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Two new species of *Entomobrya* (Collembola, Entomobryomorpha) from the cave collembolan collection of Bonet from Asturias and Cantabria (north of Spain)

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Abstract

Two new species of *Entomobrya* are described from two caves of Asturias and Cantabria (north of Spain). The specimens were found in the Bonet collembolan collection at the "Museo Nacional de Ciencias Naturales" of Madrid (Spain). *Entomomobrya boneti* n. sp. was found in three slides containing 11, 4 and 1 specimens respectively, from the "Cueva del Castillo", Puente el Viesgo (Santander). *Entomobrya luquei* **n. sp.** was found in a slide with 11 specimens from "Cueva de Cuetu-Lledías", Llanes (Asturias). The species are described considering a set of 39 morphological and chaetotaxy characters. Both species appear to be troglophiles by the pigment reduction, although there are no other troglomorphic characters present. The gut content is composed of organic matter and fungus spores.

Key words: Collembola, Entomobryomorpha, Entomobryidae, *Entomobrya*, new species, cave fauna

Introduction

While we were searching for species of *Entomobrya* "sensu lato" in different museums around Palaearctic region, we found two new species in the Bonet collection at the "Museo Nacional de Ciencias Naurales" of Madrid (Spain). These had been identified as *Entomobrya marginata*, and *Entomobrya multifasciata* by Bonet: three slides contained a total of 17 specimens collected by Benítez in "Cueva del Castillo", Puente el Viesgo (Santander), while another slide was prepared with 11 specimens collected by C. Cardín in the "Cueva de Cuetu-Lledías", Llanes (Asturias).

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Cave description

The cave named "Cueva del Castillo", is located in Puente el Viesgo (Cantabria) and was discovered by Hermilio Alcalde del Río in 1903. It is possible to visit only a part of about 760 meters in total. It is a prehistoric cave with Paleolithic paintings. In september 16th of 2004 the cave and its surrounding was protected by resolution of the Cantabria Government.

Cuetu-Lledías cave was discovered in 1936 by D. Cesáreo Cardín, at that time assistant of the "Conde de la Vega del Sella", and is a false prehistoric cave since D. Cesáreo recreated in its interior false cave paintings. It is generally known as "Cueva de Cardín". It is an interesting natural cave of 42.25 meters long, with a main gallery rich in stalactites and stalagmites, some rooms and a final chamber. It has abundant pictorial decoration, with animal figures of small size (bison, red deer and goats), in diverse attitudes (running, jumping and lying). In the slide someone has identified the specimens as *Entomobrya multifasciata*.

Entomobrya boneti n. sp. (Figs 1–6)

Type-locality: SPAIN, Cantabria, Puente el Viesgo.

Type-specimens: Holotype (female) and 10 paratypes in the same slide of 1930, labelled as: "955dN Museo de Madrid Lab. de Entomol. *Entomobrya marginata* Tullberg. — Cueva del Castillo Puente Viesgo Santander VIII-930 F. Benitez". The holotype is the number 1 in the slide, as it is marked in figure 1. Five additional paratypes in two slides (four and one specimens respectively) labelled as the first slide.

Material deposited: MNCN (Museo Nacional de Ciencias Naturales -CSIC-, Madrid).

