

Abhandlung Band 45/2005 ISSN 0077-6149	Neue Forschungen zum Höhlenbären in Europa	Seite 225-236	Naturhistorische Gesellschaft Nürnberg e.V. Marienortgraben 8, 90402 Nürnberg
---	---	------------------	--

**Evangelia Tsoukala & Gernot Rabeder**

## **Cave bears and Late Pleistocene associated faunal remains from Loutra Arideas (Pella, Macedonia, Greece) 15 years of research**

### **Zusammenfassung:**

Die Loutra Arideas Bärenhöhle ist sehr reich an paläontologischem Material. Die Ausgrabungen in der Bärenhöhle A folgten streng den archäologischen Regeln. Heute kann sie als die größte systematische Ausgrabung mit pleistozänen Höhlenbärenresten in Griechenland gelten. Funde der meisten Raubtiere sind selten, nur Bären finden sich sehr häufig. Die Untersuchung der am besten erhaltenen Knochenfragmente und Zähne von Bären zeigt das erste Mal für Griechenland das Vorkommen von *U. ingressus*. Es wurden einige gut erhaltene, komplette Schädel von adulten Tieren gefunden, die deutlich die Kennzeichen von *U. ingressus* zeigen. Die große Menge der Zähne und Knochen stammt von juvenilen und subadulten Bären, nur sehr wenige gehören zu sehr alten Individuen und wenige zu adulten Tieren. Dies weist auf eine extrem hohe Sterblichkeit von jungen und neugeborenen Bären hin. Viele Bären sind während der Winterruhe gestorben. Sehr bemerkenswert ist, daß Milchzähne trotz ihrer Zerbrechlichkeit häufig gefunden werden. Die Loutra Arideas-Höhle kann als der einzige Fundplatz in Griechenland bezeichnet werden, wo so viele und gut stratifizierte Milchzähne von Höhlenbären geborgen wurden. Sehr wenige Knochen, z. B. eine vollständige rechte Vorderpfote, wurden *in situ* gefunden, die Mehrheit war jedoch verstreut. Einige Knochen zeigen Spuren von Zähnen großer Raubtiere. Das kann entweder mit der Anwesenheit anderer Raubtiere (Feliden, Hyäniden, Caniden) erklärt werden oder durch Kannibalismus. Einige Knochen weisen Nagespuren auf, die wahrscheinlich von Nagetieren herrühren. Die Höhlenbären nutzten die Höhle als Unterschlupf. Das Alter der Fauna wird auf 30-35.000 y.B.P. geschätzt. Die Häufigkeit des Materials belegt eine relativ lange Nutzung der Höhle durch die Bären. Die Höhle wurde offenbar vom Menschen nicht benutzt, da bis heute nur ein Steingerät gefunden wurde.

### **Abstract:**

The Loutra Arideas bear-cave is very rich in paleontological material. The excavations in the bear-cave A followed strictly the archaeological rules, and today it can be considered as the biggest systematic excavation with Pleistocene cave bear remains of Greece. Carnivores are represented in scarce diversity, but ursids are extremely abundant. The study of the best

preserved bone fragments and teeth of the bears showed the presence of the *U. ingressus* for first time in Greece. There have been found few well preserved complete skulls of adults, that shows clearly the characters of *U. ingressus*. The majority of the tooth and bone remains belong to juveniles and sub-adults, while very few belong to very old individuals and few to adults, indicating thus an extremely high incidence of young and neonate mortality. There are many bear carcasses as a result of death during hibernation. The abundance of the milk teeth, in spite of their fragility, is very remarkable. The Loutra Arideas site can be considered as the unique place of Greece where so abundant and well stratified cave bear deciduous teeth have been collected. Very few bones, such as a complete right anterior foot, have been found *in situ*, but the majority has been found scattered. Few bones have traces of large carnivore teeth and this can be explained either by the presence of the other carnivores (felid, hyaenid, canid) or by cannibalism. Some bones have gnaw marks, which are probably due to many rodents. The cave bears used the cave as a den. The age of the paleofauna is estimated in 30-35.000 y.B.P. The abundance of the material shows relatively long occupation of the cave by bears. The cave does not seem to be used by humans, as only one lithic (pyrite) artefact was found up to now.

