3 PRELIMINARY STUDY OF THE CANIDS FROM THE LOWER PLEISTOCENE SITE OF TSIOTRA VRYSSI (MYGDONIA BASIN, GREECE)

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3.1 INTRODUCTION

The Lower Pleistocene site of Tsiotra Vryssi (TSR), discovered in 2014, is located in the south-eastern part of the Mygdonia Basin (northern Greece) and belongs to the upper part of the Gerakarou Formation (Konidaris et al., 2015). The site has revealed a rich late Villafranchian fauna, which is dated between 1.78 and ~1.5 Ma (Konidaris et al., 2021). Among the faunal assemblage, canids are well-represented and their cranial, mandibular and dental material consists of 17 specimens (excavation seasons 2014–2019) stored at the Museum of Geology, Palaeontology and Palaeoanthropology of the Aristotle University of Thessaloniki (LGPUT). The aim of the present study is to provide preliminary results on their taxonomy based on their morphological and metrical comparison with Early Pleistocene European taxa known from the literature.

The TSR material comprises medium- and large-sized canids, which are consistent morphologically and metrically with an attribution to *Canis*. Several *Canis* species are documented in Europe during the late Villafranchian. *Canis etruscus* and *C. arnensis* were possibly already present slightly before the beginning of the late Villafranchian, and they are best recorded in several Italian localities dated to 2.0–1.8 Ma (e.g., Cherin et al., 2014; Bartolini Lucenti and Rook, 2016). *Canis etruscus* in particular is suggested as the possible ancestor of the more advanced *C. mosbachensis* and subsequently of the modern wolf (e.g., Sotnikova and Rook, 2010). *Canis accitanus* from Fonelas-P1 (~2.0 Ma, Spain), is a debated taxon; Brugal and Boudadi-Maligne (2011) suggest that it rather belongs to *C. arnensis*, whereas Martínez-Navarro et al. (2021) propose that it could be part of the intraspecific variability of *C. etruscus*, which is also present at the site.

Recent discoveries have furthermore revealed

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new species. *Canis borjgali* from Dmanisi (~1.8 Ma, Georgia) shares morphological features with *C. mosbachensis*, therefore this species was proposed as a closer ancestor of the *C. lupus* lineage instead of the more primitive *C. etruscus* (Bartolini Lucenti et al., 2020). *Canis orcencis* from Venta Micena (~1.6 Ma, Spain) resembles *C. mosbachensis* and *C. apolloniensis* from Apollonia-1 (~1.3–1.0 Ma, Greece; Koufos, 2018), but shows some distinct morphological traits (Martínez-Navarro et al., 2021). According to Madurell-Malapeira et al. (2022), *C. orcencis* and *C. apolloniensis* could be ascribed to *C. mosbachensis*, which successfully dispersed in Europe during the late Early–Middle Pleistocene, until the appearance of *C. lupus*.

Regarding the large-sized European canids, the hypercarnivorous *Canis* (*Xenocyon*) *falconeri* is best recorded in Upper Valdarno (Italy) and Fonelas-P1, while recent findings reveal an earlier record in the middle Villafranchian (Bartolini Lucenti and Spassov, 2022). This taxon was replaced by the more advanced *Canis* (*Xenocyon*) *lycaonoides*, which is found in many European localities (e.g., Dmanisi, Pirro Nord, Apollonia-1), usually along with a medium-sized *Canis* (e.g., Bartoloni Lucenti et al., 2021).

3.2 RESULTS AND DISCUSSION

Morphological and metric data of the cranial, mandibular and dental material of TSR indicate the presence of two medium-sized canids (of which one is smaller- and the other larger-sized) and of one large-sized canid.

The larger medium-sized canid is recognized as *Canis* sp. (morphotype A). Its study is based on the specimen TSR-D17-37, which is a complete cranium associated with the mandible (Fig. 1a), and additional isolated specimens. *Canis* sp. (morphotype A) shares many morphological and metric features with both *C. borjgali* and *C. apolloniensis* (Fig. 2), thus a firm attribution to one of these two species is uncertain at the moment.