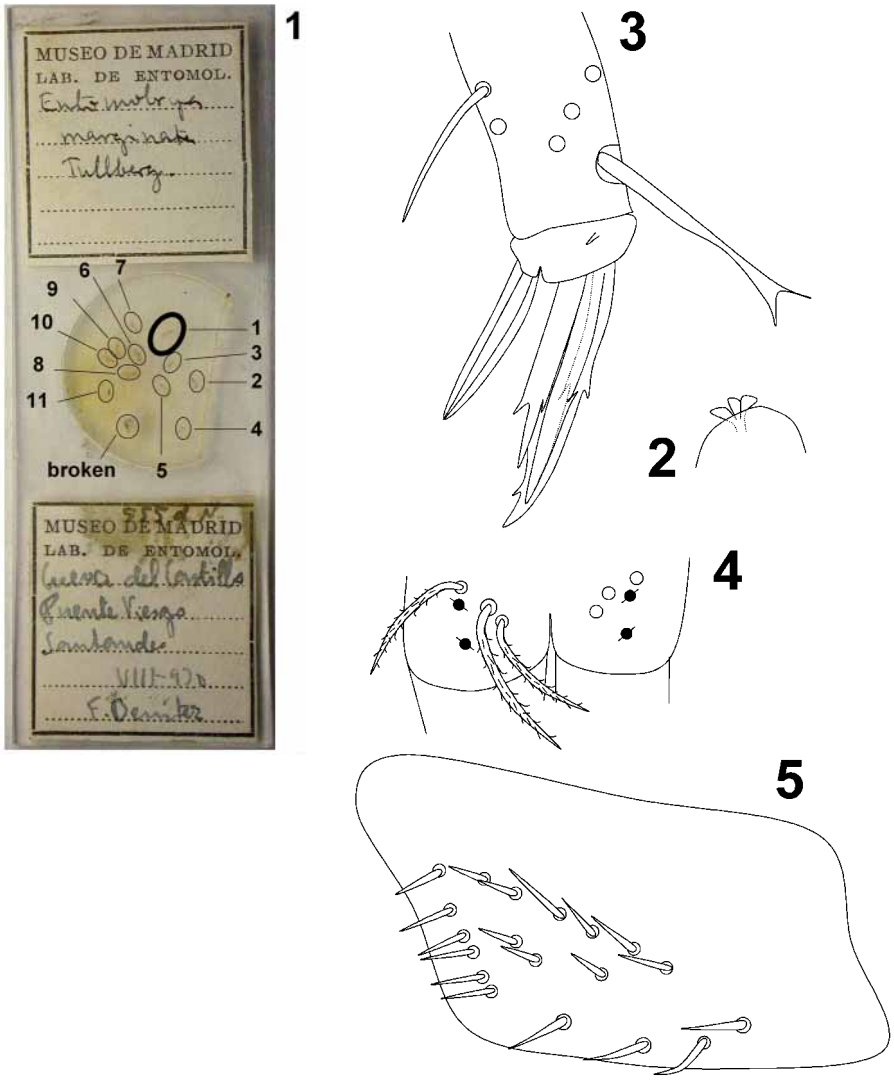
Description (Figures 1–6)

Body length up to 2.06 mm without antennae (n= 11). Ground colour pale yellow. Eye patches dark blue. Antennae without pigment (Fig. 6), but probably the colours faded over the years because Bonet described the antenna with an annuli in the distal part of antennal segment I. The colour pattern of the abdominal segments is formed by two lateral longitudinal bands from mesonotum to abdominal segment V (Fig. 6). The rest of the body is transparent and was probably white in life.

Antennae approximately half as long as the body, with a trilobed apical vesicle (Fig. 2). Dimensions of the different parts of the body of each specimen are given in Table 1. Body chaetotaxy and taxonomic features are given in the Table 3, following Jordana & Baquero (2005). Head bothriotrichum present. As in other *Entomobrya* species, the labral setae have the formula 5, 5, 4. Each labral papillae with small not setaceous projections. Trochanteral organ with 19 setae (Fig. 5), similar to *E. nivalis* in the description by STACH (1963).

TABLE 1. *Entomobrya boneti* n. sp. Measurements of the different parts of each specimen in micrometers. Abbreviations: Ant.: antennal segment; Th.: thoracic segment; Abd.: abdominal segment; Man.: manubrium.

