APPENDIX DR1

STUDY AREA, MATERIAL, AND METHODS

Study Area

According to Soriguer et al. (2003), the Iberian Peninsula is located at the latitude with the poorest small-mammal diversity in Europe. Only the area of Iberia north of latitude 40º is similar in diversity to other European latitudes. In choosing the localities, we selected sites that have been studied by us (and their materials recovered, classified and identified) and show good ^{14}C dating. All the sites analyzed are located to the north of latitude 40º at mid-altitude (from around 300 to 1000 m). A brief description of the published data for these sites is as follows:

Maltravieso-Chimeneas (MTV-CH-A)

Maltravieso is a cave located at 450 m a,s.l, It comprises a karst system formed during the early Carboniferous. The Chimeneas room is a part of this cave formed by natural processes. The archaeological remains recovered from this room were basically lithic tools and faunal remains, although perforated shells from the Upper Paleolithic have also been recovered. The use of the cave has been interpreted as an alternation of carnivore and hominid intervention. Archaeobotanical studies based on charcoal analysis show the preponderance of Mediterranean species, with a climate similar to today's in the area but slightly cooler (Rodríguez, 2008; Canals et al., 2010; Bañuls et al., 2012).

El Portalón (P1)

El Portalón site is located at about 1080 m a.s.l. It forms part of the Sierra de Atapuerca karst system formed during the Mesozoic. Layer P1 was formed by natural processes of clast embedding. There is as yet no evidence of human activity in this layer. Archaeobotanical studies based on pollen analysis show the existence of woodlands that were cold and humid in character and not very dense (López-García et al., 2010b).

El Mirón (111-110, 16, 12, 106-102.1, 11.1, 10.1, 10, 8.1, 7/5/3.3-4)

El Mirón is a large cave located about 300 m a.s.l. The late Pleistocene layers of this cave were formed by natural processes, whereas the Holocene layers were formed principally by anthropic sedimentation-animal dung accumulation. The layers analyzed here range from the Solutrean to the Bronze Age. The faunal remains of the late Pleistocene layers are composed of wild species primarily hunted by humans. The Holocene fauna is composed of domestic pen-raised species (Cuenca-Bescós et al., 2009; 2012; Cuenca-Bescós and García Pimienta, 2012).

Valdavara-1 (VLU, VUU)

Valdavara cave is located about 600 m a.s.l. Both layers identified were formed by natural processes. VUU contains pottery remains and human remains, pointing to a funerary use of the cave during the Chalcolithic period. VLU contains only lithic and faunal remains attributed to the sporadic occupation of the cave during the Magdalenian period (Vaquero et al., 2009; López-García et al., 2011).

El Mirador (MIR24, MIR17-18, MIR5)

El Mirador is a cave located about 1033 m a.s.l. It forms part of the Sierra de Atapuerca karst system formed during the Mesozoic. Layers MIR24 and MIR17-18 are formatted by anthropic sedimentation-animal dung accumulation. Principally pottery, domestic fauna and buried charcoal have been recovered from these layers, which are Neolithic in age. By contrast, layer MIR5 was formed by natural sedimentation, is archaeologically sterile and marks the transition between the Neolithic layers and the Bronze Age layers (Vergés et al., 2002; López-García et al., 2008)

Colomera (CE12/13-14, EE1/Asup)

Colomera cave is located about 670 m a.s.l. Layers CE12/13-14 are formatted by anthropic sedimentation-animal dung accumulation. Principally pottery, domestic fauna and buried charcoal have been recovered from these layers, which are Neolithic in age. By contrast, layer EE1/Asup, which is a Bronze Age, anthropic formation, is a pit used for waste deposal, where fragmented pottery, fragmented domestic fauna and buried charcoal appear (Oms et al., 2008; López-García et al., 2010a).

