

A new Early Pleistocene mammalian fauna from Burdur Basin, SW Turkey

Fatma Arzu Demirel, Serdar Mayda

ABSTRACT. A new Early Pleistocene mammalian locality, referred to as “Yassigüme” from Burdur Basin of SW Anatolia is reported here for the first time. Here, we describe remains of an equid and bovids, most frequent elements of the fauna, as *Equus* sp., *Gazellospira torticornis*, and *Leptobos* cf. *etruscus*, all being the first records in Turkey. The coexistence of medium-sized bovine *L. etruscus* with spiral-horned antelope *G. torticornis*, and *Equus* sp. suggests Late Villafranchian age (~1.5 Ma) for Yassigüme. These records fill the gap in the paleobiogeographic range of these taxa in SE Mediterranean during Pleistocene.

KEY WORDS: *Leptobos*, *Gazellospira*, Villafranchian, Early Pleistocene, Burdur Basin, Turkey.

F. Arzu Demirel [arzu demirel@mehmetakif.edu.tr], Mehmet Akif Ersoy University, Faculty of Arts and Sciences, Department of Anthropology, Burdur, Turkey; S. Mayda [serdar.mayda@ege.edu.tr], Ege University Natural History Museum, Izmir, Turkey.

Новая териофауна раннего плейстоцена из бассейна Бурдур, юго-западная Турция

Ф.А. Демирель, С. Майда

РЕЗЮМЕ. Описывается новая фауна млекопитающих раннего плейстоцена Ясигюме (Yassigüme) из бассейна Бурдур, юго-западная Турция. Преобладающие в местонахождении остатки быков и лошадей определены как *Equus* sp., *Gazellospira torticornis* и *Leptobos* cf. *etruscus*. Все эти формы впервые обнаружены в Турции. Совместное присутствие среднеразмерного быка *L. etruscus* со спиральноногой антилопой *G. torticornis* и лошадью *Equus* sp. указывает на поздневиллафранкский возраст (~1,5 млн. лет) фауны Ясигюме. Новые находки заполняют пробел в палеогеографическом распространении этих таксонов в плейстоцене юго-восточного Средиземноморья.

КЛЮЧЕВЫЕ СЛОВА: *Leptobos*, *Gazellospira*, виллафранк, ранний плейстоцен, бассейн Бурдур, Турция.

Introduction

The project “Surveys for the Identification of Fossil Localities of Neogene and Pleistocene Periods in the Province of Burdur” has been going on since 2010. It is run on behalf of Mehmet Akif Ersoy University and led by one of the authors (A.D.) with the permission granted by the Turkish Ministry of Culture and Tourism. The projects team combines researchers from Mehmet Akif Ersoy University (Burdur), Ankara University (Ankara), Ege University (İzmir), Çanakkale 18 Mart University (Çanakkale), Cumhuriyet University (Sivas), and Pamukkale University (Denizli). The foremost goal of this project is to identify the fossil localities of land mammals in the Burdur region, to take under protection these localities, and to identify an excavation site that will cast light on the natural history of the region. In addition, it is also hoped that new information will be obtained regarding the biostratigraphy of the Burdur basin with the help of fossil evidence to be collected during these surveys (Demirel, 2013).

The Burdur region, which forms the scope of the surveys, is located within the Lakes District of south-western Anatolia. The Burdur basin extends in a north-east/south-west direction along the Fethiye-Burdur fault line and the lacustrine sediments are bordered by Söğüt Mountain and Suludere-Yayla Mountain (Yiğitbaşıoğlu, 2009). The field seasons of 2011–2013 yielded considerable amount of fossil land mammal remains and led to discovery of a new Early Pleistocene locality of Yassigüme about 25 km south of Burdur town (Fig. 1) (Demirel, 2012, 2013; Demirel *et al.*, 2013; Demirel & Kapan-Yeşilyurt, 2014). The most important among these remains belong to the family Bovidae. Because Pleistocene fossil bovid remains from Turkey are rare, the new locality of Yassigüme is primarily interesting by remains of two differently sized bovids and a typical Pleistocene form of equid.

The Anatolian Plio-Pleistocene records of Bovidae include *Gazella borbonica* and *Leptobos* sp. reported by Saraç (2003) from Gülyazı (early Late Pliocene MN16, Sickenberg *et al.*, 1975) and Yukarısöğütönü



Fig. 1. Yassigüme and other Plio-Pleistocene Turkish mammalian fossil localities, discussed in this study.

