	28.42025	3.94466	0.07781794	39.66272	0.12651077	-0.10674359
18	Province + Facet + (1|Specimen)	5	18.53871	28.53871	4.06312	0.07334247	39.78119	0.12661994	-0.10459894
24	Province + Side + Tooth + (1|Specimen)	7	14.731763	28.73176	4.25617	0.04696636	44.47123	0.1223738	-0.10299129
14	Province + Tooth + (1|Specimen)	6	17.0645	29.0645	4.58891	0.05638733	42.55547	0.13300246	-0.11602883
7	Position + (1|Specimen)	4	21.07128	29.07128	4.59569	0.0710755	38.06526	0.1667659	-0.15154371
10	Facet + (1|Specimen)	4	21.17458	29.17458	4.69899	0.06749767	38.16856	0.1701926	-0.10832614
11	Province + Genus + (1|Specimen)	7	15.41248	29.41248	4.93689	0.04738249	45.15195	0.13518242	-0.18224066
17	Province + Cusp + (1|Specimen)	6	17.42298	29.42298	4.94739	0.04713454	42.91395	0.09001869	-0.15977962
2	Genus + (1|Specimen)	6	17.74088	29.74088	5.26529	0.05085311	43.23185	0.1808906	-0.18328771
9	Cusp + (1|Specimen)	5	20.20551	30.20551	5.72992	0.04031109	41.44799	0.1465462	-0.15313085

6	Tooth + (1|Specimen)	5	20.26528	30.26528	5.78969	0.03912422	41.50776	0.1695391	-0.09367774
19	Province * Genus + (1|Specimen)	8	15.40965	31.40965	6.93406	0.01745573	49.39762	0.13555318	-0.20816167
28	Province + Side + Genus + Locality + (1|Specimen)	13	7.746324	33.74632	9.27073	0.00374664	62.97676	0.1783862	-0.4697886
22	Province + Side + Locality + (1|Specimen)	10	13.765707	33.76571	9.29012	0.00379036	56.25066	0.104608	-0.32771347
3	Locality + (1|Specimen)	9	17.07224	35.07224	10.59665	0.00353694	55.3087	0.1206543	-0.39689218
12	Province + Locality + (1|Specimen)	9	17.07224	35.07224	10.59665	0.00279652	55.3087	0.12065428	-0.39689218

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
1	(1|Specimen)	3	21.224	27.224	2.74841	0.17899925	33.96949	0.1740587	-0.07446819
5	Province + (1|Specimen)	4	18.71871	26.71871	2.24312	0.2304488	35.71269	0.1367503	-0.07393859
8	Side + (1|Specimen)	4	19.06478	27.06478	2.58919	0.1938317	36.05876	0.1637596	-0.04745298
16	Province + Side + (1|Specimen)	5	15.56096	25.56096	1.08537	0.32506215	36.80343	0.12919877	-0.03912558
4	Age + (1|Specimen)	4	19.95302	27.95302	3.47743	0.12432173	36.947	0.1395636	-0.10406087
7	Position + (1|Specimen)	4	21.07128	29.07128	4.59569	0.0710755	38.06526	0.1667659	-0.15154371
10	Facet + (1|Specimen)	4	21.17458	29.17458	4.69899	0.06749767	38.16856	0.1701926	-0.10832614
15	Province + Position + (1|Specimen)	5	18.07249	28.07249	3.5969	0.09259628	39.31497	0.11086667	-0.15728798
13	Province + Age + (1|Specimen)	5	18.42025	28.42025	3.94466	0.07781794	39.66272	0.12651077	-0.10674359
20	Province * Age + (1|Specimen)	5	18.42025	28.42025	3.94466	0.07781794	39.66272	0.12651077	-0.10674359
18	Province + Facet + (1|Specimen)	5	18.53871	28.53871	4.06312	0.07334247	39.78119	0.12661994	-0.10459894
25	Province + Side + Position + (1|Specimen)	6	14.922826	26.92283	2.44724	0.11603598	40.4138	0.1077919	-0.10334301
23	Province + Side + Age + (1|Specimen)	6	15.246222	27.24622	2.77063	0.09871159	40.73719	0.1191187	-0.05210574
27	Province + Side + Facet + (1|Specimen)	6	15.393716	27.39372	2.91813	0.08816989	40.88469	0.120068	-0.08876378
9	Cusp + (1|Specimen)	5	20.20551	30.20551	5.72992	0.04031109	41.44799	0.1465462	-0.15313085
6	Tooth + (1|Specimen)	5	20.26528	30.26528	5.78969	0.03912422	41.50776	0.1695391	-0.09367774
21	Province + Side + Genus + (1|Specimen)	8	8.475592	24.47559	0	0.39445994	42.46355	0.1697818	-0.19596837
14	Province + Tooth + (1|Specimen)	6	17.0645	29.0645	4.58891	0.05638733	42.55547	0.13300246	-0.11602883
17	Province + Cusp + (1|Specimen)	6	17.42298	29.42298	4.94739	0.04713454	42.91395	0.09001869	-0.15977962
2	Genus + (1|Specimen)	6	17.74088	29.74088	5.26529	0.05085311	43.23185	0.1808906	-0.18328771
26	Province + Side + Cusp + (1|Specimen)	7	14.273694	28.27369	3.7981	0.05905482	44.01316	0.0980865	-0.10724688
24	Province + Side + Tooth + (1|Specimen)	7	14.731763	28.73176	4.25617	0.04696636	44.47123	0.1223738	-0.10299129
11	Province + Genus + (1|Specimen)	7	15.41248	29.41248	4.93689	0.04738249	45.15195	0.13518242	-0.18224066
29	Province + Side + Genus + Age + (1|Specimen)	9	8.134258	26.13426	1.65867	0.16849278	46.37072	0.1738202	-0.1960579
33	Province + Side + Genus + Facet + (1|Specimen)	9	8.345113	26.34511	1.86952	0.15163337	46.58157	0.1713279	-0.2544998
31	Province + Side + Genus + Position + (1|Specimen)	9	8.460348	26.46035	1.98476	0.14314358	46.6968	0.1699626	-0.246713
19	Province * Genus + (1|Specimen)	8	15.40965	31.40965	6.93406	0.01745573	49.39762	0.13555318	-0.20816167
32	Province + Side + Genus + Cusp + (1|Specimen)	10	7.475006	27.47501	2.99942	0.08618696	49.95996	0.1815646	-0.2503349
30	Province + Side + Genus + Tooth + (1|Specimen)	10	8.17792	28.17792	3.70233	0.06064651	50.66287	0.1733048	-0.2470612
3	Locality + (1|Specimen)	9	17.07224	35.07224	10.59665	0.00353694	55.3087	0.1206543	-0.39689218
12	Province + Locality + (1|Specimen)	9	17.07224	35.07224	10.59665	0.00279652	55.3087	0.12065428	-0.39689218
22	Province + Side + Locality + (1|Specimen)	10	13.765707	33.76571	9.29012	0.00379036	56.25066	0.104608	-0.32771347
28	Province + Side + Genus + Locality + (1|Specimen)	13	7.746324	33.74632	9.27073	0.00374664	62.97676	0.1783862	-0.4697886

Supplementary S5 – Detailed results of GLMM for Hypoplasia variables

RDATA

H: Hypo ; D: Defect ; M: Multiple; L: Localisation; S: Severity

Hypo: 0 = absence of defect, 1 = presence

Defect: 0 = no defect, 1 = LEH, 2 = Pits, 3 = Aplasia, 4 = LEH + Pits, 5 = LEH + Aplasia, 6 = Pits + Aplasia, 7 = LEH + Pits + Aplasia (not observed), 8 = Other, 9 = Pits + Other, 10 = LEH + Pits + Other (not observed), 11 = Pits + Other (not observed)

Localisation: 0 = no defect, 1 = Labial, 2 = Lingual, 3 = Both, 4 = Distal

Severity: 0 = no defect, 1 = Very light, 2 = Light, 3 = Middle, 4 = Severe

Locality	Province	Age	Specimen	Genus	Species	Tooth	Position	Side	Wear	H	D	M	L	S
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P2	Upper	Left	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P2	Upper	Right	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P3	Upper	Left	Upper	0	0	0	0	0

Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P3	Upper	Right	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P4	Upper	Left	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	P4	Upper	Right	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M1	Upper	Left	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M1	Upper	Right	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M2	Upper	Left	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M2	Upper	Right	Upper	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M3	Upper	Left	Average	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS7-3142	*Acerorhinus*	*sp.*	M3	Upper	Right	Average	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2837	*Ceratotherium*	*neumayri*	D3	Upper	Left	Under	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2837	*Ceratotherium*	*neumayri*	M1	Upper	Left	Under	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2837	*Ceratotherium*	*neumayri*	M1	Upper	Right	Under	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2912	*Ceratotherium*	*neumayri*	D1	Upper	Right	Under	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2912	*Ceratotherium*	*neumayri*	D2	Upper	Right	Average	0	0	0	0	0
Gorna Sushitsa	West	Turolian	GS8-2912	*Ceratotherium*	*neumayri*	D3	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-1054	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	1	3	1	2	3
Hadjidimovo	West	Turolian	HD-597	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	1	3	1	2	3
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P2	Upper	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P2	Upper	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P3	Upper	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P3	Upper	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P4	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	P4	Upper	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M1	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M1	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M2	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M3	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-598	*Dihoplus*	*pikermiensis*	M3	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-605	*Dihoplus*	*pikermiensis*	P3	Upper	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-605	*Dihoplus*	*pikermiensis*	P4	Upper	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-605	*Dihoplus*	*pikermiensis*	M1	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-605	*Dihoplus*	*pikermiensis*	M2	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-605	*Dihoplus*	*pikermiensis*	M3	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-606	*Dihoplus*	*pikermiensis*	M1	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-606	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-606	*Dihoplus*	*pikermiensis*	M3	Upper	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-607	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-607	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-607	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-607	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P2	Lower	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P2	Lower	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P3	Lower	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P3	Lower	Right	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P4	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	P4	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M1	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M1	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M2	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M2	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M3	Lower	Left	Average	0	0	0	0	0

Hadjidimovo	West	Turolian	HD-615	*Dihoplus*	*pikermiensis*	M3	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-617	*Dihoplus*	*pikermiensis*	D1	Lower	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-617	*Dihoplus*	*pikermiensis*	D2	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-617	*Dihoplus*	*pikermiensis*	D3	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-617	*Dihoplus*	*pikermiensis*	D4	Lower	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D3	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D4	Lower	Right	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D1	Lower	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D1	Lower	Right	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D2	Lower	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D2	Lower	Right	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D3	Lower	Left	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D3	Lower	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D4	Lower	Left	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-618	*Dihoplus*	*pikermiensis*	D4	Lower	Right	Under	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-671	*Dihoplus*	*pikermiensis*	P4	Upper	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-671	*Dihoplus*	*pikermiensis*	P2	Upper	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-671	*Dihoplus*	*pikermiensis*	P3	Upper	Left	Upper	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-673	*Dihoplus*	*pikermiensis*	P2	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-676	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-677	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Hadjidimovo	West	Turolian	HD-678	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-1050	*Acerorhinus*	sp.	P3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	D1	Upper	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P2	Upper	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P3	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P4	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	P4	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M1	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M1	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-595	*Acerorhinus*	sp.	M3	Upper	Right	Average	1	2	1	2	2
Kalimantsi	West	Turolian	K-600	*Acerorhinus*	sp.	M2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-600	*Acerorhinus*	sp.	M3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	P2	Lower	Right	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	P3	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	P3	Lower	Right	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	P4	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	P4	Lower	Right	Upper	1	1	1	2	2
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M1	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M1	Lower	Right	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M2	Lower	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M2	Lower	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M3	Lower	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-608	*Acerorhinus*	sp.	M3	Lower	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-609	*Acerorhinus*	sp.	D3	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-609	*Acerorhinus*	sp.	D4	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-609	*Acerorhinus*	sp.	M1	Lower	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-609	*Acerorhinus*	sp.	D4	Lower	Right	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-609	*Acerorhinus*	sp.	M1	Lower	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-697	*Acerorhinus*	sp.	D2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-697	*Acerorhinus*	sp.	D3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-697	*Acerorhinus*	sp.	D4	Upper	Left	Other	0	0	0	0	0
Kalimantsi	West	Turolian	K-699/700	*Acerorhinus*	sp.	P3	Upper	Left	Average	1	1	1	2	2
Kalimantsi	West	Turolian	K-699/700	*Acerorhinus*	sp.	P4	Upper	Left	Average	0	0	0	0	0

Kalimantsi	West	Turolian	K-701	*Acerorhinus*	sp.	M3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-702	*Acerorhinus*	sp.	P3	Upper	Right	Average	1	8	1	3	2
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D1	Upper	Left	Other	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D1	Upper	Right	Other	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D3	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D4	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-593	*Ceratotherium*	*neumayri*	D4	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P3	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P3	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P4	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	P4	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M3	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-594	*Ceratotherium*	*neumayri*	M3	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-603	*Ceratotherium*	*neumayri*	D1	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-603	*Ceratotherium*	*neumayri*	D2	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-603	*Ceratotherium*	*neumayri*	D3	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-611	*Ceratotherium*	*neumayri*	D3	Lower	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-611	*Ceratotherium*	*neumayri*	D4	Lower	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-611	*Ceratotherium*	*neumayri*	D4	Lower	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-686/687	*Ceratotherium*	*neumayri*	D2	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-686/687	*Ceratotherium*	*neumayri*	D3	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-601	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-601	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-602	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-602	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-602	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-602	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-604	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-604	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-604	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-688/689	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-688/689	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-690	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	0	0	0	0	0
Kalimantsi	West	Turolian	K-692	*Dihoplus*	*pikermiensis*	M1	Lower	Left	Upper	0	0	0	0	0
Kalimantsi	West	Turolian	K-695	*Dihoplus*	*pikermiensis*	P2	Upper	Left	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-696	*Dihoplus*	*pikermiensis*	P2	Upper	Right	Average	0	0	0	0	0
Kalimantsi	West	Turolian	K-703	*Dihoplus*	*pikermiensis*	P3	Upper	Left	Average	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M1	Lower	Left	Upper	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M1	Lower	Right	Upper	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M2	Lower	Left	Upper	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M2	Lower	Right	Upper	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M3	Lower	Left	Average	0	0	0	0	0
Kocherinovo	West	Turolian	KCH3-2959	*Acerorhinus*	*sp.*	M3	Lower	Right	Average	0	0	0	0	0
Slatino	West	Turolian	/	*Acerorhinus*	*sp.*	D1	Upper	Right	Upper	0	0	0	0	0
Slatino	West	Turolian	/	*Acerorhinus*	*sp.*	P2	Upper	Right	Average	0	0	0	0	0
Slatino	West	Turolian	/	*Acerorhinus*	*sp.*	P3	Upper	Right	Average	0	0	0	0	0
Slatino	West	Turolian	/	*Dihoplus*	cf. *schleiermacheri*	P2	Upper	Right	Average	0	0	0	0	0
Slatino	West	Turolian	/	*Dihoplus*	cf. *schleiermacheri*	P3	Upper	Right	Upper	0	0	0	0	0