Small-Mammal Assemblage

The small-mammal bones were recovered using the techniques of micropaleontology (water-screening and picking). The material analyzed for this paper includes a total of 3194 individuals representing at least 23 taxa. The fragments were identified following the criteria of systematic paleontology (e.g. Reumer, 1984; Van der Meulen, 1973; Pasquier, 1974; Damms, 1981). The specific attribution of this material is based principally on the best diagnostic elements: mandible, maxilla and isolated teeth for insectivores; first lower molars for Arvicolinae; and isolated teeth for Murinae, Glirinae and Sciuridae. The fossils were grouped using the minimum-number-of-individuals (MNI) method. This was determined by counting the best diagnostic element.

Normally, the small-mammal accumulation in caves is the consequence of "rejection pellets" produced by a predator or predators. There are different types of predators according to Andrews (1990). On the basis of the published data (Cuenca-Bescós et al., 2009; 2010; Bañuls and López-García, 2010; Bañuls et al., 2012; López-García et al., 2008; 2010a; 2010b; 2011), the high percentage of anatomical representation of the fragments identified (Table 1), the low level of fragmentation of these (less than 30% in all cases) and the slight signs of digestion found both in the microtine teeth and the long bone fragments, have led us to deduce that the small-mammal association encountered in the sequences from the studied sites was produced by opportunistic predators (see Andrews, 1990). Consequently, the associations are representative of the ecosystem in the immediate vicinity of the caves.

Determining Richness and Diversity

The evenness index is constrained between 0 and 1. The lower the variation in species between communities, the higher is the value of the evenness index. The index will be close to 0 if there is a single dominant species. Our study involves samples with

different numbers of individuals that affect the indices. To avoid the statistical problems of high sample-size dependence, we have standardized the absolute values by dividing by total sample abundances, expressed as percentages of MNI. This standardization allows the comparison of the taxa evenness in samples of different size
.

Rarefaction analysis allows us to read out the number of expected taxa for any smaller sample size. In our case we use layer 12 of El Mirón cave, which contains 44 individuals (Table 1), as the reference small sample.

The indices of evenness and richness were obtained using the Paleontological Statistics Program (PAST) (Hammer et al., 2001). This program allows a bootstrap to be obtained with a 95 % confidence interval. This bootstrap is obtained with the production of 1000 random samples, each with the same total number of individuals as in each original sample. The random samples are taken from the total pooled data set. For each individual in the random sample, the taxon is chosen with probabilities according to the original pooled abundance (Hammer and Harper, 2006).

Determining Climatic Parameters

The method used consists of ascertaining the current distribution area of the faunal association under study. This is done by superimposing the maps from atlases of current distribution, divided into 10x10 km squares (Palomo and Gisbert, 2005). The resulting intersection will indicate an area with climate conditions similar to those of the association under study. On the basis of this intersection, we calculated the mean annual temperature (MAT) and the mean annual precipitation (MAP). These climatic conditions were obtained using maps of present-day temperature and precipitation figures (Font-Tullot, 2000). Finally, the results were compared with data from several weather stations near the localities studied over the last 30 years (Font-Tullot, 2000).

To measure the connection between the diversity and the climatic parameters we used Kendall's tau (τ) coefficient for non-parametric variables with the PAST program (Hammer et al., 2001). Using this program we were also able to obtain the probability (p) that the two variables are not correlated (uncorr).

Determining Landscape Parameters

Habitats were divided into four types (according to Cuenca-Bescós et al., 2005; Blain et al., 2008): open land, woodland and woodland margin areas, rocky areas and areas surrounding water. These types are detailed as follows (Table 2): open: meadows with seasonal change and evergreen meadows with dense pastures and suitable topsoil; woodland: mature forest including woodland margins and forest patches, with moderate ground cover; water: areas along streams, lakes and ponds; and rocky: areas with a suitable rocky or stony substratum.

Table DR1. Percentage of the skeletal representation (according to Andrews, 1990), taking into account the elements for each layer.

