

PLEISTOCENE AMPHIBIANS AND REPTILES FROM EMIRKAYA-2, TURKEY

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The Middle Pleistocene fissure-filling deposits of Emirkaya-2 in central Turkey yielded numerous bones of amphibians and reptiles, belonging to at least 11 taxa: *Bufo viridis*, *Lacerta* sp., *Pseudopus* cf. *P. apodus*, *Scolecophidia* indet., *Coluber caspius*, *Coluber* sp., *Elaphe* cf. *E. quatuorlineata*; cf. *Telescopus* sp., *Colubridae* indet., *Natrix* cf. *N. natrix* and *Vipera* sp. from the "Oriental vipers" group. The assemblage probably comprised only living forms occurring in the area today. The faunal composition of this locality indicate warm climate and at least a partly forested environment.

INTRODUCTION

The available palaeontological data suggest that most of the modern herpetofauna of Europe is of Asiatic origin (Bailon, 1991). Due to its geographic situation, Asia Minor probably played a significant role in the distribution of amphibians and reptiles during Neogene times, serving as an important route for migrants passing around the Paratethys. However, the fossil herpetofauna of Turkey is as yet poorly known. Our knowledge concerning this group in the area (including Aegean islands) is limited to the fauna described from the early Pliocene of Maritsa, Greece (Szyndlar, 1991a, 1991b), late Pliocene of Çalta, Turkey (Rage & Sen, 1976; Sen & Rage, 1979), early

Pleistocene of Laghada A and B, Greece (Szyndlar, 1991a, 1991b), middle Pleistocene of Latomi-1 (Chios), Greece (Schneider, 1975) and late Pleistocene of Pili B, Greece (Szyndlar, 1991a, 1991b).

The fossiliferous site of Emirkaya-2 is a fissure-filling in the Emirkaya limestone quarry, 1.5 km south of the town of Seydisehir (dept. of Konya) in Central Anatolia (Fig. 1). It was discovered in October 1989 by a French team during prospecting in the area. The bituminous limestones of this quarry are attributed to the late Triassic. The fissure-filling is about 5 m wide, and nearly 10 m in thickness. Well consolidated brecciated sediments contain abundant remains of small and large mammals, amphibians, reptiles and birds. A previous paper (Sen, Bonis, Dalfes, Geraads, Jaeger & Mazin, 1991) presented this locality along with a preliminary study of a mammal assemblage. A short report on the amphibians, reptiles and birds was given by Kessler & Venczel (1993). Based on the large mammals and on the *Miomys-Arvicola* association, Sen *et al.*, (1991) tentatively assigned a Middle Pleistocene age to this fauna. Studying the small mammals, Montuire (1991) and Montuire, Sen & Michaux (in press) deduced its age as Holsteinian, which corresponds to the Mindel-Riss interglacial. The mammal fauna is characterized by its diversity, since it contains 36 species of mammals belonging to 20 families. The vertebrate remains were obtained by dissolving blocks in diluted formic acid and by washing some weathered sediment in the field. The material is stored in the collections of the Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle, in Paris.

The anatomical nomenclature of Anura follows that of Sanchíz & Mlynarski (1979), lizard nomenclature follows Rocek (1984). The anatomical nomenclature of snakes and the methodology of measurements of snake vertebrae follow Szyndlar (1984).

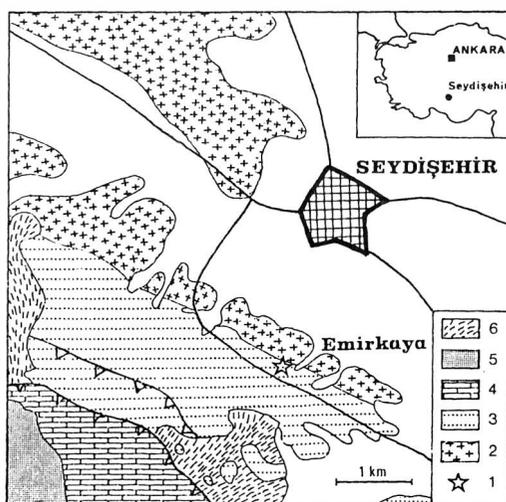


FIG. 1. Location map of the Emirkaya-2 fissure-filling. 1. The locality, 2. Cambrian, 3. Triassic, 4. Jurassic, 5. Cretaceous, 6. Screes.

