Scientific Annals, School of Geology
Aristotle University of Thessaloniki (AUTH) | Special volume 98 | 273-284 | Thessaloniki, 2006

QUATERNARY MAMMALIAN REMAINS FROM THE KITSELI POTHOLE (ALEA, NEMEA, PELOPONNESE)

Evangelia TSOUKALA[1], Antonis BARTSIOKAS[2], Katerina CHATZOPOULOU[1] & Georgios LAZARIDIS[1]

ABSTRACT: In the present study a new karstic cave in the Peloponnese, the Kitseli Pothole, is described for the first time. At its maximum depth of about 10 m, fossilized bones of a brown bear and a leopard have been found, which are best described as *Ursus arctos* and *Panthera pardus.* Additionally only a few micromammalian remains can be attributed to *Crocidura* sp., *Microtus (Microtus) arvalis*, *Microtus (Microtus)* cf. *nivalis, Microtus (Pitymys)* cf. *subterraneus/multiplex* and *Cricetulus migratorius.* Also, a maxillary fragment belongs to a small reptile. This is the first report of a fossil brown bear found in the Peloponnese and it expands the southernmost limits of the taxon. The bones of the leopard are consistent with the creation of the myth of the Nemean Lion that was killed by Hercules. The paleoenvironment and the biochronology are also discussed.

Key words: Kitseli Pothole, Quaternary fauna, Nemea, Peloponnese, Greece.

INTRODUCTION

The Kitseli Pothole is located near Alea village, in the Nemea area of the Peloponnese, South Greece (code of the site KNP: Kitseli Nemea Peloponnese) (fig. 1a). The name of the pothole is given by the present authors to honour the memory of Theodoros Kitselis who was a caver and first explored the caves of Alea, such as "Trypa tis Chionas" (Panagiotidis, 1978). Soon after the exploration of "Trypa tis Chionas" one of us (A.B.) explored the Kitseli Pothole where he found the bones presented here (fig. 1b, 2). The maximum depth of the pothole is 10

a

b

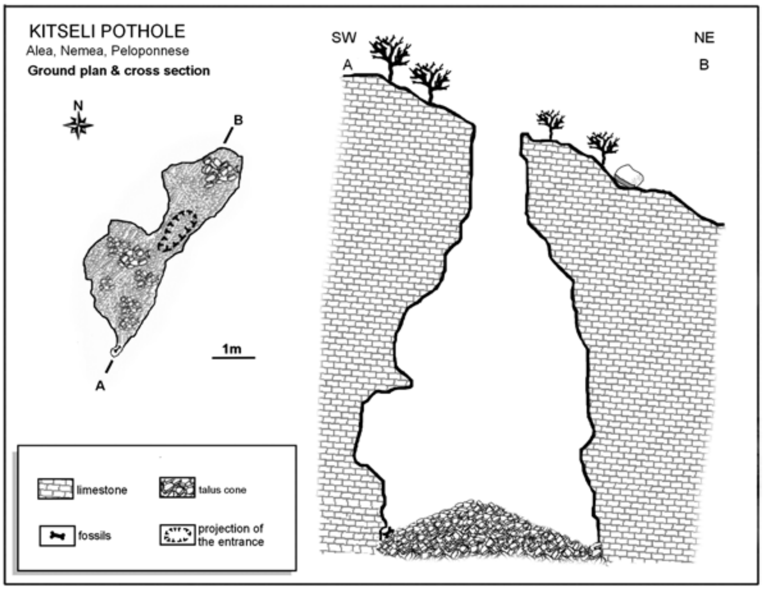


Figure 1. a. Map of Greece with the Kitseli Pothole depicted in the Nemea area.
b. Ground plan and SW-NE cross section of the Kitseli Pothole (Alea, Nemea, Peloponnese). On the bottom of the chamber, at the southernmost part of the cave, fossilized bones and teeth from mammals and micromammals have been found in a fine granulated silty sand and pebbles.

1 Geology School, Aristotle University, 54 124 Thessaloniki. lilits@geo.auth.gr
2 Democritus University of Thrace, Department of History & Ethnology, P.O. Box 217, 69100 Komotini. anaxbart@otenet.gr

m. It has a small entrance 40 X 80 cm (fig. 3). At the bottom of the pothole a small talus cone has been formed. The surface of the cave floor occupies an area of about 6 m^2 and is full of stones and has a maximum length of 5 m and a minimum breadth of 0.70 m (fig. 1b). The pothole is decorated with a few stalactites, stalagmites, flowstones and cave corals. Very few recent bones, mainly belonging to artiodactyles, were noted on the surface.

Figure 2. Animal bones at the bottom of the Kitseli Pothole.

Figure 3. The entrance of the Kitseli Pothole.

PALEONTOLOGY

Large Mammals

Taxonomy

Order: CARNIVORA BOWDISH, 1821
Sub-order: Canoidea SIMPSON, 1931
Arctoidea FLOWER, 1969
Family: Ursidae GRAY, 1825
Genus: *Ursus* LINNAEUS, 1758
Ursus arctos LINNAEUS, 1758

Material: 1 vertebra lumbar KNP 2, 1 vertebra sacral KNP 10, 2 vertebras/coccyx KNP 17 and 18, 2 pelvis frag. KNP 11 sin and 12 dex, 1 complete femur KNP 1 dex, 1 femur frag. KNP 13 sin, 2 tibia fragments KNP 3 dex and KNP 14 sin, 1 proximal frag. KNP 7, 2 fibula frag. KNP 4 and 16, calcaneus frag. KNP 15 dex, 1 cuneiform3 KNP 26 dex, metapodials: Mp distal KNP 29, 3Mp proximal KNP 28, 30 and 31, phalanges: 4 Ph1 KNP 19, 21, 22, and 20 for Mp 1, 1 Ph3 KNP 23, 2 sesamoids KNP 24 and 25.

Description: The ursid remains include only post cranial bones; most of them have not been identified confidently as they are incomplete or in small fragments. The right femur is the best preserved among the Kitseli specimens (pl. 1.1, tab. 1), the morphology and the dimensions of which point clearly to the presence of the brown bear (fig. 4). On the contrary, the left femur is very poorly preserved, a powder sample of which was XRD analysed, in order to assess the degree of fossilization. Both acetabulums are preserved, the left one being more complete, the