	NISP	MNI	MNIx100/NISP
MTV-CH-A	67	52	77.61
P1	127	77	60.63
111-110	450	229	50.89
16	95	45	47.37
VLU	154	95	61.69
12	85	44	51.76
106-102.1	430	216	50.23
11.1	260	140	53.85
10.1	420	212	50.48
MIR24	159	85	53.46
MIR17-18	547	270	49.36
CE12/13-14	372	152	40.86
10	1100	625	56.82
8.1	180	93	51.67
VUU	154	95	61.69
MIR5	166	102	61.45
7/5/3.3-4	455	230	50.55
EE1/Asup	219	93	42.47

NISP: number of identified specimens; MNI: minimum number of individuals; MNIx100/NISP: index of skeletal representation. Levels have been ordered from the elder to the younger.

Table DR2. Percentage representation of habitat weighting parameters from the studied sites. Levels have been ordered from the elder to the younger.

	Open	Woodland	Rocky	Water	**Total**
MTV-CH-A	39	40	12	9	**100**
P1	80	2	18	0	**100**
111-110	50	10	10	30	**100**
16	50	10	10	30	**100**
VLU	31	39	21	11	**100**
12	45	10	10	35	**100**
106-102.1	45	10	10	35	**100**
11.1	45	10	10	35	**100**
10.1	35	50	5	10	**100**
MIR24	55	40	5	0	**100**
MIR17-18	75	35	0	0	**110**
CE12/13-14	15	66.3	18.7	0	**100**
10	30	60	5	5	**100**
8	30	60	5	5	**100**
VUU	26	68	3	3	**100**
MIR5	91	9	0	0	**100**
7/5/3.3-4	30	55	5	10	**100**
EE1/Asup	17.7	73	6.2	0	**100**

APPENDIX DR2

Table DR3: Standardized data in percentage (%) of minimum number of individuals (MNI) identified in the different layers studied of the analyzed sites. The levels have been ordered from the elder to the younger.

Layers/Taxa	*Neomys*	*S. minutus*	*Sorex*	*Crocidura*	*Talpa*	*Erinaceus*	*M. (Iberomys)*	*A. sapidus*	*A. terrestris*	*C. nivalis*
MTV-CH-A	0	0	0	2.8	0	2.8	17	6.9	2.8	0
P1	2.6	0	0	0	0	0	2.6	0	0	14
111-110	0.9	0	3.5	0	27	0	0	0	35	7.5
16	0	0	0	0	33	0	0	0	35	6.1
VLU	0	2.1	2.1	0	4.2	1.1	2.1	12	6.3	21
12	0	0	0	0	14	0	0	0	41	11
106-102.1	0.5	0	1.9	0	13.9	0	0	0	47.2	6
11.1	1.4	0	5	0	20	0	0	0	29	7.9
10.1	2.4	0.5	3.3	0.5	3.8	0	0	0	7.5	2.8
MIR24	0	0	3.5	3.5	0	0	0	0	0	3.5
MIR17-18	0	0	7.8	11.9	0.4	0	0	0.4	0	0
CE12/13-14	0	0	0	3.3	0	0	2	0	0	23
10	2.2	0.2	5	0.3	3	0	0	0.2	2.9	2.9
8.1	4.3	0	0	5.4	7.5	0	0	0	3.2	1.1
VUU	0	0	3.4	3.4	6.9	1.7	3.4	3.4	0	1.7
MIR5	0	2.9	0	3.9	0	0	0	0	0	0
7/5/3.3-4	1.3	0	3.5	1.3	6.1	0.4	0	0	14.3	7
EE1/Asup	2	0	0	1.1	0	0	2.2	0	0	6.5

