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Eloísa BERNÁLDEZ-SÁNCHEZ &
Esteban GARCÍA-VIÑAS

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Eloísa BERNÁLDEZ-SÁNCHEZ
Laboratorio de Paleontología y Paleobiología,
Instituto Andaluz del Patrimonio Histórico,
Avda. de los Descubrimientos s/n, E-41092 Sevilla (Spain)
eloisa.bernaldez@juntadeandalucia.es

Esteban GARCÍA-VIÑAS
Departamento de Sistemas Físicos, Químicos y Naturales,
Universidad Pablo de Olavide,
Carretera de Utrera km 1, E-41013 Sevilla (Spain)
egarvin@acu.upo.es

ABSTRACT

The horse is one of the species most represented in cave art during the Paleolithic in the southwest of Europe. These representations show an equine with phenotypical characteristics close to two present-day species which are considered as ancient horses: tarpans (*Equus ferus caballus* Linnaeus, 1758) and Pzrewalski (*Equus caballus przewalskii* Poliakov, 1881) horses. There are no paleontological evidence at sites dating from the Upper Paleolithic in this area of the last species, and furthermore various authors compare these representations with Pzrewalski horses. The comparative anatomical analysis of these representations is difficult due to the variety of styles and the different sizes of the figures. In this case, we carry out a study of the body proportions on six variables measured in 42 pictures of horses represented in 15 caves (eleven from Spain and four from France) from different cultures and styles. These measurements have been compared with data obtained from pictures of present-day horses: 22 pictures of hemiones or Asian asses (*Equus hemionus* Pallas, 1775), 20 tarpans of Konik breed (*Equus ferus caballus* Linnaeus, 1758) and 25 Pzrewalski's horses. The results of these analyses were three different equations to distinguish these three current equine species and their relationship with cave art. The equids represented in the caves studied show similar body proportions to Konik horses and similar lengths of mane, tail and ears to present-day Pzrewalski's horses. The results of this analysis significantly discriminate the three current equine species, which shows that the method is reliable and that the equids represented in the caves studied have body proportions similar to Konik horses and similar lengths of mane, tail and ears to the Pzrewalski horses.

KEY WORDS
Cave art,
horse,
Pzrewalski's horse,
hemione,
horse shape.

RÉSUMÉ

Les équidés représentés dans l'art rupestre et les chevaux actuels : une proposition pour déterminer différences et similitudes morphologiques.

Le cheval est l'une des espèces les plus représentées dans l'art rupestre paléolithique du sud-ouest de l'Europe. Ces représentations montrent un équidé avec des caractéristiques phénotypiques proches de deux espèces de chevaux actuels: les tarpans (*Equus ferus caballus* Linnaeus, 1758) et les chevaux de Pzrewalski (*Equus caballus przewalskii* Poliakov, 1881). Bien qu'il n'y ait aucun enregistrement osseux de cette dernière espèce dans les sites du Paléolithiques supérieur de la zone d'étude, certains auteurs considèrent que ces représentations correspondent aux chevaux de Pzrewalski. Nous essayons de voir les différences et les similitudes entre les représentations des chevaux et les deux plus anciennes espèces de chevaux européens, les tarpans Konik et les chevaux de Pzrewalski. Bien que l'analyse anatomique comparative de ces représentations soit difficile en raison de la variété des styles et de la différence de taille des figures, nous avons étudié les proportions du corps avec six variables mesurées sur 42 images de chevaux représentées dans 15 grottes (onze en Espagne et quatre en France) de différents cultures et styles. Ces mesures ont été comparées aux données obtenues à partir de 22 images d'ânes asiatiques (*Equus hemionus* Pallas, 1775), 20 de chevaux Konik (*Equus ferus caballus* Linnaeus, 1758) et 25 de chevaux de Pzrewalski. Les résultats de cette analyse différencient significativement les trois espèces d'équidés actuelles, ce qui montre que la méthode est fiable et que les équidés représentés dans les grottes étudiées ont des proportions corporelles similaires à celles des chevaux Konik, mais des longueurs de crinière, de queue et d'oreilles similaires à celles des chevaux de Pzrewalski.

MOTS CLÉS
Art rupestre,
cheval,
cheval de Pzrewalski,
hémione,
morphologie des
chevaux.

INTRODUCTION

Wild equids became extinct in Europe during the Holocene with the last tarpan being dated to the 19th century (Eisenmann 1990, 2010; Olsen 2006: 83). Climatic changes, together with hunting by humans in the Last Glacial Maximum (LGM) were the causes of the extinction of megafauna in the Quaternary (Stuart 1991; Barnosky *et al.* 2004). Some of these species were of the genus *Equus* (Guthrie 2003). Today, the only evidence of these extinct animals is found in the cave paintings and fossil bones recorded at archaeological/palaeontological sites, but these types of evidence do not always show the same frequency of species representation. According to Altuna (1994: 309), on the Iberian Peninsula 24% of the figures in cave painting are horses, while in the caves of Altamira and Tito Bustillo (both in northern Spain) horse bones found in excavations were less than 1% of the palaeobiological records.

Ancient bones are useful for anatomical analysis, but they are not able to explain the external features of the animals, such as the coat or the length of the mane. Some experts are able to estimate the size and shape of an animal by measuring the bones (Guthrie 2003; Bignon & Eisenmann 2006; Kyselý & Peške 2016), as well as their age, ecology and diet by measuring the teeth (Eisenmann 2010). Bones can however be used to describe the colour of the coat when DNA is well preserved inside the bones (Seco-Morais *et al.* 2007; Pruvost *et al.* 2011). Morphobiometric criteria have been used by some experts to describe different kinds of wild equines from the Iberian Peninsula (Castaños 1986; Cerdeño & Alberdi 2006) that survived in the Upper Palaeolithic period: *E. ferus torralbae* (Prat, 1977), *E. ferus gallicus* (Prat, 1968), *E. ferus antunesi* Cardoso & Eisenmann, 1989 (described by Cardoso &

Eisenmann 1989), *E. ferus lusitanicus* Uerpmann, 1990 (described by Uerpmann 1990) and *E. hydruntinus* Regàlia, 1907 (Crees & Turvey 2014). The extinction of *E. hydruntinus* could probably be dated in the early Holocene (Geigl & Grange 2012; Crees & Turvey 2014), while *E. ferus ferus* Gmelin, 1769 (tarpan) is found at Iberian archaeological sites up to Recent Prehistory, when it was domesticated (Liesau 2005). Today we can find genetically modified Pzrewalski's horses and tarpans in two domesticated breeds, Konik and Heck (ARTHEN 2012; Gaunitz *et al.* 2018).