### Résumé:

La grotte Loutra Arideas contient un matériel paléontologique très riche. Les fouilles dans la grotte A ont été faites en utilisant les méthodes archéologiques, de telle sorte qu'il s'agit de la plus grande fouille systématique de restes d'ours pléistocènes en Grèce. Les prédateurs sont rares, seuls les ours sont fréquents. Les analyses des ossements et dents les mieux conservés permet d'identifier pour la première fois la présence d'*U. ingressus*. Plusieurs crâne complets et bien conservés d'individus adultes montrent des caractéristiques claires d'*U. ingressus*. La plupart des dents et des ossements proviennent d'ours juvéniles et jeunes, très peu sont vieux et peu sont adultes. Ceci indique une mortalité très élevée chez les ours jeunes. De nombreux ours sont décédés durant l'hibernation. Il faut remarquer que les dents de laits, bien que très fragiles, ont été découvertes en grand nombre. La grotte Loutra Arideas peut être considérée comme la seule grotte en Grèce où autant de dents de lait aussi bien conservées ont été découvertes. Très peu de restes, par exemple une patte antérieure, ont été découverts *in situ*, la plupart étaient dispersés et certains portaient des traces de morsures. Ceci est du soit à la présence d'autres prédateurs tels félidés, canidés ou hyènes, soit au cannibalisme. Les ours des cavernes ont utilisé la grotte en tant que refuge, il y a probablement 30-35.000 ans. L'importance numérique des restes osseux indique une utilisation relativement longue de la grotte, qui ne fut apparemment pas occupée par les êtres humains, puisque aucun artefact n'a été trouvé à ce jour.