Layers/Taxa	*M. glareolus*	*M. (Terricola)*	*M. oeconomus*	*M. agrestis*	*M. arvalis*	*M.arvalis-agrestis*	*P. lenki*	*Apodemus*	*M. minutus*	*Eliomys*
MTV-CH-A	0	11	0	5.6	8.3	0	0	36	0	6.9
P1	0	0	3.9	25	29	22	0	0	0	1.3
111-110	0	5.8	7.5	2.7	7.1	0	1.3	1.8	0	0
16	0	6.1	2	2	16	0	0	0	0	0
VLU	0	18	0	5.3	9.5	0	0	11	0	2.1
12	0	4.5	6.8	9.1	4.5	0	0	6.8	0	2.3
106-102.1	0	3.2	1.4	7.4	7.4	0	0.9	9.7	0	0
11.1	0.7	7.1	0	7.1	3.6	0	0	16	0	0.7
10.1	1.9	9.4	0.9	7.1	0	0	0	47	0	0.5
MIR24	0	23.9	0	21	13	1.2	0	31	0	0
MIR17-18	0	17.8	0	18.1	20.7	4.4	0	17.4	0	1.1
CE12/13-14	0	5.9	0	5.3	9.2	0	0	44.7	0	6.6
10	3	5.3	0	3.4	0.3	0	0	54	0	1.9
8.1	11	1.1	0	1.1	2.2	0	0	33	0	1.1
VUU	1.7	29	0	1.7	1.7	0	0	28	1.7	1.7
MIR5	0	15.2	0	15	26	33	0	2.9	0	0
7/5/3.3-4	11.3	2.6	1.7	3.5	5.2	0	0	25.2	0	0.4
EE1/Asup	0	7.5	0	5.4	3.2	0	0	58.1	0	14

Layers/Taxa	*Glis*	*Sciurus*	**Total**
MTV-CH-A	0	0	100
P1	0	0	100
111-110	0	0	100
16	0	0	100
VLU	4.2	0	100
12	0	0	100
106-102.1	0.5	0	100
11.1	1.4	0	100
10.1	12	0.5	100
MIR24	0	0	100
MIR17-18	0	0	100
CE12/13-14	0	0	100
10	16	0	100
8.1	29	0	100
VUU	10	0	100
MIR5	0	0	100
7/5/3.3-4	16.1	0	100
EE1/Asup	0	0	100

APPENDIX DR3

Table DR4. Data set of the layers studied.

Site	Lab. Ref.	Level	14C-Age ± STD [BP]	CalAge p (95%) (cal BP)
El Mirador	*estimation*	MIR5	4070 ± 40	4830-4390
El Mirador	*estimation*	MIR17	5895 ± 55	6850-6610
El Mirador	Beta-208132	MIR18	6090 ± 40	7090-6850
El Mirador	Beta-197386	MIR24	7030 ± 40	7980-7780
El Miron	GX-25851	3-3.4	3700 ± 40	4170-3930
El Miron	GX-22460	7	3740 ± 120	4460-3780
El Miron	GX-22127	5	3820 ± 240	4890-3570
El Miron	GX-22131	8.1	4680 ± 60	5620-5260
El Miron	GX-23414	10	5570 ± 50	6460-6260
El Miron	GX-23413	10	5690 ± 50	6610-6370
El Miron	GX-24463	10.1	8380 ± 175	9700-8940
El Miron	GX-25852	10.1	8700 ± 40	9800-9520
El Miron	GX-24464	10.1	9550 ± 50	11190-10630
El Miron	GX-23391	11.1	11720 ± 140	13900-13300
El Miron	GX-23417	102.1	11950 ± 70	14020-13660
El Miron	GX-32382	106	12460 ± 180	15500-13940
El Miron	GX-22132	12	12970 ± 70	15710-15390
El Miron	GX-23415	16	15180 ± 100	18750-17830
El Miron	GX-24468	111	15530 ± 230	19200-17840
El Miron	GX-23396	110	16130 ± 250	20020-18660
El Miron	GX-23395	111	16370 ± 190	20190-19070
El Portalón	Beta-209452	P1	16890 ± 80	20500-20140
La Colomera	Beta-240550	Asup	3280 ± 40	3610-3410
La Colomera	Beta-241704	EE1	3630 ± 40	4080-3840
La Colomera	OxA-17732	EE1	3659 ± 30	4120-3880
La Colomera	Beta-248523	CE12	6020 ± 50	7010-6730
La Colomera	Beta-240551	CE13-14	6150 ± 40	7200-6920
MTV-CH	Poz-30469	A	17840 ± 90	21550-21190
MTV-CH	Poz-30460	A	17930 ± 100	21630-21270
Valdavara-1	Beta-235727	VUU	4490 ± 90	5410-4850
Valdavara-1	Beta-235728	VLU	13770 ± 70	17080-16880
Valdavara-1	Beta-235726	VLU	14630 ± 70	17890-17730