(Pleistocene, Becker-Platen & Sickenberg, 1968; Sickenberg & Tobien, 1971), and *Gazellospira* cf. *torticornis*, *Gazella* sp. and *Pliotragus* sp. from Sarıkol Tepe (late Pliocene MN17, Kostopoulos & Sen, 1999). There are also records of *Leptobos* and *Gazellospira* noted from Early Pliocene localities of Dinar-Akçaköy (late MN14) and Ankara-Çalta (late MN14) although geographic and stratigraphic position of Dinar-Akçaköy remains uncertain for precise correlation (Fig. 1). Except of records from Sarıkol Tepe and Çalta, none of the bovid remains in Turkey were subjected to any taxonomic study up to now.

In Turkey, Plio-Pleistocene localities with large mammals are relatively rare comparing to abundant Late Miocene sites. In these limited localities, the systematically studied equid and bovid records came only from Sarıkol Tepe (Early Pleistocene; Kostopoulos & Sen, 1999), Gülyazı (Late Pliocene, Bernor & Limpscomb, 1991), and Denizli (Boulbes *et al.*, 2014) as *Equus stenonis*, *Plesiohipparion huangheense* Qiu Zhanxiang, Huang Weilong et Guo Zhihui, 1987, and *E. suessenbornensis* Wüst, 1901, respectively. *Equus* spp., also listed in the localities of Kamışlı, Yukarı Söğütönü (Early Pleistocene; Sickenberg *et al.*, 1975) and Dursunlu (early Middle Pleistocene; Güleş *et al.*, 1999), have not been studied in detail. The limited fossils from Yukarı Söğütönü in the collections of MTA (General Directorate of Mineral Research and Exploration, Ankara, Turkey) museum shows one type of equid which has close similarities with the small sized *E. altidens* von Reichenau, 1915 forms and the more advanced Dursunlu (latest Early – early Middle Pleistocene) equids similar to *E. mosbachensis* von Reichenau, 1903 and *E. cf. altidens* (Yiğit, 1998). Few horse fossils from the Çobanisa (late Early Pleistocene,

Mayda, 2004) and Kamışlı localities are closely comparable with a medium sized *E. stenonis*. In conclusion, the currently available limited data on the Turkish Plio-Pleistocene equids show a close resemblance with the southern European record with small to medium sized forms being dominant during Early Pleistocene and larger forms are common starting the beginning of Middle Pleistocene.

Materials and methods

Survey campaigns in 2011–2013 resulted in the discovery of Yassigüme site and first fossils collected from it. The fossil site (72°55'45.4E, 32°47'26.4N) is located close to Yassigüme Village, 12 km SE of Burdur Town, Turkey (Fig. 1). It is expected that the research in this vast geographic area will play an important role in developing a better understanding of the Plio-Pleistocene paleobiogeography of Turkey.

The locality is situated within marginal alluvial-fan to fan-deltaic sequence at the uppermost part of the basin-fill succession (Fig. 2). The fluvial sedimentation began with sands and claystones which has yielded the vast majority of the fossils. Unfortunately, the fragmentary state of fossils did not allow exact determination of the remains till 2012. In 2013, the new horse and bovid specimens were collected from the site, and bovid remains have been prepared and restored.

Here we describe the cranial and dental fossil materials on Artiodactyla (Bovidae) and Perissodactyla (Equidae). Measurements are in mm; upper teeth are in upper case, lower teeth are in lower case. APD and TD stand for “maximum anteroposterior diameter” and “maximum transverse diameter” at the base horn core, respectively. The fossil specimens are currently stored