Measurements	1 Holotype	2 Paratype	3 Paratype	4 Paratype	5 Paratype	6 Paratype	7 Paratype	8 Paratype	9 Paratype	10 Paratype	11 Paratype	Mean	Mean female	Mean male
	female	female	juvenile	male	female	male	male	female	?	male	juvenile			
Ant. I	130	100	120	100	150	130	110	120		150	100	121	125	123
Ant. II	220	250	230	210	280	300	210	230		310	210	245	245	258
Ant. III	220		220	210	270	280	190	250		260	170	207	185	235
Ant. IV	250	250	250	230	300	300	230	250		300	210	257	263	265
Antenna	820	600	820	750	1000	1010	740	850		1020	690	830	818	880
Head	380	380	390	400	430	400	310	420	430	400	340	428	403	378
Ant./Head ratio	2		2	2	2	3	2	2		3	2	2	2	2
Th. II	200	200	190	210	280	270	200	250	270	200	190	246	233	220
Th. III	140	160	120	150	200	190	120	110	190	150	140	167	153	153
Abd. I	120	100	100	10	190	100	110	100	130	100	120	118	128	80
Abd. II	130	160	100	140	250	160	160	190	150	150	160	175	183	153
Abd. III	110	140	100	140	200	130	100	150	160	140	140	151	150	128
Abd. IV	450	440	450	430	600	600	430	500	560	540	400	540	498	500
Abd. IV/III ratio	4	3	5	3	3	5	4	3	4	4	3	4	3	4
Abd. V	100	110	120	140	170	140	130	100	120	120	120	137	120	133
Abd. VI	80	100	60	100	130	110	90	80	100	70	80	100	98	93
Body	1710	1790	1630	1720	2450	2100	1650	1900	2110	1870	1690	2062	1963	1835
Man.	300	330	340	340	440	340	300	300	440	380	300	381	343	340
Dens	470	400	390	390	510	500	370	470	570	500	380	495	463	440
Furcula	770	730	730	730	950	840	670	770	1010	880	680	876	805	780



FIGURES 1–5. *Entomobrya boneti* **n. sp.** 1. Slide with the number of the types. 2. Apical vesicle of antennal segment IV. 3. End of tibiotarsi III. 4. Manubrial plate. 5. Trochanteral organ.

There are no differentiated setae on tibiotarsus, with exception of the presence of the smooth terminal setae on legs III characteristic for the genus. Pro, meso and metalegs show a small fold in the third distal part of the tibiotarsi. Unguis as in figure 3, with a pair of inner teeth to 55% from the unguis base. Lateral and dorsal teeth on the middle of the unguis, as described by Bonet (1931). Unguiculus spike-like, with smooth inner edge. Set of 39 characters in Table 3, with comparison with the closely related species.

Discussion

The set of characters used to separate the *Entomobrya* species (Jordana & Baquero, 2005), show that the species most similar to *E. boneti* n. sp. are *E. marginata* (Tullberg,

1871) Brook, 1883 and *E. albocincta* (Templeton, 1835) (differences in Table 3). The abdominal chaetotaxy is the same in the three species but there are some differences in the chaetotaxy of the head and mesonotum (this last character is very conserved among the *Entomobrya* species). The labral papilla have small teeth in the new species, whereas they are smooth in *E. marginata* and *E. albocincta*. As well as they show differences in the apical vesicle of antennal segment IV and in the location of the dorsal and lateral tooth of the unguis.