Lab. Ref.: Laboratory Reference; STD: Standard Deviation; CalBP: Calibrated data Before Present.

APPENDIX DR4

Table DR5. Values obtained for richness and evenness.

			EVENNESS			RICHNESS	
			Simpson diversity index			Individual Rarefaction	
	Taxa	**MNI**	**1-D**	**Upper Limit 95%**	**Lower limit 95%**	**$E(S_n)$**	**SE**
MTV-CH-A	10	72	0,808	0,841	0,901	9,520	0,629
P1	8	77	0,784	0,839	0,902	7,136	0,765
111-110	11	226	0,783	0,840	0,901	8,848	1,047
16	7	49	0,736	0,844	0,902	6,795	0,425
VLU	14	95	0,878	0,839	0,903	12,098	1,074
12	9	44	0,778	0,838	0,903	9	0
102-106	12	216	0,732	0,841	0,902	8,575	1,104
11.1	12	140	0,829	0,838	0,902	9,426	1,047
10.1	15	212	0,741	0,839	0,901	9,862	1,298
MIR24	8	85	0,785	0,841	0,900	7,194	0,720
MIR17-18	10	270	0,840	0,839	0,902	7,605	0,789
CE12/13-14	8	152	0,727	0,840	0,902	7,331	0,695
10	15	625	0,676	0,842	0,901	9,234	1,305
8.1	12	93	0,783	0,843	0,899	9,356	1,148
VUU	15	58	0,814	0,840	0,903	13,088	1,124
MIR5	7	102	0,770	0,843	0,903	6,541	0,611
7/5/3.3-4	15	230	0,862	0,842	0,902	11,120	1,235
EE1-Asup	9	93	0,628	0,843	0,902	7,717	0,886

Simpson diversity index = $1-\Sigma(p_i^2)$ obtained using standardized values. $E(S_n)$ = Expected number of species in a sample of size n=44.

APPENDIX DR5

Table DR6. Relation of temperatures (above) and precipitation (below) obtained using the MCR (Mutual Climate Range) method with the evenness diversity for the small mammals from the different studied sites.

		MAT	sd	current MAT	Δ	evenness (1-D)	Kendall's τ	*p* (uncorr)
LATE PLEISTOCENE	MTV-CH-A	12,40	1,10	16,10	-3,70	0,808		
	P1	7,50	2,00	15,50	-8,00	0,784		
	111-110	8,06	1,21	12,40	-6,14	0,783		
	16	8,00	1,15	12,40	-6,20	0,736	0,593	0,039
	VLU	10,60	1,80	11,10	-0,50	0,878		
	12	8,06	1,21	12,40	-6,14	0,778		
	106-102.1	8,00	1,26	12,40	-6,20	0,732		
	11.1	8,86	0,90	12,40	-5,34	0,829		
HOLOCENE	10.1	10,21	1,75	12,40	-3,99	0,741		
	MIR 24	8,11	1,36	15,50	-7,39	0,785		
	MIR17-18	10,20	1,58	15,50	-5,30	0,840		
	CE12/13-14	9,00	2,80	13,40	-4,40	0,727		
	10	8,50	1,52	12,40	-3,90	0,676	0,092	0,711
	8.1	8,57	1,13	12,40	-3,83	0,783		
	VUU	11,40	1,20	11,10	0,30	0,814		
	MIR5	10,20	1,57	15,50	-5,30	0,770		
	7/5/3.3-4	8,57	1,13	12,40	-3,83	0,862		
	EE1/ Asup	9,00	2,80	13,40	-4,40	0,628		