SYSTEMATIC STUDY

AMPHIBIA

Order Anura Rafinesque, 1815

Family Bufonidae Gray, 1825

Genus *Bufo* Laurenti, 1768*Bufo viridis* Laurenti, 1768

Material. One fragmentary atlas, 15 fragmentary vertebrae, seven fragmentary humeri, six fragmentary scapulae, six radioulnae (proximal fragments), six fragmentary ilia (EM 501 to 544).

The available postcranial fragments are distinctive enough to provide the basis for the specific identification.

The atlas, with the condyle broken off, displays morphological features of the recent *Bufo viridis*. The mode of articulation is of type II (Lynch, 1971). The neural canal is round, the postzygapophyses are moderately developed. The subzygapophyseal spine (sensu Bailon, 1986) is present, this structure being slightly expressed in *Bufo calamita* and lacking in *Bufo bufo* (Sanchíz, 1977; Bailon & Hossini, 1990). The trunk vertebrae are procoelous (generally badly preserved). The transverse process in the second vertebra (preserved only in the left side) is flattened dorsoventrally and slightly directed anteriorly. The sacral vertebrae are procoelous. In all the specimens, the diapophyses are broken off distally. A shallow groove at the base of the sacral processes is directed laterally, somewhat similarly to that of *Bufo* aff. *viridis* from Latomi-1, in Chios (Schneider, 1975: Fig. 9). The dorsal crest of the urostyle is moderately high, the cotyles are well separated from each other and are flattened dorsoventrally.

The tuber superius of ilium (Fig. 2a and 2b) is prominent, and usually divided in two protuberances, the posterior one being smaller. The preacetabular fossa is deep. In *Bufo raddei* this fossa is similarly developed (Hodrova, 1986: Figs. 5 & 6), shallow in *Bufo calamita* and lacking in *Bufo bufo* (Sanchíz, 1977).

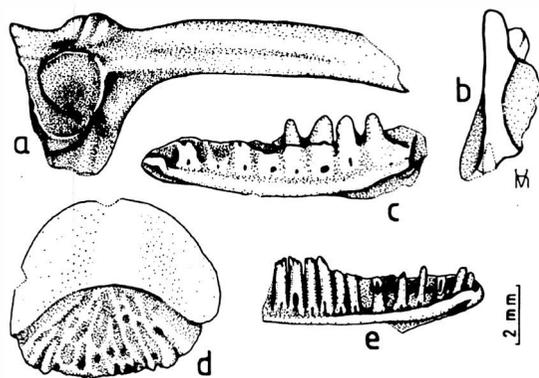


FIG. 2. Anuran and lizard remains from Emirkaya-2. a, b: right ilium of *Bufo viridis* (EM 501); c: right dentary of *Pseudopus* cf. *P. apodus* (EM 546); d: osteoderm of *Pseudopus* cf. *P. apodus* (EM 547); e: left dentary of *Lacerta* sp. (EM 545).

The pars cylindriformis lacks the 'calamit lamina', present in *Bufo calamita* and *Bufo raddei* (Sanchíz, 1977; Bailon 1986; Hodrova, 1986).

The remaining specimens are fragmentary (scapulae, humeri and radioulnae) and provide limited taxonomic information.

In the Aegean area, fossil remains assigned to this species as *Bufo* aff. *viridis* are already known from the late Pliocene of Çalta (Rage & Sen, 1976; Sen & Rage, 1979) and from the middle Pleistocene of Latomi-1 (Schneider, 1975). These localities lie within the present range of distribution of this species.