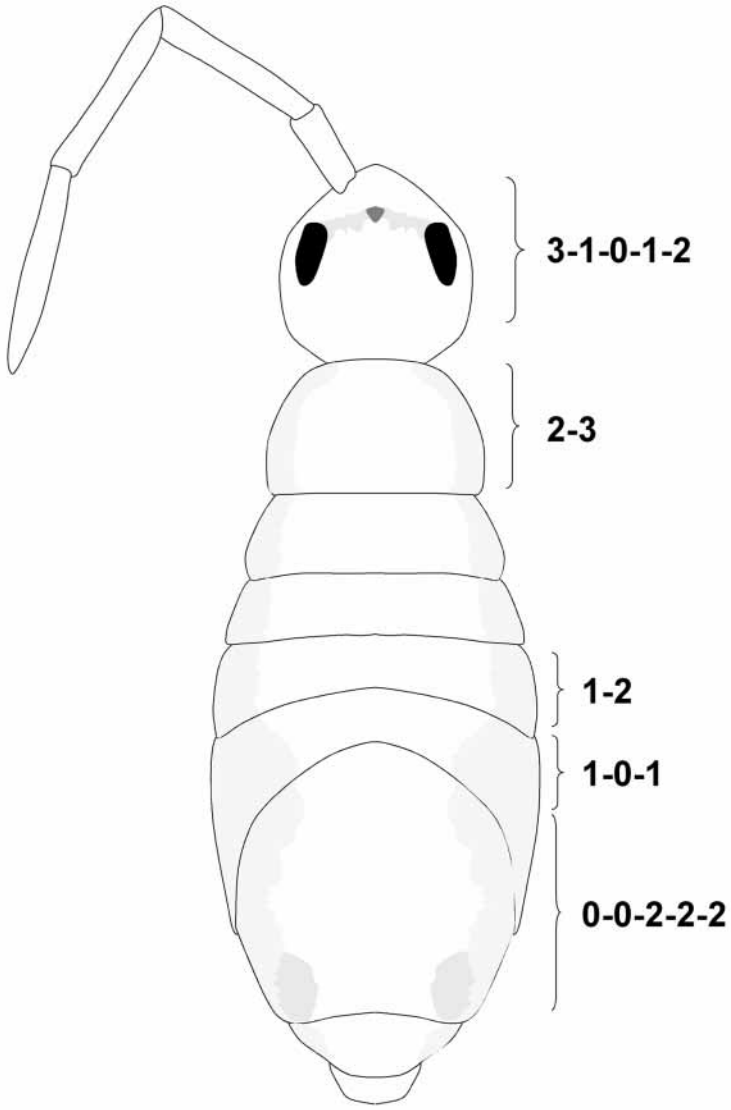


FIGURE 6. *Entomobrya boneti* n. sp. Habitus (the numbers means the chaetotaxy of the characteristics 1–5, 11–12, 18–22, 23, 25, 27, 29 and 30).

E. albocincta has a characteristic banding pattern, which has been used by many authors to identify the species; also *E. marginata* has a characteristic body pigmentation constituted by a narrow pigmented band at the end of each tergite, but this pattern is also

common to other species. On contrary *E. boneti* n. sp. which is almost colourless except for the eye patches and the slightly faded colour in the lateral part of thoracic and abdominal segments. The chaetotaxy of these three species is the same on the abdominal segments I–IV.

Derivatio nominis

The name is dedicated to F. Bonet, collembologist of the twenty century.

***Entomobrya luquei* n. sp.** (Figs 7–10)

Type-locality: SPAIN, Asturias, Llanes.

Type-specimens: Holotype (female) and 10 paratypes in the same slide dated 1929, labelled as: "226N Museo de Madrid. Lab. de Entomol. Lledia, C. de Llanes (Asturias), C. Cardin. Agua encharcada. 16-I- 929". The holotype is the specimen number 6 in the slide, which is marked in figure 8.

Material deposited: MNCN (Museo Nacional de Ciencias Naturales -CSIC-, Madrid).

Description (Figures 7–10)

Body length up to 1.71 mm without antennae (n= 11). Ground colour pale yellow. Eye patches dark blue. Antennae without pigment (Fig. 7), in these old slides. The pattern of the body pigmentation is formed by two lateral patches on the anterior part of the mesonotum, six patches on the posterior and lateral part of the abdominal segment IV and a posterior band on the abdominal tergite V. The rest of the body is transparent and was probably white in the living animal.

Antennae less than half as long as the body, with a bilobed apical vesicle. Measure and ratios of the different body parts for each specimen are given in Table 2. Body chaetotaxy and taxonomic features are given in Table 4, following Jordana & Baquero (2005). Head bothriotrichum present. As in other *Entomobrya* species, the labral setae have the formula 5, 5, 4. Each labral papillae with small not setaceous projections. Trochanteral organ with more than 15 setae.

There are no differentiated setae on tibiotarsus, with exception of the smooth terminal setae on legs III as typical for the genus. Unguis as in figure 10, a pair of inner teeth to 50% from the unguis base. Lateral teeth to 33% of the unguis and basal teeth in a basal position. Unguiculus spike-like, with smooth inner edge. Set of 39 characters in Table 4 with comparison with *E. nicoleti* (Lubbock, 1868) which is the closely related species.

