



## TRACKS AND MULTIPLE SKELETONS OF BROWN BEAR (*URSUS ARCTOS*) IN ALGAR DO VALE DA PENA, PORTUGAL

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### RESUMEN

El Algar do Vale da Pena es una cueva situada en el Parque Natural das Serras de Aire e Candeeiros (Leiria, Portugal) abierta al exterior por la excavación de una cantera a finales de la década de 1980. En la cueva hay cinco agrupamientos de restos fósiles interpretados como cinco individuos de diferentes tamaños. Los restos fueron identificados como pertenecientes a *Ursus arctos* en base a material dental, craneal y postcraneal. Veinte fósiles informativos han sido métricamente comparados con poblaciones de osos pardos y cavernarios de España Noroccidental. La población de *U. arctos* de esta cueva está dominada por ejemplares adultos de pequeño tamaño, congruentes con hembras adultas, y de menor tamaño que en otras localidades portuguesas. En las paredes hay al menos 189 huellas interpretadas como marcas de garras de osos, juveniles y adultos. El Algar do Vale da Pena fue probablemente una guarida habitada por osos pardos durante siglos.

*The Algar do Vale da Pena is a cave situated in the Natural Park of Serras de Aire e Candeeiros (Leiria, Portugal). It was discovered and opened in late 1980s in a limestone quarry excavation. The cave has five fossil bone concentrations that we interpreted as five individuals of different sizes. The remains are identified as *Ursus arctos* based on dental, cranial and postcranial material. Twenty informative fossils have been metrically compared with populations of brown and cave bears from Northwestern Spain. The population of *U. arctos* of this cave is dominated by adult specimens of small size, congruent with adult females, and smaller than in other Portuguese localities. In the walls of the cave there are at least 189 tracks interpreted as bear claw marks, from juvenile to adult sizes. The Algar do Vale da Pena was probably a den inhabited by brown bears during centuries.*

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## 1. INTRODUCTION

The Algar do Vale da Pena is situated at the coordinates 39°26'48.3"N 8°55'57"W and 289 meters above the sea level. It is located near the village of Moita do Poço, *freguesia* of Turquel, municipality of Alcobaça, district of Leiria. It is within the limits of the natural park "Parque Natural das Serras de Aire e Candeeiros"; in the Northwestern slope of the Candeeiros range, a mountain range that appear between Rio Maior in the Southwest and Porto de Mós in the Northeast; spanning for about 30 kilometers. This range is part of the system "Estrela-Montejunto" and is formed in calcareous rocks of the "Maciço Calcário Estremenho", limited between the thrust of Arrife in the East and the fault of Candeeiros in the West. The rocks that form the cave are part of the Candeeiros Formation, which is Middle Jurassic (Bajocian) in age (Zbyszewski & de Matos, 1959; Carvalho, 1996). The entire area of the Natural Park has been subject to numerous archeological and paleontological discoveries in karstic cavities of different ages (Cardoso, 1996). The cave was discovered by chance in 1988 or 1989 when it was opened during the excavation works in a limestone quarry. It also has been known in the speleological community as "O Algar dos Ursos". Today, the access is only possible by complex vertical progression using ventral croll, shunt, descensor, climbing fist, etc., through a descent of around 30 meters, which the last 15 meters are vertical. This is not the original entry of the cave which is unknown and remains closed.

## 2. MATERIALS AND TAPHONOMY

Five groups of skeletal remains have been discovered associated in different points of the cave. The location spots were well separated in different galleries, and its distribution is unlikely to be result of the dispersal by gravity, water or animals. We interpret this distribution as five independent individuals, although the minimal number of individuals based on bone elements (crania) is two.

The material includes dental, cranial and postcranial elements, but not any complete skeleton so far. The most complete individual comprises postcranial and a nearly complete articulated cranium coated in a calcite flowstone crust. This material has not been collected yet.

The list of the already collected bones and teeth is as follows (AVP stands for Algar do Vale da Pena, first digit indicates the individual and the second is the element collected): AVP 1.1: Partial left scapula. AVP 1.3: Right scapholunate. AVP 1.4: Right hamate. AVP 1.6: Second phalanx. AVP

1.7: Proximal epiphysis of third right metatarsal. AVP 1.8: Distal epiphysis of right radius. AVP 1.9: Distal part of diaphysis of left ulna; AVP 2.1: Posterior part of right hemimandible; AVP 2.2: Parietal and occipital. AVP 2.3: Temporal. AVP 2.5: Heavily damaged canine. AVP 2.6: Left upper fourth premolar. AVP 2.7: Left upper first molar. AVP 2.8: Right lower second molar. AVP 2.9: Left lower third molar. AVP 2.10: Partial third phalanx; AVP 3.1: Partial distal epiphysis of right femur. AVP 3.2: Vertebral centrum; AVP 4.1: Proximal epiphysis of second right metatarsal. AVP 4.2: Damaged proximal epiphysis of fifth right metatarsal.

