

## A complete skull and mandible of *Eomellivora piveteaui* Ozansoy, 1965 (Carnivora, Mammalia) from Batallones-3 (MN10), Upper Miocene (Madrid, Spain)

Alberto Valenciano<sup>1,2</sup>, Juan Abella<sup>3</sup>, Oscar Sanisidro<sup>3</sup>,  
M<sup>a</sup> Ángeles Álvarez-Sierra<sup>1,2</sup> and Jorge Morales<sup>3</sup>

<sup>1</sup>Departamento de Geología Sedimentaria y Cambio Climático, Instituto de Geociencias, IGEO, (UCM-CSIC). C/ José Antonio Novais 2, 28040 Madrid, Spain. a.valenciano@igeo.ucm-csic.es

<sup>2</sup>Departamento de Paleontología UCM, Facultad de Ciencias Geológicas UCM. C/ José Antonio Novais 2, 28040 Madrid, Spain. masierra@geo.ucm.es

<sup>3</sup>Departamento de Paleobiología, Museo Nacional de Ciencias Naturales-CSIC. C/ José Gutiérrez Abascal, 2, 28006 Madrid, Spain. juan.abella@mncn.csic.es; osanisidro@mncn.csic.es; jorge.morales@mncn.csic.es

### Introduction

The *Cerro de los Batallones* fossil sites, Upper Miocene (MN10), are located in the south of the province of Madrid (Spain) (Morales et al., 2008). Batallones-1 and Batallones-3 have an unusually high proportion of fossil carnivores (over 98.5% of the remains determined as mammals are carnivores) and both localities have been interpreted as carnivore traps (Morales et al., 2008; Abella et al., 2011; Domingo et al., 2011). The Batallones-3 carnivores association (Abella et al., 2011) comprises two amphicionids (*Magericyon* sp and *Thaumastocyon* sp), one ursid (*Indarctos* sp), three felids (*Machairodus aphanistus*, *Promegantereon ogygia* and *Styriofelis vallesiensis*), one hyenid (*Protictitherium crasum*) and five musteloids (*Eomellivora piveteaui*, *Martes* sp, *Proputorius* sp, Mephitinae indet and Mustelidae indet).

The aim of the present paper is to study the systematics of the fossil of *Eomellivora* from Batallones-3, as well as to describe

the complete skull preserved from Batallones-3 by means of a virtual 3D model.

### Systematic Palaeontology

Order Carnivora BOWDICH, 1881

Family Mustelidae, FISCHER Von WALDHEIM, 1817

Subfamily Mellivorinae, GRAY, 1865

Genus *Eomellivora* ZDANSKY, 1924

*Eomellivora piveteaui* OZANSOY, 1965

Lectotype: A parcial right dentary with i2-p4 and m1 trigonid, figured by OZANSOY, 1965 pl.II, fig.1)

Type locality: Yassiören (Turkey)

Age: MN9. Upper Miocene, lower Vallesian (Wolsan and Semenov, 1996)

Description of the Batallones-3 fossils

Material studied: Bat-3'09-1000: skull with P2-M1 plus two hemimandibles with p2-m1; Bat-3'08-526: right mandible with c, p2-m1; Bat-3'11-1180: left mandible fragment with p4; Bat-3'08-796: m2; Bat-3'09-250: I3; Bat-3'08-635: upper canine; Bat-3'09-250: P3.

Description: p2 birradiculated, with oval occlusal morphology, elongated and slender; p3 with posterior secondary cusp, sub-triangular occlusal morphology, wider posteriorly; p4 slender and elongated with posterior accessory cusp; m1 with very high talonid, valley between protoconid and hypoconid present; m2 with two labial cuspids in central position, hypoconid in posterior-central position; P3 with posterior secondary cusp, triangular occlusal morphology, with a widened concave postero-lingual labial wall; P4 (broken protocone), parastyle present, slightly concave labial wall.

### Discussion

*Eomellivora* Zdansky, 1924, had been found in Spain in the Upper Miocene locality of Los Valles de Fuentidueña (MN9) (Crusafont-Pairó and Ginsburg, 1973), from an M1 identified as *E. liguritor*. Subsequently Ginsburg et al. (1981) determined a P4

with a broken protocone and an ectocuneiform as belonging to the same species from Los Valles de Fuentidueña. The material attributed to *Eomellivora* in Batallones-3 is remarkable, since it includes very complete cranial and postcranial material, practically unknown in the other species of the genus. Although some fossil specimens such as the mandible Bat-3'08-526 are well preserved, others such as the skull and articulated mandible Bat-3'09-1000 are deformed due to processes of compression by sediments. Other fossil specimens have undergone dissolution and bioerosion as a result of the activity of extant plants.

Currently, 8 species of *Eomellivora* have been described in 16 different localities. The known temporal range is from the MN8 to the MN13 (approx. 12 – 5.3 Ma). Their geographical distribution is Holarctic and Palaeotropic (Wolsan and Semenov 1994, 1996; Morales and Pickford, 2006). Wolsan and Semenov (1996) only considered two chronosubspecies for Eurasian forms, a Vallesian *E. wimani piveteaui* that included *E. piveteaui* Ozansoy, 1965 and *E. liguritor* Crusafont-Pairó and Ginsburg, 1973, and another Turolian *E. wimani wimani*, including *E. wimani* Zdansky, 1924, *E. ursogulo* (Orlov), 1948, *E. hungarica* Kretzoi, 1942, *E. orlovi* Kretzoi, 1965 and *E. rumana* Simionescu, 1938. This view is rather simplistic and is partly influenced by the relatively homogeneous size of all these forms. In our opinion there are several criteria to distinguish the species *E. piveteaui*, *E. wimani*, *E. ursogulo* and *E. hungarica*. The Batallones-3 species, although it is only represented by three individuals, presents a high variability which affects p1, present in the mandibles articulated with the skull Bat-3'09-1000 and absent in the mandible Bat-3'08-526, which in addition it is more slender. Additionally, there is a big difference in the size and robustness of the dentition, which may indicate the existence of a marked sexual dimorphism, as happens in other extant and extinct mustelids (eg. Moors, 1980; Hunt Jr and Skolnick, 1996).