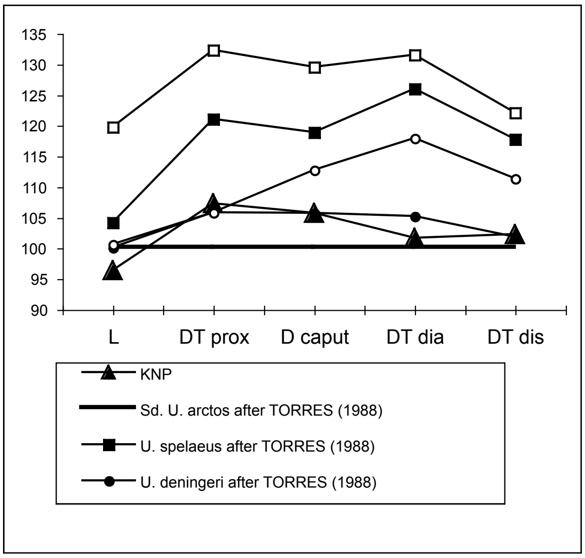


Figure 4. Comparative diagram with the femur dimensions of various species of *Ursus*. The Kitseli bear (KNP) falls within the range of the arctoid bears. Standard *Ursus arctos*, Spain (Torres, 1988).

tuber ischiadicum of which seems to be unfused, showing thus a sub-adult individual. The vertebral column is well represented by an almost complete sacral (pl. 1.2), the *alae* of which are missing, an almost complete lumbar (pl. 1.3) and two complete caudal vertebras (pl. 1.4 and 5). Only parts of the shaft of the right and left tibias are preserved. Of the fibulas, the shaft (pl. 1.6) and a proximal part are preserved. Of the relatively small and slender calcaneus the tuber, the shaft and the *sustentaculum tali* are preserved, while the distal part is missing (pl. 1.7). Of the rest tarsals, only a right incomplete third cuneiform is preserved. The metapodials are badly preserved –two shafts and a distal epiphysis (KNP 29: DTXDAPdist.art.= 17.44 X 16.55 mm, I(DAP/DT)X100= 94.90), while three first phalanges-one for the first metapodial (pl. 1.8) and the other two (pl. 1.9 and 10) are well preserved. Only one Ph3 (pl. 1.11) is poorly preserved.

Sub-order Feloidea SIMPSON, 1931
Family: Felidae GRAY, 1821
Genus: *Panthera* OKEN, 1816
Panthera pardus (LINNAEUS, 1758)

Material: Tibia diaphysis frag. KNP 46 dex, metapodial distal frag. KNP 27.

Description: The diaphysis of the tibia is slender, curved with intense *linea* m. *poplitea,* a feature noted in felids (pl. 1.12). The metapodial distal part is distinguished by the rounded distal trochlea, from the rather flattened ursid trochlea. (KNP 27: DTXDAPdist.art.=(14.54)X14.40 mm, I(DAP/DT)X100= 99.04) (tab. 1).

Discussion

The Kitseli Pothole fauna is composed of two species of carnivores and various micromammals: many skeletal elements of the brown bear *Ursus arctos* and only two bones from the leopard *Panthera pardus* a tibia diaphysis and a distal metapodial (fig. 3). The latter two are slenderer than those specimens reported from Vraona Cave, Attiki that have been dated to 7-25 Ka old (NAGEL, 1995 and 1999). Comparing to bears, felids are more frequent in the Peloponnese: leopard, lynx and wild cat have been found in the same context in the Middle Pleistocene cave of Apidima, Mani peninsula in the Southern Peloponnese (TSOUKALA, 1989). Also, two skeletons of leopards were found in Dyros cave one of which is about 28 Ka old (BASSIAKOS, 1993; GEORGIADOU - DIKAIOULIA *et al.* 2002).

The broader area of the Kitseli Pothole is of historical importance as in Greek Mythology Hercules killed the famous lion of Nemea. In a myth told by Hesiod, the Nemean Lion was the son of Orthos - a giant dog - and according to Pausanias, people believed that the Nemean Lion came out of the ground. MAYOR (2000) suggested that the bones of mythological super sized animals are none other than the fossil remains of extinct animals. Hence, it is possible that the ancient people mistook a fossil skeleton of a leopard as that of a lion, thus how the myth of Nemean Lion might have come about. Thus the bones of *Panthera pardus* reported here are the only material evidence so far as to the existence and nature of the Nemean Lion. Indeed, Hercules killed the Nemean Lion in a cave (Apollodorus Β′ V 1). It is interesting to note, that no fossil bone from *Panthera leo spelaea* (GOLDFUSS, 1810) has ever been reported from the Peloponnese, except the presence of its ancestor *Panthera leo fossilis* (REICHENAU) of Early Biharian (Middle Pleistocene) from Megalopolis-Marathousa (SICKENBERG, 1976).

Brown bear does not live in the Peloponnese nowadays but its presence had been reported by travellers until the 17th century (PAPAVASSILEIOU, 1963; SIMOPOULOS, 1984). Fossil brown bear has not been reported earlier from the Peloponnese until the present paper while its Early Pleistocene ascendant *Ursus cf. etruscus* has been reported from Kastritsi, Achaia by SYMEONIDIS *et al.* (1985/1986). The presence of fossil brown bear is rather rare in Greece. It has been recorded in Vraona, Attiki by SYMEONIDIS *et al.* (1980) and RABEDER (1995), as well as in Kouklesi, Epirus by THEODOROU (1992), and in Petralona Cave by TSOUKALA (1989) and Almopia Speleopark.