The smaller medium-sized canid is identified as *Canis* sp. (morphotype B) based on the specimen TSR-G20-11, which is a complete cranium with a right hemimandible and three associated but isolated teeth, all belonging to the same individual (Fig. 1b). This morphotype is generally similar in morphology to *Canis* sp. (morphotype A) but differs metrically (Fig. 2), as well as in some morphological traits such as the blunter outline of the nuchal crest of the cranium in dorsal view

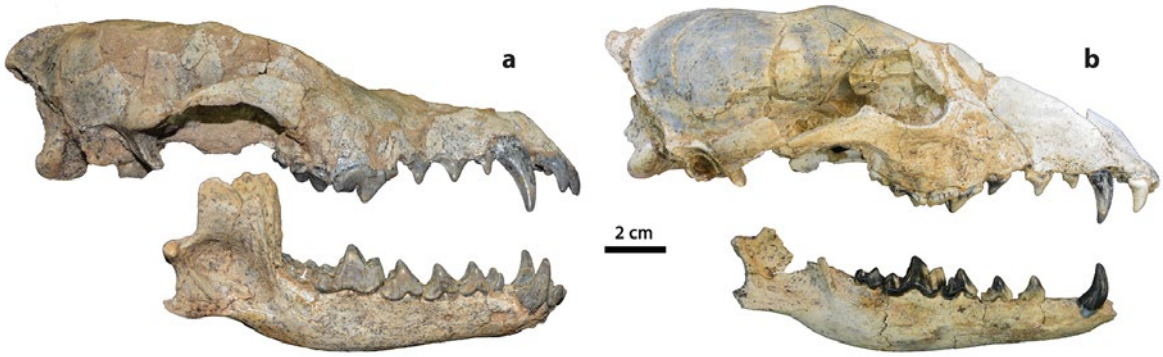

Figure 1: Right lateral view of crania and mandibles of the medium-sized canids from TSR. a, *Canis* sp. (morphotype A) (TSR-D17-37a, b); b, *Canis* sp. (morphotype B) (TSR-G20-11a, b).