**Key words:** Loutra Arideas bear-cave, Greece, Upper Pleistocene, *Ursus ingressus*

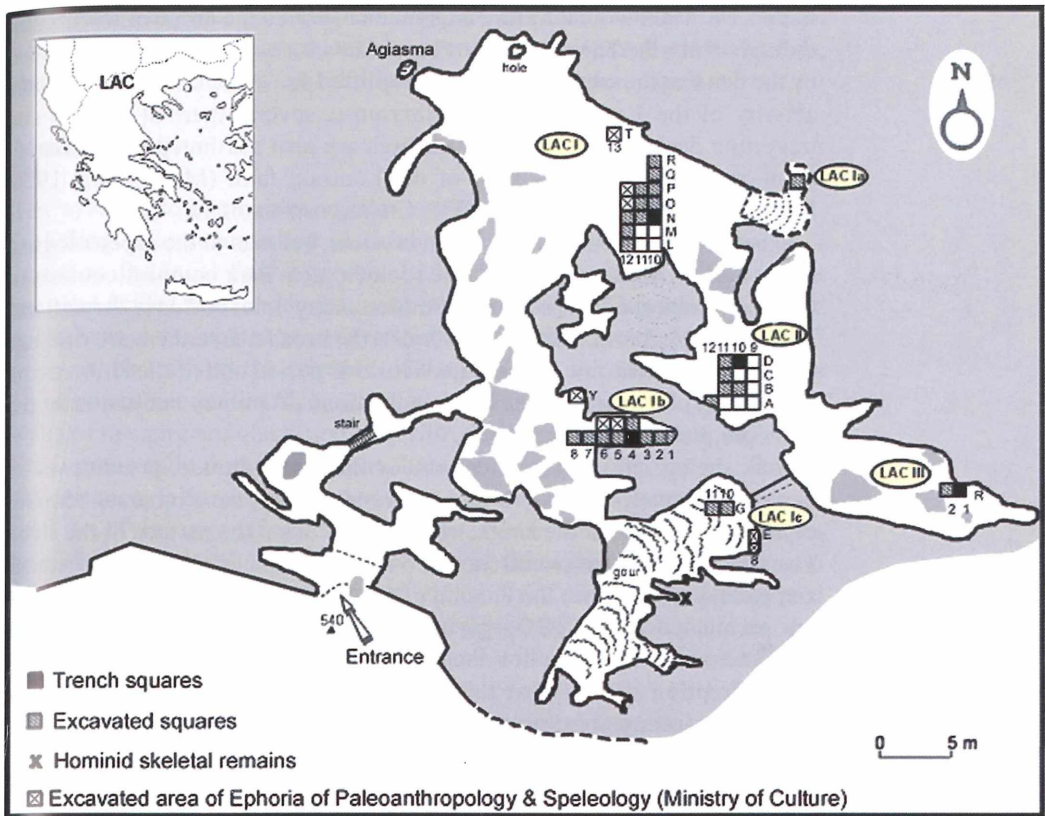


Figure 1. Ground plan of the bear cave Loutra (LAC: Loutra Arideas Caves) is located in Northern Greece (Macedonia), 120km north-west of Thessaloniki and 2km from the Loutraki village (Fig. 1). The site administratively belongs to Municipality of Arideia, Prefecture of Pella that is so called from the ancient Macedonian capital Pella, and birthplace of Alexander the Great. A system of caves has been developed mainly in the northern side of the V-shaped gorge of Nicolaou stream, on the slopes of the Voras Mt (2524m) that is one of the highest mountains of Greece, very close to the former Yugoslavian border. The broader area is situated near the geological boundary between Almopia zone to the east and Pelagonian zone to the west, (MERCIER 1968, MOUNTRAKIS 1976) and it consists of Mesozoic metamorphic and sedimentary rocks, and more precisely the gorge of the Nicolaou stream consists of Maastrichtian limestone of Almopia zone. A NW-SE striking ore-bearing fault zone and the ENE-WSW striking Loutraki fault dominate the wider area. The latter with a length of more than 10km bounds the Arideia basin against the Voras Mt. The region is characterized by intense karstic phenomena that have been influenced by the pre-existing

## Introduction-Geological setting

The cave-site of Loutra (LAC: Loutra Arideas Caves) is located in Northern Greece (Macedonia), 120km north-west of Thessaloniki and 2km from the Loutraki village (Fig. 1). The site administratively belongs to Municipality of Arideia, Prefecture of Pella that is so called from the ancient Macedonian capital Pella, and birthplace of Alexander the Great.

A system of caves has been developed mainly in the northern side of the V-shaped gorge of Nicolaou stream, on the slopes of the Voras Mt (2524m) that is one of the highest mountains of Greece, very close to the former Yugoslavian border. The broader area is situated near the geological boundary between Almopia zone to the east and Pelagonian zone to the west, (MERCIER 1968, MOUNTRAKIS 1976) and it consists of Mesozoic metamorphic and sedimentary rocks, and more precisely the gorge of the Nicolaou stream consists of Maastrichtian limestone of Almopia zone. A NW-SE striking ore-bearing fault zone and the ENE-WSW striking Loutraki fault dominate the wider area. The latter with a length of more than 10km bounds the Arideia basin against the Voras Mt. The region is characterized by intense karstic phenomena that have been influenced by the pre-existing

faults. The 150m down-cutting erosion that formed the gorge of the Loutra, through which the Thermopotamos stream flows, could be possibly explained by the fact that the whole area has been uplifted due to the intense neotectonic activity of the Loutraki fault. Furthermore, several thermal springs and travertine deposits that occur in the area are also attributed to the above-mentioned neotectonic activity of the Loutraki fault (MOUNTRAKIS 1976, MERCIER 1968, ELEFThERIADES 1977, CHATZIDIMITRIADIS 1974).

The bear cave A, which is part of this system, belongs to the „speleological park“ of the Loutra spa region. The speleological park complex consists of 6 caves, 4 rock shelters (abris), 2 potholes, many holes and cave formations. The bear-cave A is at altitude of 540m. In the broader area there are findings dated to the Paleolithic or the Late Neolithic period and of the Bronze Age with many pottery-remains, while indications of Roman habitation in the Almopia plain have been noted.

A rock shelter, 50 m west of cave A, at the same altitude, presents on its base an old travertine layer, as well as a very cohesive conglomerate, remains of an old river bed, at the height of about 70m from the surface of the river. The thickness of this occurrence is 3-4m, and consists of various stones and sand deriving from the erosion of the surrounding rocks. These stones are permeated with CaCO<sub>3</sub>, giving a clast-supported conglomerate, the imbrications of which is not clearly shown. In some places it is shown a flow direction opposite to the today's river flow direction. Thus the paleogeographical structure was different in the period of the old river bed deposition. There are 3 older river bed remains in various altitudes.