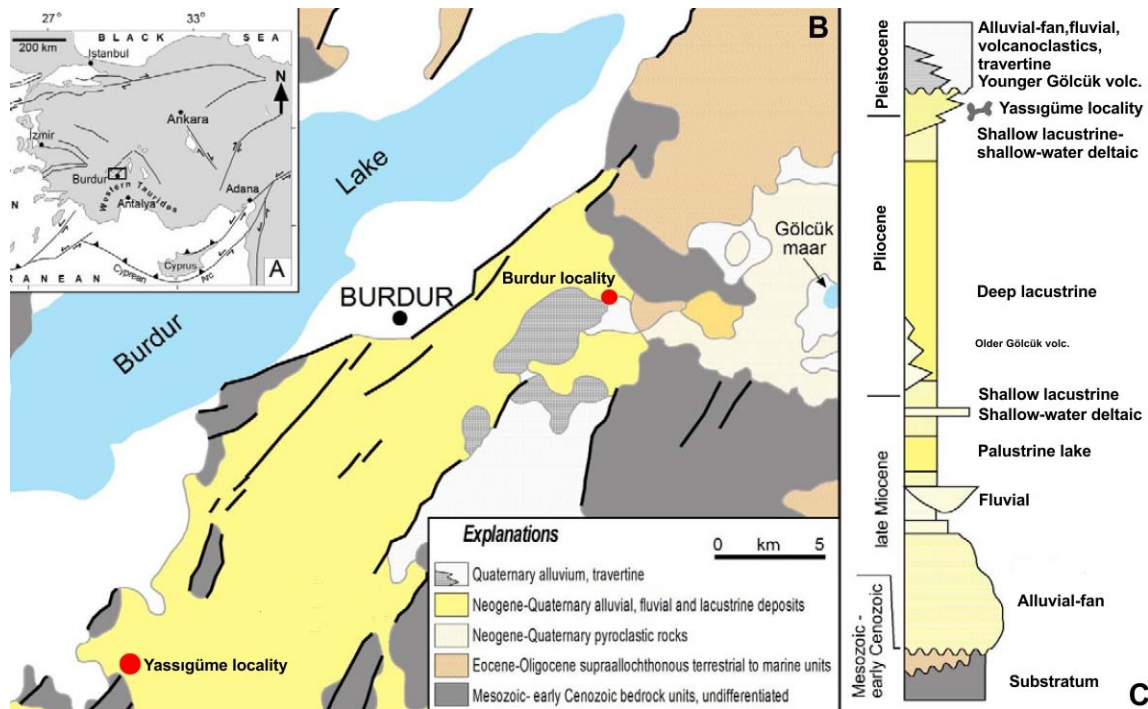


Fig. 2. A. Location map of the eastern Mediterranean Region (after Alçiçek *et al.*, 2013). B. Geological map of the Burdur Basin (based on Şenel, 2002 and Alçiçek *et al.*, 2013). Yassigüme and Burdur fossil localities are indicated by dots. C. Composite stratigraphy of the Burdur basin-fill succession, not to scale (based on Karaman, 1986; Price, 1989 and Alçiçek *et al.*, 2013).

in Mehmet Akif Ersoy University, Department of Anthropology.

Systematic palaeontology

Order Perissodactyla Owen, 1848
Family Equidae Gray, 1821
Subfamily Equinae Gray, 1821
Genus *Equus* Linnaeus, 1758
Equus sp.

Material. Right maxillar fragment with P3–P4 (YG-21) (Fig. 3), lower m3 (YG-22).

Description. The fragmentary maxilla belongs to an aged individual, the isolated lower m3 represents a subadult individual. The strong wear of the upper teeth obliterated many morphological features. However, it

is clear that premolars have small and oval-shaped protocone while molars have more elongated and narrow triangular-shaped protocones with slightly concave lingual borders. None of the teeth preserved any trace of pli caballin (Fig. 3). Premolars have wider and larger mesostyles and closed fossettes comparing to molars.

Lower m3 has a V-shaped linguaeflexid, as in stenooid horses, contrary to U-shaped linguaeflexids of caballoid forms. Preflexid has simple margins whereas postflexid looks slightly complex, and both are equal in size. Ectoflexid is very deep and almost touches the linguaeflexids. There is no sign of pli caballinid and ectostylid.

Remarks. The measurements clearly show that the Yassigüme horse is a large-sized *Equus* sharing the same size with the clade of *E. stenooides* Cocchi, 1867 (Tab. 1). The studied material showing short proto-

Table 1. Measurements of equid specimens from Yassigüme.

Cat. num.		Length (occlusal)	Width (occlusal)	Protocone length	Preflexid length	Double knot length	Postflexid length	Height
YG-21	P3	30.25	29.56	7.75				
	P4	28.1	29.87	8.85				
	M1	24.3	28.97	10				
	M2	24.3	27.51	11.3				
	M3	22.65	28.5	—				
YG-22	m3	33.9	12.1		8.87	15.12	8.8	81.9



Fig. 3. *Equus* sp.: upper right P3–P4 (YG-21).

cone, deep ectoflexid and stenoid type double-knot is comparable with the equid described as *E. stenonis*, the characteristic horse of the Middle–Late Villafranchian faunas of Europe. Several subspecies of *Equus stenonis* were identified from Europe as *E. s. stenonis*, *E. s. senezensis* (Prat, 1964), *E. s. granatensis* (Marin, 1987), *E. s. vireti* (Prat, 1964), *E. s. guthi* (Boeuf, 1983), *E. s. mygdoniensis* (Koufos, 1992), *E. s. pueblensis* (Caloi & Palombo, 1987), and *E. s. olivolanus* (Caloi, 1997). However, due to strong wear degree of the upper dentition and lack of postcranial materials, it is not possible to place fossils under study among any of the subspecies. Therefore, we tentatively refer the studied specimens to as *Equus* sp.