REPTILIA

Order Sauria McCartney, 1802

Family Lacertidae Bonaparte, 1831

Genus *Lacerta* Linnaeus, 1758*Lacerta* sp.

Material. One fragmentary dentary (EM 545).

The dentary fragment preserves 18 tooth positions and corresponds in size and shape with the living *Lacerta viridis* - *Lacerta trilineata* (Fig. 2e). The dentition is of pleurodont type, the teeth are provided with bicuspid or tricuspid tips.

Family Anguidae Gray, 1825

Genus *Pseudopus* Merrem, 1820*Pseudopus* cf. *P. apodus* (Pallas, 1775)

Material. One fragmentary dentary, nine osteoderms (eight of them fragmentary), two fragmentary caudal vertebrae (EM 546 to 557).

The medium-sized dentary preserves 12 tooth positions (Fig. 1c). The Meckelian groove opens ventrally, being visible medially only in its anterior portion (below the symphysis). The crista splenialis is ended anteriorly in the moderately developed spina splenialis. The teeth are conical, with a fine striation near the crown tips. The two caudal vertebrae, although fragmentary, can be assigned to this genus by their size and morphology. The posterior part of the osteoderms is covered with vermicular-shaped tubercles, while the anterior part is smooth and devoid of tubercles (Fig. 2d).

The observable features of the above described skeletal fragments are consistent with those of living *P. apodus*. In Turkey, fossil remains belonging to *Pseudopus* (= *Ophisaurus*) were also reported from the late Pliocene of Çalta by Rage & Sen (1976).

It should be noted that the genus *Pseudopus* has been revalidated by Klembara (1979). This author, using the rich fossil material from Dolnice (MN4), described *Ophisaurus fejfari* and *O. spinari*, and came to the conclusion that *Ophisaurus* (including fossil and living forms) and *Pseudopus* (*P. moguntinus*, *P. pannonicus* and *P. apodus*) were two distinct phylogenetic lineages. In contrast, Sullivan (1987)

pointed out that the genus *Ophisaurus* comprises only New World forms, and the Old World '*Ophisaurus*' may be assigned to the *Ophisauriscus-Anguis* lineage.

The fossil relatives of the living *Pseudopus apodus* (i.e. *P. moguntinus* and *P. pannonicus*) inhabited a large part of Europe from the Upper Oligocene up to the Middle Pleistocene (Fejérváry-Lángh, 1923; Bachmayer & Mlynarski, 1977; Klembara, 1979, 1981, 1986; Rocek, 1984; Bailon, 1989, 1991). The youngest of them, *P. pannonicus*, progressively retreated from the north during the late Neogene, to become extinct during the early Pleistocene. On the other hand, it should be mentioned that *P. pannonicus*, by its morphology, was rather similar to the living *P. apodus*, differing mainly from the latter by its larger dimensions.

Although in Europe the extinct *P. pannonicus* survived up to the Middle Pleistocene (i.e. in the Vaalian of Betfia, Romania, pers. obs.), at the same time in Anatolia, the genus was already represented by the living species.

Order Serpentes Linnaeus, 1758
Scolecophidia indet.

Material. Four trunk vertebrae (EM 558 to 561).

The vertebrae are well preserved and of minute size. The centrum length in three measured vertebrae ranges between 0.8-1.05 mm, while the centrum width between 0.61-0.75 mm. All the vertebrae are depressed dorsoventrally, lacking the neural spine and paracotylar foramina. The haemal keel is imperceptible, the synapophyses are undivided, the cotyle and condyle are strongly flattened dorsoventrally (Fig. 3).