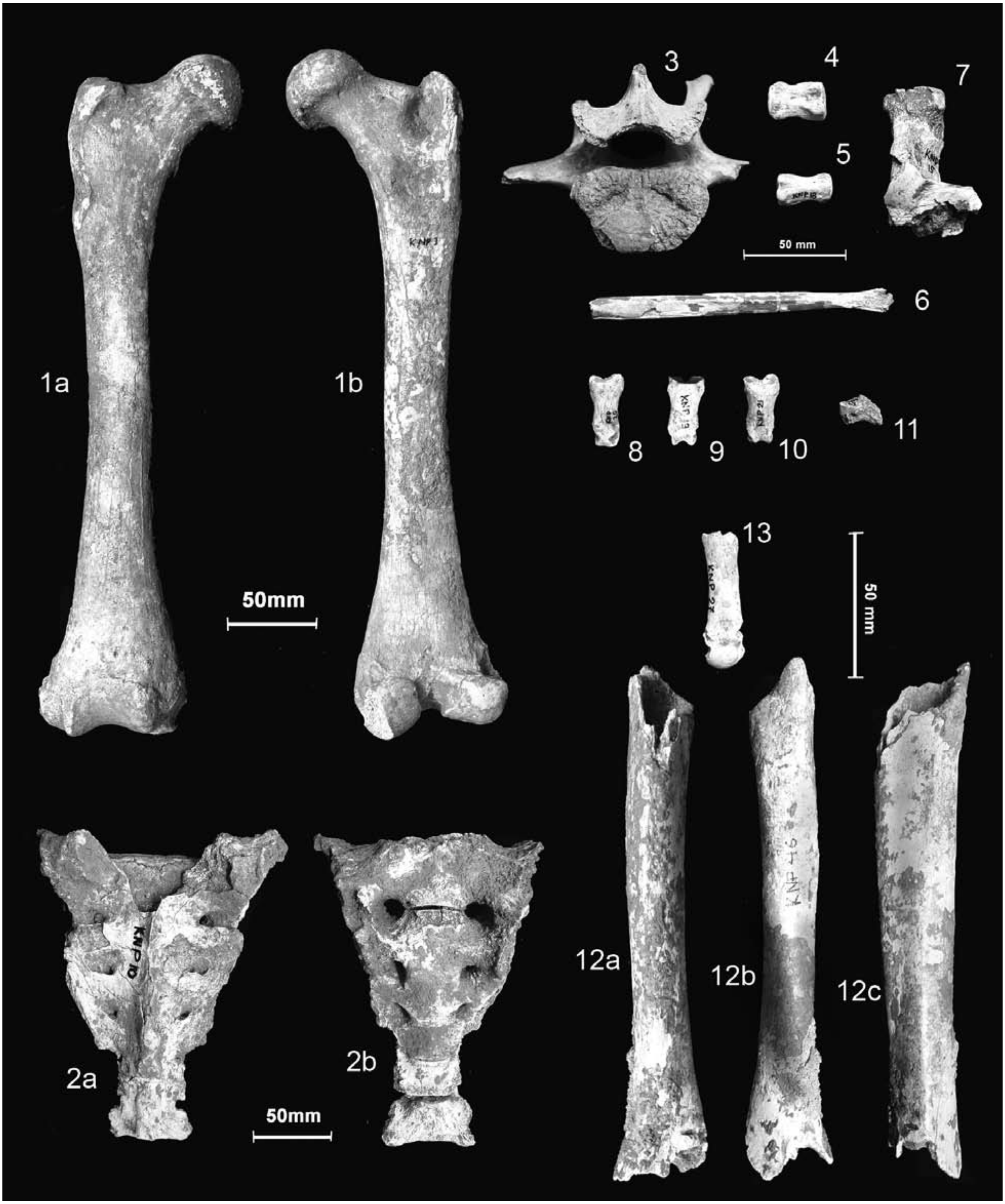
Brown bear still lives in the mountainous areas of Northern Greece and its early presence in Nemea is consistent with this environment.

The leopard entered Europe in the Middle Pleistocene (Cromerian, KURTÉN, 1968) with a wide distribution but more restricted than the cave lion. The possible existence of the leopard in the Holocene in the Balkans is discussed by SPASSOV & RAYCHEV (1997) according to zoogeographic, climate and environmental conditions. A systematic study of material that comes from archaeological sites of Greece would provide evidence of its existence during this period.

The spread of modern humans over the whole planet played a main role in the Late Pleistocene megafaunal extinction. A number of Late Pleistocene survivors such as leopard disappeared from Europe in historical times. Others were severely enlarged having become considerably restricted in their original habitat as was the case of brown bear (AGUSTI & ANTON, 2002).

The geological age of the Kitseli Pothole large mammalian fauna presented here might be of Late Pleistocene.

Plate 1



Ursus arctos KNP: 1. Right femur KNP 1: a) anterior and b) posterior view); 2. Sacral bone KNP 10: a) dorsal and b) ventral view; 3. Lumbar KNP 2; 4 and 5. Coccyx KNP 17 and 18 vertebras; 6. Fibula diaphysis frag. KNP 16; 7. Left calcaneus KNP 15, anterior view; 8. Ph1 for Mp1 KNP 20; 9 and 10. Ph1 KNP 19 and 21, anterior view; 11. Ph3 lateral view. *Panthera pardus* KNP: 12. Right tibia (diaphysis): a) anterior, b) posterior and c) lateral view; 13. Metapodial distal frag. KNP 27, anterior view.

Table 1
Ursus arctos and *Panthera pardus* KNP: Measurements of the postcranial bones.

Ursus arctos	**Femur**	**Ph1**			**Calcaneus**	
	KNP 1	KNP19	KNP 21	KNP 20 (Mp 1)	KNP 15	
L	382.00	34.21	34.57	35.63	L	-
DT prox.	97.80	17.78	17.67	17.50	DT	(42.75)
DAP troch.	40.50	14.84	15.55	13.99	DT tuber	28.77
DT dia.	35.33	13.03	12.90	12.14	DAP tuber	35.17
DAP dia.	31.88	9.83	11.23	10.51	L manubrium	43.55
DT dist..	82.96	14.78	13.97	13.66	DT min	17.28
DAP dist..	62.88	8.81	9.36	8.87		
D caput	47.87					
L trochas	78.08					
L collum	55.95					

Fibula		**Cuneiform 3**	
		KNP 26	
DT prox.	23.42		
DAP prox.	18.79	L	14.82
DT dia.	(10.33)	DT	19.26
DAP dia.	(13.45)	DAP	27.00

Tibia		**Sacrum**	
		KNP 10	
DT dia.	(27.00)	L	178.00
DAP dia.	(33.52)	DT min	33.20
		DT S6	51.00
		DAP S6	22.50

Pelvis	
D acetab.	49.30
D pubic min	33.67

Panthera pardus	KNP	***LAO****
Tibia		
DT dia.	(18.40)	*19.00*
DAP dia.	(24.90)	*22.20*
Metapodials	**Mp**	***Mc V***
DT dia.	min 10.44	*7.80*
DAP dia.	10.50	*8.20*
DT dist.	14.34	*12.30*
DAP dist.	14.42	*12.50*
DT d.art.	14.30	*12.00*
DAP d.art.	14.42	*12.50*

LAO* *Panthera pardus* from Apidima Cave (South Peloponnese)(Tsoukala, 1999)

The micromammals from the Kitseli Pothole

The matrix sampled has been screen-washed through sieves with a mesh of 0.5 mm. The micromammalian elements were picked out of the residue and studied under a light microscope. The measurements of the teeth were taken using a Wild Photomakroskop M400 stereoscope. The drawings were made using a light microscope with a camera lucida attached. The terminology and the measuring method used for each taxon are recorded in text. The material is stored in the Geology and Paleontology Laboratory, the Geology School, Aristotle University of Thessaloniki, Greece.

Taxonomy

Order: INSECTIVORA BOWDICH, 1821

Family: Soricidae FISHER VON WALDHEIM, 1817

Sub-family: Crocidurinae MILNE-EDWARDS, 1872

Genus: *Crocidura* WAGLER, 1832

Crocidura sp.

Material: M^1 sin KNP 65, M^2 sin KNP 66, M^2 frag dex KNP 67, mandible with M_2 dex KNP 58.

Measurements (in mm): The measurements (table 2) and terminology are according to Reumer (1984) and Koliadimou (1996). Dimensions of M_2: L=1.402, TAW=0.917, TRW=0.861.

Description: M^1 (pl. 2.2): The first molar is relatively broad and short of a slender appearance. The hypocone is poorly developed and separated from the protocone by a valley. There is no metaloph, hence the protocone has an L-shape. The parastyle shows a little knob. The postero-buccal corner protrudes strongly.

M^2 (pl. 2.3): The shape of M^2 is trapezoidal. The protocone is connected to the paracone. The mesostyle is well developed.