In Turkey, systematically studied equid records from Sarıkol Tepe (Early Pleistocene; Kostopoulos & Sen, 1999), Gülyazi (Late Pliocene, Bernor & Lipscomb, 1991), Denizli (Erten *et al.*, 2005; Boulbes *et al.*, 2014), and Çal (Alçiçek *et al.*, 2012) have been identified as *Equus stenonis*, *Plesiohipparion huangheense*, and *E. suessenbornensis*, *E. apolloniensis* and *E. hydruntinus*, respectively. There are also preliminary described remains of Pleistocene forms from Middle Villafranchian sites of Kamlı and Yukarı Söğütözü (Sickenberg & Tobien, 1971). The famous site of Dursunlu (Early–Middle Pleistocene transition) has also yielded a quiet rich equid collection which has not been studied in detail and only presented in the faunal list. The few equid fossils from the Çobanisa (late Early Pleistocene, Mayda, 2004) and Kamlı localities are closely comparable with a medium-sized *E. stenonis*. It is clear that

Turkish Plio–Pleistocene equids show similarities with coeval southern European forms.

Order Artiodactyla Owen, 1848
Family Bovidae Gray, 1821
Subfamily Bovinae Gray, 1821
Genus *Leptobos* Rütimeyer, 1877–1878
Leptobos cf. *etruscus* (Falconer, 1868)

Material. Fragmentary left maxilla with M2–3 (YG-4a); fragmentary right maxilla with P3–M1 (YG-4b), upper right M2 (YG-5), upper left P2 (YG-2) (Fig. 4a–d).

Description. All specimens are most probably belong to the same individual that shares the typical morphology corresponding to the tribe Bovini. Rectangular upper molars are moderately hypsodont, and lack traces of cement at the middle wear stage. The enamel is smooth and moderately thick. The labial styles, parastyle, mesostyle, and metastyle are well developed as well as paracone and metacone ribs in all molars. Protocone and hypocone are well rounded and without constriction. Spurs are projecting into the postfossettes in both upper molars. In M2, contrary to M3, entostyle is strong and connected with the anterior lobe. As the lingual side of P3–M1 series is not well preserved, exact measurements cannot be taken. However, it is clear that parastyle and paracone rib are prominent in P3 and P4 and labial styles are moderately developed in M1.

Remarks. Morphological and biometrical features of the specimens clearly represent a medium sized