Slatino	West	Turolian	/	*Dihoplus*	cf. *schleiermacheri*	P4	Upper	Right	Upper	0	0	0	0	0
Slatino	West	Turolian	/	*Dihoplus*	cf. *schleiermacheri*	M1	Upper	Right	Average	0	0	0	0	0
Slatino	West	Turolian	/	*Dihoplus*	cf. *schleiermacheri*	M2	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P2	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P2	Lower	Right	Upper	1	1	1	2	2
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P3	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P4	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	P4	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M1	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M2	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M2	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M3	Lower	Left	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2468	*Ceratotherium*	*neumayri*	M3	Lower	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	P2	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	P3	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	P4	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	P4	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	M1	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	M2	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	M2	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2800	*Ceratotherium*	*neumayri*	M3	Lower	Left	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2469	*Dihoplus*	*pikermiensis*	P3	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P2	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P3	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P3	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P4	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P4	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M1	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M1	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M2	Lower	Left	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M2	Lower	Right	Upper	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M3	Lower	Left	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	M3	Lower	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2470	*Dihoplus*	*pikermiensis*	P4	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2471	*Dihoplus*	*pikermiensis*	M1	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2472	*Dihoplus*	*pikermiensis*	M2	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2473	*Dihoplus*	*pikermiensis*	M3	Upper	Right	Average	0	0	0	0	0
Strumyani 2	West	Turolian	FM-2474	*Dihoplus*	*pikermiensis*	M3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	D1	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	D2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	D4	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	M1	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	P2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	P3	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	D4	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	M1	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Ceratotherium*	*neumayri*	M2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	P2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	P3	Lower	Left	Average	1	9	2	1	3
Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	P3	Lower	Right	Average	1	9	1	1	2
Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	P4	Lower	Left	Average	1	9	3	1	4
Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	P4	Lower	Right	Average	1	1	2	1	4

Pentalophos-1	West	Vallesian	PNT119	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT13	*Ceratotherium*	*neumayri*	D1	Lower	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT13	*Ceratotherium*	*neumayri*	D2	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT14	*Ceratotherium*	*neumayri*	D3	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT14	*Ceratotherium*	*neumayri*	D4	Lower	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	D1	Upper	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	P2	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	P2	Upper	Right	Other	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	P3	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	P3	Upper	Right	Other	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	P4	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	D4	Upper	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	M2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	M2	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT143	*Ceratotherium*	*neumayri*	M3	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D1	Upper	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D2	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D3	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D3	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D4	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	D4	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	M1	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT144	*Ceratotherium*	*neumayri*	M1	Upper	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT26	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P3	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P4	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	P4	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M1	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M3	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT34	*Ceratotherium*	*neumayri*	M3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT48	*Ceratotherium*	*neumayri*	D2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT48	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT48	*Ceratotherium*	*neumayri*	D4	Lower	Right	Average	1	1	1	1	1
Pentalophos-1	West	Vallesian	PNT89	*Ceratotherium*	*neumayri*	D1	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT89	*Ceratotherium*	*neumayri*	D2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT89	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT89	*Ceratotherium*	*neumayri*	D4	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P3	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P3	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P4	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	P4	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	M1	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	M2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT?	*Chilotherium*	*kiliasi*	M3	Lower	Left	Other	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P2	Lower	Left	Upper	1	8	2	3	4
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P2	Lower	Right	Upper	1	3	1	2	4
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P3	Lower	Left	Upper	1	1	1	1	3
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P3	Lower	Right	Upper	1	1	1	1	3
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P4	Lower	Left	Average	1	1	3	1	4

Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	P4	Lower	Right	Average	1	1	3	1	4
Pentalophos-1	West	Vallesian	PNT12	*Chilotherium*	*kiliasi*	M1	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT122	*Chilotherium*	*kiliasi*	M2	Upper	Right	Average	1	8	1	2	1
Pentalophos-1	West	Vallesian	PNT122	*Chilotherium*	*kiliasi*	M3	Upper	Right	Average	1	1	2	2	2
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	D1	Upper	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	P2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	P3	Upper	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	P4	Upper	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	M1	Upper	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	M2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT135	*Chilotherium*	*kiliasi*	M3	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P3	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P3	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P4	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	P4	Lower	Right	Upper	1	8	1	1	1
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M1	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M1	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M2	Lower	Left	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M3	Lower	Left	Upper	1	1	1	1	2
Pentalophos-1	West	Vallesian	PNT142	*Chilotherium*	*kiliasi*	M3	Lower	Right	Upper	1	1	1	1	2
Pentalophos-1	West	Vallesian	PNT3	*Chilotherium*	*kiliasi*	D2	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT3	*Chilotherium*	*kiliasi*	D3	Lower	Right	Upper	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT3	*Chilotherium*	*kiliasi*	D4	Lower	Right	Average	1	1	1	3	4
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	P2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	P3	Upper	Left	Average	1	1	1	1	2
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	P4	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	M1	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	M2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT32	*Chilotherium*	*kiliasi*	M3	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT56	*Chilotherium*	*kiliasi*	D2	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT56	*Chilotherium*	*kiliasi*	D3	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT56	*Chilotherium*	*kiliasi*	D4	Upper	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D1	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D2	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D2	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D3	Upper	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D3	Upper	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D4	Upper	Left	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D4	Upper	Right	Under	1	1	1	1	3
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D1	Lower	Right	Under	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D2	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D2	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D3	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D3	Lower	Right	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D4	Lower	Left	Average	0	0	0	0	0
Pentalophos-1	West	Vallesian	PNT95	*Chilotherium*	*kiliasi*	D4	Lower	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1854/0003/0008	*Ceratotherium*	*neumayri*	D2	Lower	Left	Under	0	0	0	0	0
Pikermi	West	Turolian	1854/0003/0008	*Ceratotherium*	*neumayri*	D3	Lower	Right	Under	0	0	0	0	0
Pikermi	West	Turolian	1854/0003/0010a	*Ceratotherium*	*neumayri*	D3	Upper	Left	Under	0	0	0	0	0
Pikermi	West	Turolian	1854/0003/0010b	*Ceratotherium*	*neumayri*	M3	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1854/0003/0010c	*Ceratotherium*	*neumayri*	D3	Lower	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1860/0032/0059	*Dihoplus*	*pikermiensis*	D3	Lower	Left	Under	0	0	0	0	0
Pikermi	West	Turolian	1860/0032/0059	*Dihoplus*	*pikermiensis*	D4	Lower	Left	Under	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	0	0	0	0	0

Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0018	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1863/0001/0019	*Dihoplus*	*pikermiensis*	M2	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	0	0	0	0	0
Pikermi	West	Turolian	1973/1613/11	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	1	9	2	3	4
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P2	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P2	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P3	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P3	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P4	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P4	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P2	Lower	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P2	Lower	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P3	Lower	Right	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P4	Lower	Left	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	P4	Lower	Right	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	M1	Lower	Right	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	M2	Lower	Left	Under	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO?	*Ceratotherium*	*neumayri*	M2	Lower	Right	Under	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P2	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P2	Upper	Right	Average	0	0	0	0	0

Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P3	Upper	Left	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P3	Upper	Right	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P4	Upper	Left	Upper	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	P4	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M2	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M2	Upper	Right	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M3	Upper	Left	Average	0	0	0	0	0
Ravin des zouaves-5 (RZO)	West	Turolian	RZO26	*Ceratotherium*	*neumayri*	M3	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0040	*Ceratotherium*	*neumayri*	D2	Lower	Right	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0040	*Ceratotherium*	*neumayri*	D3	Lower	Right	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0043	*Ceratotherium*	*neumayri*	D2	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D1	Lower	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D1	Lower	Right	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D2	Lower	Left	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D2	Lower	Right	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D3	Lower	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D4	Lower	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0044	*Ceratotherium*	*neumayri*	D4	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D1	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D1	Upper	Right	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D2	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D2	Upper	Right	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D3	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D3	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D4	Upper	Left	Average	1	1	1	2	3
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	D4	Upper	Right	Average	1	1	1	2	3
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	M1	Upper	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0045	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D1	Lower	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D2	Lower	Left	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D2	Lower	Right	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D3	Lower	Left	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D3	Lower	Right	Upper	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D4	Lower	Left	Average	1	1	1	1	3
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	D4	Lower	Right	Average	1	1	1	1	3
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	M1	Lower	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0439	*Ceratotherium*	*neumayri*	M1	Lower	Right	Under	1	8	1	3	2
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P2	Upper	Left	Average	1	1	1	1	2
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P2	Upper	Right	Average	1	1	1	1	2
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P3	Upper	Left	Average	1	1	2	3	2
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P3	Upper	Right	Average	1	1	2	3	2

Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P4	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	P4	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M2	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M2	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M3	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	Sam-1	*Ceratotherium*	*neumayri*	M3	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	P2	Lower	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	P3	Lower	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	P3	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	D4	Lower	Left	Upper	1	1	1	1	2
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	D4	Lower	Right	Upper	1	1	1	1	3
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	M1	Lower	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	M1	Lower	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	M2	Lower	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0033	*Chilotherium*	*schlosseri*	M2	Lower	Right	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	1	8	1	1	3
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	1	3	1	1	2
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	1	1	1	1	3
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0030	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D1	Upper	Left	Average	1	1	1	1	3
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D1	Upper	Right	Average	0	0	0	0	0
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D2	Upper	Left	Average	1	8	1	1	2
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D2	Upper	Right	Average	1	2	1	2	2
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D3	Upper	Left	Average	1	2	1	2	2
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D3	Upper	Right	Average	1	2	1	2	2
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D4	Upper	Left	Under	0	0	0	0	0
Samos	East	Turolian	1911/0005/0041	*Dihoplus*	*pikermiensis*	D4	Upper	Right	Under	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	P2	Upper	Left	Under	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	P2	Upper	Right	Under	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	D3	Upper	Left	Upper	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	D3	Upper	Right	Upper	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	D4	Upper	Left	Average	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	D4	Upper	Right	Average	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	M1	Upper	Left	Average	1	1	1	1	3
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	M1	Upper	Right	Average	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	M2	Upper	Left	Under	0	0	0	0	0
Xirochori	West	Vallesian	XIR	*Chilotherium*	sp.	M2	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar1949	*Ceratotherium*	*neumayri*	M2	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar1959	*Ceratotherium*	*neumayri*	M1	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2035	*Ceratotherium*	*neumayri*	M2	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2057	*Ceratotherium*	*neumayri*	D4	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2058	*Ceratotherium*	*neumayri*	D2	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2110	*Ceratotherium*	*neumayri*	M3	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2117	*Ceratotherium*	*neumayri*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2117	*Ceratotherium*	*neumayri*	P3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2117	*Ceratotherium*	*neumayri*	P4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2117	*Ceratotherium*	*neumayri*	M1	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2142	*Ceratotherium*	*neumayri*	M2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2143	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	1	1	3	1	2
Maragheh	East	Turolian	Mar2144	*Ceratotherium*	*neumayri*	M1	Lower	Left	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2145	*Ceratotherium*	*neumayri*	P4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2166	*Ceratotherium*	*neumayri*	P3	Lower	Right	Under	1	1	1	1	2
Maragheh	East	Turolian	Mar2168	*Ceratotherium*	*neumayri*	D2	Lower	Left	Average	0	0	0	0	0

Maragheh	East	Turolian	Mar2169	*Ceratotherium*	*neumayri*	D3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2169	*Ceratotherium*	*neumayri*	D4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2173	*Ceratotherium*	*neumayri*	M2	Lower	Left	Average	1	1	2	1	1
Maragheh	East	Turolian	Mar2176	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2176	*Ceratotherium*	*neumayri*	P4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2176	*Ceratotherium*	*neumayri*	M2	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2176	*Ceratotherium*	*neumayri*	P4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2176	*Ceratotherium*	*neumayri*	P3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2199	*Ceratotherium*	*neumayri*	D1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2200	*Ceratotherium*	*neumayri*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2272	*Ceratotherium*	*neumayri*	M3	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2320	*Ceratotherium*	*neumayri*	D2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M3	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M3	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	P4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M1	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M1	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M3	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	2014-0424-0001a+b	*Ceratotherium*	*neumayri*	M3	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0385	*Ceratotherium*	*neumayri*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0385	*Ceratotherium*	*neumayri*	M2	Lower	Left	Average	1	8	1	1	3
Maragheh	East	Turolian	Mar0385	*Ceratotherium*	*neumayri*	M3	Lower	Left	Average	1	1	1	2	2
Maragheh	East	Turolian	Mar1948	*Chilotherium*	*persiae*	D2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1948	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1948	*Chilotherium*	*persiae*	D4	Lower	Right	Average	1	1	2	1	2
Maragheh	East	Turolian	Mar1960	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1962	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0