M_2 (pl. 2.1): A mandible fragment bearing a lightly worn second molar was found. Part of the anterior root of M_3 is preserved. The mental foramen is not visible because the mandible is damaged. The protoconid is the highest cusp of M_2. The lingual cusps are shorter. The buccal re-entrant valley opens high above the cingulum. The entoconid crest is rather low. The buccal cingulum is narrow but well pronounced. The lingual one is weak. Both cingula are straight.

Discussion: The subfamily Crocidurinae has white teeth. In the lower molars the buccal re-entrant valley opens

Table 2
Crocidura sp. (KNP): Dimensions (in mm) of the first and second upper molars.

	BL	LL	PE	AW	PW
KNP 65	1.731	1.549	1.260	1.728	2.022
KNP 66	1.380	1.279	1.119	1.933	1.662
KNP 67	1.374	1.335	1.095	-	1.730

high above the cingulum (plate 1.1b), the entoconid crest is low to nearly absent (pl. 2.1c), and the buccal cingulum is narrow but well pronounced (pl. 2.1b). These characteristics are consistent with the genus *Crocidura* (Reumer, 1984).

Crocidura russula is characterized by a constriction in the buccal cingulum of M_2 (Reumer, 1986), which is absent in the KNP specimen. The position of protocone on P^4 is indicative for this species. Since no P^4 has been preserved in the KNP material, an identification at a species level is uncertain. Although there are only a few KNP specimens, it seems that M_2 belongs to a smaller individual/species (smaller than *C. kornfeldi* and *C. zimmermanni*) (fig. 5), than the upper molars from Kitseli (larger than *C. kornfeldi* and *C. zimmermanni*) (fig. 6). Nevertheless, these differences in size can be explained by the range of variation of a single species.

Order: RODENTIA BOWDICH, 1821
Family: Arvicolidae GRAY, 1821
Sub-family: Arvicolinae GRAY, 1821
Tribe: Microtini SIMPSON, 1945
Genus: *Microtus* SCHRANK, 1798
Microtus (Microtus) arvalis (PALLAS, 1778)

Material: mandible with M_1, M_2, M_3 frag sin KNP 59, M^3 sin KNP 53, M^3 frag sin KNP 56, M^3 dex KNP 51.

Measurements: The measurements (table 3) and terminology are according to Van Kolfschoten & Roebroeks from Koliadimou, 1996 and Rabeder, 1981.

Description: One of the specimens is a mandible fragment bearing all the cheek-teeth. The incisor and the posterior lobe of M_3 are broken. The occlusal surface of the teeth was covered with calcite crust. Most of the cement in the triangles is not revealed, because the cleaning could break the fragile enamel. There are no roots.

M_1 (pl. 2.4)**:** It consists of the posterior lobe, five closed triangles and the anteroconid complex. There are five lingual and four buccal synclines with crown cement. BSA5 and LSA6 are developed to the same degree. The triangle T6 is widely connected with T7. The constriction between anteroconid AC3 and T6-T7 complex is relatively narrow (morphotype C6 according to Nadachowski, 1982). AC3 is rather symmetrical.

M^3: It consists of the anterior lobe, three triangles and the posterior cap. There are three lingual and three buccal synclines with crown cement. The specimen KNP3

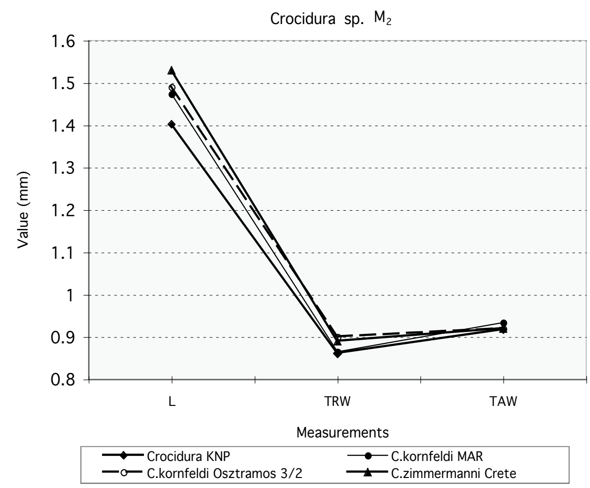


Figure 5. Line diagram comparing the dimensions of M_2 of *Crocidura* sp. from KNP, *Crocidura kornfeldi* from Marathousa (Koufos *et al.*, 2001), Osztramos 3/2 (Reumer, 1984) and *C. zimmermanni* from Crete (Reumer,1986).

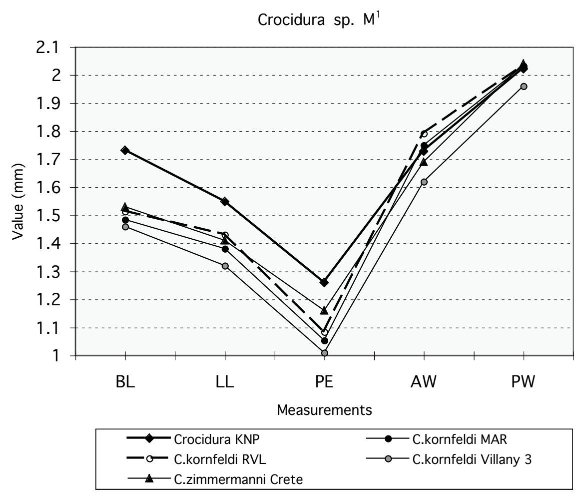


Figure 6. Line diagram comparing the dimensions of M^1 of *Crocidura* sp. from KNP, *Crocidura kornfeldi* from Marathousa (Koufos *et al.*, 2001), Rema Voulgaraki (Koliadimou, 1996), Villany 3 (Reumer, 1984) and *C. zimmermanni* from Crete (Reumer, 1986).

Table 3
Microtus arvalis (KNP): Dimensions (in mm) of the lower first molar and upper third molars.

Maximum occlusal length (L-L')	L=2.768
Length of the anteroconid complex (a-L)	a=1.473
Width of the anteroconid complex (w-w')	W=1.010
Shortest distance between BRA4 and LRA5 (d-d')	d=0.143
Shortest distance between BSA4 and LSA5 (e-e')	e=0.781
Maximum occlusal length of M^3	l=1.939 & l=1.817

(pl. 2.5) shows a very deep LRA4 resulting distinct T5 and T7. LRA4 is weaker in specimens KNP1 and KNP6 (Plate 2.6-7) showing T5 blended with PC (morphotype "artimultiplex" according to RABEDER, 1981). There are no roots.