The *Eomellivora* dentition of Batallones-3 is similar in size to that of *E. wimani* and *E. piveteaui*. It is comparable to *E. piveteaui* in the absence of posterior accessory cusp p2, and anterior accessory cusp in p3; both species present the same robustness in

p4, m1, P4 and M1, as well as a similar morphology in P4 and M1. However, the Batallones-3 *Eomellivora* presents somewhat different proportions in p2 and p3 compared to the same teeth of *E. piveteaui* (p2 less robust and p3 more robust). Moreover, it presents a p2 without a posterior accessory cusp and p4 without an anterior accessory cusp. One should bear in mind that *E. piveteaui* was described on the basis of a fragment of mandible and a fragment of maxillary, so that differences could only be due to intraspecific variability. At the Ukrainian site at Gritsev (MN10), Wolsan and Semenov (1996) assigned an important dentition sample to *E. wimani piveteaui*. These teeth are larger and more robust than the one of the Batallones-3 species. Without figures or detailed descriptions it is difficult to compare these two populations.

The Batallones-3 *Eomellivora* dentition differs from *E. wimani* in that it lacks an anterior accessory cusp in p4 and P3, in a more primitive morphology in the m2, which has two labial cusps in a central position, a quite slender p2, a p4 with a lower anterior widening, a weaker concavity in the labial wall of both P3 and P4 and a narrower M1. However, the W/L ratios of p3, p4, m1, P3 and P4 are similar. *E. ursogulo* is a more derived form than that represented in Batallones-3; it has a higher number of accessory cusps in p2-p4, more robust premolars, p3 has a very strong posterior enlargement, m2 is very reduced and has a single labial cusp (similar to *Gulo gulo*) and a narrower M1. Equally, *E. hungarica* differs from the Batallones-3 species in its larger size and more robust dentition. On the other hand, *E. hungarica* has a larger number of accessory cusps on the premolars and the anterior accessory cusp of p4 is very high and robust.

### Description of skull and mandibles

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The Bat-3'09-1000 specimen, comprising a skull and its two hemimandibles, presented strong lateral compression, which masked its overall morphology. It was scanned in 3D and the result was compared to the extant wolverine (*Gulo gulo*).

3D model: A raw surface 3D model was obtained with a Next Engine 2020i scanner. The specimen distortion was

corrected by means of the CAD Software 3D Studio Max. Two different shearing orientations have been estimated observing unaligned paired structures: an 18.3° deformation angle on the sagittal plane and a 3.4° angle on the transverse one. Finally, an idealized specimen was created on the basis of the corrected 3D model. Recovery of the original shape in individuals with linear distortions eases overall morphological descriptions, and constitutes a necessary first step towards a correct anatomical reconstruction.

Description of the skull: Robust, elongated, triangular dorsal morphology, forehead lower than *G. gulo*. Rectilinear dental series different from *G. gulo*, which is convex. Infraorbital foramen more developed in width and height. Small ocular orbits, subcircular and open caudally. Both species present a large lateral expansion of the zygomatic arch. Frontal process of zygomatic arch higher than, and temporal process of zygomatic bone lower than *G. gulo*. Greater robustness of the caudo-ventral area of the zygomatic arch, where the muscle *masseter pars profunda* inserts. Well-developed sagittal crest with the external occipital protuberance barely exceeding the nuchal region. In contrast, the external part of *G. gulo*'s sagittal crest is more developed and far exceeds the nuchal region. Paraoccipital process more developed and ventro-caudal projected. Mastoid process more robust, with lateral projection, unlike that of *G. gulo*, in which this projection is ventral. Greater area of insertion of the muscles *sternocephalicus* and *obliquus capiti cranialis*. Nuchal crest and external occipital crest well marked in both species.

Description of mandibles: The disposition of the dental series is rectilinear, unlike that of *G. gulo*, which is convex. The mandible is longer, without the typical reduction observed in *G. gulo*. Ascending ramus with greater rostro-caudal width and greater height between the angular and articular processes. Its angular process presents a greater caudal development than that of *G. gulo*. Coronoid process turned laterally to the articular process with an angle of less than 90°, whereas in *G. Gulo* this angle is approximately 90°. Greater *temporalis profundus* muscle attachment. Masseteric fossa more

developed and larger muscle attachment for the muscles *masseter pars superficialis* and *pars profundus*. Robust mandibular body in both species. The area between the angular process and the insertion of the muscle *digastricus* has a ventral expansion and its lower edge is convex in *Eomellivora*, whereas in *G. gulo* it lacks this expansion and its lower edge is concave. It has two lateral foramina located under the p2 and p3, whereas in *G. gulo* they are located under the p3 and p4. Both species have a somewhat a vertically integrated mandibular symphysis.

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