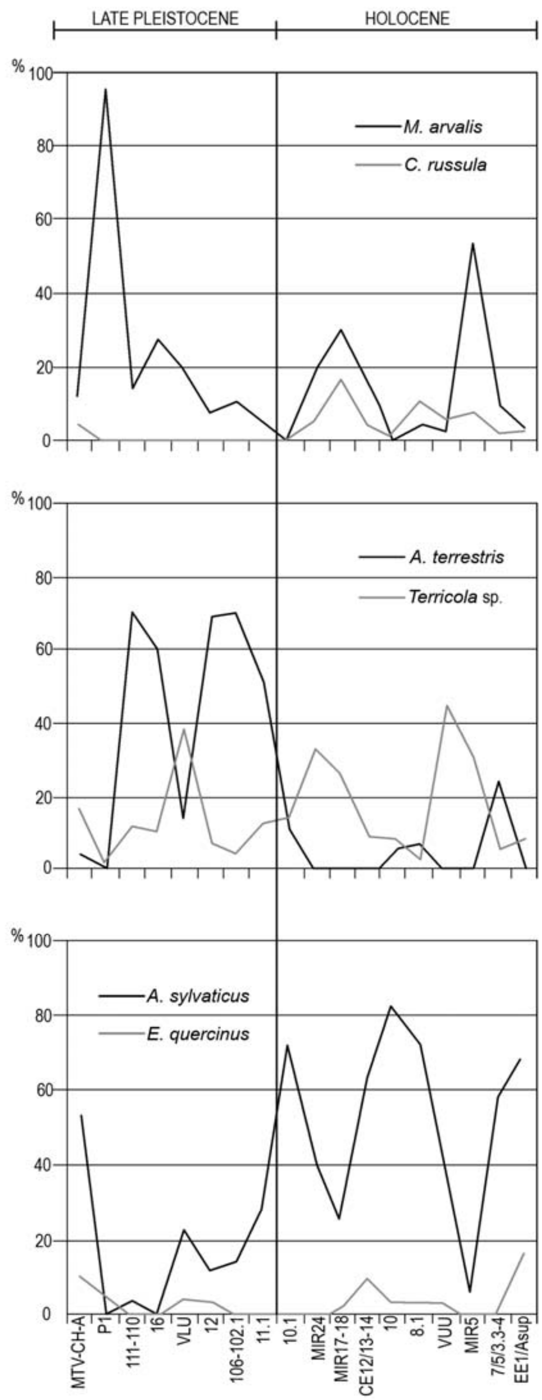
		MAP	sd	current MAP	Δ	evennes (1-D)	Kendall's τ	*p* (uncorr)
LATE PLEISTOCENE	MTV-CH-A	1193	461	481	712	0,808		
	P1	950	87	572	378	0,784		
	111-110	1658	435	1269	389	0,783		
	16	1658	435	1269	389	0,736	-0,188	0,512
	VLU	1123	235	1033	90	0,878		
	12	1658	435	1269	389	0,778		
	106-102.1	1985	267	1269	717	0,732		

	11.1	1988	247	1269	719	0,829		
HOLOCENE	10.1	2053	187	1269	784	0,741		
	MIR 24	1044	278	572	472	0,785		
	MIR17-18	809	184	572	237	0,840		
	CE12/13-14	1100	565	587	520	0,727		
	10	1986	267	1269	717	0,676	-0,138	0,578
	8.1	1988	247	1269	719	0,783		
	VUU	1690	575	1033	657	0,814		
	MIR5	1044	278	572	472	0,770		
	7/5/3.3-4	1986	267	1269	717	0,862		
	EE1/ Asup	1100	565	587	520	0,628		