In the bigger of the two potholes, 50m of depth, which is now a showing cave, a recent human skeleton was found and it belongs to a middle-aged man. The most important of these caves have been explored and mapped (LAZARIDIS, this volume).

## Historical overview

Quaternary research has not distinguished history in Pella, as only the archaeological research has been developed up to now. The research in the Loutra Aridea area started in 1990 due to the great paleontological interest, when the speleologist K. Ataktidis gave information about fossil bones of a cave bear, which were brought to light by treasure seekers, in the cave A. The first excavation circle started in 1992 by School of Geology of Aristotle University, under the supervision of Ephoria of Paleoanthropology and Speleology (EPS) of Ministry of Culture, in cooperation with Prof. G. Chourmouziadis of Archaeology, with the contribution of Prof. †Eitan Tchernov (University of Jerusalem). The excavations were continued in 1993-1994 in cooperation with EPS (Dr. E. Kambouroglou) and since 1996, 1999-today the excavations have been carried out by Aristotle University, EPS, with cooperation of the Vienna University (Profs G. Rabeder, †S. Verginis and their team) (TSOUKALA 1994, TSOUKALA et al. 1998, 2001). The research is still in progress.

The local authorities gave financial support, as well as the former Loutraki community and Physiographical Museum of Almopia, the Pella Prefecture, the Aridea Municipality and the Loutra spas local administration.

## Methodology

Ten systematic excavation circles, under strictly archaeological rules, including micromammalian research, took place and all the material is stored in the local Physiographical Museums of Almopia in the Loutra area and Aridea town and in the Aristotle University of Thessaloniki. Going to the bear-cave, where the excavations were carried out, there is an abrupt path, which leads to the entrance of the cave. On the entrance, there is a polished surface on the rock, which may be due to chemical reasons. The walls of the cave are black-grayish, with „cave-corals“, and rarer, stalactite - stalagmite fully developed speleothemes, as well as small gour. Next to the entrance, following a wooden stair, there is the first largest chamber - LAC I - of the cave, of about 10m height, where the main excavation has been realized (eleven squares). The floor of this chamber is full of guano from the bats, a great number of which habit the cave. Many pottery and glass remains, from Neolithic/Byzantine period up to recent years are due to religious customs that concern a natural collection of water, so called „Agiasma“, in a small karstic basin, north of the chamber (Fig. 1). Four smaller chambers present also special paleontological interest. The entrance of the chamber LAC II is short, of about 70cm height. This chamber is much smaller, with no pottery remains on the floor. This is the chamber where the first excavations started in 1992. Six squares have been excavated and it must be noted that in B10 square an artifact, found in association with the ursid remains, in the sieving of the third layer as well as whole metapodial range of very juvenile with no fusion of their epiphyses was found *in situ* added great archaeological and taphonomical interest to the excavations. To the end of easternmost branch of the cave, the third chamber LAC III has been almost destroyed by diggings of the treasure seekers, and only two squares have been excavated with fewer large mammal remains but thicker fossiliferous sediments with special micromammalian interest. In the smallest chamber LAC Ib, the V and W nine squares gave interesting material, from paleontological and taphonomical point of view, especially of hyaenid remains, as well as large stones and large ursid specimens, such as skulls, complete pelvis, long bones etc. Unfortunately, two squares left unexcavated for future research were dug out by EPS of Ministry of Culture. In the gour area (chamber LAC Ic) cranial fragments and mandible of a child covered by calcite were found. The sediments in this chamber include many pebbles and gravels, much more than the other chambers. In 2004, an almost complete, well preserved skull has been found, in G11 square, of the two excavated squares of this chamber. Finally, in the main chamber, the small chamber - LAC Ia - is very difficult of access, as it is more than 6m higher the floor of the LAC I, on the top of a slippery rock. Only with the help of ropes it is possible to climb. During the 1996 a quick excavation of

this chamber resulted in abundant material of macro- and micromammals of different taphonomy, probably of Holocene age.

The excavations in the bear-cave A followed strictly the archaeological rules. After the definition of 0 point, three coordinates were measured for the bones: the west east, the north south, the depth from the 0 point and for the long bones the azimuth was also measured. Each layer has been photographed, and it was figured in mm paper and in the diary as well.