In additional to the ancient bones, the painted or carved horse motifs are the only other record of the equine species during the Palaeolithic period. The horse is the most frequently painted animal in European cave art (Sauvet & Wlodarczyk 1995; Altuna 2002). The authors of some papers have studied the shape of these horse paintings in an attempt to understand the realism of the motifs (Halverson 1992; Cheyne 1993; Hodgson 2003), some using image analysis to study equid depiction (Pigeaud 2002, 2007; Cheyne *et al.* 2009). In this case our main objective is test a mathematics method to study the anatomical features of the ancient equids painted and carved in the caves of southwest Europe in relation to the three present-day equine species, which are described by the Interagency Taxonomic Information System (ITIS), most closely to ancient horses (Oakenfull *et al.* 2000; Eisenmann 2006; Levine 2006; Kavar & Dovč 2008; Outram *et al.* 2009; Eisenmann 2010; Orlando 2015). Although it is probably that these horses could be subspecies, in our work we have maintained the classification proposed by the ITIS, that also is based in the differences in the number of chromosomes (Oakenfull *et al.* 2000; Levine 2006; Kavar & Dovč 2008) and the differences in the phenotypic characteristics.
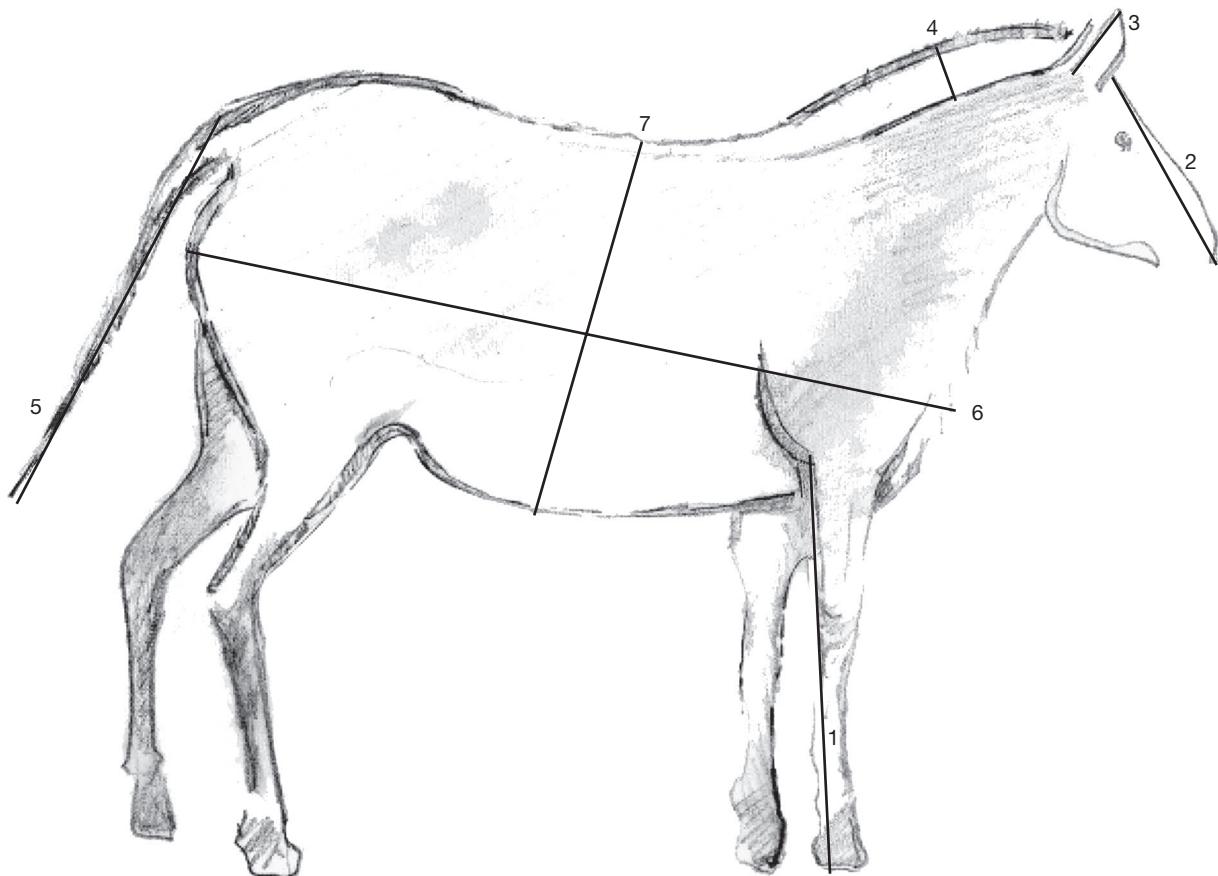
Fig. 1. — Different biometric data taken in the horses representations. Figure of a horse from the "Tito Bustillo" cave, drawn by Francisco Salado (Instituto Andaluz del Patrimonio Histórico). Indications: **1**, length of the foreleg (LFL); **2**, length of the face (LF); **3**, length of the ear (LE); **4**, length of the mane (LM); **5**, length of the tail (LT); **6**, length of the body (LB); **7**, width of the body (WB).

In the ancient record (fossil bones and paintings) it is possible to find individuals of these three different species of equines: *E. hydruntinus*, *E. ferus* and *E. caballus przewalskii* Poliakov, 1881 (Madariaga 1963; Wakefield *et al.* 2002; Guthrie 2006), but the last of these is not mentioned in archaeozoological analysis of the same period on the Iberian Peninsula. Nowadays we can find individuals from the two species of horses genetically modified (Gaunitz *et al.* 2018), but no *E. hydruntinus*. Nevertheless, there are populations of *E. hemionus* Pallas, 1775, a wild species related to *E. hydruntinus* (Burke *et al.* 2003; Orlando *et al.* 2006).