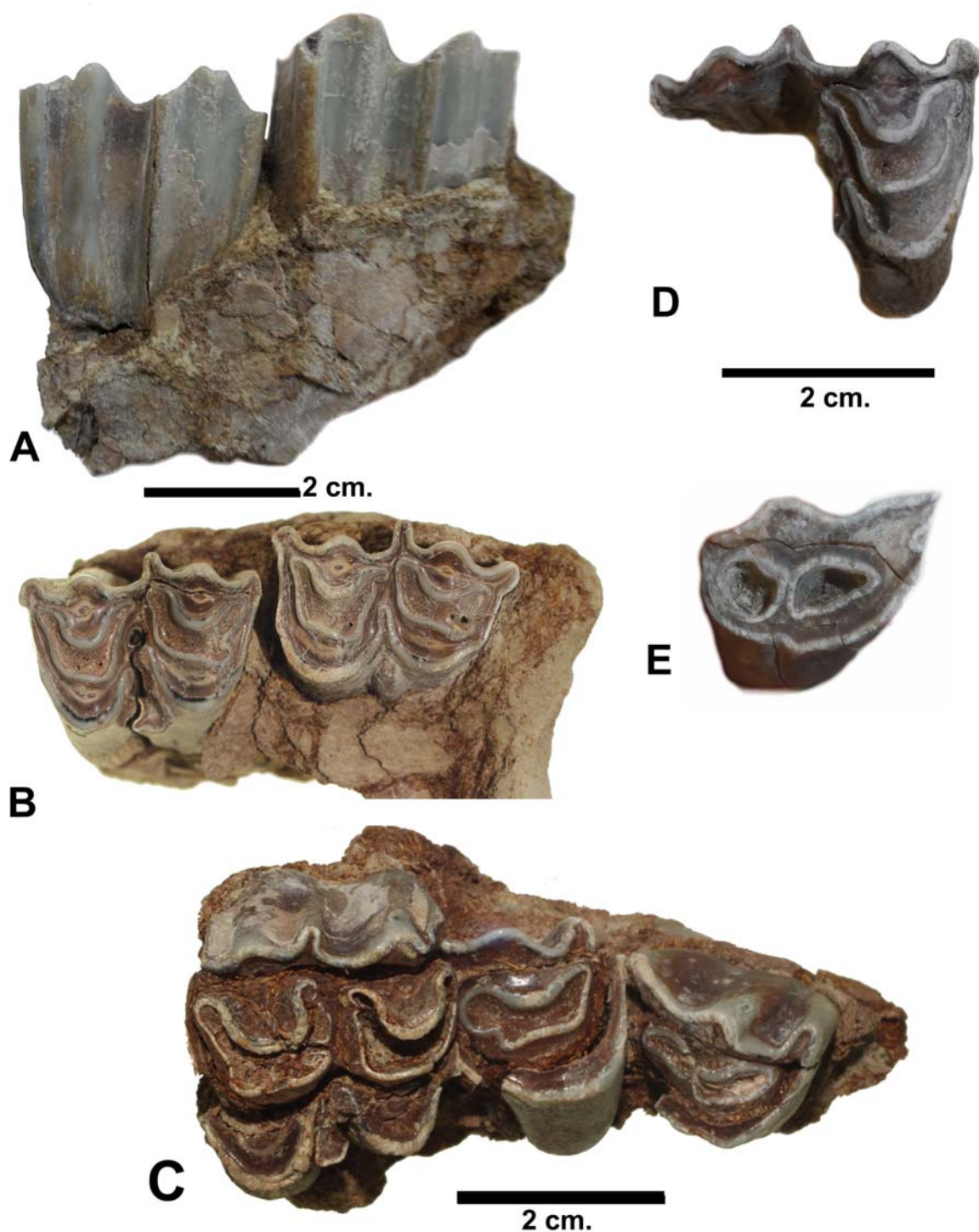


Fig. 4. *Leptobos* cf. *etruscus*: fragmentary left maxilla with M2-3 (YG-4a) A. (labial view), B. (occlusal view); fragmentary right maxilla with P3-M1 (YG-4b) C. (occlusal view); right M2 (YG-5) D. (occlusal view); left P2 (YG-2) E. (occlusal view).

Bovini. The lack of skull and limb bones does not allow a precise identification of Yassigüme material. The available material is, however, most similar in dimensions with the late Villafranchian leptobovines. The upper molars of the described form are only slightly

larger than that of *Leptobos etruscus* ((length $\times$ width) M3 (32.1–21.6), M2 (32.4–23.2)).

Leptobos is the one of the most common elements of Middle-Late Villafranchian faunas (approximately 3.5–1.0 Ma) being represented by 11 species from sites



Fig. 5. Geographic distribution of fossil sites with *Leptobos* spp. (NOW, 2014) (star stands for Yassigüme).

widely dispersed geographically in Mediterranean, Central Europe, India, and China (Fig. 5) (Mead *et al.*, 2014; NOW, 2014). The genus first appearance is recorded in the Eastern Mediterranean in the locality of Damatria (MN16). It was probably an immigrant from Southern Asia. Geologically later abundant remains of the genus originate mainly from localities of Italy (Olivola, Tasso, Farneta, etc.), France (Saint-Vallier, Seneze, etc.) and, in a lesser degree, Greece (Gerakarou, Kos) and Spain (Villaroya, Fonelas). It was replaced by first true *Bison* forms at the end of Early Pleistocene (Venta Micena, Pirro Nord, Apollonia) (Koufos *et al.*, 2005; Rook *et al.*, 2010; Mead *et al.*, 2014).

Yassigüme specimens are less hypsodont than those of *Bos* or *Bison*, but are clearly more hypsodont than Middle Villafranchian forms *Leptobos merlai* de Giuli, 1987 and *Leptobos furlivus* Duvernois et Guerin, 1989 from Western Europe. As a result, its relative size, moderate hypsodonty, missing cement, well developed labial styles with pronounced mesostyle in both molars and premolars of the Yassigüme form rule out its assignment to *Bison* and *Bos* and match it with a latest form of *Leptobos etruscus*. Nevertheless, the incompleteness of the available material make us to tentatively assign the described specimens to *Leptobos* cf. *etruscus*.

Subfamilia Antilopinae Gray, 1821

Tribe Antilopini Gray, 1821

Genus *Gazellospira* Pilgrim et Schaub, 1939

Gazellospira torticornis (Aymard, 1854)

Material. Right horn core (YG-20a); left horn core (YG-20b) (Fig. 6).

Description. Horn pairs belongs to same individual (APD x TD x length (mm): 47.5 x 38 x 204). The horn cores show the normal torsion with the right horn twisting clockwise, with large supraorbital pits. The surface of the horns bears longitudinal grooves that trace its torsion. A keel at the postero-lateral side is weakly developed at the horn's base and getting stronger upwards.

Remarks. The genus *Gazellospira* has been represented by the typical *G. torticornis* (Aymard, 1854) from Europe during Early to Middle Villafranchian. The peculiar Early Pleistocene (Middle Villafranchian) form, *G. gromovae* Dmitrieva, 1975, has been originally only recorded from Kuruksaj, Tajikistan. Titov (2008) recognized new specimens of *G. gromovae* from the Middle Villafranchian locality Liventsovka (southern Russia) and refined its paleogeographic range.