Maragheh	East	Turolian	Mar1962	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1965	*Chilotherium*	*persiae*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar1969	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	1	1	1	1	2
Maragheh	East	Turolian	Mar1970	*Chilotherium*	*persiae*	P4	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1971	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar1972	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D4	Lower	Left	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2032	*Chilotherium*	*persiae*	D4	Lower	Right	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2034	*Chilotherium*	*persiae*	D2	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2034	*Chilotherium*	*persiae*	D2	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2034	*Chilotherium*	*persiae*	D3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2034	*Chilotherium*	*persiae*	D4	Upper	Left	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar2034	*Chilotherium*	*persiae*	D4	Upper	Right	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar2070	*Chilotherium*	*persiae*	D2	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2070	*Chilotherium*	*persiae*	D2	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2070	*Chilotherium*	*persiae*	D3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2072	*Chilotherium*	*persiae*	P2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2118	*Chilotherium*	*persiae*	P2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2118	*Chilotherium*	*persiae*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2118	*Chilotherium*	*persiae*	P3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2118	*Chilotherium*	*persiae*	P3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D4	Lower	Left	Average	1	1	1	1	1
Maragheh	East	Turolian	Mar2119	*Chilotherium*	*persiae*	D4	Lower	Right	Average	1	1	1	1	1
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	D1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2123	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	D4	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	D4	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	M2	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2124	*Chilotherium*	*persiae*	M2	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0

Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	P4	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	P4	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	M1	Upper	Right	Average	1	1	1	2	2
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2125	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	D1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	P3	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	P4	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	P4	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M3	Upper	Left	Average	1	1	1	2	2
Maragheh	East	Turolian	Mar2127	*Chilotherium*	*persiae*	M3	Upper	Right	Average	1	1	1	2	2
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	D2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	D3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	D4	Lower	Left	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	D4	Lower	Right	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2128	*Chilotherium*	*persiae*	M1	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2131	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2131	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2131	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2131	*Chilotherium*	*persiae*	M3	Lower	Right	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2132	*Chilotherium*	*persiae*	D4	Lower	Left	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	P4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M2	Lower	Left	Average	1	8	1	1	1
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M3	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2133	*Chilotherium*	*persiae*	M3	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	D1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P3	Upper	Right	Upper	0	0	0	0	0

Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P4	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2134	*Chilotherium*	*persiae*	M3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	D2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	D3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	D4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	D4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	M1	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2135	*Chilotherium*	*persiae*	M1	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2138	*Chilotherium*	*persiae*	D2	Upper	Right	Average	1	3	1	2	4
Maragheh	East	Turolian	Mar2138	*Chilotherium*	*persiae*	D2	Upper	Left	Average	1	3	1	2	4
Maragheh	East	Turolian	Mar2138	*Chilotherium*	*persiae*	D3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2172	*Chilotherium*	*persiae*	P3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2174	*Chilotherium*	*persiae*	M2	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2196	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2196	*Chilotherium*	*persiae*	M2	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2198	*Chilotherium*	*persiae*	P2	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2202	*Chilotherium*	*persiae*	P3	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2202	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2203	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2203	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2203	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2205	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2206	*Chilotherium*	*persiae*	P2	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2221	*Chilotherium*	*persiae*	M1	Upper	Right	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar2273	*Chilotherium*	*persiae*	M3	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2279	*Chilotherium*	*persiae*	D3	Lower	Right	Upper	1	1	1	1	2
Maragheh	East	Turolian	Mar2283	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2284	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2286	*Chilotherium*	*persiae*	D4	Upper	Left	Average	1	1	1	3	2
Maragheh	East	Turolian	Mar2288	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2289	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2312	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2313	*Chilotherium*	*persiae*	M2	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2314	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2315	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2316	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2317	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2318	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2319	*Chilotherium*	*persiae*	D4	Upper	Left	Average	1	1	1	3	4
Maragheh	East	Turolian	Mar2321	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0

Maragheh	East	Turolian	Mar2322	*Chilotherium*	*persiae*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2323	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2324	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2325	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2326	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2327	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2331	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2334	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2337	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2340	*Chilotherium*	*persiae*	D4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2341	*Chilotherium*	*persiae*	P2	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2343	*Chilotherium*	*persiae*	P2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2344	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2348	*Chilotherium*	*persiae*	D3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2353	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2353	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	D1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	D1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar4111	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	P2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	P4	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	P4	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M3	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar ?	*Chilotherium*	*persiae*	M3	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	D1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P3	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M1	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M3	Upper	Left	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M3	Upper	Right	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P4	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0

Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0382	*Chilotherium*	*persiae*	M3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	D1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M3	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M3	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P4	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M2	Lower	Left	Upper	1	1	5	1	2
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	1	1	4	1	2
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M3	Lower	Left	Under	1	1	3	1	2
Maragheh	East	Turolian	Mar0383	*Chilotherium*	*persiae*	M3	Lower	Right	Under	1	1	3	1	2
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	P4	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M2	Upper	Left	Average	1	9	1	2	2
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M2	Upper	Right	Average	1	9	1	2	2
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0384	*Chilotherium*	*persiae*	M3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D4	Upper	Left	Average	1	3	1	2	3
Maragheh	East	Turolian	Mar0386	*Chilotherium*	*persiae*	D4	Upper	Right	Average	1	3	1	2	3
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M3	Upper	Right	Average	1	1	1	1	2
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0

Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M1	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0387	*Chilotherium*	*persiae*	M3	Lower	Right	Upper	1	9	2	1	3
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P2	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P3	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P3	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P4	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	P4	Lower	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	M1	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	M2	Lower	Left	Upper	1	1	1	1	2
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	M2	Lower	Right	Upper	1	1	1	1	2
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	M3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0388	*Chilotherium*	*persiae*	M3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0390	*Chilotherium*	*persiae*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0390	*Chilotherium*	*persiae*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0390	*Chilotherium*	*persiae*	P4	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0390	*Chilotherium*	*persiae*	M1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar0391	*Chilotherium*	*persiae*	M1	Upper	Right	Under	1	9	1	2	3
Maragheh	East	Turolian	Mar0393	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0393	*Chilotherium*	*persiae*	M2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0393	*Chilotherium*	*persiae*	M3	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0394	*Chilotherium*	*persiae*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0394	*Chilotherium*	*persiae*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0399	*Chilotherium*	*persiae*	D1	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar0399	*Chilotherium*	*persiae*	D2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0399	*Chilotherium*	*persiae*	D3	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar0399	*Chilotherium*	*persiae*	D4	Upper	Right	Average	1	1	1	2	3
Maragheh	East	Turolian	Mar2307-08	*Chilotherium*	*persiae*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2307-08	*Chilotherium*	*persiae*	P4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2307-08	*Chilotherium*	*persiae*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	NMB-Mgh2	*Chilotherium*	*persiae*	P2	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	NMB-Mgh2	*Chilotherium*	*persiae*	P3	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	NMB-Mgh2	*Chilotherium*	*persiae*	P4	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	NMB-Mgh2	*Chilotherium*	*persiae*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	NMB-Mgh2	*Chilotherium*	*persiae*	M2	Upper	Right	Average	1	1	1	2	4
Maragheh	East	Turolian	Mar2175	*Iranotherium*	*morgani*	P3	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2208	*Iranotherium*	*morgani*	D1	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2209	*Iranotherium*	*morgani*	D1	Lower	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2209	*Iranotherium*	*morgani*	D2	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2209	*Iranotherium*	*morgani*	D3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2210	*Iranotherium*	*morgani*	D1	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2210	*Iranotherium*	*morgani*	D2	Lower	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2210	*Iranotherium*	*morgani*	D3	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2215	*Iranotherium*	*morgani*	D1	Upper	Left	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2215	*Iranotherium*	*morgani*	D1	Upper	Right	Under	0	0	0	0	0
Maragheh	East	Turolian	Mar2224	*Iranotherium*	*morgani*	D2	Lower	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2227	*Iranotherium*	*morgani*	M2	Lower	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	Mar2227	*Iranotherium*	*morgani*	M3	Lower	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0425/0001	*Iranotherium*	*morgani*	M1	Upper	Left	Upper	0	0	0	0	0
Maragheh	East	Turolian	2014/0425/0001	*Iranotherium*	*morgani*	M2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0425/0001	*Iranotherium*	*morgani*	M3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	Mar2345	*Persiatherium*	*rodleri*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	D1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	P2	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	P2	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	P3	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	P3	Upper	Right	Average	0	0	0	0	0

Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	D4	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	D4	Upper	Right	Upper	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	M1	Upper	Left	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	M1	Upper	Right	Average	0	0	0	0	0
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	M2	Upper	Left	Average	1	1	1	2	1
Maragheh	East	Turolian	2014/0426/0001	*Persiatherium*	*rodleri*	M2	Upper	Right	Average	1	1	1	2	1

Excluded specimens

Museum	Drawer	Local number	Exposition	Locality	Age	Number	Genus	Species	Tooth	Position	Side	Wear
NHMW	18-PIKERMI	L244-01-0	A4672	Pikermi	MN11-12	1863/0001/0018	*Dihoplus*	*pikermiensis*	Skull			
									M1 (emerging)	Upper	Left	1
									M1 (emerging)	Upper	Right	1
NHMW	13-PIKERMI	L239-05-0	/	Pikermi	MN11-12	1860/0032/0045	*Ceratotherium*	*neumayri*	Maxilla			
									D3	Upper	Left	5/6
									D4	Upper	Left	5/6
									M1	Upper	Left	1/2
NHMW	SAMOS L443	11072-03-0	/	Samos	MN11-12	1911/0005/0040	*Ceratotherium*	*neumayri*	Hemi-mandibule			
									d1 (emerging)	Lower	Right	1/2
									d4 (emerging)	Lower	Right	1
NHMW	SAMOS L443	11072-04-0	/	Samos	MN11-12	1911/0005/0043	*Ceratotherium*	*neumayri*	Hemi-mandibule			
									d4 (emerging)	Lower	Right	1
NHMW	SAMOS L443	11072-02-0	/	Samos	MN11-12	2009/0088/0002	*Chilotherium*	*sp.*	P4	Upper	Right	8
NHMW	SAMOS F1	/	A4734	Samos	MN11-12	1911/0005/0044	*Ceratotherium*	*neumayri*	Mandibule			
									m1 (emerging)	Lower	Left	1
									m1 (emerging)	Lower	Right	1
NHMW	SAMOS F1	11072-01-0	A4733	Samos	MN11-12	1911/0005/0032	*Chilotherium*	*schlosseri*	Mandibule			
									i2	Lower	Left	/
									i2	Lower	Right	/
									p2	Lower	Right	8
									p3	Lower	Left	9
									p3	Lower	Right	10
									p4	Lower	Left	9
									p4	Lower	Right	9
									m1	Lower	Left	9
									m1	Lower	Right	10
									m2	Lower	Left	10
									m2	Lower	Right	10
NHMW	SAMOS F1	/	A4730	Samos	MN11-12	1911/0005/0128	*Chilotherium*	*schlosseri*	Skull			
									D1	Upper	Left	6
									P2	Upper	Left	7
									P3	Upper	Left	7
									P4	Upper	Left	7
									M1	Upper	Left	8
									M2	Upper	Left	7
									M2	Upper	Right	7
									M3	Upper	Left	8
									M3	Upper	Right	6
NHMW	Maragha L459	Mar0389	/	Maragha	MN11	/	*Iranotherium*	*morgani*	Mandibule			
									p3	Lower	Left	9
									p3	Lower	Right	9
									p4	Lower	Left	8
									m1	Lower	Left	9

									m1	Lower	Right	9
									m2	Lower	Left	8
									m2	Lower	Right	8
									m3	Lower	Left	6/7
									m3	Lower	Right	6/7
NHMW	Maragha F2	Mar4111	A4820	Maragha	MN11	/	*Chilotherium*	*persiae*	Skull			
									M3 (emerging)	Upper	Left	1
NHMW	Maragha L472	Mar1948	/	Maragha	MN11	/	*Chilotherium*	*persiae*	Hemi-mandibule			
									m1 (emerging)	Lower	Right	1/2
NHMW	Maragha L472	Mar1949	/	Maragha	MN11	/	*Ceratotherium*	*neumayri*	Hemi-mandibule			
									m3 (emerging)	Lower	Right	1
NHMW	Maragha L474	Mar2034	/	Maragha	MN11	/	*Chilotherium*	*persiae*	Maxillary			
									M1 (emerging)	Upper	Left	2
NHMW	Maragha L480	Mar2210	/	Maragha	MN11	/	*Iranotherium*	*morgani*	Hemi-mandibule			
									d4 (emerging)	Lower	Right	2
NHMW	Maragha L480	Mar2209	/	Maragha	MN11	/	*Iranotherium*	*morgani*	Hemi-mandibule			
									d4 (emerging)	Lower	Left	2
NHMW	Maragha F2	Mar2132	/	Maragha	MN11	/	*Chilotherium*	*persiae*	Skull + Mandibule			
									M1 (emerging)	Upper	Left	1/2
									M1 (emerging)	Upper	Right	1/2
		Mar2132/1							m1 (emerging)	Lower	Left	1
NHMW	Maragha F2	Mar2135	/	Maragha	MN11	/	*Chilotherium*	*persiae*	Mandibule			
									m2 (emerging)	Lower	Right	1
NHMW	Maragha F1	Mar2125	A4819	Maragha	MN11	/	*Chilotherium*	*persiae*	Skull			
									M3 (emerging)	Upper	Left	1
									M3 (emerging)	Upper	Right	1
NHMW	Maragha F1	Mar2126	/	Maragha	MN11	2014/0426/0001	*Persiatherium*	*rodleri*	Skull			
									M3 (emerging)	Upper	Left	1
									M3 (emerging)	Upper	Right	1
NHMW	Maragha F1	Mar2128	/	Maragha	MN11	/	*Chilotherium*	*persiae*	Mandibule			
									m1 (fragments)	Lower	Left	5
NMHNA	/	/	/	Kalimantsi	Turolian (Upper Miocene)	K-697	*Acerorhinus*	*sp.*	Maxillary			
									D4	Upper	Left	?
AUTh	/	/	/	Pentalophos 1 (Greece)	Upper Miocene	PNT31	*Chilotherium*	*kiliasi*	Skull (too worn excluded) + Mandible			