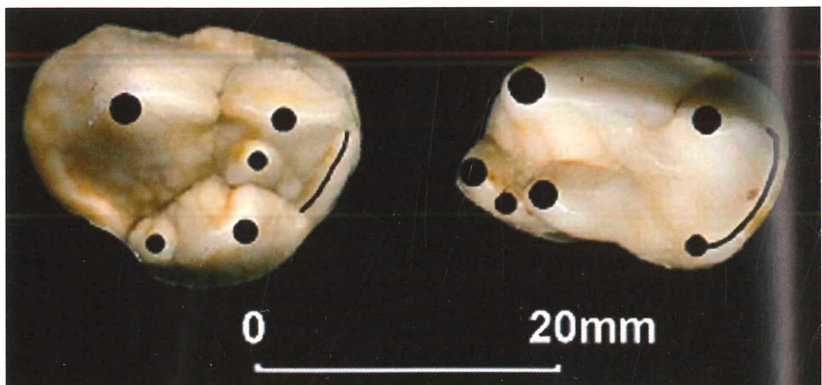
The material of the large mammals was cleaned in detail, it was conserved mainly with paraloid and it has been listed in archive of the excavation. All the sediments of the 189 levels (about 5cm of thickness each) have been washed to a system of double sieves, one for micromammals of 0.8mm diameter and the other for large mammal remains of 5mm. Sometimes three- sieve system was used, the third one being of 7mm in order the material to be more homogenous.

### Excavating results

The bear remains represent animals of all ages but the young ages are dominant, as it commonly occurs in bear-caves. They mainly belong to very young or to juveniles. The presence of the most abundant milk teeth, in spite of their fragility, is remarkable and unique for the Greek bear-caves, as well as of teeth, which have just been substituted, shows clearly, except these with external origin within the sediments (TSIRAMBIDIS 1998), also that the bears used the cave as a den. They are hundreds of teeth, representing all the milk tooth-row. Other large mammalian fauna remains that were found in association with the cave-bear, refer to the spotted cave hyaena, leopard, fox, mustelids and artiodactyls.

The fossiliferous layer is rather homogenous and consists of brownish silty sediments of various thickness depending upon the chamber (the thinner - about 40 cm - being in the main chamber and the thicker being in LAC Ic), deposited mainly under calm conditions of the paleo-environment. In all chambers there are many disturbances made by the treasure-seekers. On some bones there are carnivore traces, either of other ursids or large carnivores-scavengers.

Figure 2. *Ursus ingressus* (LAC), upper (left) and lower (right) occlusals of the fourth premolars with the tubercles depicted showing their complex morphotype (after RABEDER 1983).



Many milk teeth, in spite of their fragility, are very well preserved (PAPPA et al., this volume), as well as long bones and mandibles. These may be of a male or of female bears, and the morphotype for the upper premolars of these ursids is complicated and for the lower ones the morphotype is of the stage of 3 or even of 4 cuspids (Fig. 2).

Prehistoric humans seem not to have used the cave, as the findings so far (except one lithic-pyrite-artifact) do not give evidence for this, but the excavation is still in progress.

Seeds found during sieving were determined by the archaeologist †Maria Magafa as *Rumex crispus*, *Picris echioides*, *Matricaria chamomilla* (*Chamomila recutita*), Compositae, typical Mediterranean plants. The first one is the most common and loam, clay and nutrient indicator. The second is stony waste land indicator and the third one indicates fresh or sandy loams, rich in nutrients, also saline soils.

## Taxonomy

Order: CARNIVORA BOWDISH 1821

Sub-order: Canoidea SIMPSON 1931/Arctoidea FLOWER 1969

Family: Ursidae GRAY 1825

Genus: *Ursus* LINNAEUS 1758

***Ursus ingressus*** RABEDER et al. 2004 (3)

**Material:** Thousands of elements represent entire skeleton (bones and teeth): 3 skulls, 44 maxilla fragments, 93 mandibles and mandible fragments, many isolated teeth. Of the vertebrae: 14 atlas, 9 epistropheus, 15 cervical, 34 thoracic, 25 lumbar, and 6 sacrum. Many ribs, 9 sternum, 22 scapulae, 30 pelvis, 74 humeri, 98 femurs, 54 radii, 62 ulnae, 59 tibiae, 24 fibulae, 3 baculum, 208 ossa sesamoidea, 7 patellae, of the carpals: 25 pisiform, 21 scapholunatum, 15 pyramidal, 10 trapezium, 6 trapezoid, 14 magnum, 20 unciform, of the tarsals: 25 astragali, 29 calcanei, 23 cuboid, 20 naviculars, 15 cuneiform 1, 8 cuneiform 2, 26 cuneiform 3. Metapodials, 81 metapodial fragments, 332 first phalanges, 219 second phalanges, 175 third phalanges.