The distribution of *Gazellospira* in Eurasia, compiled from NOW, 2014, is shown in Figure 5. It is clear from the figure, *G. torticornis* has a rich record in French Villafranchian localities of Seneze, Saint-Vallier, Chilac & Pardines (Heintz, 1966; Duvernois & Gerin, 1989; Cregut-Bonnore, 2007) and Greek localities of Dafnero, Halykés, Krimni, Sésklo, Vatera, and Vólax (Symeonidis, 1992; Kostopoulos & Koufos, 1994; Kostopoulos, 1996, 1997; Athanassiou, 1996, 2005; de Vos *et al.*, 2002). In Turkey, the species has been recorded from the in the Middle Villafranchian locality of Sarikol Tepe, Ankara (Fig. 7) (Kostopoulos & Sen, 1996). There is also an earlier record of *Gazellospira* sp. from the Ruscinian locality of Çalta (MN15) (Bouvrain, 1998). Besides these two Turkish localities, there are also two more records coming from the Early Villafranchian locality of Gülyazi and the Middle Vil-



Fig. 6. *Gazellospira torticornis*: anterior view of right (YG-20a) and left (YG-20b) horn cores.

lafranchian locality of Y.Söğütözü (Sickenberg & Tobien, 1971). However, precise stratigraphy of the locality and taxonomic information of the findings are missing.

The distribution of *Gazellospira* in Anatolia during Plio-Pleistocene is not completely in accordance with what is known in other regions (Greece, France, or Spain) due to limited numbers of coeval Turkish local-

ities that makes it difficult to establish precise correlations. Yassigözü material shows morphology and size fitting with that of the material from the Middle Villafranchian Greek locality Séslo, described by Athanassiou (2005). It is the second record of this species from Turkey which proves its broader distribution throughout the Western and Central Anatolia during the Late Villafranchian.



Fig. 7. Geographic distribution of fossil sites with *Gazellospira* spp. (NOW, 2014) (star stands for Yassigüme).

Conclusions

Recently discovered fossil mammals from Yassigüme are herein described as *Leptobos* cf. *etruscus*, *Gazellospira torticornis*, and *Equus* sp. This association has a clear Late Villafranchian appearance, typical for coeval Western and South-East European faunas. This assemblage also confirms the early Late Villafranchian (~1.5 million years) age of the uppermost part of the Burdur Formation at the SE of the Burdur Lake. The Yassigüme bovine *Leptobos etruscus* is the first record in Anatolia. This record extends the known range of the species during Pleistocene. The faunal composition of the locality suggests that the animals inhabited savanna-type open and dry environment during the Early Pleistocene in the Burdur Region. This is also in concordance with another coeval locality of Burdur where *Paracamelus* and *Equus* were found together (Alçiçek *et al.*, 2013).

ACKNOWLEDGEMENTS. The authors would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the quality of the paper. We are also grateful to Dr. T. Kaya and Dr. Alexey Tesakov for reviewing the manuscript and making useful comments. We wish to thank all colleagues and students from the teams of Mehmet Akif Ersoy University (Burdur), Ankara University (Ankara), Çanakkale 18 Mart University (Çanakkale), Cumhuriyet University (Sivas) and Pamukkale University (Denizli) who participated in the field trips. The study was supported by international bilateral cooperation between The Scientific and Technological Research Council of Turkey and the Russian Foundation for Basic Research (TUBITAK-RFBR 111Y192 grant). SM also thanks the Ege University projects TTM/001/2010, 2011 and 2013.