The above morphological features, shared by the members of the families Typhlopidae, Anomalepididae and Leptotyphlopidae, make it impossible to identify these fossils below the subordinal level (Szyndlar, 1987, 1991a; Szyndlar & Zerova, 1992). Fossil remains of Scolecophidia, coming from the area, are known from the early Pliocene of Maritsa (Szyndlar, 1991a) and from the late Pliocene of Çalta (Rage & Sen, 1976). Presently, Anatolia is inhabited by members of both the Typhlopidae and the Leptotyphlopidae (Baran, 1976, 1978).

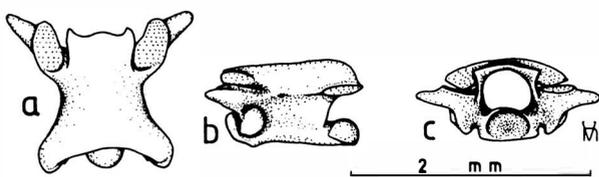


FIG. 3. Trunk vertebra (EM 558) of Scolecophidia indet. in dorsal (a), lateral (b) and anterior views (c).

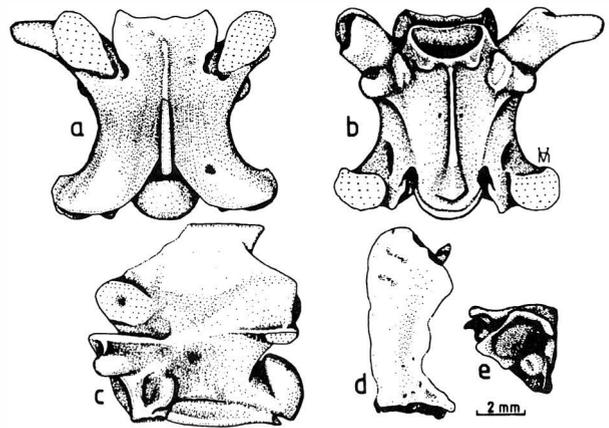


FIG. 4. *Coluber caspius*. Trunk vertebra (a-c: EM 563) and frontal (d, e: EM 562). a, d: dorsal; b: ventral; c: lateral; e: anterior views.

Suborder Alethinophidia Nopcsa, 1923
Family Colubridae Opperl, 1811
Genus *Coluber* Linnaeus, 1758
Coluber caspius Gmelin, 1789

Material. One right frontal, 44 vertebrae (EM 562 to 606).

The frontal resembles closely that of the living *Coluber caspius* because of its internal prefrontal process projecting anteriorly (Fig. 4d, 4e). The vertebrae are vaulted, the neural spine is high, overhanging posteriorly and slightly anteriorly. The epizygapophyseal spine is absent, the zygosphene is concave. Prezygapophyseal processes are equal in length to the prezygapophyseal articular facets and are blunt on their edge. Below the cotyle rim a pair of tubercles can be observed. The subcentral ridge is better defined posteriorly to the paradiapophyses. The haemal keel is sharp and prominent, in lateral view it is slightly curved ventrally, its depth diminishing posteriorly, where it becomes wider. The para- and diapophyseal portions of the paradiapophyses are equal in height. The diapophyses are slightly shifted posteriorly (Fig. 4b, 4c). The centrum length of the largest vertebra is 6.84 mm, while the centrum width is 5.56 mm (centrum length/centrum width ratio: 1.23).

For comparison of these remains, it was not possible to see comparative material of all living colubrids, but only some species from Eastern Europe and Anatolia. However, some key characters of vertebrae and frontal bones are sufficiently characteristic for species allocation. As indicated by Szyndlar (1991a), the trunk vertebrae of *C. caspius* can be well differentiated from the other large-sized European colubrids by their distinctly elongated centra, concave zygosphene, prominent and sharp haemal keel, and long prezygapophyseal process. Moreover, the prefrontal

process of the Emirkaya-2 specimen has a similar shape to that of *C. caspius*. These diagnostic features, as well as the geographical distribution of this species, allow us to assign this material to *C. caspius*.