We have analysed a sample of 42 prehistoric figures, the majority of them included in the style IV (Magdalenian) defined by Leroi-Gourhan (1965), but we have used some Gravettian-Solutrean figures. The analysis of the styles in Palaeolithic art is useful to understand different moments and different geographical areas, but according to Pigeaud (1997:320), the analysis of horse proportions in Palaeolithic art is not useful to distinguish these differences. This is the reason to include in our study different geographical areas and styles together where the horse represented could be the same species, which looks like a current *E. przewalski* at first sight.

MATERIAL AND METHODOLOGY

This study is based on the relationship between the shape of three present-day species of equids and the horses represented in cave paintings and motifs. We used 2D images in both cases to unify the metric criteria, which had to show a complete animal in profile position.

Modern horses are described using phenotypic features such as the length of anatomical parts and the length and shape of hair, but the biometric data in the ancient representations depends on the author and we do not know if the painting reflects a correctly proportioned animal. For this reason, to obtain metric data we selected the length of the foreleg (from the hoof to the beginning of the elbow; Fig. 1) and compared this value with the rest of measurements using Image Fiji software. The values are a percentage of the lineal number of pixels on the foreleg. Finally, we have relative values for the length of the face (LF), tail (LT), body (LB), mane (LM) and ear (LE) and the width of the body (WB). LF was taken from the nose to the position of the ears; LT was the maximum length of the tail; LE was the maximum length of the ears; LM was the perpendicular length of the hair; LB was the maximum value taken from the chest to the buttocks; and WB was taken from the most convex part of the croup and the most concave part of the belly (Fig. 1). These measurements

Fig. 2. — The three species of equids studied: **A**, Heck's tarpan *Equus ferus caballus* Linnaeus, 1758; **B**, Konik tarpan *Equus ferus caballus* Linnaeus, 1758; **C**, *E. caballus przewalskii* Poliakov, 1881; **D**, *E. hemionus* Pallas, 1775. Pictures from Wikipedia: **A**, "Two Heck horses in the zoo of Stadt Haag, Austria." by Christian Jansky – Own work, licensed under CC BY-SA 2.5. https://commons.wikimedia.org/wiki/File:Two_Tarpans.jpg, last consultation: 14/01/2019; **B**, "Koniks3" by Gerard M. (presumed – based on copyright claims). Licensed under CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Koniks3.JPG, last consultation: 14/01/2019; **C**, Przewalskipferd (Kölner Zoo). https://commons.wikimedia.org/wiki/File:Przewalskipferd_cologne.jpg, last consultation: 14/01/2019; **D**, "Equus kiang holdereri (Prague Zoo)" by Bodlina – Own work, licensed under CC BY 3.0. https://commons.wikimedia.org/wiki/File:Equus_kiang_holdereri04.jpg, last consultation: 14/01/2019.

can be grouped into two sets; the first is related to the differences between horses and donkeys (LE, LM and LT) and the second to the human management of equids (LM, LF, LB and WB).

We selected three current equids for the study of cave representations that have been recognised as the most ancient species of equids (Eisenmann 1990: 755; Orlando 2015; Fig. 2). This allowed us, on the basis of our measurements, to identify 22 *Equus hemionus*, 20 Konik horses (*E. ferus caballus* probably close to *Equus ferus*; ARTHEN 2012) and 25 *Equus pzrewalski*. The results of the different measurements were processed with SPSS 14.0 software using discriminant function analyses following two methods:

In the first case, we analysed the values obtained directly from the Fiji software: LF, LT, LB, LM, LE and WB designated "absolute variable".

In the second, we transformed these values to study the proportions of the figures: LF/LE, LF/LW, LF/WB, LB/WB, LM/LT designated "index".

We obtained three functions with the analysis of the three selected current equids, one for each species using Fisher's classification function coefficients, that were evaluated using data of 38 pictures of present-day horses from 19 native Iberian breeds (Ministerio de Agricultura, Pesca y Alimentación 2008). This functions were used to determine the selected cave paintings and engravings. We studied 42 cave paintings and engravings from 15 caves dated to the Upper Palaeolithic (Figs 3 - 5) with two styles according to Leroi-Gourham system (Menéndez *et al.* 2009): eleven in Spain and four in France.