Discussion: The morphological characteristics and the size of the M_1 conform rather well to *M. arvalis* or *M. agrestis*. Differentiation between the Common Vole (*M. arvalis*) and the Field Vole (*M. agrestis*) is problematic since their structure and dimensions overlap to a large extent. According to Dienske, it is not possible to separate *M. arvalis* from *M. agrestis* on the basis of the M_1 structure only and according to Fedyk and Ruprecht the teeth of the Common Vole are smaller and lighter than the molars of the Field Vole (NADACHOWSKI, 1982). Dimension of teeth overlap, but still there is a difference which enables us to assign KNP specimen to *M. arvalis* (fig. 7). Additionally, the M^2s that have been studied, lack small postero-lingual lobe, which is characteristic of *M. agrestis* (CHALINE, 1974).

The Common Vole is one of the most frequent rodents in Europe in the last glaciation, especially during warmer phases. At present this species inhabits mainly cultivated fields. During Pleistocene it was probably connected with open areas (NADACHOWSKI, 1982).

Microtus (Microtus) cf. *nivalis* (MARTINS, 1842)

Material: M^3 dex KNP 55.

Measurements (in mm)**:** l=1,828.

Description: M^3 (pl. 2.8)**:** The molar is rather massive. It consists of the anterior lobe, three triangles and the posterior cap. There are two lingual and two buccal synclines with crown cement. Triangle T2, T3 and T4 are slightly interconnected since the triangles are not completely closed. T4, T5 and PC have confluent dentine fields with incipient BRA3 and LRA4 (morphotype "simplex" according to RABEDER, 1981). There are no roots.

Discussion: In comparison with other species of *Microtus* found in the Kitseli Pothole, the enamel in the grinding surface of the molars studied here is relatively thicker and the enamel triangles are massive. Nevertheless, these features are not sufficient for secure specific identification as it is the morphological pattern of the occlusal surface of lower first molar. No M_1 has been found in the KNP material. Based on the simple structure ("simplex" morphotype) of the single M^3 and the slightly confluent dentine fields of the tooth (CHALINE, 1974), the specimen is referred to as *Microtus* cf. *nivalis*.

At present, the Snow Vole is found in the mountains. Its inhabitat is the high slopes above the timber line. During Late Pleistocene it was widespread in Europe (KURTÉN, 1968).

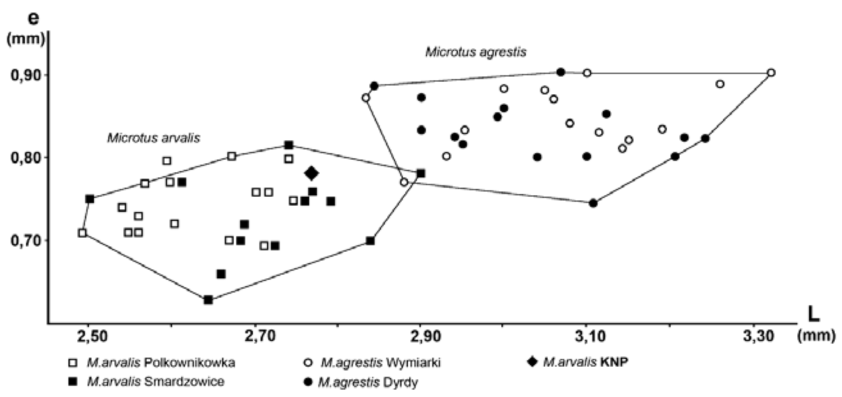


Figure 7. The ratio of the maximum occlusal length of M_1 (L) to the shorter distance between BSA4 and LSA5 (e) in recent species *Microtus arvalis* (squares) and *Microtus agrestis* (circles) from Poland (NADACHOWSKI, 1982). The KNP specimen marked with rhomb.

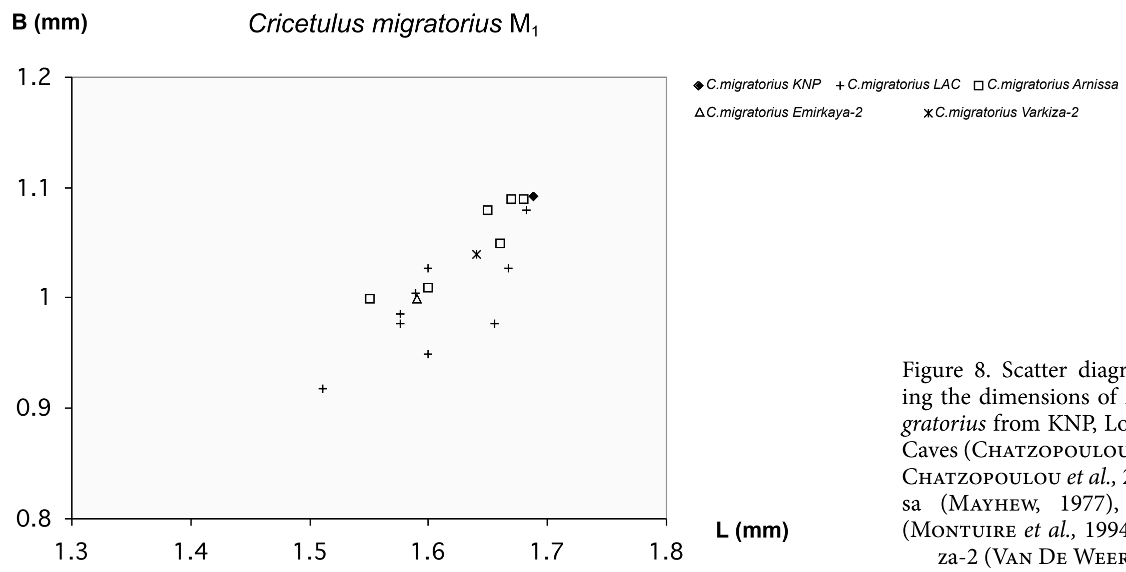


Figure 8. Scatter diagram comparing the dimensions of M_1 of *C. migratorius* from KNP, Loutra Arideas Caves (Chatzopoulou, 2001; 2003; Chatzopoulou *et al.*, 2001), Arnissa (Mayhew, 1977), Emirkaya-2 (Montuire *et al.*, 1994) and Varkiza-2 (Van De Weerd, 1973).

Sub-genus: *Pitymys* McMURTIE, 1831
cf. *Microtus (Pitymys) subterraneus/multiplex*

Material: M^3 sin KNP 52, M^3 frag dex KNP 54.
Measurements (in mm): l=1,684 & l=1,673.

Description: **M^3:** It consists of the anterior lobe, three triangles and the posterior cap. There are three lingual and three buccal synclines with crown cement. Both specimens (pl. 2.9-10) show a deep LRA4 resulting in a distinct T5 and T7 widely interconnected. PC is distinct (morphotype "arvalis" according to Rabeder, 1981). Dentine fields of T4 and T5 are slightly confluent. The enamel occurs on the whole lateral surface of the teeth (lack of the enamel-free areas) except the PC. All samples are smaller and lighter than all other M^3s studied.