Family: Canidae GRAY 1821

Genus: *Vulpes* FRISCH 1775

***Vulpes vulpes*** (LINNAEUS 1758)

**Material:** M<sup>2</sup>

Sub-order Feloidea SIMPSON 1931

Family: Hyaenidae GRAY 1869

Genus: *Crocuta* KAUP 1828

***Crocuta crocuta spelaea*** (GOLDFUSS 1832)

**Material:** Canines, incisors, cheek teeth, post cranial skeleton: scapula, radius, ulna, tibia, metapodials

Family: Felidae GRAY 1821

Genus: *Panthera* OKEN 1816

***Panthera pardus*** (LINNAEUS 1758)

**Material:** Ph I, Ph II

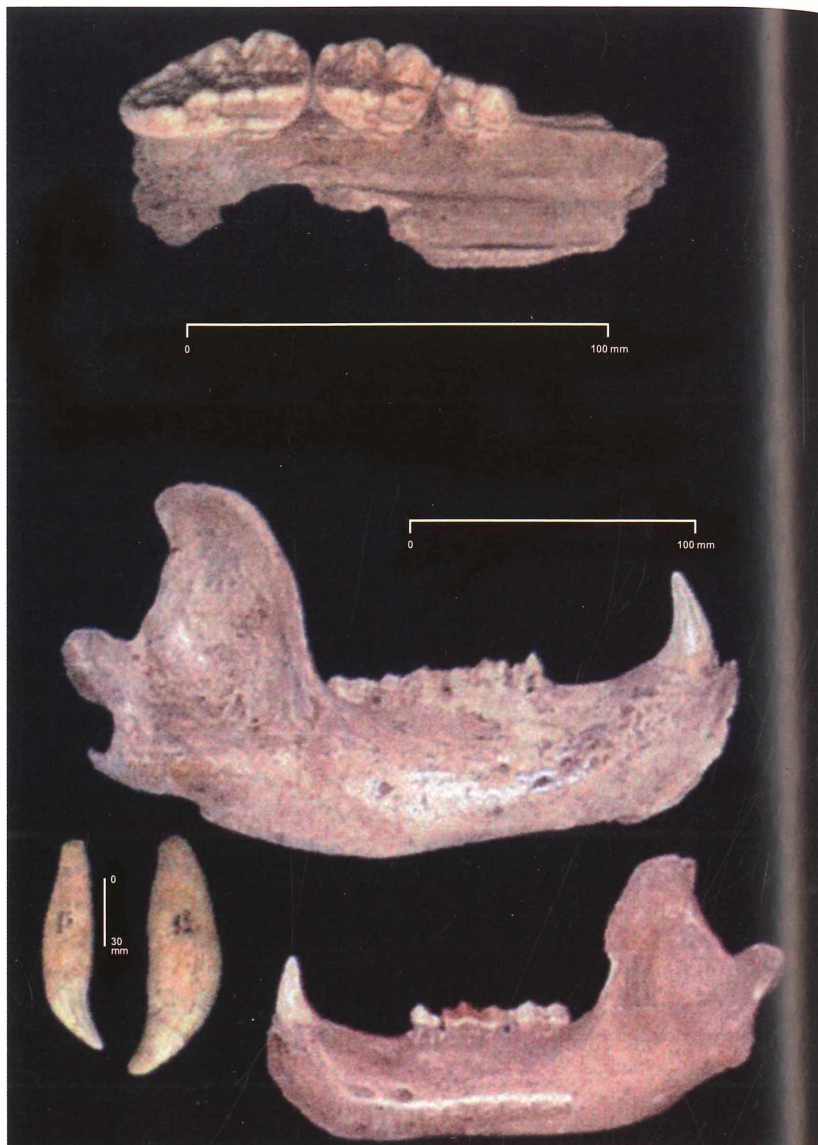


Figure 3.