We have selected Magdalenian art from Tito Bustillo, Buxu and Peña de Candamo in Asturias; Ekain and Santimamiñe in the Basque Country; Altamira, La Cullalvera and Las Monedas in Cantabria and Lascaux, Font de Gaume and Niaux in France. Also, in order to check the method, we have used some Gravettian-Solutrean art from Cueva del Moro and La Pileta in Andalusia, La Pasiega in Cantabria and Pech-Merle in France.
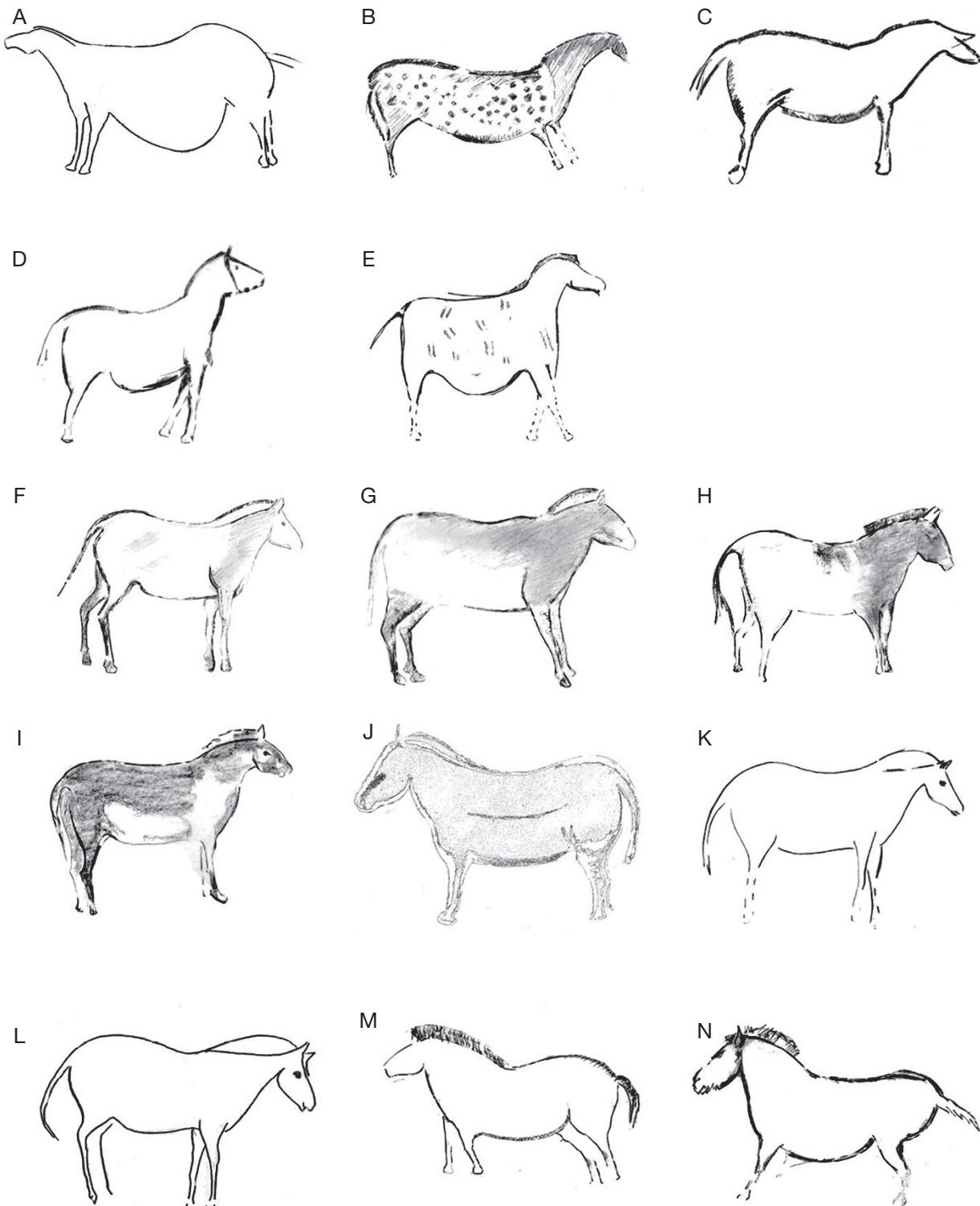
FIG. 3. — Representation of the Gravetien-Solutrean horse figures studied: **A**, "Cueva del Moro"; **B, C**, "Pech-Merle"; **D**, "La Pasiega"; **E**, "La Pileta". Magdalenian figures: **F-I**, "Tito Bustillo"; **K, L**, "Buxu"; **M**, "Peña de Candamo"; **N**, "Santimañine". Designed by Francisco Salado (IAPH), using dashed lines in some recreated parts of the figures.

RESULTS

ANATOMICAL DIFFERENCES BETWEEN PRESENT-DAY EQUIDS

One of our objectives was to prove the viability of this image analysis to determine differences between the three current species of equines. The first expected result was the difference between *E. hemionus* and the both horses (Fig. 6), which have very disparate lengths of ear and tail. Nevertheless, differences between both species of horses are provided by mane length and body width.

The statistical results of the classification of *E. hemionus*, *E. ferus caballus* (Konik) and *E. przewalski* showed significant differences between them, using both kinds of data (absolute
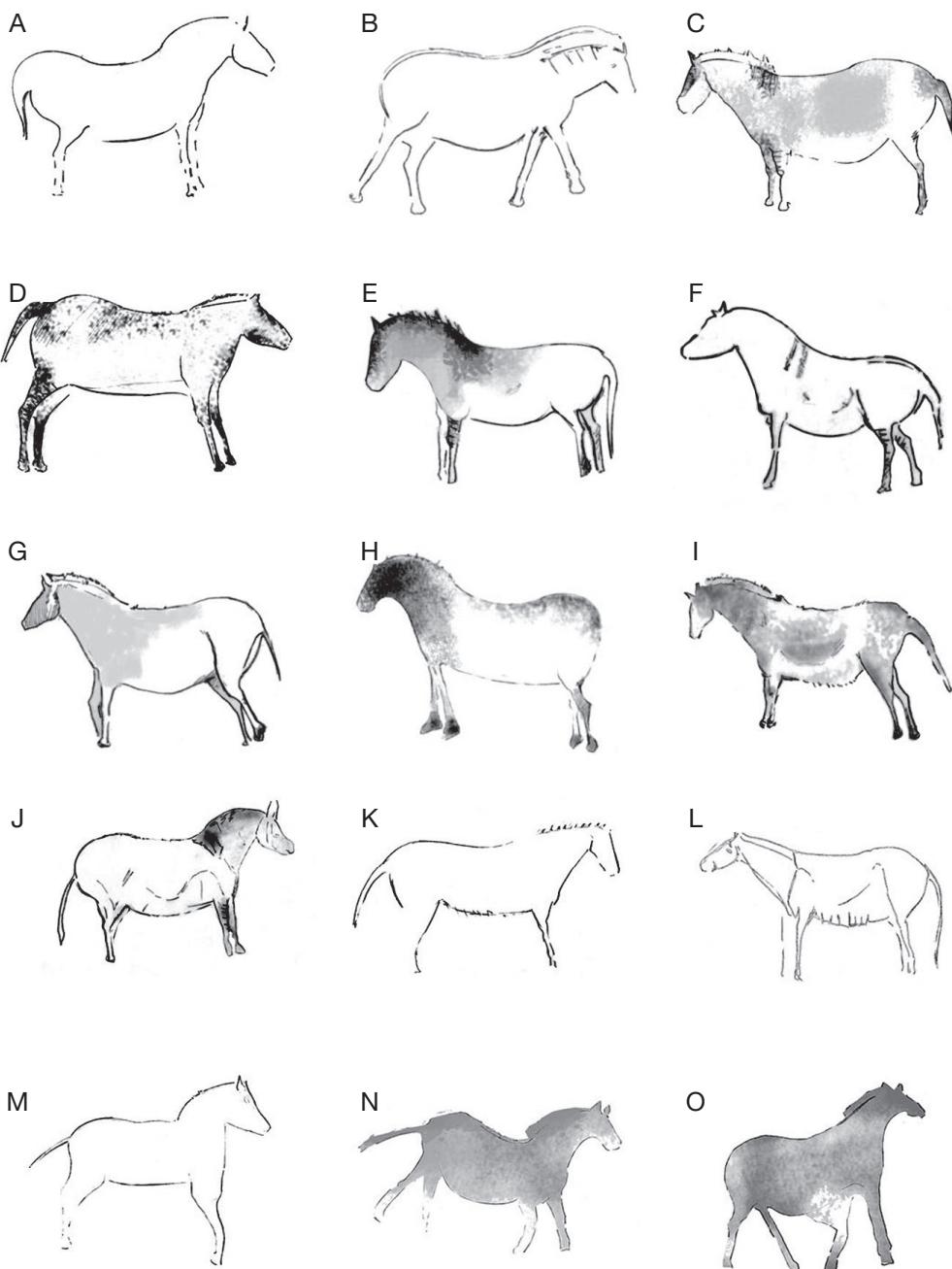
Fig. 4. — Representation of the Magdalenian horse figures studied: **A-J**, "Ekain"; **K**, "La Cullalvera"; **L**, "Las Monedas"; **M-O**, "Altamira". Designed by Francisco Salado (IAPH), using dashed lines in some recreated parts of the figures.