References

- Alçiçek M.C., Mayda S. & Alçiçek H. 2012. Faunal and palaeoenvironmental changes in the Çal Basin, SW Anatolia: Implications for regional stratigraphic correlation of late Cenozoic basins // *Comptes Rendus Geoscience*. Vol.344. P.89–98.
- Alçiçek M.C., Mayda S. & Titov V.V. 2013. Lower Pleistocene stratigraphy of the Burdur Basin of SW Anatolia // *Comptes Rendus Palevol*. Vol.12. P.1–11.
- Athanassiou A. 1996. Contribution to the study of the fossil mammals of Thessaly, Greece. PhD thesis, National and Kapodistrian University of Athens, Athens. 393 p. [in Greek].
- Athanassiou A. 2005. *Gazellospira torticornis* (Aymard, 1854) from the Late Pliocene locality of Sésiklo (Thessaly, Greece) // *Quaternaire*. Vol.2. P.137–144.
- Becker-Platen J.-D. & Sickenberg O. 1968. Die unterpleistozänen Kiese von Eskisehir (Anatolien) und ihre Säugetierfauna // *Mitteilungen aus dem Geologischen Institut der Technischen Universität Hannover*. Vol.8. P.7–20.
- Bernor R.L. & Lipscomb D. 1991. The systematic position of “*Plesiohipparion*” aff. *huangheense* (Equidae, Hipparionini) from Gülyazi, Turkey // *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Historische Geologie*. Vol.31. P.107–123.
- Boeuf O. 1983. Le site Villafranchien de Chilhac (Haute-Loire, France). Étude paléontologique et biochronologique. Thèse, Université de Paris VII, Paris, France, 253 p.
- Boulbes N., Mayda S., Titov V.V. & Alçiçek M.C. 2014. Les grands mammifères du Villafranchien supérieur des travertins du Bassin de Denizli (Sud-Ouest Anatolie, Turquie) // *L’Anthropologie*. Vol.118. No.1. P.44–73.
- Bouvrain G. 1998. Le gisement de vertébrés pliocènes de Çalta, Ankara, Turquie. 10. Bovidae // *Geodiversitas*. Vol.20. No.3. P.467–485.
- Caloi L. 1997. New forms of *Equus* in the Western Europe and palaeoenvironmental changes // *Geobios*. Vol.30. P.262–284.
- Caloi L. & Palombo M.R. 1987. Osservazioni sugli Equidi Italiani del Pleistocene Medio inferior // *Geologica Romana*. Vol.26. P.187–221.
- Cregut-Bonnoure E. 2007. Apport des Caprinae et Antilopinae (Mammalia, Bovidae) à la biostratigraphie du Pliocène terminal et du Pléistocène d’Europe // *Quaternaire*. Vol.18. No.1. P.73–97.
- Demirel A. 2012. Burdur İli ve İlçelerinde Neojen ve Pleistosen Dönem Fossil Lokalitelerinin Tespiti Yüzey Araştırması-2010. 29. Araştırma Sonuçları Toplantısı, I. Cilt, sf. 361–368, Kültür Varlıkları ve Müzeler Genel Müdürlüğü Yayınları, Ankara.
- Demirel A. 2013. Surveys for the Identification of Fossil Localities in the Province of Burdur, 2012 Campaign. ANMED – News of Archaeology from Anatolia’s Mediterranean Areas (2013-11). Suna & İnan Kırarç Research Institute on Mediterranean Civilizations, Antalya.