Surprisingly, a species, *C. caspioides*, very similar to the living *C. caspius* was recently described from the late Lower Miocene (MN4) of Petersbuch 2 in Germany (Szyndlar & Schleich, 1993). The fossil record from Emirkaya-2 lies within the present range of distribution of the living species.

Coluber sp.

Material. One frontal, 15 vertebrae (EM 607 to 622).

The frontal somewhat resembles those of the living *Coluber najadum*-*C. rubriceps* group (Fig. 5c, 5d), but the internal prefrontal process of the above group is comparatively larger and slightly projecting anteriorly. The vertebrae are moderately vaulted, with long and low neural spine. The centrum length of the largest vertebra (Fig. 5a, 5b) is 3.74 mm, while the centrum width is 2.29 mm (centrum length/width ratio: 1.63). The zygosphenal roof is slightly convex, the zygosphene is provided with three lobes. The prezygapophyseal articular facets are ovaloid, the prezygapophyseal processes are slightly longer than the prezygapophyseal articular facets with pointed tips. The haemal keel is prominent, its depth slightly diminishing posteriorly. The paradiapophyses are minute, divided into para- and diapophyseal portions. The diapophyses are not shifted posteriorly and are equal in height with the parapophyses.

The above features somewhat resemble those of the recent *C. najadum*, *C. rubriceps*, and also *C. gemonensis*. The scantiness of the available material, as well as the overlapping vertebral characters of the above species (see Szyndlar, 1991a) do not permit more precise identification of these fossils.

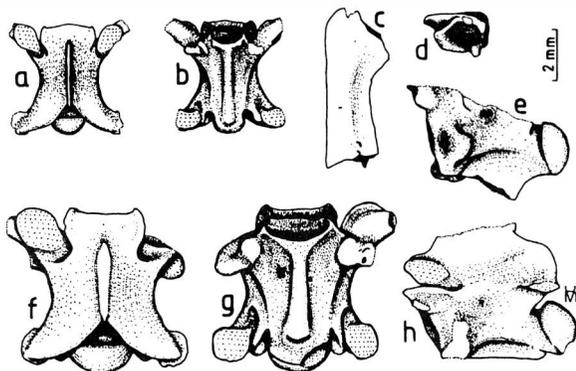


FIG. 5. Fossil remains of *Coluber* sp. and *Elaphe* cf. *E. quatuorlineata*. a, b: trunk vertebra of *Coluber* sp. (EM 607); c, d: frontal of *Coluber* sp. (EM 608); e: cervical vertebra of *Elaphe* cf. *E. quatuorlineata* (EM 623); f, g, h: trunk vertebra of *Elaphe* cf. *E. quatuorlineata* (EM 624). a, c, f: dorsal; b, g: ventral; d: anterior; e, h: lateral views.

Nowadays, the area is inhabited by several members of the genus *Coluber* (Baran, 1976; Schètti & Agasian, 1985; and others).

Genus *Elaphe* Fitzinger, 1833

Elaphe cf. *E. quatuorlineata* (Lacépède, 1789)

Material. One fragmentary cervical vertebra, four trunk vertebrae (EM 623 to 627).

Only the centrum of the cervical vertebra is preserved (Fig. 5e). The tip of the hypapophysis is broken off, but its base is orientated forward, as observed in the living *Elaphe quatuorlineata* (condition also shared by other members of the genus, e.g. *E. schrenki*). The trunk vertebrae are vaulted, the zygosphene is concave, the haemal keel is flattened and is not widened before the condyle. The paradiapophyses are large, projecting laterally. Neither neural spine, nor prezygapophyseal processes are preserved in the material (Fig. 5f, 5g, 5h).

The anteriorly projected hypapophyses of the cervical vertebrae, combined with the strongly flattened haemal keel, concave zygosphene and very short prezygapophyseal process of the middle trunk vertebrae are considered as key characters of the living *E. quatuorlineata* (Szyndlar, 1991a).