variables and indexes, Table 1). In both cases, significant results. with Box's M test are less than 0.05, and Wilk's lambda values are close to zero:

Using absolute variables, the statistical analysis defines two functions using length of tail (LT), length of mane (LM) and length of ears (LE). Of these, LM is the most discriminant variable (Table 2) and classified these species correctly in 97% of cases. Length of mane (LM) is a variable that divides the measured individuals into two groups; one is composed of individuals with short manes (hemiones and Przewalski horses) and the other of individuals with long manes (current tarpans of the Konik breed). Therefore, LM

could be considered as a phenotypic variable related to the wild state of the species, whereas ear and tail length are phylogenetic variables that differentiate donkeys (hemiones) and horses (see the average in Table 3). The centroids of the three variables show statistically significant differences between these three groups of equids (Table 3). Finally, we can obtain three mathematical expressions with Fisher's classification function coefficients:

– *E. hemionus* = 269*LE – 29.20*LM + 30.79*LT – 49.81;
– *E. przewalski* = 153.73*LE – 8.69*LM + 60.35*LT – 54.59;
– *E. ferus caballus* (konik) = 114.13*LE + 51.19*LM + 89.26*LT – 64.283.
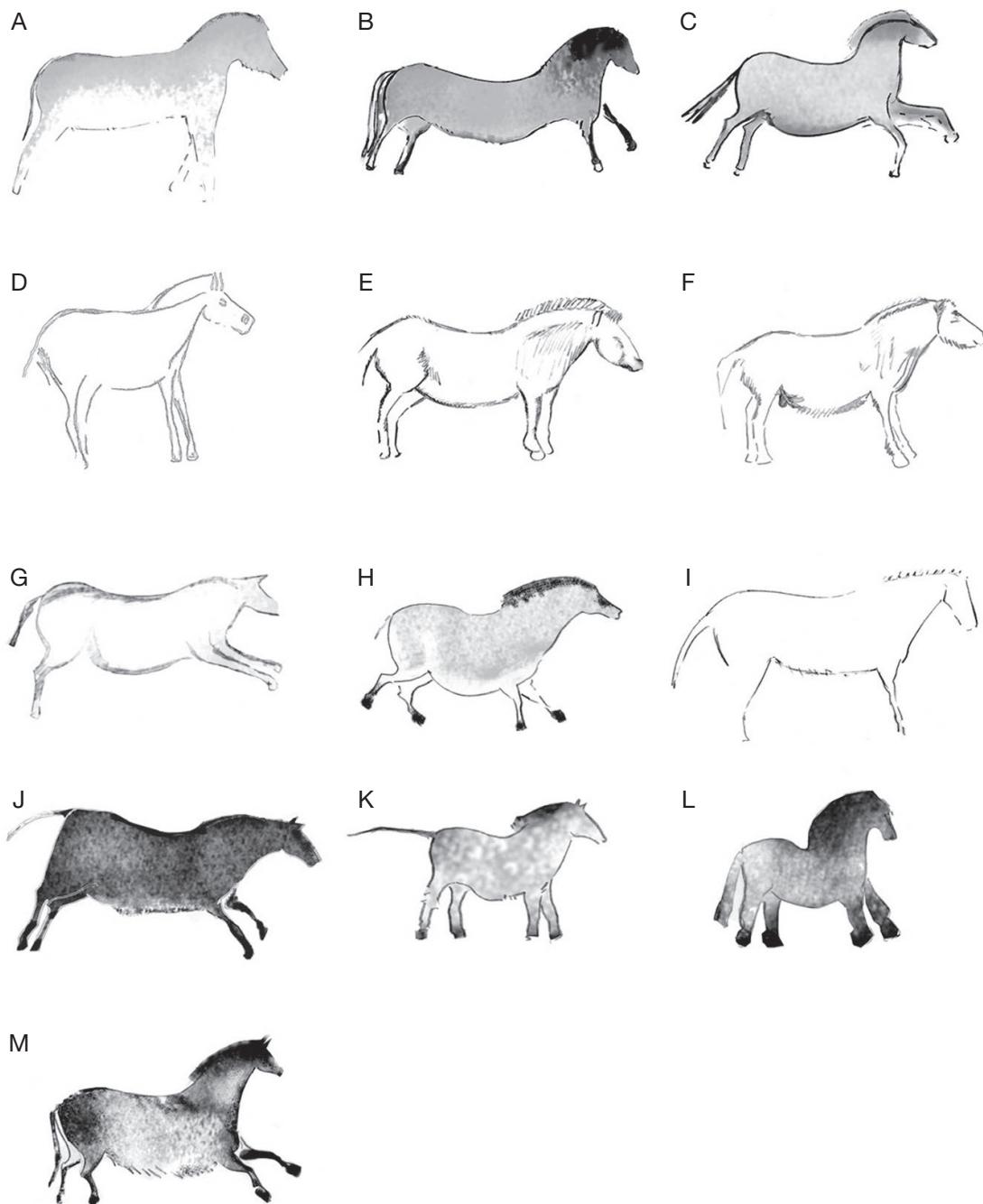
FIG. 5. — Representation of the Magdelian horse figures studied: **A-D**, "Altamira"; **E, F**, "Niaux"; **G**, "Font de Gaume"; **H-M**, "Lascaux". Designed by Francisco Salado (IAPH), using dashed lines in some recreated parts of the figures.