GLMM Hypo

Bottom-up approach for model selection

SET 1

model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2

6	(1|Specimen) + Tooth	11	494.0038	516.0038	0	1.00E+00	568.7566	0.4502803	-151.77268
4	(1|Specimen) + Province	3	555.9991	561.9991	45.99523	1.03E-10	576.3862	0.2517496	-94.19995
9	(1|Specimen) + Wear	5	553.0346	563.0346	47.03075	6.13E-11	587.0131	0.2823176	-120.90813
3	(1|Specimen) + Locality	13	537.093	563.093	47.08919	5.95E-11	625.4372	0.2246928	-436.88942
7	(1|Specimen) + Position	3	560.8284	566.8284	50.8246	9.20E-12	581.2156	0.2601609	-92.0852
1	(1|Specimen)	2	563.2644	567.2644	51.26056	7.39E-12	576.8558	0.2552651	-90.39121
5	(1|Specimen) + Age	3	561.5186	567.5186	51.51478	6.51E-12	581.9057	0.253382	-89.80428
2	Genus + (1|Specimen)	7	553.5811	567.5811	51.57724	6.31E-12	601.151	0.2593721	-198.1955
8	(1|Specimen) + Side	3	562.3879	568.3879	52.38403	4.22E-12	582.775	0.2559591	-91.46664

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
19	(1|Specimen) + Tooth * Province	21	455.8035	497.8035	0	9.93E-01	598.5134	0.439491	-1662.6974
16	(1|Specimen) + Tooth + Wear	14	481.1702	509.1702	11.36668	3.38E-03	576.3101	0.4607627	-166.2088
12	(1|Specimen) + Tooth + Province	12	485.6147	509.6147	11.81112	2.71E-03	567.1631	0.4472027	-162.2315
11	(1|Specimen) + Tooth + Locality	22	469.7192	513.7192	15.91569	3.47E-04	619.2248	0.4081552	-662.6548
14	(1|Specimen) + Tooth + Position	12	491.5845	515.5845	17.78097	1.37E-04	573.133	0.4439702	-155.7136
6	(1|Specimen) + Tooth	11	494.0038	516.0038	18.20029	1.11E-04	568.7566	0.4502803	-151.7727
10	(1|Specimen) + Tooth + Genus	16	484.6984	516.6984	18.89486	7.83E-05	593.4297	0.4354622	-249.0437
17	(1|Specimen) + Tooth * Genus	54	408.7943	516.7943	18.99078	7.47E-05	775.7624	0.5986598	-3160.3052
15	(1|Specimen) + Tooth + Side	12	492.9724	516.9724	19.16881	6.83E-05	574.5208	0.4525452	-150.0895
13	(1|Specimen) + Tooth + Age	12	493.0202	517.0202	19.21661	6.67E-05	574.5686	0.4375502	-146.7975
18	(1|Specimen) + Tooth * Locality	92	379.91	563.91	66.10644	4.39E-15	1005.1149	0.5243044	-3230.6653

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
22	(1|Specimen) + Tooth * Province + Age	22	445.1253	489.1253	0	0.85604176	594.6308	0.3979473	-1326.614
25	(1|Specimen) + Tooth * Province + Wear	24	445.5017	493.5017	4.376383	0.09597884	608.5986	0.4379658	-1205.496
26	(1|Specimen) + Tooth * Province * Genus	78	341.4279	497.4279	8.302568	0.01347768	871.4929	0.6540226	-3809.538
19	(1|Specimen) + Tooth * Province	21	455.8035	497.8035	8.678258	0.01116954	598.5134	0.439491	-1662.697
23	(1|Specimen) + Tooth * Province + Position	22	454.0212	498.0212	8.895947	0.01001762	603.5268	0.4240829	-1094.591
24	(1|Specimen) + Tooth * Province + Side	22	454.5456	498.5456	9.420266	0.00770744	604.0511	0.4428575	-1505.863
21	(1|Specimen) + Tooth * Province + Locality	31	437.5454	499.5454	10.420068	0.00467526	648.2122	0.4032175	-1898.245
20	(1|Specimen) + Tooth * Province + Genus	26	450.7711	502.7711	13.645787	0.00093186	627.4594	0.4264697	-1280.469

SET 4

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
31	(1|Specimen) + Tooth * Province + Age + Wear	25	434.8565	484.8565	0	0.71850622	604.7492	0.4240046	-1178.326
22	(1|Specimen) + Tooth * Province + Age	22	445.1253	489.1253	4.268752	0.0850125	594.6308	0.3979473	-1326.614
27	(1|Specimen) + Tooth * Province + Age + Genus	27	435.376	489.376	4.519492	0.07499551	618.8601	0.402272	-1449.775
29	(1|Specimen) + Tooth * Province + Age + Position	23	443.5822	489.5822	4.725673	0.06764935	599.8834	0.4248306	-1263.862
30	(1|Specimen) + Tooth * Province + Age + Side	23	444.056	490.056	5.199459	0.05338046	600.3572	0.3965137	-1329.649
28	(1|Specimen) + Tooth * Province + Age + Locality	31	437.5816	499.5816	14.725078	0.00045595	648.2485	0.4004243	-1896.093

SET 5

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
34	(1|Specimen) + Tooth * Province + Age + Wear + Position	26	432.2587	484.2587	0	0.37995635	608.947	0.4339518	-1111.423
31	(1|Specimen) + Tooth * Province + Age + Wear	25	434.8565	484.8565	0.5978686	0.28177872	604.7492	0.4240046	-1178.326
35	(1|Specimen) + Tooth * Province + Age + Wear + Side	26	433.7886	485.7886	1.5299018	0.17681527	610.4769	0.4135763	-1267.263
32	(1|Specimen) + Tooth * Province + Age + Wear + Genus	30	425.9932	485.9932	1.7345347	0.15961889	629.8644	0.4068286	-1526.031
33	(1|Specimen) + Tooth * Province + Age + Wear + Locality	34	426.9293	494.9293	10.6706422	0.00183077	657.9833	0.4114714	-1892.058

SET 6

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
36	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus	31	421.7306	483.7306	0	0.44060638	632.3974	0.4191026	-1310.666
34	(1|Specimen) + Tooth * Province + Age + Wear + Position	26	432.2587	484.2587	0.5280951	0.33835794	608.947	0.4339518	-1111.423
38	(1|Specimen) + Tooth * Province + Age + Wear + Position + Side	27	431.132	485.132	1.4014214	0.2186432	614.616	0.428264	-1165.413
37	(1|Specimen) + Tooth * Province + Age + Wear + Position + Locality	35	424.1622	494.1622	10.431647	0.00239248	662.0119	0.4183263	-1833.938

SET 7

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
36	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus	31	421.4016	483.4016	0	0.62894031	632.0685	0.4397746	-1138.966
40	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side	32	420.4735	484.4735	1.07193	0.36799573	637.9361	0.4344221	-1230.966
39	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Locality	40	415.0781	495.0781	11.67648	0.00183272	686.9063	0.4314801	-2274.148
41	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side + Locality	41	413.8736	495.8736	12.47201	0.00123125	692.4975	0.4324249	-2319.985

Ranking of all models by AIC

Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2

36	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus	31	421.7306	483.7306	0	0.44060638	632.3974	0.4191026	-1310.666
34	(1|Specimen) + Tooth * Province + Age + Wear + Position	26	432.2587	484.2587	0.5281	0.33835794	608.947	0.4339518	-1111.423
40	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side	32	420.4735	484.4735	0.7429	0.36799573	637.9361	0.4344221	-1230.966
31	(1|Specimen) + Tooth * Province + Age + Wear	25	434.8565	484.8565	1.1259	0.71850622	604.7492	0.4240046	-1178.326
38	(1|Specimen) + Tooth * Province + Age + Wear + Position + Side	27	431.132	485.132	1.4014	0.2186432	614.616	0.428264	-1165.413
35	(1|Specimen) + Tooth * Province + Age + Wear + Side	26	433.7886	485.7886	2.058	0.17681527	610.4769	0.4135763	-1267.263
32	(1|Specimen) + Tooth * Province + Age + Wear + Genus	30	425.9932	485.9932	2.2626	0.15961889	629.8644	0.4068286	-1526.031
22	(1|Specimen) + Tooth * Province + Age	22	445.1253	489.1253	5.3947	0.85604176	594.6308	0.3979473	-1326.614
27	(1|Specimen) + Tooth * Province + Age + Genus	27	435.376	489.376	5.6454	0.07499551	618.8601	0.402272	-1449.775
29	(1|Specimen) + Tooth * Province + Age + Position	23	443.5822	489.5822	5.8516	0.06764935	599.8834	0.4248306	-1263.862
30	(1|Specimen) + Tooth * Province + Age + Side	23	444.056	490.056	6.3254	0.05338046	600.3572	0.3965137	-1329.649
25	(1|Specimen) + Tooth * Province + Wear	24	445.5017	493.5017	9.7711	0.09597884	608.5986	0.4379658	-1205.496
37	(1|Specimen) + Tooth * Province + Age + Wear + Position + Locality	35	424.1622	494.1622	10.4316	0.00239248	662.0119	0.4183263	-1833.938
33	(1|Specimen) + Tooth * Province + Age + Wear + Locality	34	426.9293	494.9293	11.1987	0.00183077	657.9833	0.4114714	-1892.058
39	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Locality	40	415.0781	495.0781	11.3475	0.00183272	686.9063	0.4314801	-2274.148
41	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side + Locality	41	413.8736	495.8736	12.143	0.00123125	692.4975	0.4324249	-2319.985
26	(1|Specimen) + Tooth * Province * Genus	78	341.4279	497.4279	13.6973	0.01347768	871.4929	0.6540226	-3809.538
19	(1|Specimen) + Tooth * Province	21	455.8035	497.8035	14.0729	9.93E-01	598.5134	0.439491	-1662.6974
23	(1|Specimen) + Tooth * Province + Position	22	454.0212	498.0212	14.2906	0.01001762	603.5268	0.4240829	-1094.591
24	(1|Specimen) + Tooth * Province + Side	22	454.5456	498.5456	14.815	0.00770744	604.0511	0.4428575	-1505.863
21	(1|Specimen) + Tooth * Province + Locality	31	437.5454	499.5454	15.8148	0.00467526	648.2122	0.4032175	-1898.245
28	(1|Specimen) + Tooth * Province + Age + Locality	31	437.5816	499.5816	15.851	0.00045595	648.2485	0.4004243	-1896.093
20	(1|Specimen) + Tooth * Province + Genus	26	450.7711	502.7711	19.0405	0.00093186	627.4594	0.4264697	-1280.469
16	(1|Specimen) + Tooth + Wear	14	481.1702	509.1702	25.4396	3.38E-03	576.3101	0.4607627	-166.2088
12	(1|Specimen) + Tooth + Province	12	485.6147	509.6147	25.8841	2.71E-03	567.1631	0.4472027	-162.2315
11	(1|Specimen) + Tooth + Locality	22	469.7192	513.7192	29.9886	3.47E-04	619.2248	0.4081552	-662.6548
14	(1|Specimen) + Tooth + Position	12	491.5845	515.5845	31.8539	1.37E-04	573.133	0.4439702	-155.7136
6	(1|Specimen) + Tooth	11	494.0038	516.0038	32.2732	1.00E+00	568.7566	0.4502803	-151.77268
10	(1|Specimen) + Tooth + Genus	16	484.6984	516.6984	32.9678	7.83E-05	593.4297	0.4354622	-249.0437
17	(1|Specimen) + Tooth * Genus	54	408.7943	516.7943	33.0637	7.47E-05	775.7624	0.5986598	-3160.3052
15	(1|Specimen) + Tooth + Side	12	492.9724	516.9724	33.2418	6.83E-05	574.5208	0.4525452	-150.0895
13	(1|Specimen) + Tooth + Age	12	493.0202	517.0202	33.2896	6.67E-05	574.5686	0.4375502	-146.7975
4	(1|Specimen) + Province	3	555.9991	561.9991	78.2685	1.03E-10	576.3862	0.2517496	-94.19995
9	(1|Specimen) + Wear	5	553.0346	563.0346	79.304	6.13E-11	587.0131	0.2823176	-120.90813
3	(1|Specimen) + Locality	13	537.093	563.093	79.3624	5.95E-11	625.4372	0.2246928	-436.88942
18	(1|Specimen) + Tooth * Locality	92	379.91	563.91	80.1794	4.39E-15	1005.1149	0.5243044	-3230.6653
7	(1|Specimen) + Position	3	560.8284	566.8284	83.0978	9.20E-12	581.2156	0.2601609	-92.0852
1	(1|Specimen)	2	563.2644	567.2644	83.5338	7.39E-12	576.8558	0.2552651	-90.39121
5	(1|Specimen) + Age	3	561.5186	567.5186	83.788	6.51E-12	581.9057	0.253382	-89.80428
2	Genus + (1|Specimen)	7	553.5811	567.5811	83.8505	6.31E-12	601.151	0.2593721	-198.1955
8	(1|Specimen) + Side	3	562.3879	568.3879	84.6573	4.22E-12	582.775	0.2559591	-91.46664