Discussion. The set of characters used to separate the *Entomobrya* species (Jordana & Baquero, 2005), show that the species most similar to *E. luquei* n. sp. is *E. nicoleti*, (differences in Table 4). The abdominal chaetotaxy is the same in the two species but they differ in the chaetotaxy of the head. The labral papilla have small teeth in the new species

whereas they are smooth in *E. nicoleti*. There are also differences in the apical vesicle of antennal segment IV, simple in *E. nicoleti* and bilobed in the new species. *E. luquei* n. sp. presents a very small distal tooth on the unguis, even though it was observed in only one specimen. This tooth is very clear in *E. nicoleti*. A striking and important character is the number of setae on the manubrial plate, 5–6 in *E. luquei* n. sp. (Fig. 9) and 3 in *E. nicoleti*.

Bonet (1931) at page 277 cited C. Cardin as a collector of the different caves from Asturias, but did not cite this particular cave from Llanes. The information of the slide (Fig. 8) can be interpreted as Lledia, road of Llanes, water pool. Thus the species could be a surface species, not from a cave but stored with the Bonet cave collection slides. The commentary written above about the activities of C. Cardin and his discovery of the cave that now bear his name, lead us to think that this new species was collected in a cave.

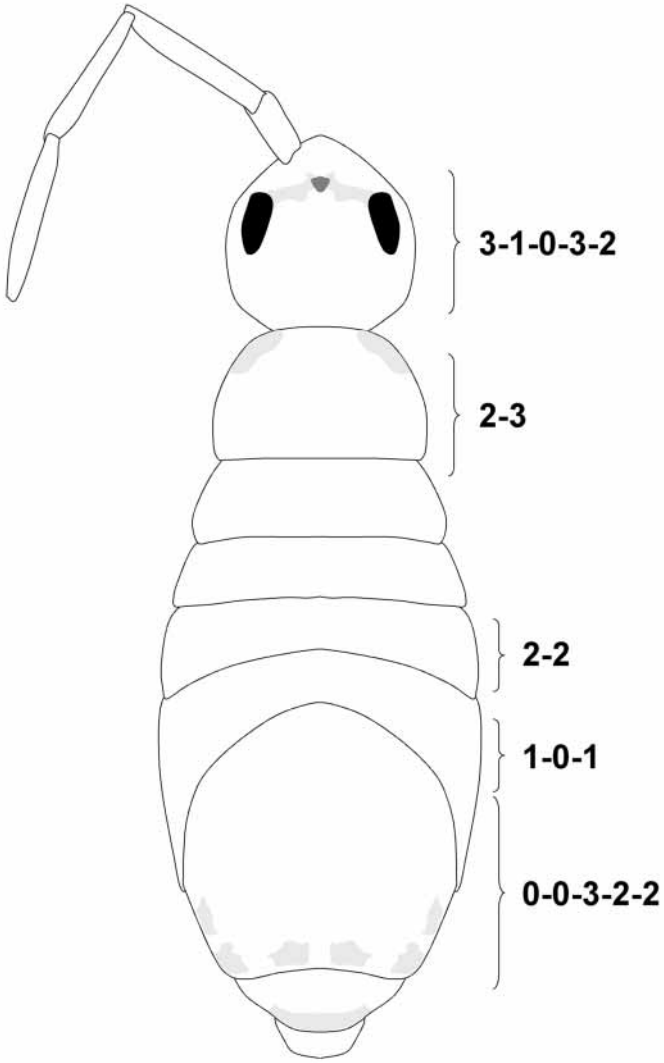


FIGURE 7. *Entomobrya luquei* n. sp. Habitus (the numbers means the chaetotaxy of the characteristics 1–5, 11–12, 18–22, 23, 25, 27, 29 and 30).