MAT: mean annual temperature; sd: standard deviation; current MAT: the present-day mean annual temperature obtained from weather stations near the studied sites; Δ: the difference between the current means from weather stations over 30 years and those obtained for small mammals; evenness (1-D): values obtained for evenness with the Simpson diversity index; Kendall's (τ): Kendall's tau coefficient obtained for the late Pleistocene and Holocene layers comparing the evenness (1-D) with the Δ; *p* (uncorr): the probability that the two variables (evenness (1-D) and Δ) were not correlated; MAP: mean annual precipitation; current MAP: the present-day mean annual precipitation obtained from weather stations near the studied sites.

APPENDIX DR6

Figure DR1. Quantitative evolution, in percentage (%) of minimum number of individuals (MNI), of the most highly represented species in the 18 layers analyzed



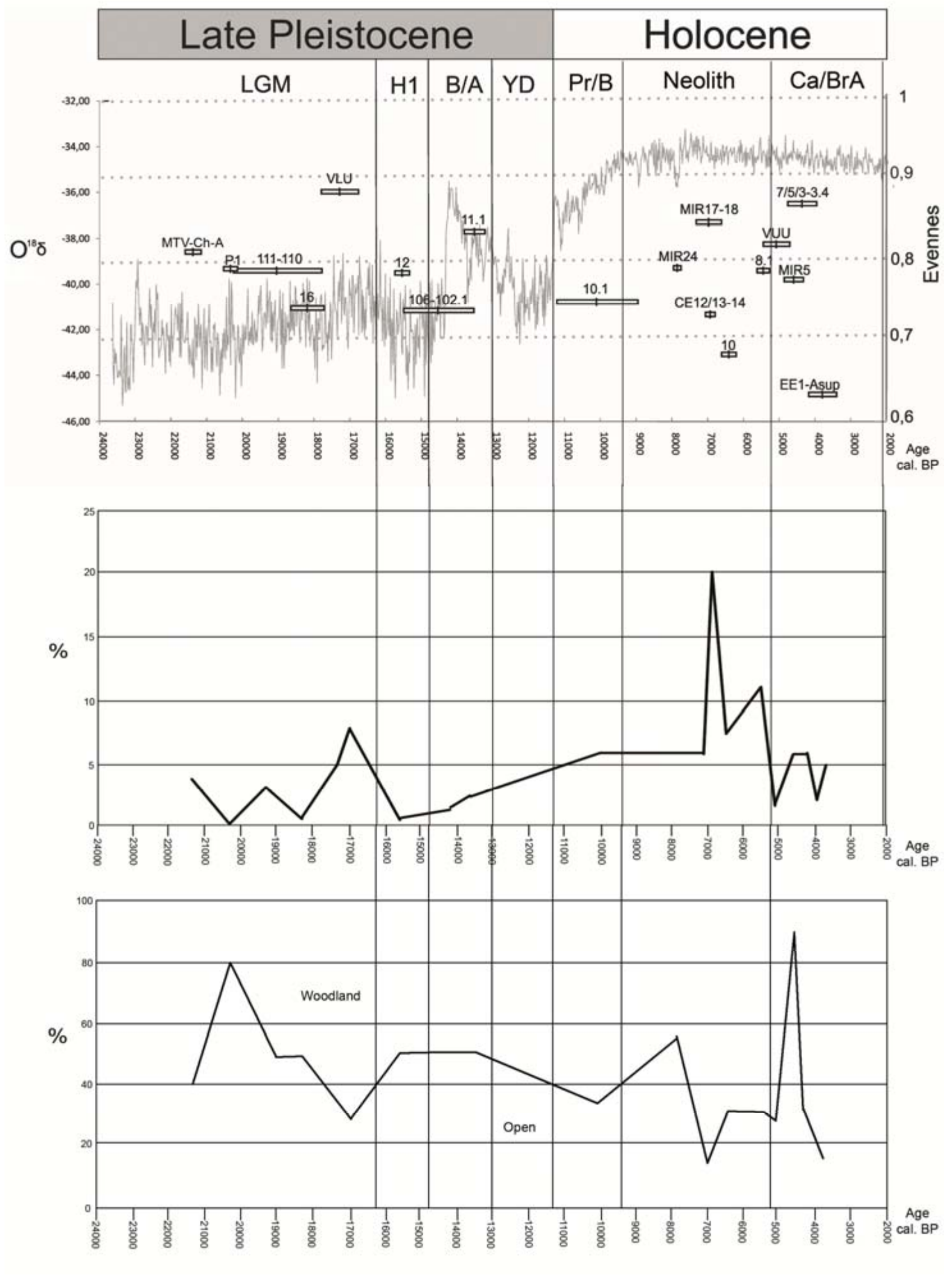
APPENDIX DR7

Table DR7. Standardized data in percentage (%) of minimum number of individuals (MNI) of the most representative taxa in the different layers studied of the analyzed sites.

Layers/Taxa	*M. arvalis*	*C. russula*	*Terricola sp.*	*A.terrestris*	*A.sylvaticus*	*E. quercinus*	**Total**
MTV-CH-A	12.24	4.08	16.33	4.08	53.06	10.20	**100**
P1	95.65	0.00	0.00	0.00	0.00	4.35	**100**
111-110	14.29	0.00	11.61	70.54	3.57	0.00	**100**
16	28.57	0.00	10.71	60.71	0.00	0.00	**100**