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
12	(1|Specimen) + Tooth + Province	12	485.6147	509.6147	0	2.71E-03	567.1631	0.4472027	-162.2315
6	(1|Specimen) + Tooth	11	494.0038	516.0038	6.3891	1.00E+00	568.7566	0.4502803	-151.77268
14	(1|Specimen) + Tooth + Position	12	491.5845	515.5845	5.9698	1.37E-04	573.133	0.4439702	-155.7136
15	(1|Specimen) + Tooth + Side	12	492.9724	516.9724	7.3577	6.83E-05	574.5208	0.4525452	-150.0895
13	(1|Specimen) + Tooth + Age	12	493.0202	517.0202	7.4055	6.67E-05	574.5686	0.4375502	-146.7975
16	(1|Specimen) + Tooth + Wear	14	481.1702	509.1702	-0.4445	3.38E-03	576.3101	0.4607627	-166.2088
4	(1|Specimen) + Province	3	555.9991	561.9991	52.3844	1.03E-10	576.3862	0.2517496	-94.19995
1	(1|Specimen)	2	563.2644	567.2644	57.6497	7.39E-12	576.8558	0.2552651	-90.39121
7	(1|Specimen) + Position	3	560.8284	566.8284	57.2137	9.20E-12	581.2156	0.2601609	-92.0852
5	(1|Specimen) + Age	3	561.5186	567.5186	57.9039	6.51E-12	581.9057	0.253382	-89.80428
8	(1|Specimen) + Side	3	562.3879	568.3879	58.7732	4.22E-12	582.775	0.2559591	-91.46664
9	(1|Specimen) + Wear	5	553.0346	563.0346	53.4199	6.13E-11	587.0131	0.2823176	-120.90813
10	(1|Specimen) + Tooth + Genus	16	484.6984	516.6984	7.0837	7.83E-05	593.4297	0.4354622	-249.0437
22	(1|Specimen) + Tooth * Province + Age	22	445.1253	489.1253	-20.4894	0.85604176	594.6308	0.3979473	-1326.614
19	(1|Specimen) + Tooth * Province	21	455.8035	497.8035	-11.8112	9.93E-01	598.5134	0.439491	-1662.6974
29	(1|Specimen) + Tooth * Province + Age + Position	23	443.5822	489.5822	-20.0325	0.06764935	599.8834	0.4248306	-1263.862
30	(1|Specimen) + Tooth * Province + Age + Side	23	444.056	490.056	-19.5587	0.05338046	600.3572	0.3965137	-1329.649
2	Genus + (1|Specimen)	7	553.5811	567.5811	57.9664	6.31E-12	601.151	0.2593721	-198.1955
23	(1|Specimen) + Tooth * Province + Position	22	454.0212	498.0212	-11.5935	0.01001762	603.5268	0.4240829	-1094.591
24	(1|Specimen) + Tooth * Province + Side	22	454.5456	498.5456	-11.0691	0.00770744	604.0511	0.4428575	-1505.863

31	(1|Specimen) + Tooth * Province + Age + Wear	25	434.8565	484.8565	-24.7582	0.71850622	604.7492	0.4240046	-1178.326
25	(1|Specimen) + Tooth * Province + Wear	24	445.5017	493.5017	-16.113	0.09597884	608.5986	0.4379658	-1205.496
34	(1|Specimen) + Tooth * Province + Age + Wear + Position	26	432.2587	484.2587	-25.356	0.33835794	608.947	0.4339518	-1111.423
35	(1|Specimen) + Tooth * Province + Age + Wear + Side	26	433.7886	485.7886	-23.8261	0.17681527	610.4769	0.4135763	-1267.263
38	(1|Specimen) + Tooth * Province + Age + Wear + Position + Side	27	431.132	485.132	-24.4827	0.2186432	614.616	0.428264	-1165.413
27	(1|Specimen) + Tooth * Province + Age + Genus	27	435.376	489.376	-20.2387	0.07499551	618.8601	0.402272	-1449.775
11	(1|Specimen) + Tooth + Locality	22	469.7192	513.7192	4.1045	3.47E-04	619.2248	0.4081552	-662.6548
3	(1|Specimen) + Locality	13	537.093	563.093	53.4783	5.95E-11	625.4372	0.2246928	-436.88942
20	(1|Specimen) + Tooth * Province + Genus	26	450.7711	502.7711	-6.8436	0.00093186	627.4594	0.4264697	-1280.469
32	(1|Specimen) + Tooth * Province + Age + Wear + Genus	30	425.9932	485.9932	-23.6215	0.15961889	629.8644	0.4068286	-1526.031
36	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus	31	421.7306	483.7306	-25.8841	0.44060638	632.3974	0.4191026	-1310.666
40	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side	32	420.4735	484.4735	-25.1412	0.36799573	637.9361	0.4344221	-1230.966
21	(1|Specimen) + Tooth * Province + Locality	31	437.5454	499.5454	-10.0693	0.00467526	648.2122	0.4032175	-1898.245
28	(1|Specimen) + Tooth * Province + Age + Locality	31	437.5816	499.5816	-10.0331	0.00045595	648.2485	0.4004243	-1896.093
33	(1|Specimen) + Tooth * Province + Age + Wear + Locality	34	426.9293	494.9293	-14.6854	0.00183077	657.9833	0.4114714	-1892.058
37	(1|Specimen) + Tooth * Province + Age + Wear + Position + Locality	35	424.1622	494.1622	-15.4525	0.00239248	662.0119	0.4183263	-1833.938
39	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Locality	40	415.0781	495.0781	-14.5366	0.00183272	686.9063	0.4314801	-2274.148
41	(1|Specimen) + Tooth * Province + Age + Wear + Position + Genus + Side + Locality	41	413.8736	495.8736	-13.7411	0.00123125	692.4975	0.4324249	-2319.985
17	(1|Specimen) + Tooth * Genus	54	408.7943	516.7943	7.1796	7.47E-05	775.7624	0.5986598	-3160.3052
26	(1|Specimen) + Tooth * Province * Genus	78	341.4279	497.4279	-12.1868	0.01347768	871.4929	0.6540226	-3809.538
18	(1|Specimen) + Tooth * Locality	92	379.91	563.91	54.2953	4.39E-15	1005.1149	0.5243044	-3230.6653

GLMM Defect

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
5	(1|Specimen) + Age	3	2279.099	2285.099	0	4.43E-01	2299.486	0.2187339	-1.178469
1	(1|Specimen)	2	2282.694	2286.694	1.595102	2.00E-01	2296.286	0.2208436	-1.185007
4	(1|Specimen) + Province	3	2282.184	2288.184	3.085242	9.48E-02	2302.571	0.2197686	-1.185639
7	(1|Specimen) + Position	3	2282.516	2288.516	3.416814	8.03E-02	2302.903	0.2205353	-1.188707
8	(1|Specimen) + Side	3	2282.56	2288.56	3.46087	7.86E-02	2302.947	0.2205577	-1.188549
9	(1|Specimen) + Wear	5	2278.951	2288.951	3.851541	6.46E-02	2312.929	0.2246782	-1.193544
6	(1|Specimen) + Tooth	11	2268.202	2290.202	5.103113	3.46E-02	2342.955	0.2556307	-1.209527
2	(1|Specimen) + Genus	7	2281.36	2295.36	10.26066	2.62E-03	2328.93	0.2226919	-1.187008
3	(1|Specimen) + Locality	13	2270.765	2296.765	11.666042	1.30E-03	2359.109	0.2068629	-1.180964

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
12	(1|Specimen) + Age + Province	4	2275.727	2283.727	0	0.31345864	2302.91	0.2140645	-1.171657
17	(1|Specimen) + Age * Province	4	2275.727	2283.727	0	3.13E-01	2302.91	0.2140645	-1.171657
5	(1|Specimen) + Age	3	2279.099	2285.099	1.372045	0.15784995	2299.486	0.2187339	-1.178469
16	(1|Specimen) + Age + Wear	6	2274.903	2286.903	3.176241	6.40E-02	2315.678	0.2215205	-1.184321
15	(1|Specimen) + Age + Side	4	2278.985	2286.985	3.257699	6.15E-02	2306.168	0.2184506	-1.181946
14	(1|Specimen) + Age + Position	4	2279.069	2287.069	3.342116	5.89E-02	2306.252	0.2186484	-1.181623
13	(1|Specimen) + Age + Tooth	12	2264.58	2288.58	4.85307	2.77E-02	2346.129	0.2533113	-1.203033
10	(1|Specimen) + Age + Genus	8	2277.934	2293.934	10.207053	1.90E-03	2332.3	0.220272	-1.181072
18	(1|Specimen) + Age * Genus	9	2277.934	2295.934	12.206743	7.01E-04	2339.095	0.2202643	-1.182601
11	(1|Specimen) + Age + Locality	13	2270.768	2296.768	13.040766	4.62E-04	2359.112	0.2068695	-1.180506

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
12	(1|Specimen) + Age + Province	4	2275.727	2283.727	0	0.26001036	2302.91	0.2140645	-1.171657
17	(1|Specimen) + Age * Province	4	2275.727	2283.727	0	0.26001035	2302.91	0.2140645	-1.171657
19	(1|Specimen) + Age + Province + Wear	7	2271.526	2285.526	1.799	0.10576689	2319.096	0.2178175	-1.180083
20	(1|Specimen) + Age * Province + Wear	7	2271.526	2285.526	1.799	0.10576688	2319.096	0.2178175	-1.180083
21	(1|Specimen) + Age + Province + Side	5	2275.627	2285.627	1.900	0.10053913	2309.606	0.2137852	-1.175208
22	(1|Specimen) + Age * Province + Side	5	2275.627	2285.627	1.900	0.10053912	2309.606	0.2137852	-1.175208

23	(1|Specimen) + Age + Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
24	(1|Specimen) + Age * Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
25	(1|Specimen) + Age + Province * Genus	11	2263.912	2285.912	2.185	0.08719931	2338.665	0.2032597	-1.171758
26	(1|Specimen) + Age * Province * Genus	11	2263.912	2285.912	2.185	0.08719935	2338.665	0.2032667	-1.171758
27	(1|Specimen) + Age + Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
28	(1|Specimen) + Age * Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
29	(1|Specimen) + Age + Province + Tooth	13	2261.577	2287.577	3.850	0.03792197	2349.922	0.2481967	-1.198544
30	(1|Specimen) + Age * Province + Tooth	13	2261.577	2287.577	3.850	0.03792197	2349.922	0.2481967	-1.198544
31	(1|Specimen) + Age + Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764
32	(1|Specimen) + Age * Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
12	(1|Specimen) + Age + Province	4	2275.727	2283.727	0	0.26001036	2302.91	0.2140645	-1.171657
17	(1|Specimen) + Age * Province	4	2275.727	2283.727	0	0.26001035	2302.91	0.2140645	-1.171657
5	(1|Specimen) + Age	3	2279.099	2285.099	1.372	4.43E-01	2299.486	0.2187339	-1.178469
19	(1|Specimen) + Age + Province + Wear	7	2271.526	2285.526	1.799	0.10576689	2319.096	0.2178175	-1.180083
20	(1|Specimen) + Age * Province + Wear	7	2271.526	2285.526	1.799	0.10576688	2319.096	0.2178175	-1.180083
21	(1|Specimen) + Age + Province + Side	5	2275.627	2285.627	1.9	0.10053913	2309.606	0.2137852	-1.175208
22	(1|Specimen) + Age * Province + Side	5	2275.627	2285.627	1.9	0.10053912	2309.606	0.2137852	-1.175208
23	(1|Specimen) + Age + Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
24	(1|Specimen) + Age * Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
25	(1|Specimen) + Age + Province * Genus	11	2263.912	2285.912	2.185	0.08719931	2338.665	0.2032597	-1.171758
26	(1|Specimen) + Age * Province * Genus	11	2263.912	2285.912	2.185	0.08719935	2338.665	0.2032667	-1.171758
1	(1|Specimen)	2	2282.694	2286.694	2.967	2.00E-01	2296.286	0.2208436	-1.185007
16	(1|Specimen) + Age + Wear	6	2274.903	2286.903	3.176	6.40E-02	2315.678	0.2215205	-1.184321
27	(1|Specimen) + Age + Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
28	(1|Specimen) + Age * Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
15	(1|Specimen) + Age + Side	4	2278.985	2286.985	3.258	6.15E-02	2306.168	0.2184506	-1.181946
14	(1|Specimen) + Age + Position	4	2279.069	2287.069	3.342	5.89E-02	2306.252	0.2186484	-1.181623
29	(1|Specimen) + Age + Province + Tooth	13	2261.577	2287.577	3.85	0.03792197	2349.922	0.2481967	-1.198544
30	(1|Specimen) + Age * Province + Tooth	13	2261.577	2287.577	3.85	0.03792197	2349.922	0.2481967	-1.198544
4	(1|Specimen) + Province	3	2282.184	2288.184	4.457	9.48E-02	2302.571	0.2197686	-1.185639
7	(1|Specimen) + Position	3	2282.516	2288.516	4.789	8.03E-02	2302.903	0.2205353	-1.188707
8	(1|Specimen) + Side	3	2282.56	2288.56	4.833	7.86E-02	2302.947	0.2205577	-1.188549
13	(1|Specimen) + Age + Tooth	12	2264.58	2288.58	4.853	2.77E-02	2346.129	0.2533113	-1.203033
9	(1|Specimen) + Wear	5	2278.951	2288.951	5.224	6.46E-02	2312.929	0.2246782	-1.193544
6	(1|Specimen) + Tooth	11	2268.202	2290.202	6.475	3.46E-02	2342.955	0.2556307	-1.209527
10	(1|Specimen) + Age + Genus	8	2277.934	2293.934	10.207	1.90E-03	2332.3	0.220272	-1.181072
2	(1|Specimen) + Genus	7	2281.36	2295.36	11.633	2.62E-03	2328.93	0.2226919	-1.187008
18	(1|Specimen) + Age * Genus	9	2277.934	2295.934	12.207	7.01E-04	2339.095	0.2202643	-1.182601
3	(1|Specimen) + Locality	13	2270.765	2296.765	13.038	1.30E-03	2359.109	0.2068629	-1.180964
31	(1|Specimen) + Age + Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764
32	(1|Specimen) + Age * Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764
11	(1|Specimen) + Age + Locality	13	2270.768	2296.768	13.041	4.62E-04	2359.112	0.2068695	-1.180506