TABLE 2. *Entomobrya luquei* n. sp. Measurements of the different parts of each specimen in micrometers. Abbreviations: Ant.: antennal segment; Th.: thoracic segment; Abd.: abdominal segment; Man.: manubrium.

Measurements	1 Paratype	2 Paratype	3 Paratype	4 Paratype	5 Paratype	6 Holotype	7 Paratype	8 Paratype	9 Paratype	10 Paratype	11 Paratype	Mean
	female	female	female	?	juvenile	female	female	female	female	female	female	
Ant. I	70	100	120	120	100	145	110	100	120	100	120	121
Ant. II	170	205	210	240	150	250	190	180	260	230	280	237
Ant. III	160	200	210	200	210	240	155	175	235	250	250	229
Ant. IV	230	250	255	260	250	300	190	210	300	270	295	281
Antenna	630	755	795	820	710	935	645	665		850	945	775
Head	270	310	300	350	330	330	310	270	330	410	390	360
Ant./Head ratio	2	2	3	2	2	3	2	2		2	2	2
Th. II	145	185	180	190	190	180	170	150	170	190	210	196
Th. III	110	145	140	150	135	160	160	120	150	150	180	160
Abd. I	75	115	100	100	105	100	90	90	90	100	110	108
Abd. II	85	125	110	150	140	140	130	100	100	150	145	138
Abd. III	90	100	100	110	110	100	120	90	110	110	100	114
Abd. IV	330	390	390	420	410	450	420	360	420	440	500	453
Abd. IV/III ratio	4	4	4	4	4	5	4	4	4	4	5	4
Abd. V	60	100	100	100	110	125	100	90	100	130	120	114
Abd. VI	45	55	60	50	50	75	80	50	60	70	80	67,5
Body	1210	1525	1480	1620	1580	1660	1580	1320	1530	1750	1835	1709
Man.	230	250	250	250	250	310	250	240	250	270	290	284
Dens	320	250	380	360	380	370	350	310	300	430	450	390
Furcula	550	500	630	610	630	680	600	550	550	700	740	674

TABLE 3. Comparative set of characteristics between *E. boneti* **n. sp.**, *E. marginata* and *E. albocincta*. For legend of characteristics see Jordana and Baquero (2005) (in bold the differences).