*Ursus ingressus*  
(LAC).

Upper: Maxilla  
fragment with  
P<sup>4</sup>, M<sup>1</sup>, M<sup>2</sup> dex.

Lower: mandibles of  
a male (middle) and  
female (lower) and  
canines of a male  
(right) and female  
(left).



Order: ARTIODACTYLA

Family: Bovidae GRAY 1821

Subfamily: Bovinae GILL 1872

Genus: *Bos* LINNAEUS 1758

*Bos primigenius* BOJANUS 1827

**Material:** Ph I

Subfamily: Caprinae GILL 1872

Genus: *Capra* LINNAEUS 1758

*Capra ibex* LINNAEUS 1758

**Material:** Carpal, Metacarpal 3 + 4, 2 Ph II



Family: Cervidae GRAY 1821

Genus: *Dama* FRISCH 1775

*Dama dama* (LINNAEUS 1758)

**Material:** Scapula fragment, Carpal IV

Many micromammalian remains have also been found and they are preliminarily attributed to 23 species of bats, insectivores, rodents and lagomorphs (CHATZOPOULOU, this volume).

## Conclusions

The Loutra Arideas bear-cave is very rich in paleontological material. The excavations in the bear-cave A followed strictly the archaeological rules, and today it can be considered as the biggest systematic excavation with Pleistocene cave bear remains of Greece. Since 1990, 10 excavation seasons took place in 31 excavated squares with total 189 levels and approximately 15000 specimens (mostly indeterminable) of large mammals, further the micromammals, by 80 different people (researchers, students and co-operators).

Carnivores are represented in scarce diversity, but ursids are extremely abundant.

The study of the best preserved bone fragments and teeth of the bears, the most representative, showed the presence of the *U. ingressus* for first time in Greece.

The bones are mostly well preserved. Few long bones are complete and well preserved.

There have been found few well preserved complete skulls of adults, among this rich material one found in the main chamber LAC I, the other, most important, that shows clearly the characters of *U. ingressus* has been found in G11 square of LAC Ic chamber, while a skull of a juvenile has been found at the end of chamber LAC Ib among other specimens of juveniles and of sub-adults as well.

The majority of the tooth and bone remains belong to juveniles and sub-adults, while very few belong to very old individuals and few to adults, indicating thus an extremely high incidence of young and neonate mortality. There are many bear carcasses as a result of death during hibernation. The abundance of the milk teeth, in spite of their fragility, is very remarkable. The Loutra Arideas site can be considered as the unique place of Greece where so abundant and well stratified cave bear deciduous teeth have been collected.

The presence of both sexes has been established due to the sexual dimorphism either of the teeth (mainly canines) or of the postcranial skeleton, with a slight predominance of females over males.

Very few bones, such as a complete right anterior foot, have been found *in situ*, but the majority has been found scattered, and this is due either to the animals themselves or to the action of flowing water.

- The rounding and abrasion of some bones such as metapodials, phalanges and patellas also establish the action of flowing water. The not so good preservation of certain remains, as well as their position within the sediments, indicate a rather considerable, but not great flow as few were found in situ over the deposit.
- Few bones have traces of large carnivore teeth and this can be explained either by the presence of the other carnivores (felid, hyaenid, canid) or by cannibalism.
- Some bones have gnaw marks, which are probably due to many rodents.
- The cave bears used the cave as a den. The abundance of the material, the juvenile remains, establishes the inhabitation.
- Certain pebbles of LAC Ib chamber were brought into the cave with the sediments by the river overflows.
- The age of the paleofauna is estimated in 30-35.000 y.B.P.  
The paleoenvironment seems to be predominantly open with deciduous and mixed forests. The surroundings of the Bear-cave are geomorphologically very complex-forest peaks, rocky slopes, vast fields and mountain plateaus alternate in a small area. Just like today, in the Late Pleistocene geomorphological density had to result in vegetational and faunal variety.
- The abundance of the material shows relatively long occupation of the cave by bears. The cave does not seem to be used by humans, as only one lithic (pyrite) artefact was found up to now.