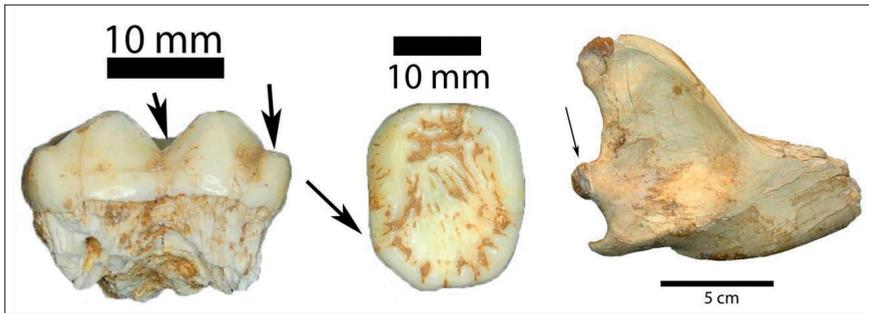


Figure 1: Diverse brown bear (*Ursus arctos*) material from Algar do Vale da Pena, Portugal. Left, first upper molar (AVP 2.7) in labial view with small sized metastyle and clear separation between paracone and metacone marked; center, third lower molar (AVP 2.9) in oclusal view without notch in the labial part and posterior right hemimandible (AVP 2.1) in exterior view with the low position of condyle marked.

### 3. METHODS

The brown bear bones and teeth have been prepared mechanically using a Micro-jackhammer and Paraloid B72 as consolidating and glue. The remains were identified using the osteological atlas for the Pleistocene ursids of the Iberian Peninsula (Torres Pérez-Hidalgo, 1984) and measured with a caliper, following the recommended measurements for ursids by Tsoukala & Grandal-d'Anglade, (2002). Finally, the remains were metrically compared with brown bears (García Vázquez, 2015) and cave bears (unpublished own data) from NW Spain.

### 4. RESULTS AND DISCUSSION

All of the remains are favorably comparable with the morphology of *U. arctos*, possessing a first upper molar with clearly individualized metacone-paracone and protocone-hypocone, but without a marked and big cingulum; mandible with a low condyle compared with the mandibular ramus,

slender long bones without marked muscle insertions, occipital bone with a shallow nugal crest and straight third phalanxes with robust proximal parts. The morphology of a first upper molar (without clear crests running over metacone-paracone and protocone-hypone, plus a small sized metastyle) and the scapholunar (without a slightly exteriorly tipping apophysis) allowed us to rule out the presence of *Ursus thibetanus* Cuvier, 1823. In addition, the morphology of the third phalanx (Not clearly curved and with a robust base), a first upper molar (without rugged enamel between the paracone and protocone) and a third molar (without the notch in the labial part) are not congruent with the morphology of *Ursus spelaeus* Rosenmüller, 1794 (Figure 1).

More than 40 measurements of 20 different limb bones, one mandible and dental remains were compared and fall into the range of metrical variability of the *U. arctos*, meanwhile none fall within the range of *U. spelaeus*. Given the degree of fusion of the epiphysis, we can establish the ontogenetic stage as adults or nearly-adults. However, the measurements of Algar de Vale da Pena specimens are below the average of the population of NW Spain (see measurements provided by García Vázquez, 2015) and, even more markedly, below other Portuguese specimens (Torres Pérez-Hidalgo, 1979; Cardoso, 1996). The proportions of limb, metapodial and cranial bones, indicate a population most likely dominated by small to average sized adult females.

These findings agree with previous works that state that brown bear, *U. arctos* is the only known species of bear in the Portuguese Pleistocene, but our findings contrast with them due to the smaller size of Portuguese specimens when compared with material from Spain (Torres Pérez-Hidalgo, 1979; Cardoso, 1996).

## 5. THE CLAW MARKS

The walls of the cave present two types of substrate: i) younger hard calcite flowstone speleothems that often covers the ii) soft and older clay and mud. All clay surfaces are covered with parallel marks of claws, normally of four or five grooves in a total counting of 189. We interpreted them as foreclaw marks of brown bears (Figure 2) given that bears climbing vertical walls are unlikely. They vary in size, between five to twelve centimeters in width, therefore from juvenile to adults. If all calcite surfaces were not covered, we estimated the total number of traces in hundreds. Given that brown bears tend to not produce nearly as many of these scratches as cave bears (Fosse *et al.*, 2004)L. the numbers encountered were probably resulting of the grope navigation of the bears in the darkness of the cave and/or excavation of a bed for hibernation during decades or centuries of use of the cave. Bear tracks were known in Portugal but not like the ones described above: walking bear tracks have been reported in Praia do Cavalo (Neto de

Carvalho, 2018) and large hibernation beds made by bears have been observed and communicated to us by speleologist in the Almonda cave system.



Figure 2: Bear claw marks in the walls of the Algar do Vale da Pena, Portugal. Scale bar is 7 cm.

## 6. CONCLUSIONS

The Algar do Vale da Pena is a new Portuguese fossil bear locality, where five brown bear skeletons have been discovered. The remains are congruent with small to average sized adult *U. arctos* females. These specimens are smaller in size compared to fossil brown bears from Spain and other Portuguese localities. This cave also presents the first bear claw marks reported in Portugal. The Algar do Vale da Pena was probably a den inhabited by brown bear for hibernation, during decades or centuries.

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