Discussion: The light structure and the morphology of the M^3s are consistent rather well with subspecies *Pitymys*. The Pine Voles are difficult to determine since the morphological features show faint differences. The structure of M^3 permits the separation of two groups. The M^3s of "complex" structure (two clearly closed triangles and T4 slightly open to the posterior part of the tooth) are attributed to *subterraneus/multiplex* group. The M^3s of "simplex" structure (triangles T2 and T3 are often interconnected and T4 broadly confluent with the posterior part of the tooth) are attributed to *duodecimcostatus* group (Chaline, 1974). The KNP samples are consistent with the *"arvalis"* morphotype, which is a form of the "complex" structure (Rabeder, 1981). However, since the material is so extremely scanty, farther classification cannot be achieved. It must be noted that the limited enamel-free areas imply that these teeth belong to a young animal (Nadachowski, 1982).

The Pine Vole inhabits differentiated environments; open fields, forests. In the southern part of its distribution this species is connected with moist habitats. During Late Pleistocene it can be regarded as an indicator of the warming-up of the climate (Nadachowski, 1982).

Family: Cricetidae ROCHENBRUNE, 1883
Sub-family: Cricetinae MURRAY, 1886
Genus: *Cricetulus* MILNE-EDWARDS, 1867
Cricetulus migratorius (PALLAS, 1773)

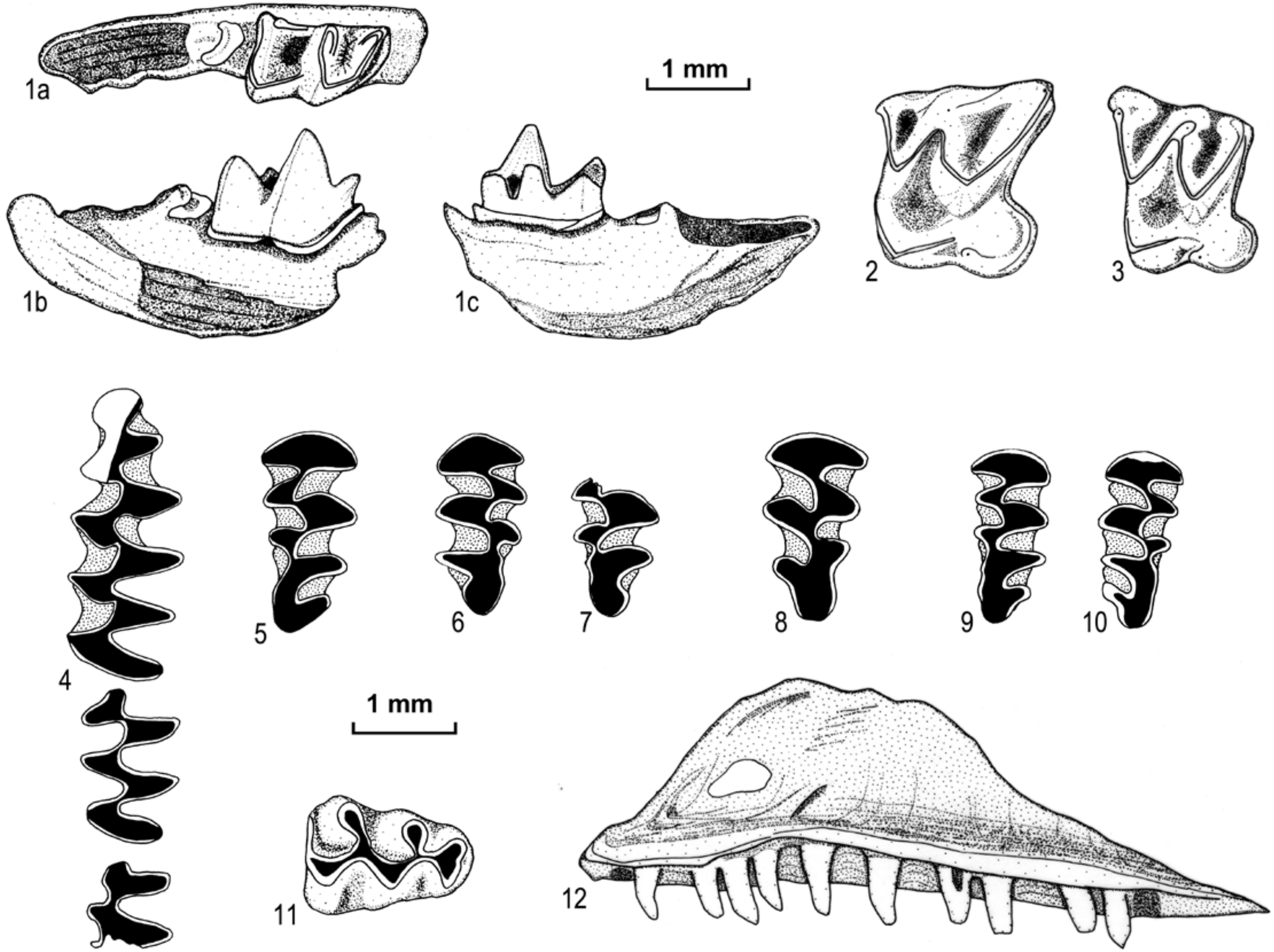
Material: M_1 dex KNP 57.

Measurements (in mm): L=1,688 and B=1,092. The measurements and terminology are according to Mein & Freudental and Hir from Koliadimou, 1996.

Description: **M_1** (pl. 2.11)**:** The anteroconid consists of two developed cuspules that are merged due to the advanced stage of wear. The anterolophid connects with the anterior cuspules to the protoconid. The entoconid joins the protoconid with the ectolophid. The posterolophid is well developed and reaches the postero-lingual margin of the tooth. The posterosinus is closed and crescent. The labial sinuses are wider than the lingual ones. The labial and lingual cingula are well developed. There are two roots.

Discussion: The lower first molar from the Kitseli Pothole shows no morphological differences from recent species. The size of the tooth is considerably larger than that of other *C. migratorius* populations (fig. 8), yet still lies in the variation range of the species. The Grey Hamster inhabits open areas, especially steppes and semi-deserts (Nadachowski, 1982).

Plate 2



Kitseli Nemea Peloponesse. *Crocidura* sp. 1. KNP 58 - Mandible with M_2 dex. 1a. occlusal view, 1b. lateral view, 1c. lingual view; 2. KNP 65 - M^1 sin; 3. KNP 66 - M^2 sin; *Microtus arvalis* 4. KNP 59 - Mandible with M_1-M_3 frag sin; 5. KNP 53 - M^3 sin; 6. KNP 51 - M^3 dex; 7. KNP 56 - M^3 frag. sin; *Microtus* cf. *nivalis* 8. KNP 55 - M^3 dex; *Microtus (Pitymys)* cf. *subterraneus/multiplex* 9. KNP 52 - M^3 sin; 10. KNP 54 - M^3 frag. dex; *Cricetulus migratorius* 11. KNP 57 - M_1 dex; Reptilia 12. KNP 68 - maxilla.