## References

- CHATZIDIMITRIADIS, E. A. (1974): Die Problematik der Erwärmung von Thermalquellen und ihre Zusammenhänge zu den geologisch-tektonischen Verhältnissen ihrer Umgebungen anhand von zwei Beispielen nämlich der Heilquelle von Ano Loutraki bei Aridea West Mazedonien und von Trajanoupolis West Thrakiens.- *Annals Fac. Phys. & Mathem., Univ. Thessaloniki*, 14, 113-128.
- CHATZOPOULOU, K. (2005): The small mammal fauna from the Loutra Arideas Bear-Cave (Pella, Macedonia, Greece) with emphasis on the third chamber.- (this volume).
- ELEFThERIADES, G. (1977): Study of the volcanic rocks in South Almopia.- Thesis Dissert. Aristotle University, 1-173, Thessaloniki.
- KAMBOUROGLOU, E., CHATZITHEODOROU, Th. (1999): Geomorphological changes and sedimentation of the A cave (Agiasma) of Loutraki (Pella, Macedonia, Greece). *Proc. 5<sup>th</sup> Congr. Greek Geographical Society*, 83-93, Athens. (in Greek)
- LAZARIDIS, G. (2005): Speleological research in the Loutra Arideas area (Macedonia, Greece).- (this volume).
- MERCIER, J. (1968): Étude géologique des zones internes des Hellénides en Macédoine centrale (Grèce).- *Annales Géologiques des Pays Helléniques*, 20, 1-792, Athens.
- MOUNTRAKIS, D. (1976): Geological study of the Pelagonien and Vardar Zone boundary in the Almopia area (North Macedonia).- Thesis Dissert. Aristotle University, 1-164, Thessaloniki.
- PAPPA, S., TSOUKALA, E., LAZARIDIS, G., RABEDER, G. (2005): Milk teeth of Quaternary carnivores from Northern Greek Caves.- (this volume).
- RABEDER, G. (1983): Neues vom Höhlenbären. Zur Morphogenetik der Backenzähne.- *Die Höhle*, 2 (34), 67-85, Wien.
- RABEDER, G., HOFREITER M., NAGEL D. & WITHALM G. (2004): New taxa of Alpine Cave Bears (ursidae, Carnivora).- *Cahiers Scientifiques*, 2: 49-67, Dept. du Rhone, Museum Lyon.

- TSIRAMBIDIS, A. (1998): Study of floor sediments from the Agiasma Cave of Loutraki, Pella (Macedonia, Greece).- Proceedings of the 8<sup>th</sup> Congress in Patras, Bulletin of the Geological Society of Greece, 34, 339-349. (in Greek)
- TSOUKALA, E. (1994): Bärenreste aus Loutraki (Mazed., Griechen.)- „*Ursus spelaeus*“: 2<sup>nd</sup> Höhlenbären Sympos. (Corvara, 15-18/9/94), Italy.
- TSOUKALA, E., RABEDER, G., VERGINIS, S. (1998): *Ursus spelaeus* and associated faunal remains from Loutraki (Pella, Macedonia, Greece) - Excavations of 1996. Geological and geomorphological approach.- 4<sup>th</sup> International Höhlenbären Symposium, 17-19/9/98, Velenje, Slovenia.
- TSOUKALA, E., RABEDER, G., †VERGINIS, S. (2001): *Ursus spelaeus* and Late Pleistocene associated faunal remains from Loutraki (Pella, Macedonia, Greece). Excavations of 1999.- Cadernos Lab. Xeolóxico de Laxe, 26, 441-446, Coruña.

Addresses of authors:

Evangelia Tsoukala, School of Geology, Aristotle University, 54 124 Thessaloniki, Macedonia, Greece  
Gernot Rabeder, Institute of Paleontology, University of Vienna, Althanstrasse 14, A-1090, Vienna, Austria



# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Abhandlungen der Naturhistorischen Gesellschaft Nürnberg](#)

Jahr/Year: 2005

Band/Volume: [45](#)

Autor(en)/Author(s): Tsoukala Evangelia, Rabeder Gernot

Artikel/Article: [Cave bears and Late Pleistocene associated faunal remains from Loutra Arideas \(Pella, Macedonia, Greece\) 15 years of research 225-236](#)