The scarcity of the material from Emirkaya-2 and its poor state of preservation does not allow observation of all the features mentioned above. Thus, the allocation of these remains to the living *Elaphe quatuorlineata* cannot be fully demonstrated.

Genus *Telescopus* Wagler, 1830

Cf. *Telescopus* sp.

Material. Six trunk vertebrae (EM 628 to 633).

The vertebrae are somewhat fragmentary. The neural arch is depressed; the neural spines in all the specimens are lacking. The zygosphene is crenate, the prezygapophyseal articular facets are oval, the prezygapophyseal processes are very short and obtuse shaped. The haemal keel is flattened and only slightly widened before the condyle. The parapophyses are not preserved in the material (Fig. 6d, 6e).

The lack of the neural spine and the parapophyses, which are extremely important to determine *Telescopus fallax*, makes impossible the specific allocation of these remains. Presently, South Anatolia is inhabited by the living *T. fallax*.

Colubridae indet.

Material. Fourteen trunk vertebrae (EM 634 to 644).

The vertebrae are vaulted, the neural spine is high, the zygosphene usually is triangle-shaped. The prezygapophyseal processes are slightly longer than or

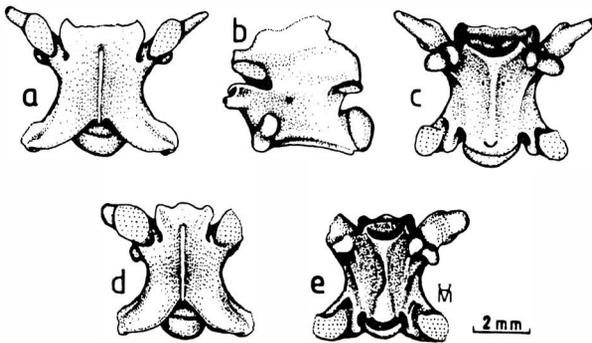


FIG. 6. Trunk vertebrae of Colubridae indet. (a-c: EM 634) and cf. *Telescopus* sp. (d, e: EM 628). a, d: dorsal; b: lateral; c, e: ventral views.

of equal length with the prezygapophyseal articular facets, ending in pointed tips. The haemal keel is poorly developed. The subcentral area is somewhat concave. The paradiapophyses are slightly divided into para- and diapophyseal portions and are equal in height (Fig. 6a, 6b, 6c). The centrum length in three measured vertebrae ranges between 2.90-3.32 mm, while the centrum width is between 2.31-2.70 mm. Some of the above vertebral characters are shared by several small members of the genus *Coluber* (e.g. *C. ravergeri*), but more precise identification of this material is impossible.

Genus *Natrix* Laurenti, 1768

Natrix cf. *N. natrix* (Linnaeus, 1758)

Material. One fragmentary dentary, 150 vertebrae (EM 645 to 648).

The dentary fragment, with its proximal and distal portions broken off, preserves 16 tooth sockets. Its assignment to this form remains doubtful. The vertebrae display all the diagnostic features of the living *Natrix natrix* (Szyndlar, 1991b). The neural arch is moderately vaulted, the neural spine strongly overhangs anteriorly and posteriorly, the hypapophysis is sigmoid-shaped with obtuse tip, the parapophyseal process is obtuse-shaped (Fig. 7a, 7b, 7c). The centrum length in six measured vertebrae ranges between 4.33-5.08 mm, the centrum width between 2.75-3.41 mm. The centrum length/width ratio is between 1.43-1.66.

Fossil remains belonging to the Natricinae were reported from the Middle Pleistocene of Latomi-1, in Chios Island, by Schneider (1975), while remains of *Natrix* sp. from the Lower Pleistocene of Laghada B, Greece, and from the late Quaternary of Pili B, Greece, were reported by Szyndlar (1991b).

In addition, the fossil material comprises 480 fragmentary vertebrae, grouped under the number EM 656, probably belonging to the above taxa of the family Colubridae.