DEGREE OF FOSSILIZATION

To assess the degree of fossilization, the Crystallinity Index (I) of one modern bear bone (FL1) and one bear bone from the Kitseli Pothole (KNP) were measured according to the method of X-ray diffraction used by Bartsiokas & Middleton (1992). The Index of the former is 6.4 and of latter 6.7. The only conspicuous difference between the two bones is in the amount of calcite that is appreciably higher in the bear bone from the Kitseli Pothole that in the modern bear bone (fig. 9). Systematic measurements of a number of bear bone specimens should be made before one can make any conclusive arguments.

CONCLUSIONS

- The Kitseli Pothole (Nemea, Peloponnese) is a karstic cave with paleontological interest that is described and mapped for the first time here.
- The fossilized bones belong mainly to *Ursus arctos* L. that were found either complete and well preserved or fragmented.
- A tibia diaphysis and a distal metapodial are best described as *Panthera pardus* (L.). These leopard bones from Nemea constitute the first hard evidence as to the origin of the Nemean lion mythology.
- The micromammalian remains belong to the following rodents: *Crocidura* sp., *Microtus (Microtus) arvalis* (PALLAS, 1778), *Microtus (Microtus)* cf. *nivalis* (MARTINS, 1842), *Microtus (Pitymys)* cf. *subterraneus/multiplex*, *Cricetulus migratorius* (PALLAS, 1773). A maxilla fragment belongs to a small reptile.
- The fossil brown bear is referred to for the first time in the Peloponnese, while its Early Pleistocene ascendant *Ursus cf. etruscus* has already been reported from Achaia. However, felids have already been reported in the Peloponnese: leopard, lynx and wild cat are found in the same context in the Middle Pleistocene site of Apidima (Mani peninsula) to the south. Also, two leopard skeletons were found in the Dyros Cave.
- The brown bear that still lives in Greece is indicative of a mountainous environment and this is consistent with the environment of the Kitseli Pothole.
- Of the KNP micromammals, the presence of *Microtus* with three species implies a Middle Pleistocene to Holocene age for the fauna of Kitseli, while the micromammalian assemblage suggests a temperate climatic phase.
- The association of a brown bear, a leopard as well as of the rodents *Microtus nivalis* and *Cricetulus migratorius* has been also determined in the Late Pleistocene fauna the Vraona Cave (Attiki).
- The geological age of the Kitseli Pothole fauna is Late Pleistocene.

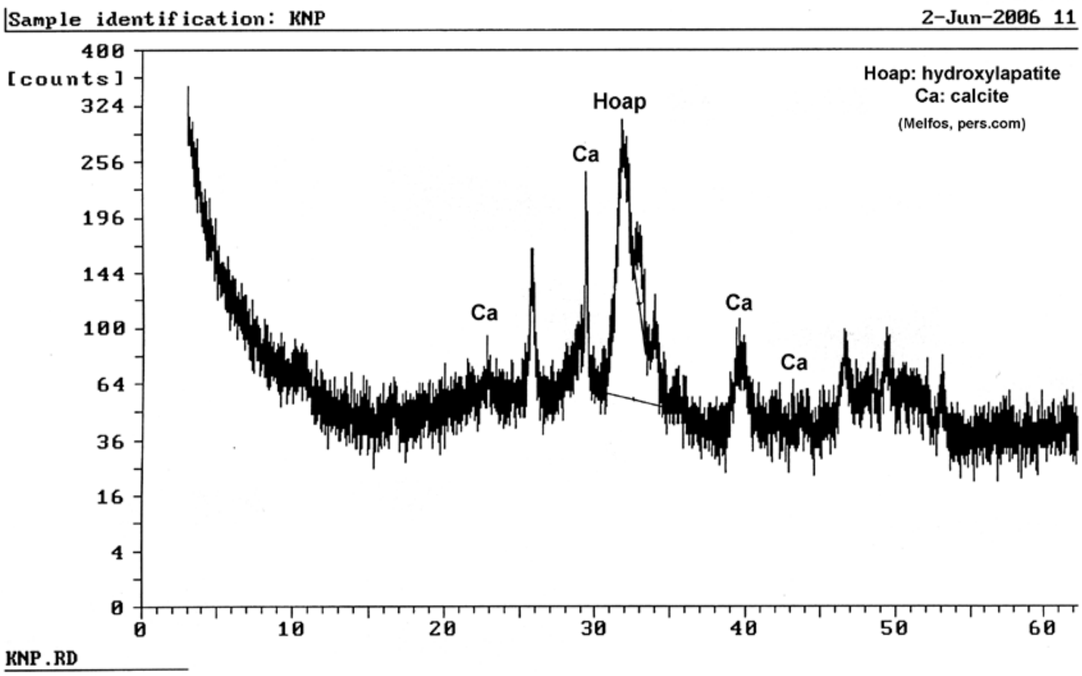


Figure 9. The XRD profile of bear bone powder (KNP). The Crystallinity Index is measured according to the method of X-Ray diffraction (used by Bartsiokas & Middleton, 1992) in order to access the degree of fossilization. The sample was analyzed by Dr B. Melfos.

REFERENCES

AGUSTI, J. & ANTON, M., 2002. Mammoths, Sabertooths and Hominids, 65 millions yeras of mammalian evolution in Europe.- Columbia University Press, 312 pp., N. York.

BARTSIOKAS, A. & MIDDLETON, A. P., 1992. Characterization and dating of recent and fossil bone by X-ray diffraction. - *Journal of Archaeological Science*, **19**: 63-72.

BASSIAKOS, J. E., 1993. Dating of fossils from caves and speleothemes: evidence from electron spin resonance (E.S.R.) technique, the study of underground karst morphology and the relevant radiometric ang geological conditions in speleoenvironnments of Dyros, Mani (Peloponnese).- *Doctorate Thesis*, University of Athens, School of Geology,180 pp., 82 fif., 23 tab. 35 pl. (in Greek).

CHALINE, J., 1974. Les proies des rapaces. Petits Mammifères et leur environnement.- Eds. Doin: 4-141, Paris.

CHATZOPOULOU, K., 2001. *Contribution to the study of Quaternary micromammals and the stratigraphy of the Cave A from Loutra Arideas (Pella, Macedonia, Greece).*- Postgraduate thesis (unpublished). Aristotle University, Thessaloniki (in Greek).

CHATZOPOULOU, K., 2003. The Late Pleistocene small mammal fauna from the Loutra Arideas Bear-cave (Pella, Macedonia, Greece) - Additional data.- *Atti Mus. Civ. Stor. Nat.*, **49** (suppl.), 35-45, Trieste.

CHATZOPOULOU, K., VASILEIADOU, A., KOLIADIMOU, K., TSOUKALA, E., RABEDER, G. & NAGEL, D., 2001. Preliminary report on the Late Pleistocene small mammal fauna from Loutraki Bear-cave (Pella, Macedonia, Greece).- *Cadernos Lab. Xeolóxico de Laxe*, **26**: 485-495, Coruña.