Using indexes, the best classificatory characteristics were the coefficients between length of face and length of ear (LF/LE), length of face and width of body (LF/WB), and length of mane and length of tail (LM/LT) in two functions (Table 2), which classified these species correctly in 95% of the cases. In the first, LM/LT is the best discriminating index and sets two phenotypic groups; the first is composed of individuals with short manes (hemiones and Przewalski horses) and the second consists of current tarpans with long manes. LF/LE is the most influential index in the second function and is, as is LF/WB, a phylogenetic index that divides hemiones

and horses. Also in this case, the centroid functions are very different (Table 3) and we can obtain three mathematical expressions using Fisher's classification function coefficients:
– *E. hemionus* = 8.41*LF/LE + 158.03*LF/WB + 29.27*LM/LT − 84.10;
– *E. przewalski* = 15.48*LF/LE + 137.17*LF/WB + 64.20*LM/LT − 90.75;
– *E. ferus caballus* (konik) = 18.42*LF/LE + 118.97*LF/WB + 148.52*LM/LT − 105.56.

In order to solve the cited equations it is necessary to replace the values measured in one picture. The species most similar to
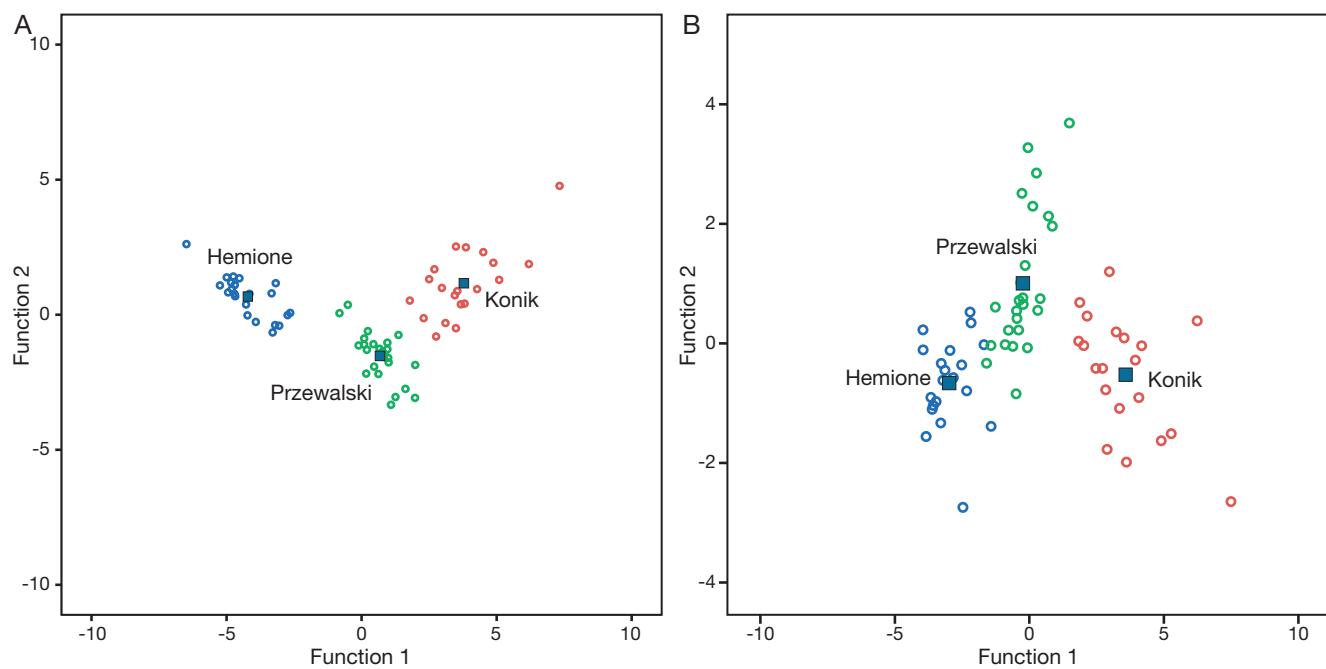
FIG. 6. — Discriminant body proportion analysis of three species of modern horses show three separate groups using: **A**, absolute variables and **B**, indexes.

the horse represented in this picture will be the species which corresponds to the equation with the major value. Using both kinds of data (variables and indexes), all the native Iberian breeds of horses studied were seen to be related to the Konik horse. It is assumed that ancient tarpan is the agriotype of current domesticated horses. Attending to the result we could think that this method could be useful to study horse pictures, at least we have related the native Iberian breeds with their ancestor.

CLASSIFICATION OF HORSES FROM CAVE PAINTINGS AND ENGRAVINGS

The classification of painted motifs found in caves using the above functions gave the following results. On the one hand, using the absolute variable (proportions referring to the forelimb) we determined that 81% of the equid paintings seemed to be *E. przewalski*, 5% *E. hemionus*, 5% *E. ferus caballus* (Konik) and 9% null (Figs 3A, K; 4M; 5L). On the other hand, using indexes (proportions referring to other body parts), 100% of the painting and engraving horses looked like current Konik tarpans. In conclusion, this study describes an animal with face and belly proportions similar to those of *E. ferus caballus* of the Konik breed and the mane of the present-day *E. przewaslki*. It is interesting to note that in the analysis in all the native Iberian breeds the mane is long and hangs by the neck (Fig. 7); maybe is this a feature related to domestication and breeding.

DISCUSSION

The animals depicted in Upper Palaeolithic cave paintings and engravings are realistic in terms of the zoological groups represented: horses, cattle, goats or mammoths. Doubts arise when we try to determine the species or some of the specific morphological characteristics (Pigeaud 2007). Nevertheless, considering the more easily recognisable morphological features of equid species, it is possible to distinguish at least two groups. The length of ears, tail and mane are features that clearly distinguish certain species of equids, as in the case of the specimens drawn in the Trois Frères, Bernifal, Cosquer, Bara-Bahau and Mont Maurin caves in France, or the Levanzo cave in Italy, where it is possible to recognize two species, one horse and one asine (Guthrie 2006: 72). According to Guthrie (2006: 61), these asses could be *E. hydruntinus* or Asian asses, for which skeletal remains are sometimes found in the fossil records of European archaeological/palaeontological sites (Eisenmann & Patou 1980; Crees & Turvey 2014).