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
1	(1|Specimen)	2	2282.694	2286.694	2.967	2.00E-01	2296.286	0.2208436	-1.185007
5	(1|Specimen) + Age	3	2279.099	2285.099	1.372	4.43E-01	2299.486	0.2187339	-1.178469
4	(1|Specimen) + Province	3	2282.184	2288.184	4.457	9.48E-02	2302.571	0.2197686	-1.185639
7	(1|Specimen) + Position	3	2282.516	2288.516	4.789	8.03E-02	2302.903	0.2205353	-1.188707
12	(1|Specimen) + Age + Province	4	2275.727	2283.727	0	0.26001036	2302.91	0.2140645	-1.171657
17	(1|Specimen) + Age * Province	4	2275.727	2283.727	0	0.26001035	2302.91	0.2140645	-1.171657
8	(1|Specimen) + Side	3	2282.56	2288.56	4.833	7.86E-02	2302.947	0.2205577	-1.188549
15	(1|Specimen) + Age + Side	4	2278.985	2286.985	3.258	6.15E-02	2306.168	0.2184506	-1.181946
14	(1|Specimen) + Age + Position	4	2279.069	2287.069	3.342	5.89E-02	2306.252	0.2186484	-1.181623
21	(1|Specimen) + Age + Province + Side	5	2275.627	2285.627	1.9	0.10053913	2309.606	0.2137852	-1.175208
22	(1|Specimen) + Age * Province + Side	5	2275.627	2285.627	1.9	0.10053912	2309.606	0.2137852	-1.175208
23	(1|Specimen) + Age + Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
24	(1|Specimen) + Age * Province + Position	5	2275.725	2285.725	1.998	0.09574509	2309.704	0.2140418	-1.174387
9	(1|Specimen) + Wear	5	2278.951	2288.951	5.224	6.46E-02	2312.929	0.2246782	-1.193544
16	(1|Specimen) + Age + Wear	6	2274.903	2286.903	3.176	6.40E-02	2315.678	0.2215205	-1.184321
19	(1|Specimen) + Age + Province + Wear	7	2271.526	2285.526	1.799	0.10576689	2319.096	0.2178175	-1.180083
20	(1|Specimen) + Age * Province + Wear	7	2271.526	2285.526	1.799	0.10576688	2319.096	0.2178175	-1.180083
2	(1|Specimen) + Genus	7	2281.36	2295.36	11.633	2.62E-03	2328.93	0.2226919	-1.187008
27	(1|Specimen) + Age + Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
28	(1|Specimen) + Age * Province + Genus	9	2268.93	2286.93	3.203	0.05242358	2330.091	0.2080906	-1.180501
10	(1|Specimen) + Age + Genus	8	2277.934	2293.934	10.207	1.90E-03	2332.3	0.220272	-1.181072
25	(1|Specimen) + Age + Province * Genus	11	2263.912	2285.912	2.185	0.08719931	2338.665	0.2032597	-1.171758
26	(1|Specimen) + Age * Province * Genus	11	2263.912	2285.912	2.185	0.08719935	2338.665	0.2032667	-1.171758
18	(1|Specimen) + Age * Genus	9	2277.934	2295.934	12.207	7.01E-04	2339.095	0.2202643	-1.182601
6	(1|Specimen) + Tooth	11	2268.202	2290.202	6.475	3.46E-02	2342.955	0.2556307	-1.209527

13	(1|Specimen) + Age + Tooth	12	2264.58	2288.58	4.853	2.77E-02	2346.129	0.2533113	-1.203033
29	(1|Specimen) + Age + Province + Tooth	13	2261.577	2287.577	3.85	0.03792197	2349.922	0.2481967	-1.198544
30	(1|Specimen) + Age * Province + Tooth	13	2261.577	2287.577	3.85	0.03792197	2349.922	0.2481967	-1.198544
3	(1|Specimen) + Locality	13	2270.765	2296.765	13.038	1.30E-03	2359.109	0.2068629	-1.180964
31	(1|Specimen) + Age + Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764
32	(1|Specimen) + Age * Province + Locality	13	2270.766	2296.766	13.039	0.00038331	2359.11	0.2068445	-1.180764
11	(1|Specimen) + Age + Locality	13	2270.768	2296.768	13.041	4.62E-04	2359.112	0.2068695	-1.180506

GLMM Multiple

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	(1|Specimen) + Defect	7	1871.914	1885.914	0	1.00E+00	1919.484	0.75460573	-5.420304
1	(1|Specimen)	2	1973.868	1977.868	91.95404	1.08E-20	1987.459	0	-5.657312
7	(1|Specimen) + Position	3	1972.442	1978.442	92.52811	8.09E-21	1992.829	0.00838487	-5.678861
4	(1|Specimen) + Province	3	1972.738	1978.738	92.82413	6.97E-21	1993.125	0.00660821	-5.661937
5	(1|Specimen) + Age	3	1972.826	1978.826	92.91266	6.67E-21	1993.213	0.00623158	-5.665254
8	(1|Specimen) + Side	3	1973.85	1979.85	93.93629	4.00E-21	1994.237	0.00010407	-5.660234
9	(1|Specimen) + Wear	5	1973.267	1983.267	97.35313	7.24E-22	2007.245	0.00349478	-5.65947
2	Genus + (1|Specimen)	7	1972.3	1986.3	100.386	1.59E-22	2019.87	0.00910465	-5.663862
6	(1|Specimen) + Tooth	11	1966.684	1988.684	102.77066	4.83E-23	2041.437	0.04338937	-5.672654
3	(1|Specimen) + Locality	13	1968.259	1994.259	108.34532	2.97E-24	2056.603	0.03295369	-5.688889

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	(1|Specimen) + Defect	7	1871.914	1885.914	0	3.81E-01	1919.484	0.7546057	-5.420304
16	(1|Specimen) + Defect + Position	8	1871.594	1887.594	1.679966	1.65E-01	1925.959	0.7603636	-5.432813
14	(1|Specimen) + Defect + Age	8	1871.837	1887.837	1.923476	1.46E-01	1926.203	0.7559634	-5.421924
17	(1|Specimen) + Defect + Side	8	1871.879	1887.879	1.965492	1.43E-01	1926.245	0.75524	-5.422765
13	(1|Specimen) + Defect + Province	8	1871.89	1887.89	1.976421	1.42E-01	1926.256	0.7550551	-5.420237
18	(1|Specimen) + Defect + Wear	10	1871.707	1891.707	5.793879	2.10E-02	1939.665	0.7582677	-5.426189
11	(1|Specimen) + Defect + Genus	12	1871.859	1895.859	9.945576	2.64E-03	1953.408	0.7555361	-5.422739
15	(1|Specimen) + Defect + Tooth	16	1871.149	1903.149	17.235223	6.90E-05	1979.88	0.7675509	-5.427446
12	(1|Specimen) + Defect + Locality	18	1871.721	1907.721	21.807173	7.01E-06	1994.043	0.7578929	-5.416891
19	(1|Specimen) + Defect * Genus	23	1871.047	1917.047	31.133633	6.62E-08	2027.348	0.7654074	-5.44141
20	(1|Specimen) + Defect * Tooth	41	1866.771	1948.771	62.857041	8.55E-15	2145.395	0.8215211	-5.460167

Ranking of all models by AIC

	Model	**nPar**	**D**	**AIC**	**ΔAIC**	**w.aic**	**bic**	**r2**	**crv2**
10	(1|Specimen) + Defect	7	1871.914	1885.914	0	1.00E+00	1919.484	0.75460573	-5.420304
16	(1|Specimen) + Defect + Position	8	1871.594	1887.594	1.68	1.65E-01	1925.959	0.7603636	-5.432813
14	(1|Specimen) + Defect + Age	8	1871.837	1887.837	1.923	1.46E-01	1926.203	0.7559634	-5.421924
17	(1|Specimen) + Defect + Side	8	1871.879	1887.879	1.965	1.43E-01	1926.245	0.75524	-5.422765
13	(1|Specimen) + Defect + Province	8	1871.89	1887.89	1.976	1.42E-01	1926.256	0.7550551	-5.420237
18	(1|Specimen) + Defect + Wear	10	1871.707	1891.707	5.793	2.10E-02	1939.665	0.7582677	-5.426189
11	(1|Specimen) + Defect + Genus	12	1871.859	1895.859	9.945	2.64E-03	1953.408	0.7555361	-5.422739
15	(1|Specimen) + Defect + Tooth	16	1871.149	1903.149	17.235	6.90E-05	1979.88	0.7675509	-5.427446
12	(1|Specimen) + Defect + Locality	18	1871.721	1907.721	21.807	7.01E-06	1994.043	0.7578929	-5.416891
19	(1|Specimen) + Defect * Genus	23	1871.047	1917.047	31.133	6.62E-08	2027.348	0.7654074	-5.44141
20	(1|Specimen) + Defect * Tooth	41	1866.771	1948.771	62.857	8.55E-15	2145.395	0.8215211	-5.460167
1	(1|Specimen)	2	1973.868	1977.868	91.954	1.08E-20	1987.459	0	-5.657312
7	(1|Specimen) + Position	3	1972.442	1978.442	92.528	8.09E-21	1992.829	0.00838487	-5.678861
4	(1|Specimen) + Province	3	1972.738	1978.738	92.824	6.97E-21	1993.125	0.00660821	-5.661937
5	(1|Specimen) + Age	3	1972.826	1978.826	92.912	6.67E-21	1993.213	0.00623158	-5.665254
8	(1|Specimen) + Side	3	1973.85	1979.85	93.936	4.00E-21	1994.237	0.00010407	-5.660234
9	(1|Specimen) + Wear	5	1973.267	1983.267	97.353	7.24E-22	2007.245	0.00349478	-5.65947
2	Genus + (1|Specimen)	7	1972.3	1986.3	100.386	1.59E-22	2019.87	0.00910465	-5.663862
6	(1|Specimen) + Tooth	11	1966.684	1988.684	102.77	4.83E-23	2041.437	0.04338937	-5.672654
3	(1|Specimen) + Locality	13	1968.259	1994.259	108.345	2.97E-24	2056.603	0.03295369	-5.688889

Ranking of all models by BIC

	Model	**nPar**	**D**	**AIC**	**ΔAIC**	**w.aic**	**bic**	**r2**	**crv2**
10	(1|Specimen) + Defect	7	1871.914	1885.914	0	1.00E+00	1919.484	0.75460573	-5.420304
16	(1|Specimen) + Defect + Position	8	1871.594	1887.594	1.68	1.65E-01	1925.959	0.7603636	-5.432813
14	(1|Specimen) + Defect + Age	8	1871.837	1887.837	1.923	1.46E-01	1926.203	0.7559634	-5.421924
17	(1|Specimen) + Defect + Side	8	1871.879	1887.879	1.965	1.43E-01	1926.245	0.75524	-5.422765

13	(1|Specimen) + Defect + Province	8	1871.89	1887.89	1.976	1.42E-01	1926.256	0.7550551	-5.420237
18	(1|Specimen) + Defect + Wear	10	1871.707	1891.707	5.793	2.10E-02	1939.665	0.7582677	-5.426189
11	(1|Specimen) + Defect + Genus	12	1871.859	1895.859	9.945	2.64E-03	1953.408	0.7555361	-5.422739
15	(1|Specimen) + Defect + Tooth	16	1871.149	1903.149	17.235	6.90E-05	1979.88	0.7675509	-5.427446
1	(1|Specimen)	2	1973.868	1977.868	91.954	1.08E-20	1987.459	0	-5.657312
7	(1|Specimen) + Position	3	1972.442	1978.442	92.528	8.09E-21	1992.829	0.00838487	-5.678861
4	(1|Specimen) + Province	3	1972.738	1978.738	92.824	6.97E-21	1993.125	0.00660821	-5.661937
5	(1|Specimen) + Age	3	1972.826	1978.826	92.912	6.67E-21	1993.213	0.00623158	-5.665254
12	(1|Specimen) + Defect + Locality	18	1871.721	1907.721	21.807	7.01E-06	1994.043	0.7578929	-5.416891
8	(1|Specimen) + Side	3	1973.85	1979.85	93.936	4.00E-21	1994.237	0.00010407	-5.660234
9	(1|Specimen) + Wear	5	1973.267	1983.267	97.353	7.24E-22	2007.245	0.00349478	-5.65947
2	Genus + (1|Specimen)	7	1972.3	1986.3	100.386	1.59E-22	2019.87	0.00910465	-5.663862
19	(1|Specimen) + Defect * Genus	23	1871.047	1917.047	31.133	6.62E-08	2027.348	0.7654074	-5.44141
6	(1|Specimen) + Tooth	11	1966.684	1988.684	102.77	4.83E-23	2041.437	0.04338937	-5.672654
3	(1|Specimen) + Locality	13	1968.259	1994.259	108.345	2.97E-24	2056.603	0.03295369	-5.688889
20	(1|Specimen) + Defect * Tooth	41	1866.771	1948.771	62.857	8.55E-15	2145.395	0.8215211	-5.460167

GLMM Localisation

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	(1|Specimen) + Defect	7	241.0476	255.0476	0	1.00E+00	288.6175	0.8428587	-4947.86972
6	(1|Specimen) + Tooth	11	723.7814	745.7814	490.7338	2.74E-107	798.5342	0.4139937	-42.80775
9	(1|Specimen) + Wear	5	784.8154	794.8154	539.7678	6.18E-118	818.794	0.3487865	-45.31113
4	(1|Specimen) + Province	3	792.3372	798.3372	543.2896	1.06E-118	812.7243	0.3301951	-36.27412
2	Genus + (1|Specimen)	7	786.9324	800.9324	545.8848	2.90E-119	834.5023	0.3337148	-82.92196
8	(1|Specimen) + Side	3	795.6993	801.6993	546.6517	1.98E-119	816.0865	0.3334304	-35.65802
1	(1|Specimen)	2	798.0907	802.0907	547.0431	1.63E-119	811.6821	0.332979	-35.24891
5	(1|Specimen) + Age	3	797.4297	803.4297	548.3821	8.32E-120	817.8168	0.3328075	-35.24879
3	(1|Specimen) + Locality	13	777.5992	803.5992	548.5516	7.65E-120	865.9433	0.317943	-208.6473
7	(1|Specimen) + Position	3	798.0355	804.0355	548.988	6.15E-120	818.4227	0.3333471	-35.33543

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
16	(1|Specimen) + Defect + Position	8	235.1237	251.1237	0	7.48E-01	289.4893	0.8780616	-3954.309
10	(1|Specimen) + Defect	7	241.0476	255.0476	3.923938	1.05E-01	288.6175	0.8428587	-4947.87
14	(1|Specimen) + Defect + Age	8	240.3796	256.3796	5.255951	5.40E-02	294.7453	0.8465374	-4612.722
17	(1|Specimen) + Defect + Side	8	240.8295	256.8295	5.705824	4.31E-02	295.1951	0.8444575	-4056.64
13	(1|Specimen) + Defect + Province	8	241.0344	257.0344	5.910784	3.89E-02	295.4001	0.843048	-3918.814
18	(1|Specimen) + Defect + Wear	10	239.9393	259.9393	8.815612	9.11E-03	307.8963	0.8491084	-4596.461
11	(1|Specimen) + Defect + Genus	12	239.7138	263.7138	12.590167	1.38E-03	321.2623	0.8520024	-4892.579
21	(1|Specimen) + Defect * Province	13	239.9601	265.9601	14.83642	4.49E-04	328.3043	0.8506939	-3985.443
15	(1|Specimen) + Defect + Tooth	16	238.2514	270.2514	19.127758	5.25E-05	346.9827	0.8621031	-3778.952
12	(1|Specimen) + Defect + Locality	18	238.4726	274.4726	23.348946	6.36E-06	360.7953	0.86133	-5051.699
20	(1|Specimen) + Defect * Genus	23	236.3963	282.3963	31.272686	1.21E-07	392.6976	0.8753024	-4322.667
19	(1|Specimen) + Defect * Tooth	41	233.4601	315.4601	64.336397	8.00E-15	512.084	0.8967388	-3486.819