GEORGIADOU-DIKAIOULIA, E., SYMEONIDIS, N. K. & THEODOROU, G.E., 2002. Palaiontologia, Spondylota. Part C.- University of Athens (in Greek).

KOLIADIMOU, K. K., 1996. *Palaeontological and biostratigraphical study of the Neogene/ Quaternary micromammals from Mygdonia basin* - Ph.D. Thesis, Aristotle University, 1-612, Thessaloniki. (in Greek).

KOUFOS, G., VASSILIADOU, K., KOLIADIMOU, K. & SYRIDES, G., 2001. Early Pleistocene small mammals from Marathousa, a new locality in the Mygdonia basin, Macedonia, Greece.- *DEINSEA*, **8**: 49-102.

KURTÉN, B., 1968. Pleistocene Mammals of Europe.- Adline Publishing Company: 191-225, Chicago.

MAYHEW, D. F., 1977. Late Pleistocene small mammals from Arnissa (Macedonia, Greece).- *Proc. Kon. Ned. Akad. Wetensch.*, ser. B, **81**(3): 302-321, Amsterdam.

MAYOR, A., 2000. The first fossil hunters. Paleontology in Greek and Roman times.- Princeton, Princeton University Press, 361 pp.

MONTUIRE, S., SEN, S. & MICHAUX, J., 1994. The Middle Pleistocene mammalian fauna from Emirkaya-2, Central Anatolia (Turkey). Systematics and Paleoenviroment.- *N. Jb. Geol. Palaeont. Abh.*, **193**(1): 107-144, Stuttgart.

NADACHOWSKI, A., 1982. Late Quaternary Rodents of Poland with special reference to morphotype dentition analysis of voles.- *Panstwowe Wydawnictwo Naukowe, Warszawa:* 3-108, Kraków.

NAGEL, D., 1995. Die felidenreste aus dem Jungpleistozän von Vraona Griechenland.- In: "Das Jungpleistozän in der "Höhle" von Vraona auf Attica in Griechenland, eds. SYMEONIDIS, N. & RABEDER, G.- *Ann. Geol. des Pays Hellen.*, **36**: 60-102, Athens.

NAGEL, D., 1999. *Panthera pardus vraonensis* n.ssp., a new leopard from the Pleistocene of Vraona/Greece.- *N. Jb. Geol. Palaont. Mh.*, **3**: 129-150, Stuttgart.

PANAGIOTIDIS, G., 1978. Gouffre-caverne "Troupa de Chiona" au village Alea Nemeas Argolide (No 6518).- *Bulletin de la Société Spéléologique de Grèce*, **XV(1)**: 108-111, Athènes.

PAPAVASSILEIOU, A., 1963. The brown bear in Greece.- "Kynigetika nea", 828-830 (in Greek).

RABEDER, G., 1981. Die Arvicoliden (Rodentia, Mammalia) aus dem Pliozän und dem älteren Pleistozän von Niederösterreich.- *Beitr. Paläont. Österr.,* **8**: 1-373, Wien.

RABEDER, G., 1995. Jungpleistozäne und Fruhholozäne säugetier-reste aus der Höhle von Vraona auf Attika, Griechenland.- In: "Das Jungpleistozän in der "Höhle" von Vraona auf Attica in Griechenland, eds. SYMEONIDIS, N. & RABEDER, G.- *Ann. Geol. des Pays Hellen.*, **36**: 48-59, Athens.

REUMER, J. W. F., 1984. Ruscinian and Early Pleistocene Soricidae (Insectivora, Mammalia) from Telegen (The Netherlands) and Hungary.- *Scripta Geol.*, **73**: 1-140, tabs. 54.

REUMER, J. W. F., 1986. Notes on the Soricidae (Insectivora, Mammalia) from Crete. I. The Pleistocene species *Crocidura zimmermanni*.- *Bonn. zool. Beitr.,* **3** (37): 161-171, Bonn.

REUMER, J. W. F., 1996. Quaternary Insectivora (Mammalia) from southern France.- *Acta Zool. Cracov.*, **39** (1): 413-426, Kraków.

SICKENBERG, O., 1976. Eine Säugertierfauna des Tieferen Bihariums aus dem Becken von Megalopolis

(Peloponnes, Griechenland).- *Ann. Geol. des Pays Hell.,* **27**: 25-73, Athens.

SIMOPOULOS, K., 1984. Foreign travelers in Greece from 333 A.D. to 1850.- Papyros edit., 1400 p., Athens (in Greek).

SPASSOV, N. & RAYCHEV, D., 1997. Late Würm *Panthera pardus* remains from Bulgaria: the European fossil leopards and the question of the probable species survival until the Holocene on the Balkans.- *Historia naturallis bulgarica*, **7**: 71-96.

SYMEONIDIS, N., BACHMAYER, F. & ZAPFE, H., 1980. Ergebnisse weiterer grabungen in der Höhle von Vraona (Attika, Griechenland).- *Ann. Geol. des Pays Hellen.* **30(1)**: 329-365, Athens.

SYMEONIDIS, N., THEODOROU, G., SCHÜTT, H. & VELITZELOS, E., 1985/1986. Palaeontological and stratigraphical observations in the area of Achaia and Etoloakarnania (W. Greece).- *Ann. Geol. des Pays Hell.,* **33(1)**: 329-365, Athens.

THEODOROU, G., 1992. On *Ursus* cf. *arctos* from the Upper Pleistocene of Kouklesi Cave (Ioannina, W. Greece).- *Ann. Geol. des Pays Hell.,* **35**: 339-363, Athens.

TORRES PEREZ-HIDALGO, T. J., 1988. Osos (Mammalia, Carnivora, Ursidae) del Pleistoceno de la Peninsula Iberica.- Boletin Geol. Y Minero, Madrid (publ. espec.), **1-4**: 1-316.

TSOUKALA, E., 1989. Contribution to the study of the Pleistocene fauna of large mammals (CARNIVORA, PERISSODACTYLA, ARTIODACTYLA) from Petralona Cave (Chalkidiki, N. Greece). *Doctorate Thesis*, Aristotle University of Thessaloniki, *Sci. Ann.*, School of Geology, **1(8)**: 1-360, 124 fig., 64 tabl., 62. pl., (in Greek, with summary in English).- *C.R.A.S.* Paris, 1991, **312 (II):** 331-336 (preliminary report).

TSOUKALA, E., 1999. Quaternary large mammals from the Apidima Caves (Lakonia, S. Peloponnese, Greece).- *Beiträge zur Paläont. von Österreich*, **24:** 207-229, Wien.

VAN DE WEERD, A., 1973. Rodentia from two Pleistocene fissure fillings near Athens.- *Proc. Kon. Ned. Akad. Wetensch.*, ser. B, **76**(2): 148-166, Amsterdam.