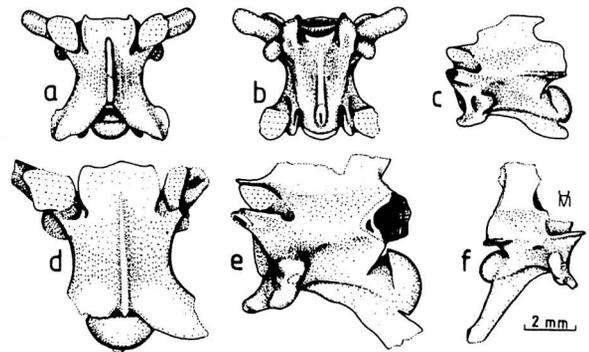


FIG. 7. Vertebrae of *Natrix* cf. *N. natrix* (a-c) and *Vipera* sp. (d-f). a, b and c: trunk vertebrae of *Natrix* cf. *N. natrix* (EM 646 and 647); d, e: trunk vertebra of *Vipera* sp. (EM 649); f: cervical vertebra of *Vipera* sp. (EM 650). a, d: dorsal; b: ventral, c, e, f: lateral views.

Family Viperidae Oppel, 1811

Genus *Vipera* Laurenti, 1768

Vipera sp.

Material. Six fragmentary vertebrae (EM 649 to 655).

The neural spine of the cervical vertebra is lacking, the hypapophysis presumably was longer than the centrum (Fig. 7f). The centrum length of the largest middle trunk vertebra is 6.4 mm, and its width is 4.68 mm. The centrum is 1.36 times longer than wide. The neural arch is flattened. In all specimens, the neural spine and the hypapophyses are lacking. The zygospheneal roof is slightly convex; in dorsal view, the anterior margin of this structure is trilobate. The pre- and postzygapophyseal articular facets are rectangle-shaped, the parapophyseal processes are oriented anteroventrally, having pointed tips (Fig. 7d, 7e).

These remains, despite their fragmentary state, but considering the absolute size of the trunk vertebrae and their relatively low centrum length/centrum width ratio, are consistent with those of the larger members of the genus *Vipera* ('Oriental vipers' group - sensu Szyndlar, 1987, 1988, 1991b).

Fossil remains belonging to this group of vipers were reported from the Middle Pleistocene of Latomi-1, Chios, by Schneider (1975). Today Anatolia is inhabited by members of both the 'lebetina' and 'xanthina' complexes of the 'Oriental vipers' (sensu Groombridge, 1986).

CONCLUSIONS

The previous studies of mammals (Sen *et al.*, 1991; Montuire, 1991; Montuire *et al.*, in press) and the present study of the herpetofauna show that the Emirkaya-2 fissure filling locality has yielded one amphibian, at least ten species of reptiles, several birds and thirty-six species of mammals. Based on the abundance of bears and beavers in this locality (Sen *et al.*,

1991), we can conclude the presence of a forested, or at least woodland, environment. However, some elements among the mammals, such as a dipodid *Allactaga* sp. and a bat *Hipposideros* sp., are indicative of high temperature and open environments (Montuire, 1991; Montuire *et al.*, in press).

The herpetofauna of Emirkaya-2, on the basis of the available fossil remains, was composed exclusively of extant genera and species, the majority of them belonging to thermophilous and xeric- adapted forms (e.g. *Pseudopus* cf. *P. apodus*, *Coluber caspius*, *Elaphe* cf. *E. quatuorlineata*, cf. *Telescopus* sp., etc.). Probably only one form, *Natrix* cf. *N. natrix*, was closely associated with aquatic environments, as are the above mentioned beavers. The anuran *Bufo viridis*, the single amphibian recognized in the fossil assemblage, is a form with a wide ecological tolerance. The herpetofauna of Emirkaya-2 only contains Palaeoartic species, and it does not include an African component.

From the available data, it can be concluded that the Emirkaya-2 fauna was living in a temperate period, and its environment was partly forested with permanent water ponds.

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