However, it is not easy to determine different horse species (*E. ferus* and *E. przewalski*) in cave representations with a visual analysis. Madariaga (1963) mentions the first authors to classify the Upper Palaeolithic representations of horses into two types by analysing the habitat, the silhouette of the face and the phylogeny. Some prehistory researchers now consider Przewalski's horse as a benchmark in cave painting studies (Pigeaud 2007; Cheyne *et al.* 2009), due to the similarity of the coat, mane and tail (Guthrie 2006).

According to Pigeaud (1997), the analysis of horse proportions in Palaeolithic art is not useful to distinguish chronologies or geographical areas deduced by the stylistic studies in Palaeolithic art (Breuil 1952; Leroi-Gourhan 1965). We have tried a method for analysing cave paintings that does not seem to be influenced by the skill of the painter or the style variations cited by Pigeaud (2007). Some of these pictures are very simple, such as the "pregnant mare" from La Pileta cave in southern Spain, or very disproportionate, such as the "Chinese pony" from the Lascaux cave in France (Figs 3E;

TABLE 1. — Codex range of the different absolute variables and indexes. Abbreviations: **LB**, length of body; **LE**, length of ears; **LF**, length of face; **LM**, length of mane; **LT**, length of tail; **WB**, width of body.

	E. hemionus Pallas, 1775		*E. caballus przewalskii* Poliakov, 1881		*E. ferus caballus* Linnaeus, 1758 - konik	
	Main	Error	Main	Error	Main	Error
LM	0.067	0.023	0.174	0.036	0.451	0.121
LE	0.283	0.039	0.196	0.028	0.187	0.027
LT	0.742	0.145	1.298	0.147	1.382	0.129
LF	0.676	0.058	0.675	0.06	0.656	0.065
LB	1.682	0.114	1.728	0.155	1.782	0.173
WB	0.748	0.042	0.802	0.082	0.822	0.082
LM/LT	0.092	0.034	0.136	0.032	0.325	0.076
LF/LE	2.428	0.392	3.5	0.521	3.547	0.372
LF/WB	0.904	0.072	0.848	0.079	0.801	0.066
LF/LB	0.404	0.048	0.391	0.024	0.368	0.026
LB/WB	2.255	0.187	2.167	0.15	2.175	0.15

TABLE 2. — Standardised canonical discriminant coefficients. The major value in each function is linked to the major classificatory characteristic. Abbreviations: **LE**, length of ears; **LF**, length of face; **LM**, length of mane; **LT**, length of tail; **WB**, width of body.

	Functions	
	1	2
LE	−0.641	0.268
LM	0.662	0.813
LT	0.546	−0.688
LF/LE	0.655	0.788
LF/WB	−0.431	−0.206
LM/LT	0.918	−0.462

TABLE 3. — Functions at group centroids. The difference between the centroid values are related to the differences between the three species of equids taking these features.

	Breeds	Functions	
		1	2
Absolute variables	*E. hemionus* Pallas, 1775	−4.214	0.673
	E. caballus przewalskii Poliakov, 1881	0.680	−1.524
	E. ferus caballus Linnaeus, 1758 – konik	3.785	1.166
Indexes	*E. hemionus*	−2.980	−0.664
	E. *caballus przewalskii*	−0.240	1.004
	E. ferus caballus – konik	3.578	−0.524

5L). However, our results show that the shape of the horses from the cave paintings and engravings is similar to that of present-day horses, considering certain body proportions and features, thus confirming earlier research analysing horses in prehistoric paintings in the same way (Pigeaud 2007; Cheyne *et al.* 2009). However, those authors used the body proportions of Przewalski's horse as a reference for their studies, whereas in this paper we have taken three species into account: Przewalski's horse, the Konik horse and the hemione (used to check the reliability of the method). The results obtained allow us to make reliable use of the variables and functions obtained in the analysis of cave paintings, as more than 95% of the current specimens of Konik, hemiones and Przewalski's horses studied were classified correctly in their specific groups. The differences between these three species of equids have been checked genetically (Gaunitz *et al.* 2018). The Asiatic ass is a different species and the two horses studied are considered as two species because they have a different number of chromosomes in their genetic codes (66 chromosomes of Pzrewalski versus 64 domestic horse; Oakenfull *et al.* 2000; Levine 2006; Kavar & Dovč 2008) and behavioural differences (Sarkissian *et al.* 2015).

These results confirm that the length of the ears and tail and the proportion between the length of the face and the width of belly are variables and indexes that could be used to distinguish equid species, donkeys and horses. The length of the mane can be used to identify the feral state in horses.

Applying this classification method to prehistoric paintings and carvings, the statistical results show the existence of a unique type of horse with the body proportions of a current Konik (head-body index, tail-mane index and head-ear index), but with a short mane (Table 1). Palaeolithic painters probably depicted the only surviving horse species, which could have had the shape of a current "tarpan" with a short mane and longer ears. The size of this ancient horse could be estimated using the skeletal remains preserved at archaeological/palaeobiological sites. In fact, several studies have shown that this animal seems to be different to *E. przewalski*. Castaños (1986) undertook a morphobiometric study