SET 3

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
16	(1|Specimen) + Defect + Position	8	235.1237	251.1237	0	4.36E-01	289.4893	0.8780616	-3954.309
27	(1|Specimen) + Defect + Position + Side	9	234.8341	252.8341	1.710444	1.85E-01	295.9955	0.8800563	-4380.316
24	(1|Specimen) + Defect + Position + Province	9	234.8549	252.8549	1.73127	1.83E-01	296.0163	0.879339	-4283.118
25	(1|Specimen) + Defect + Position + Age	9	235.0763	253.0763	1.952685	1.64E-01	296.2377	0.878732	-4036.82
28	(1|Specimen) + Defect + Position + Wear	11	234.8614	256.8614	5.737765	2.47E-02	309.6142	0.8798435	-4400.646
22	(1|Specimen) + Defect + Position + Genus	13	233.582	259.582	8.458313	6.35E-03	321.9261	0.8886574	-4881.171
26	(1|Specimen) + Defect + Position + Tooth	17	231.6037	265.6037	14.480033	3.13E-04	347.1307	0.9015476	-3900.102
23	(1|Specimen) + Defect + Position + Locality	19	232.9268	270.9268	19.80319	2.18E-05	362.0453	0.8942497	-4136.073
29	(1|Specimen) + Defect + Position * Tooth	26	227.7003	279.7003	28.576632	2.72E-07	404.3886	0.930009	-3880.88

Ranking of all models by AIC

	Model	**nPar**	**D**	**AIC**	**ΔAIC**	**w.aic**	**bic**	**r2**	**crv2**
16	(1|Specimen) + Defect + Position	8	235.1237	251.1237	0	4.36E-01	289.4893	0.8780616	-3954.309
27	(1|Specimen) + Defect + Position + Side	9	234.8341	252.8341	1.7104	1.85E-01	295.9955	0.8800563	-4380.316
24	(1|Specimen) + Defect + Position + Province	9	234.8549	252.8549	1.7312	1.83E-01	296.0163	0.879339	-4283.118
25	(1|Specimen) + Defect + Position + Age	9	235.0763	253.0763	1.9526	1.64E-01	296.2377	0.878732	-4036.82

10	(1|Specimen) + Defect	7	241.0476	255.0476	3.9239	1.00E+00	288.6175	0.8428587	-4947.86972
14	(1|Specimen) + Defect + Age	8	240.3796	256.3796	5.2559	5.40E-02	294.7453	0.8465374	-4612.722
17	(1|Specimen) + Defect + Side	8	240.8295	256.8295	5.7058	4.31E-02	295.1951	0.8444575	-4056.64
28	(1|Specimen) + Defect + Position + Wear	11	234.8614	256.8614	5.7377	2.47E-02	309.6142	0.8798435	-4400.646
13	(1|Specimen) + Defect + Province	8	241.0344	257.0344	5.9107	3.89E-02	295.4001	0.843048	-3918.814
22	(1|Specimen) + Defect + Position + Genus	13	233.582	259.582	8.4583	6.35E-03	321.9261	0.8886574	-4881.171
18	(1|Specimen) + Defect + Wear	10	239.9393	259.9393	8.8156	9.11E-03	307.8963	0.8491084	-4596.461
11	(1|Specimen) + Defect + Genus	12	239.7138	263.7138	12.5901	1.38E-03	321.2623	0.8520024	-4892.579
26	(1|Specimen) + Defect + Position + Tooth	17	231.6037	265.6037	14.48	3.13E-04	347.1307	0.9015476	-3900.102
21	(1|Specimen) + Defect * Province	13	239.9601	265.9601	14.8364	4.49E-04	328.3043	0.8506939	-3985.443
15	(1|Specimen) + Defect + Tooth	16	238.2514	270.2514	19.1277	5.25E-05	346.9827	0.8621031	-3778.952
23	(1|Specimen) + Defect + Position + Locality	19	232.9268	270.9268	19.8031	2.18E-05	362.0453	0.8942497	-4136.073
12	(1|Specimen) + Defect + Locality	18	238.4726	274.4726	23.3489	6.36E-06	360.7953	0.86133	-5051.699
29	(1|Specimen) + Defect + Position * Tooth	26	227.7003	279.7003	28.5766	2.72E-07	404.3886	0.930009	-3880.88
20	(1|Specimen) + Defect * Genus	23	236.3963	282.3963	31.2726	1.21E-07	392.6976	0.8753024	-4322.667
19	(1|Specimen) + Defect * Tooth	41	233.4601	315.4601	64.3364	8.00E-15	512.084	0.8967388	-3486.819
6	(1|Specimen) + Tooth	11	723.7814	745.7814	494.6577	2.74E-107	798.5342	0.4139937	-42.80775
9	(1|Specimen) + Wear	5	784.8154	794.8154	543.6917	6.18E-118	818.794	0.3487865	-45.31113
4	(1|Specimen) + Province	3	792.3372	798.3372	547.2135	1.06E-118	812.7243	0.3301951	-36.27412
2	Genus + (1|Specimen)	7	786.9324	800.9324	549.8087	2.90E-119	834.5023	0.3337148	-82.92196
8	(1|Specimen) + Side	3	795.6993	801.6993	550.5756	1.98E-119	816.0865	0.3334304	-35.65802
1	(1|Specimen)	2	798.0907	802.0907	550.967	1.63E-119	811.6821	0.332979	-35.24891
5	(1|Specimen) + Age	3	797.4297	803.4297	552.306	8.32E-120	817.8168	0.3328075	-35.24879
3	(1|Specimen) + Locality	13	777.5992	803.5992	552.4755	7.65E-120	865.9433	0.317943	-208.6473
7	(1|Specimen) + Position	3	798.0355	804.0355	552.9118	6.15E-120	818.4227	0.3333471	-35.33543

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	(1|Specimen) + Defect	7	241.0476	255.0476	0	1.00E+00	288.6175	0.8428587	-4947.86972
16	(1|Specimen) + Defect + Position	8	235.1237	251.1237	-3.9239	4.36E-01	289.4893	0.8780616	-3954.309
14	(1|Specimen) + Defect + Age	8	240.3796	256.3796	1.332	5.40E-02	294.7453	0.8465374	-4612.722
17	(1|Specimen) + Defect + Side	8	240.8295	256.8295	1.7819	4.31E-02	295.1951	0.8444575	-4056.64
13	(1|Specimen) + Defect + Province	8	241.0344	257.0344	1.9868	3.89E-02	295.4001	0.843048	-3918.814
27	(1|Specimen) + Defect + Position + Side	9	234.8341	252.8341	-2.2135	1.85E-01	295.9955	0.8800563	-4380.316
24	(1|Specimen) + Defect + Position + Province	9	234.8549	252.8549	-2.1927	1.83E-01	296.0163	0.879339	-4283.118
25	(1|Specimen) + Defect + Position + Age	9	235.0763	253.0763	-1.9713	1.64E-01	296.2377	0.878732	-4036.82
18	(1|Specimen) + Defect + Wear	10	239.9393	259.9393	4.8917	9.11E-03	307.8963	0.8491084	-4596.461
28	(1|Specimen) + Defect + Position + Wear	11	234.8614	256.8614	1.8138	2.47E-02	309.6142	0.8798435	-4400.646
11	(1|Specimen) + Defect + Genus	12	239.7138	263.7138	8.6662	1.38E-03	321.2623	0.8520024	-4892.579
22	(1|Specimen) + Defect + Position + Genus	13	233.582	259.582	4.5344	6.35E-03	321.9261	0.8886574	-4881.171
21	(1|Specimen) + Defect * Province	13	239.9601	265.9601	10.9125	4.49E-04	328.3043	0.8506939	-3985.443
15	(1|Specimen) + Defect + Tooth	16	238.2514	270.2514	15.2038	5.25E-05	346.9827	0.8621031	-3778.952
26	(1|Specimen) + Defect + Position + Tooth	17	231.6037	265.6037	10.5561	3.13E-04	347.1307	0.9015476	-3900.102
12	(1|Specimen) + Defect + Locality	18	238.4726	274.4726	19.425	6.36E-06	360.7953	0.86133	-5051.699
23	(1|Specimen) + Defect + Position + Locality	19	232.9268	270.9268	15.8792	2.18E-05	362.0453	0.8942497	-4136.073
20	(1|Specimen) + Defect * Genus	23	236.3963	282.3963	27.3487	1.21E-07	392.6976	0.8753024	-4322.667
29	(1|Specimen) + Defect + Position * Tooth	26	227.7003	279.7003	24.6527	2.72E-07	404.3886	0.930009	-3880.88
19	(1|Specimen) + Defect * Tooth	41	233.4601	315.4601	60.4125	8.00E-15	512.084	0.8967388	-3486.819
6	(1|Specimen) + Tooth	11	723.7814	745.7814	490.7338	2.74E-107	798.5342	0.4139937	-42.80775
1	(1|Specimen)	2	798.0907	802.0907	547.0431	1.63E-119	811.6821	0.332979	-35.24891
4	(1|Specimen) + Province	3	792.3372	798.3372	543.2896	1.06E-118	812.7243	0.3301951	-36.27412
8	(1|Specimen) + Side	3	795.6993	801.6993	546.6517	1.98E-119	816.0865	0.3334304	-35.65802
5	(1|Specimen) + Age	3	797.4297	803.4297	548.3821	8.32E-120	817.8168	0.3328075	-35.24879
7	(1|Specimen) + Position	3	798.0355	804.0355	548.9879	6.15E-120	818.4227	0.3333471	-35.33543
9	(1|Specimen) + Wear	5	784.8154	794.8154	539.7678	6.18E-118	818.794	0.3487865	-45.31113
2	Genus + (1|Specimen)	7	786.9324	800.9324	545.8848	2.90E-119	834.5023	0.3337148	-82.92196
3	(1|Specimen) + Locality	13	777.5992	803.5992	548.5516	7.65E-120	865.9433	0.317943	-208.6473

GLMM Severity

Bottom-up approach for model selection

SET 1

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	(1|Specimen) + Defect	7	1907.156	1921.156	0	1.00E+00	1954.726	0.90054699	-1.358437
6	(1|Specimen) + Tooth	11	2164.912	2186.912	265.7563	1.96E-58	2239.665	0.1443605	-1.693451
5	(1|Specimen) + Age	3	2190.468	2196.468	275.3118	1.65E-60	2210.855	0.08075619	-1.698224
4	(1|Specimen) + Province	3	2190.938	2196.938	275.7823	1.30E-60	2211.325	0.07821581	-1.697948
1	(1|Specimen)	2	2193.57	2197.57	276.4147	9.49E-61	2207.162	0.07927716	-1.699612
7	(1|Specimen) + Position	3	2193.087	2199.087	277.9312	4.45E-61	2213.474	0.08101544	-1.69998
8	(1|Specimen) + Side	3	2193.291	2199.291	278.1355	4.01E-61	2213.678	0.07960986	-1.703458

9	(1|Specimen) + Wear	5	2189.33	2199.33	278.1738	3.94E-61	2223.308	0.08190498	-1.703351
3	(1|Specimen) + Locality	13	2175.101	2201.101	279.9452	1.62E-61	2263.445	0.04525897	-1.695469
2	Genus + (1|Specimen)	7	2189.205	2203.205	282.0496	5.67E-62	2236.775	0.08271075	-1.701225

SET 2

	model	nPar	D	aic	d.aic	w.aic	bic	R2	cv.R2
10	(1|Specimen) + Defect	7	1907.156	1921.156	0	3.79E-01	1954.726	0.900547	-1.358437
14	(1|Specimen) + Defect + Age	8	1906.812	1922.812	1.656739	1.66E-01	1961.178	0.9036871	-1.35841
13	(1|Specimen) + Defect + Province	8	1906.989	1922.989	1.833435	1.52E-01	1961.355	0.9021569	-1.358077
16	(1|Specimen) + Defect + Position	8	1907.134	1923.134	1.978474	1.41E-01	1961.5	0.9007141	-1.357646
17	(1|Specimen) + Defect + Side	8	1907.148	1923.148	1.99241	1.40E-01	1961.514	0.9006112	-1.359102
18	(1|Specimen) + Defect + Wear	10	1907.154	1927.154	5.997996	1.89E-02	1975.111	0.9005606	-1.35847
11	(1|Specimen) + Defect + Genus	12	1906.653	1930.653	9.496868	3.29E-03	1988.201	0.904592	-1.360802
15	(1|Specimen) + Defect + Tooth	16	1906.391	1938.391	17.235635	6.86E-05	2015.123	0.9076827	-1.35997
12	(1|Specimen) + Defect + Locality	18	1906.609	1942.609	21.453384	8.33E-06	2028.932	0.9054264	-1.359642
19	(1|Specimen) + Defect * Genus	23	1904.195	1950.195	29.039363	1.88E-07	2060.496	0.9180969	-1.371709
20	(1|Specimen) + Defect * Tooth	41	1900.715	1982.715	61.559434	1.63E-14	2179.339	0.9418697	-1.36409