- Demirel A., Kapan-Yeşilyurt S., Yiğit A. & Yiğitbaşıoğlu H. 2013. Burdur İli ve İlçelerinde Neojen ve Pleistosen Dönem Fosil Lokalitelerinin Tespiti Yüzey Araştırması-2011. 30. Araştırma Sonuçları Toplantısı Ankara. 1. Cilt, P.307–316.
- Demirel A. & Kapan-Yeşilyurt S. 2014. Burdur İli ve İlçelerinde Neojen ve Pleistosen Dönem Fosil Lokalitelerinin Tespiti Yüzey Araştırması-2012. 31. Araştırma Sonuçları Toplantısı, Kültür Varlıkları ve Müzeler Genel Müdürlüğü Yayınları, Ankara.
- de Vos J., van der Made J., Athanassiou A., Lyras G., Sondaar P.Y., & Dermitzakis M.D. 2002. Preliminary note on the Late Pliocene fauna from Vatera (Lesvos, Greece) // *Annales Geologiques des Pays Helleniques*. Vol.39(A). P.37–70.
- Duvernois M.P. & Guérin C. 1989. Les Bovidae (Mammalia, Artiodactyla) du Villafranchien supérieur d'Europe occidentale // *Geobios*. Vol.22. No.3. P.339–379.
- Erten H., Sen S. & Ozkul M. 2005. Pleistocene mammals from travertine deposits of the Denizli basin (SW Turkey) // *Annales de Paléontologie*. Vol.91. No.3. P.267–278.
- Güleç E., Clark Howell F. & White T.D. 1999. Dursunlu – a new lower Pleistocene faunal and artifact-bearing locality in southern Anatolia // Ulrich H. (ed.). "Hominid Evolution: Lifestyles and Survival Strategies" Berlin: Edition Andrea. P.349–364.
- Heintz E. 1966. La presence de *Gazellospira torticornis* Aymard (Ruminant) dans le gisement Villafranchien de Saint-Vallier (Drome). Essai de repartition géographique et stratigraphique // *Bull. Soc. géol. Fr. (Ser. 7)*. Vol.8. P.25–30.
- Karaman E. 1986. Burdur dolayının genel stratigrafisi // *Akdeniz Üniversitesi İsparta Mühendislik Fakültesi Dergisi*. Vol.2. P.23–36.
- Kostopoulos D.S. & Koufos G.D. 1994. The Plio-Pleistocene artiodactyls of Macedonia (Northern Greece) and their biostratigraphic significance; preliminary report // *Comptes Rendus de l'Académie des Sciences*. Vol.318. P.1267–1272.
- Kostopoulos D.S. 1996. The Plio-Pleistocene Artiodactyls of Macedonia (Greece) – systematics, palaeoecology, biochronology, biostratigraphy. PhD thesis, Aristotle University of Thessaloniki, Thessaloniki, 671 p. [in Greek].
- Kostopoulos D.S. 1997. The Plio-Pleistocene artiodactyls from Macedonia, Greece: 2. The fossiliferous site of Volakas, VOL (Volakas basin, Drama, NE Greece) // *Paleontologia i Evolució*. Vol.30–31. P.83–92.
- Kostopoulos D.S. & Sen S. 1999. Late Pliocene (Villafranchian) mammals from Sarıkol Tepe, Ankara, Turkey // *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Historische Geologie*. Vol.39. P.165–202.
- Koufos G.D. 1992. Early Pleistocene Equids from Mygdonia basin (Macedonia, Greece) // *Palaeontographia Italica*. Vol.74. P.167–199.
- Koufos G.D., Kostopoulos D.S. & Vlachou T.D. 2005. Neogene/Quaternary mammalian migrations in Eastern Mediterranean // *Belgian Journal of Zoology*. Vol.135. No.2. P.181–190.
- Marin M. 1987. *Equus stenonis granatensis* en el Pleistoceno inferior de Venta Micena (Granada, España). *Paleontologia i Evolució* Mem. Esp.1. P.255–282.
- Mayda S. 2002. Aşağıçobanisa (Manisa-Turgutlu) ve çevresi kum ocağı Neojen-Kuvaterner omurgalı faunalarının paleontolojik incelenmesi. Yüksek Lisans Tezi, Ege Üniversitesi Fen Bilimleri Enstitüsü.
- Mayda S. 2004. A new Pleistocene fauna from Western Anatolia (Manisa-Turgutlu-Asağı Çobanisa) // 5th International Symposium on Eastern Mediterranean Geology, Thessaloniki, Greece, 14–20 April 2004. Vol.1. P.333–334.
- Mead J.I., Changzhu Jin C., Wei G., Sun C., Wang Y., Swift S.L. & Zheng L. 2014. New data on *Leptobos crassus* (Artiodactyla, Bovidae) from Renzidong Cave, Early Pleistocene (Nihewanian) of Anhui, China, and an overview of the genus // *Quaternary International*. In Press. DOI: 10.1016/j.quaint.2014.02.019.
- NOW, 2014. New and Old Worlds Database of Fossil Mammals. Fortelius M. (coordinator). University of Helsinki. <http://www.helsinki.fi/science/now/>.
- Prat F. 1964. Contribution à la classification des Équidés villafranchiens // *Procès verbaux de la Société linnéenne de Bordeaux*. Vol.101. P.14–32.
- Price S.P. 1989. Sedimentation and neotectonics of the Burdur region, SW Turkey. Unpubl. PhD Thesis, University of Leicester.
- Rook L. & Martínez-Navarro B. 2010. Villafranchian: the long story of a Plio-Pleistocene European large mammal biochronologic unit // *Quaternary International*. Vol.219. P.134–144.
- Saraç G. 2003. The vertebrate fossil localities of Turkey. Scientific Report No. 10609, General Directorate of the Mineral Research and Exploration of Turkey. Ankara, 208 pp.
- Şenel M. 2002. Geological map of Turkey in 1/500.000 scale: Isparta J10 sheet. Publication of Mineral Research and Explanition Directorate of Turkey.
- Sickenberg O. & Tobien H. 1971. New Neogene and Lower Quaternary vertebrate faunas in Turkey // *Newsletters on Stratigraphy*. Vol.1. No.3. P.51–61.
- Sickenberg O., Becker-Platen J.D., Benda L., Berg D., Engesser B., Gaziry W., Heissig K., Hunermann K.A., Sondaar P.Y., Schmidt-Kittler N., Staesche K., Staesche U., Steffens P. & Tobien H. 1975. Die Gliederung des höheren Jungtertiärs und Altquartärs in der Türkei nach Vertebraten und ihre Bedeutung für die Internationale Neogen-Stratigraphie // *Geologisches Jahrbuch B*. Vol.15. P.1–167.
- Symeonidis N. 1992. Lower Pleistocene (Villafranchian) fossil mammals from the Sesklo basin (Volos) // *Annales Géologiques des Pays Helléniques*. Vol.35. P.1–21.
- Titov V.V. 2008. [Late Pliocene large mammals from North-eastern Sea of Azov Region]. Rostov-on-Don: SSC RAS Publishing. 262 p. [in Russian].
- Yiğit A. 1998. Dursunlu (İlgin-Konya)'da Bulunan Pleistosen Döneme Ait Equuslar'ın Paleontolojik Analizi. M.S. Dissertation. Ankara University.
- Yiğitbaşıoğlu H. 2009. Burdur Havzasında Arazi Kullanım Özellikleri ve Sorunları (Land Use Features and Problems in Burdur Basin), T.C. Ankara Üniversitesi, Bilimsel Araştırma Projesi Kesin Raporu, Proje No: 20020901009, Ankara.