of horses from Upper Palaeolithic archaeological sites on the Cantabrian coast and concluded that all the horse bones belonged to a single species related to Solutré horse called *E. caballus gallicus* Prat, 1968 or *E. ferus solutrensis* Nobis, 1971. At the Saone-et-Loire archaeological site in France, Gromova & Saint-Aubin (1955) described a horse species that was different to *E. przewalski* and resembled *E. gmelini* Antonius, 1912 (tarpan). Therefore, the archaeozoological studies agree with our results on the existence of a kind of horse (*E. caballus gallicus*) different to the current *E. przewalski* individuals and tarpans (Eisenmann 2010). In fact, during the review period of our paper, Gaunitz *et al.* (2018) have published a genetic analysis in which they concluded that the current *E. przewalski* descent to the first domesticated horses. The horses depicted in the Ekain, Tito Bustillo and Niaux caves may be the most detailed paintings from this period (Guthrie 2006); they resemble *E. przewalski* according to the coat colour and horsehair shape (Wakefield *et al.* 2002). The majority of the painted or carved horses show a coat with the typical "belly bicha" form (Madariaga 1963) or an "M-shaped bipartite dorso-ventral division" (Pigeaud 2007: 414), a non-distinguishing feature of horse species, given that we also find it in today's Asiatic wild ass. Perhaps this feature could have been common in wild equines, but not only horses. Similarly, we could interpret the dark colour of the limbs of the horses from the Altamira or Lascaux caves as that observed in the current Heck breed of tarpans or the Andalusian Retuertas horses (Fig. 4). Moreover, the dark stripes depicted in the equine paintings from the Tito Bustillo and Ekain caves can be found in the Konik breed
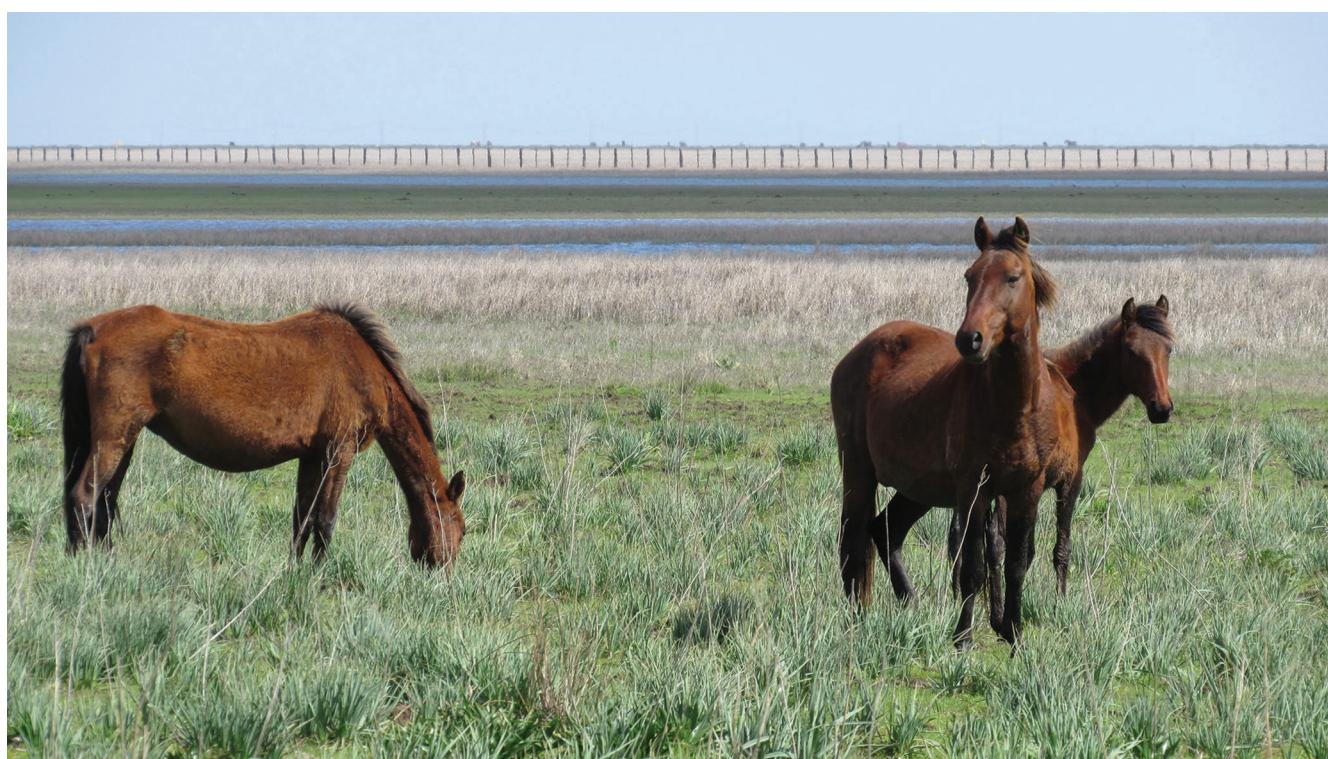
Fig. 7. — In current breeds of horses, the mane is long and hangs by the neck. In this picture, the "Retuertas" horse could be one of the most ancient breeds. Photo Esteban García-Viñas.

of tarpans (and in some European asses with an African origin). In fact, all these features were present in Olsen's reconstructed image of an extinct wild tarpan (Olsen 2006: 83) based on references from the 18th and 19th centuries. This animal is different to the current "tarpan", but very similar to horses from cave paintings in terms of the shape and colour of the coat and stripes.

Finally, the body proportions of the current specimens of Iberian native breeds measured are similar to those of the current Konik horse (tarpan). It is now accepted that the origin and exploitation of early domestic horses, the first *Equus caballus* or *Equus ferus caballus*, can be found in ancient extinct tarpans from the Northern Caucasus during the Eneolithic (Levine 1990, 1999; Olsen 2000; Greenfield 2006; Outram *et al.* 2009). However, in this case it seems that the long mane present in all the Iberian horse breeds studied could be the feature they have in common with the current tarpans studied, which are not the agriotype as they are not entirely wild.

CONCLUSION

The 2D image analysis and zootechnical position of present-day tarpans, Przewalski's horses and hemiones has provided a method to study horses represented in European Upper Palaeolithic caves. These paintings and carvings represent equids with a similar shape to present-day Konik horses in terms of the length of the face in front to the width of the

abdomen, as well as the length of the ears and the relationship between mane and tail length, and a form of mane (erect) similar to that of the current Przewalski's horse.

Morphobiometric analyses of horse bones preserved in some contemporary archaeological sites show an animal that could not be related to current tarpans (Koniks) or Przewalski's horses. This conclusion is corroborated by the genetic analysis of current horses, whose ancestor is none of current individuals of these species, which are not completely wild.

The erect mane, the presence of stripes and the "M-shaped" coat or "bicha belly" are wild features of the *Fam. Equidae* that we see in horses, asses and zebras. Therefore, these features cannot be considered as only belonging to Przewalski's horses and could perhaps have been present in extinct wild tarpans (*E. ferus ferus* Gmelin, 1769).

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