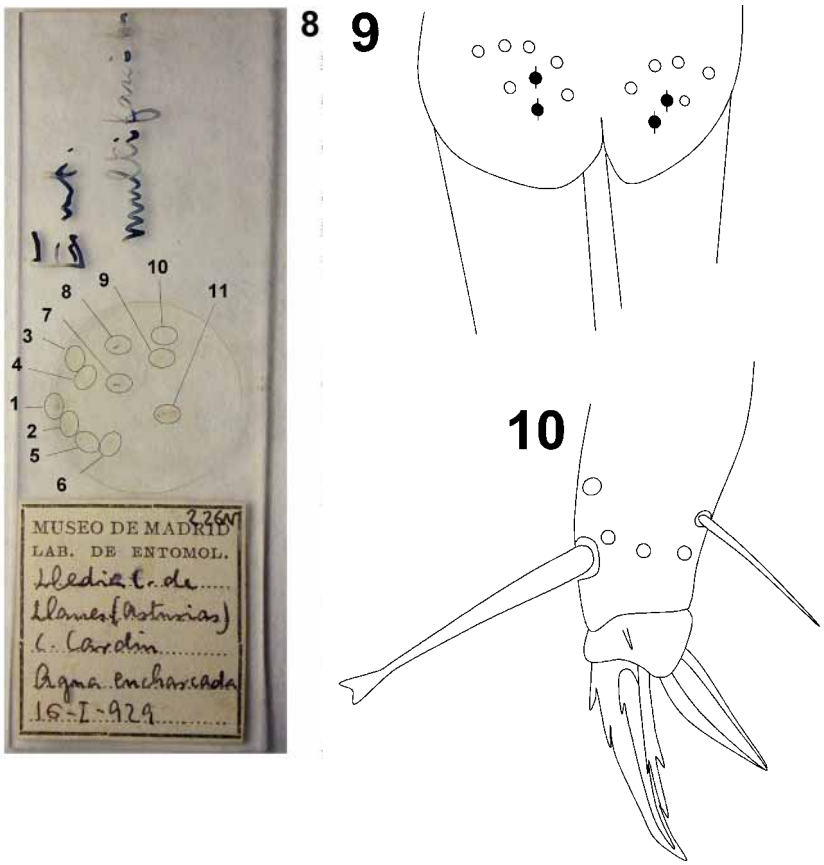
Species	Ch.1	**Ch.2**	Ch.3	Ch.4	**Ch.5**	**Ch.6**	Ch.7	**Ch.8**	Ch.9	Ch.10
Entomobrya marginata	3	**2**	0	2	**3**	**1**	2	**2**	2	1
Entomobrya albocincta	3	**1**	0	3	**2**	**1**	2	**1**	2	1
Entomobrya boneti n. sp.	3	**1**	0	1	**2**	**2**	2	**3**	2	1
Species	**Ch.11**	**Ch.12**	Ch.13	Ch.14	**Ch.15**	Ch.16	Ch.17	Ch.18	Ch.19	Ch.20
Entomobrya marginata	**2**	**4**	0	4	**1**	0	0	1	2	1
Entomobrya albocincta	**3**	**3**	0	4	**2**	0	0	1	2	1
Entomobrya boneti n. sp.	**2**	**3**	0	4	**2**	0	0	1	2	1
Species	Ch.21	Ch.22	Ch.23	Ch.24	Ch.25	Ch.26	Ch.27	Ch.28	Ch.29	Ch.30
Entomobrya marginata	0	1	0	0	0	0	2	0	2	2
Entomobrya albocincta	0	1	0	0	0	0	2	0	2	2
Entomobrya boneti n. sp.	0	1	0	0	0	0	2	0	2	2
Species	Ch.31	Ch.32	Ch.33	Ch.34	**Ch.35**	Ch.36	**Ch.37**	Ch.38	Ch.39	
Entomobrya marginata	0	1	1	0	**1**	?	**?**	1	1	
Entomobrya albocincta	0	1	1	0	**1**	3	**1**	1	1	
Entomobrya boneti n. sp.	0	1	1	0	**2**	3	**2**	1	1	

TABLE 4. Comparative set of characteristics between *E. luquei* **n. sp.** and *E. nicoleti*. For legend of characteristics see Jordana and Baquero (2005) (in bold the differences).

Species	**Ch.1**	Ch.2	Ch.3	Ch.4	**Ch.5**	Ch.6	Ch.7	**Ch.8**	Ch.9	Ch.10
E. nicoleti	**2**	1	0	3	**3**	2	2	**1**	2	1
Entomobrya luquei n. sp.	**3**	1	0	3	**2**	2	2	**2**	2	1
Species	Ch.11	Ch.12	Ch.13	Ch.14	Ch.15	Ch.16	Ch.17	Ch.18	Ch.19	Ch.20
E. nicoleti	2	3	0	4	?	0	0	2	2	1
Entomobrya luquei n. sp.	2	3	0	4	1	0	0	2	2	1
Species	Ch.21	Ch.22	Ch.23	Ch.24	Ch.25	Ch.26	Ch.27	Ch.28	Ch.29	Ch.30
E. nicoleti	0	1	0	0	0	0	3	0	2	2
Entomobrya luquei n. sp.	0	1	0	0	0	0	3	0	2	2
Species	Ch.31	Ch.32	Ch.33	Ch.34	**Ch.35**	**Ch.36**	Ch.37	Ch.38	Ch.39	
E. nicoleti	0	1	1	0	**1**	**3**	2	1	1	
Entomobrya luquei n. sp.	0	1	1	0	**2**	**5–6**	2	1	1	

Derivatio nominis

The name is dedicated to Carlos González Luque, cantabrian speleologist.



FIGURES 8–10. *Entomobrya luquei* n. sp. 8. Slide with the number of the types. 9. Manubrial plate. 10. End of tibiotarsi III.

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