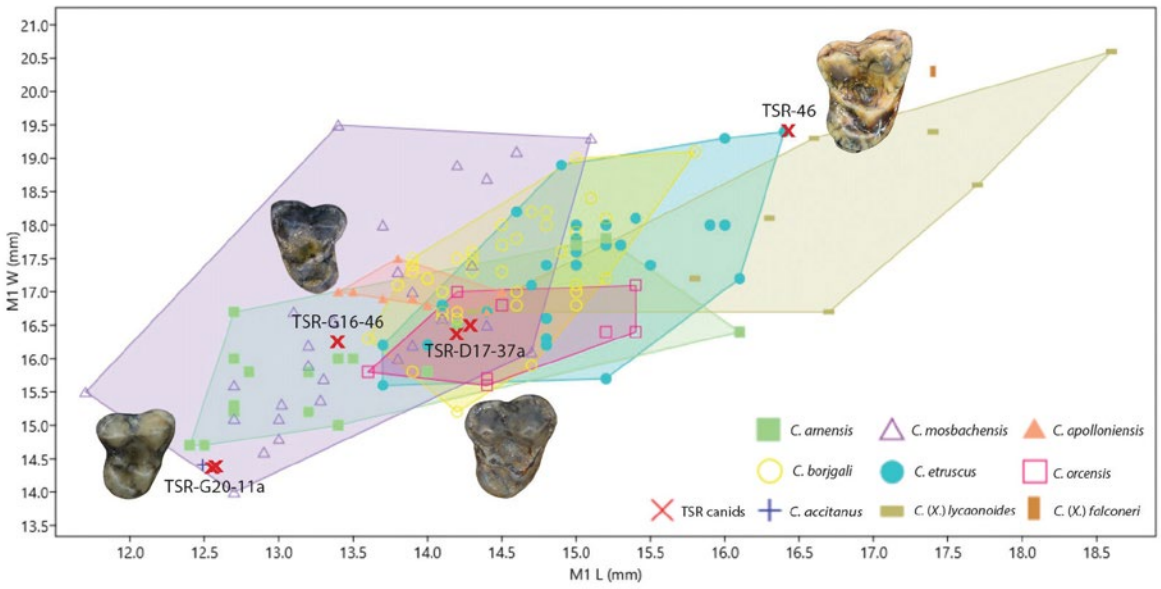

Figure 2: Scatter plot of length/width of the upper M1 of the TSR canids in comparison to several European ones. *Canis* sp. (morphotype A) (TSR-D17-37a; TSR-G16-46), *Canis* sp. (morphotype B) (TSR-G20-11a) and *Canis* (*Xenocyon*) sp. (TSR-46).

instead of triangular on TSR-D17-37a; and the smaller and not so mesially placed P4 protocone. However, several dissimilarities may be part of the unknown intraspecific variability, and thus both morphotypes could belong to a single species. *Canis* sp. (morphotype B) also portrays an overall slenderer cranial and dental morphology, that could be perhaps attributed to sexual dimorphism. Sex-related differences are already mentioned for *C. mosbachensis* (Sotnikova, 2001) and modern wolves (e.g., Trbojević and Ćirović, 2016). Although *Canis* sp. (morphotype B) displays metric similarities with *C. accitanus* and *C. arnensis* (Fig. 2), clear morphological differences preclude an attribution to any of these species.

Canis sp. (morphotype A) and *Canis* sp. (morphotype B) differ from *C. etruscus* and *C. arnensis* in many dental characters, e.g., the M1 trigon basin is deeper than the talon one; the p3 alveolus lays lower in the mandible than those of the adjacent teeth; the mesial margin of the paraconid of m1 is distally inclined (e.g., Bartolini Lucenti et. al., 2020). Overall, their morphology seems to mostly resemble that of taxa related to the *C. mosbachensis* lineage such as *C. borjgali*, *C. apolloniensis* and *C. orcensis.*

The large-sized canid of TSR is attributed to *Canis* (*Xenocyon*) sp., based on the study of the isolated upper first molar (M1) TSR-46, which was originally ascribed to *C. etruscus* (Konidaris et al., 2015) and subsequently to *Canis* sp. (Konidaris et al., 2021). The proportions of the tooth (Fig. 2) are indeed very similar to the lectotype of *C. etruscus*; yet, unlike *C. etruscus*, the trigon basin of the tooth is deeper, while the talon one is shallower. Metrically, it is larger than the rest of the TSR *Canis* morphotypes (Fig. 2). It is also distinct in the crest-like morphology of the metaconule, which is commonly observed in the hypercarnivorous forms (e.g., Martínez-Navarro et al., 2021). In general, the morphology of the tooth is similar to that of the holotype of *C.* (*Xenocyon*) *lycaonoides* from Gombasek (Slovakia; Kretzoi, 1938: Tafel 3, Fig. 4), but is not so robust and triangular in shape as in *C.* (*Xenocyon*) *lycaonoides* from Apollonia-1 (Koufos, 2018: Fig. 8c).

3.3 CONCLUSIONS

Two medium-sized canids were recognized at TSR, *Canis* sp. (morphotype A) and *Canis* sp. (morphotype B), both showing notable resemblance with the taxa related to the *Canis mosbachensis* lineage; however, their relationships (i.e., two distinct species *vs* intra-specific variants related to sexual dimorphism) remain currently unclear and require further examination. The large-sized canid is attributed to *Canis* (*Xenocyon*) sp. and represents the oldest record of the taxon in Mygdonia Basin, and perhaps also in Greece.

The recent discoveries of new material in several European sites and the erection of new species have modified the old established taxonomy of the *Canis* representatives. Tsiotra Vryssi is dated to a critical period for the *Canis* intrageneric speciation, and as such the rich and well-preserved canid material from the site may shed light into the evolutionary history of the lineage during the European Pleistocene. Therefore, future research will focus on the comprehensive study and comparison of all available material (cranial and postcranial, plus recently discovered new material), aiming to illuminate the status and relationships of the two identified medium-sized morphotypes, and thus to contribute to the better understanding of the Early Pleistocene European canids.

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