Ranking of all models by AIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	(1|Specimen) + Defect	7	1907.156	1921.156	0	1.00E+00	1954.726	0.90054699	-1.358437
14	(1|Specimen) + Defect + Age	8	1906.812	1922.812	1.656	1.66E-01	1961.178	0.9036871	-1.35841
13	(1|Specimen) + Defect + Province	8	1906.989	1922.989	1.833	1.52E-01	1961.355	0.9021569	-1.358077
16	(1|Specimen) + Defect + Position	8	1907.134	1923.134	1.978	1.41E-01	1961.5	0.9007141	-1.357646
17	(1|Specimen) + Defect + Side	8	1907.148	1923.148	1.992	1.40E-01	1961.514	0.9006112	-1.359102
18	(1|Specimen) + Defect + Wear	10	1907.154	1927.154	5.998	1.89E-02	1975.111	0.9005606	-1.35847
11	(1|Specimen) + Defect + Genus	12	1906.653	1930.653	9.497	3.29E-03	1988.201	0.904592	-1.360802
15	(1|Specimen) + Defect + Tooth	16	1906.391	1938.391	17.235	6.86E-05	2015.123	0.9076827	-1.35997
12	(1|Specimen) + Defect + Locality	18	1906.609	1942.609	21.453	8.33E-06	2028.932	0.9054264	-1.359642
19	(1|Specimen) + Defect * Genus	23	1904.195	1950.195	29.039	1.88E-07	2060.496	0.9180969	-1.371709
20	(1|Specimen) + Defect * Tooth	41	1900.715	1982.715	61.559	1.63E-14	2179.339	0.9418697	-1.36409
6	(1|Specimen) + Tooth	11	2164.912	2186.912	265.756	1.96E-58	2239.665	0.1443605	-1.693451
5	(1|Specimen) + Age	3	2190.468	2196.468	275.312	1.65E-60	2210.855	0.08075619	-1.698224
4	(1|Specimen) + Province	3	2190.938	2196.938	275.782	1.30E-60	2211.325	0.07821581	-1.697948
1	(1|Specimen)	2	2193.57	2197.57	276.414	9.49E-61	2207.162	0.07927716	-1.699612
7	(1|Specimen) + Position	3	2193.087	2199.087	277.931	4.45E-61	2213.474	0.08101544	-1.69998
8	(1|Specimen) + Side	3	2193.291	2199.291	278.135	4.01E-61	2213.678	0.07960986	-1.703458
9	(1|Specimen) + Wear	5	2189.33	2199.33	278.174	3.94E-61	2223.308	0.08190498	-1.703351
3	(1|Specimen) + Locality	13	2175.101	2201.101	279.945	1.62E-61	2263.445	0.04525897	-1.695469
2	Genus + (1|Specimen)	7	2189.205	2203.205	282.049	5.67E-62	2236.775	0.08271075	-1.701225

Ranking of all models by BIC

	Model	nPar	D	AIC	ΔAIC	w.aic	bic	r2	crv2
10	(1|Specimen) + Defect	7	1907.156	1921.156	0	1.00E+00	1954.726	0.90054699	-1.358437
14	(1|Specimen) + Defect + Age	8	1906.812	1922.812	1.656	1.66E-01	1961.178	0.9036871	-1.35841
13	(1|Specimen) + Defect + Province	8	1906.989	1922.989	1.833	1.52E-01	1961.355	0.9021569	-1.358077
16	(1|Specimen) + Defect + Position	8	1907.134	1923.134	1.978	1.41E-01	1961.5	0.9007141	-1.357646
17	(1|Specimen) + Defect + Side	8	1907.148	1923.148	1.992	1.40E-01	1961.514	0.9006112	-1.359102
18	(1|Specimen) + Defect + Wear	10	1907.154	1927.154	5.998	1.89E-02	1975.111	0.9005606	-1.35847
11	(1|Specimen) + Defect + Genus	12	1906.653	1930.653	9.497	3.29E-03	1988.201	0.904592	-1.360802
15	(1|Specimen) + Defect + Tooth	16	1906.391	1938.391	17.235	6.86E-05	2015.123	0.9076827	-1.35997
12	(1|Specimen) + Defect + Locality	18	1906.609	1942.609	21.453	8.33E-06	2028.932	0.9054264	-1.359642
19	(1|Specimen) + Defect * Genus	23	1904.195	1950.195	29.039	1.88E-07	2060.496	0.9180969	-1.371709
20	(1|Specimen) + Defect * Tooth	41	1900.715	1982.715	61.559	1.63E-14	2179.339	0.9418697	-1.36409
1	(1|Specimen)	2	2193.57	2197.57	276.414	9.49E-61	2207.162	0.07927716	-1.699612
5	(1|Specimen) + Age	3	2190.468	2196.468	275.312	1.65E-60	2210.855	0.08075619	-1.698224
4	(1|Specimen) + Province	3	2190.938	2196.938	275.782	1.30E-60	2211.325	0.07821581	-1.697948
7	(1|Specimen) + Position	3	2193.087	2199.087	277.931	4.45E-61	2213.474	0.08101544	-1.69998
8	(1|Specimen) + Side	3	2193.291	2199.291	278.135	4.01E-61	2213.678	0.07960986	-1.703458
9	(1|Specimen) + Wear	5	2189.33	2199.33	278.174	3.94E-61	2223.308	0.08190498	-1.703351
2	Genus + (1|Specimen)	7	2189.205	2203.205	282.049	5.67E-62	2236.775	0.08271075	-1.701225
6	(1|Specimen) + Tooth	11	2164.912	2186.912	265.756	1.96E-58	2239.665	0.1443605	-1.693451
3	(1|Specimen) + Locality	13	2175.101	2201.101	279.945	1.62E-61	2263.445	0.04525897	-1.695469

Supplementary S6 – Detail of hypoplasia counts and prevalence by locality, species, and tooth loci

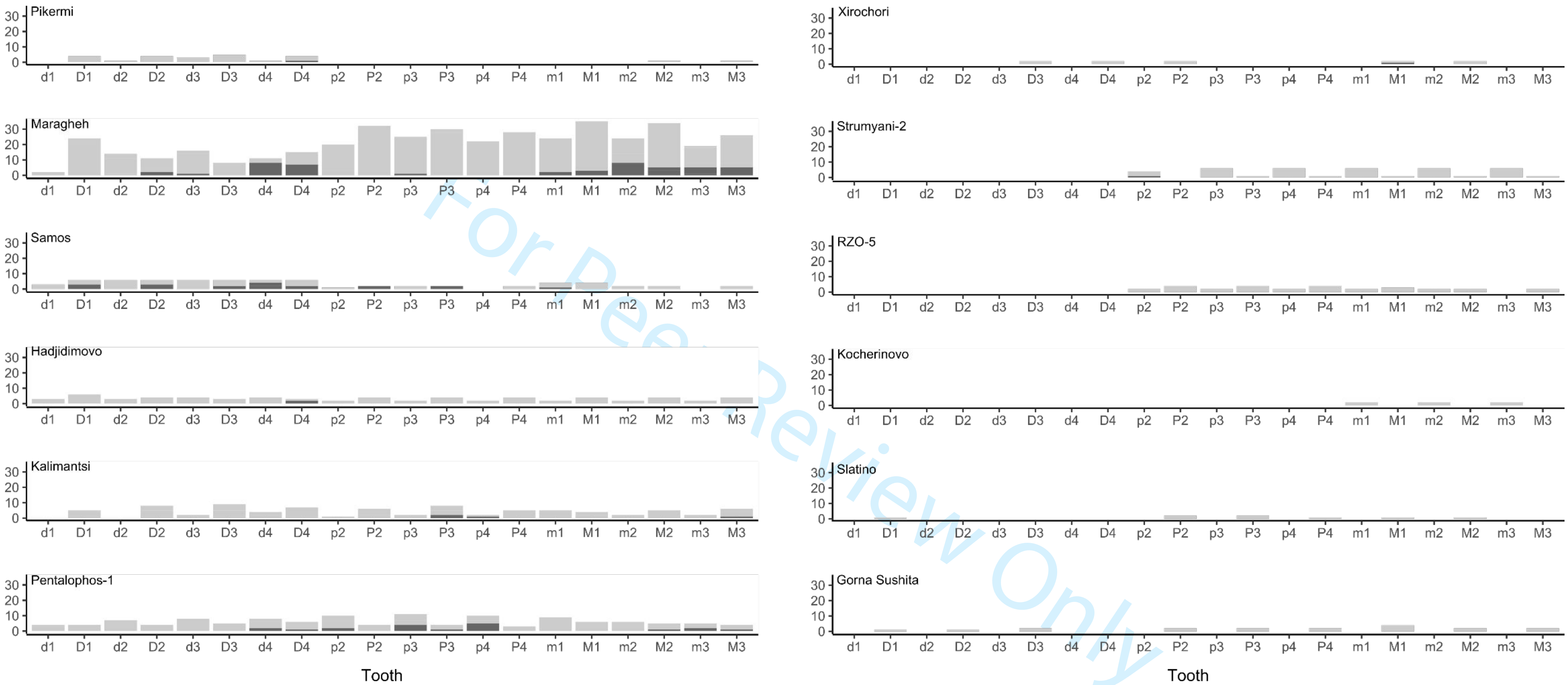


Figure 1: Hypoplasia occurences by locality and tooth loci
Species merged at each locality
Dark grey: hypoplasic teeth; Light grey: normal teeth

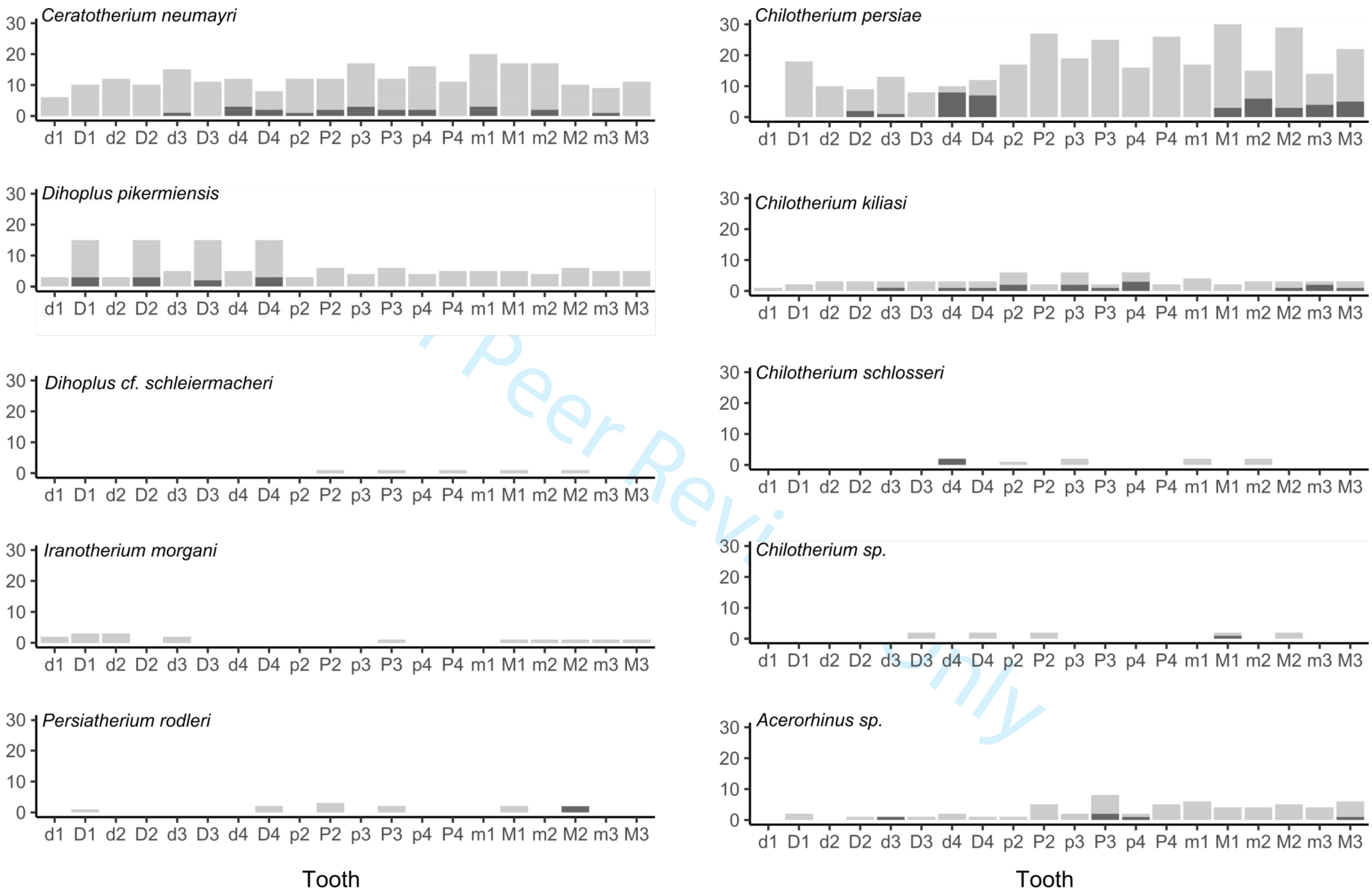

Ceratotherium neumayri
Chilotherium persiae
Dihoplus pikermiensis
Chilotherium kiliasi
Dihoplus cf. schleiermacheri
Chilotherium schlosseri
Iranotherium morgani
Chilotherium sp.
Persiatherium rodleri
Acerorhinus sp.
0 10 20 30
d1 D1 d2 D2 d3 D3 d4 D4 p2 P2 p3 P3 p4 P4 m1 M1 m2 M2 m3 M3
Tooth
Tooth

Figure 2: Hypoplasia counts by species and tooth loci

Occurences of hypoplasia by tooth loci and species: *Ceratotherium neumayri* (merged specimens from: Pikermi, Kalimantsi, Maragheh, Pentalophos-1, RZO-5, Samos, Strumyani-2), *Dihoplus pikermiensis* (merged specimens from: Pikermi, Hadjidimovo, Kalimantsi, Samos, Strumyani-2), *Dihoplus cf. schleiermacheri* (all specimens from Slatino), *Iranotherium morgani* (all specimens from Maragheh), *Persiatherium rodleri* (all specimens from Maragheh), *Chilotherium persiae* (all specimens from Maragheh), *Chilotherium kiliasi* (all specimens from Pentalophos-1), *Chilotherium schlosseri* (all specimens from Saùos), *Chilotherium sp.* (all specimens from Xirochori), and *Acerorhinus sp.* (merged specimens from: Gorna Sushita, Kalimantsi, Kocherinovo, Slatino)

Dark grey: hypoplasic teeth; Light grey: normal teeth