VLU	20.45	0.00	38.64	13.64	22.73	4.55	**100**
12	7.69	0.00	7.69	69.23	11.54	3.85	**100**
106-102.1	10.96	0.00	4.79	69.86	14.38	0.00	**100**
11.1	6.33	0.00	12.66	51.90	27.85	1.27	**100**
10.1	0.00	0.72	14.49	11.59	72.46	0.72	**100**
MIR24	18.33	5.00	33.33	0.00	43.33	0.00	**100**
MIR17-18	30.11	17.20	25.81	0.00	25.27	1.61	**100**
CE12-13-14	13.21	4.72	8.49	0.00	64.15	9.43	**100**
10	0.49	0.49	8.15	4.69	83.21	2.96	**100**
8.1	4.65	11.63	2.33	6.98	72.09	2.33	**100**
VUU	2.70	5.41	45.95	0.00	43.24	2.70	**100**
MIR5	54.00	8.00	32.00	0.00	6.00	0.00	**100**
7-5-3.3-4	9.09	2.27	4.55	25.00	58.33	0.76	**100**
EE1-Asup	3.80	2.53	8.86	0.00	68.35	16.46	**100**

APPENDIX DR8

Figure DR2. Comparison of the evenness (above) with the percentage representation of synanthropic (*Eliomys quercinus* and *Terricola* sp.) species (centre) and the percentage representation of the landscape (below) in the studied sites. LGM: Last Glacial Maximum; H1: Heinrich Event 1; B/A: Bølling/Allerød; YD: Younger Dryas; Pr/B: Preboreal/Boreal; Neolith: Neolithic period; Ca/BrA: Chalcolithic/Bronze Age; MTV-Ch-A: Maltravieso-Chimeneas; P1: El Portalón (Atapuerca); 111-110, 16, 12, 106-102.1, 11.1, 10.1, 10, 8.1 and 7/5/3.3-4: El Mirón; VLU and VUU: Valdavara Lower Unit and Valdavara Upper Unit; CE12/13-14 and EE1-Asup: C. Colomera; MIR24, MIR17 and MIR5: El Mirador (Atapuerca).



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