Distinctive Collembola Communities in the Mesovoid Shallow Substratum: Entomobryomorpha of the Sierra de Guadarrama National Park (Central Spain)

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Habitus and color patterns of some species described in the article.
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ABSTRACT

The material for this study was obtained after intensive sampling in the colluvial mesovoid shallow substratum, or MSS, of the Sierra de Guadarrama National Park using 33 subterranean sampling devices (SSD). The data were obtained from the first extraction of the traps between May and October of 2015. This paper presents the results for the Entomobryomorpha Börner, 1913, which was part of the Collembola captured. Four families and 12 genera have been studied: Isotomidae Schäffer, 1896 (Folsomia Willem, 1902, Tetraancphella Schött, 1891, Uzelia Absolon, 1901, Folsomides Stach, 1922, Isotomurus Börner, 1903, Parisotoma Bagnall, 1940, Pseudisotoma Handschin, 1924 and Pachyotoma Bagnall, 1949), Orchesellidae Börner, 1906 (Orchesella Templeton, 1835 and Heteromurus Wankel, 1860), Entomobryidae Schäffer, 1896 (Entomobrya Rondani, 1861) and Lepidocystidae Wahlgren, 1906 (Lepidocyrtus Bourlet, 1839 and Pseudosinella Schäffer, 1897). The species of Orchesella were studied in a previous paper (Baquero et al. 2017). The richness of the habitat sampled is defined by twenty-one species, eight of which are new: Pachyotoma penalarensis Baquero & Jordana n. sp., Entomobrya guadarramensis Jordana & Baquero n. sp., Entomobrya ledesmai Jordana & Baquero n. sp., Lepidocyrtus labyrinthi Baquero & Jordana n. sp., Lepidocyrtus paraligurovus Baquero & Jordana n. sp., Lepidocyrtus purgatori Baquero & Jordana n. sp., Pseudosinella valverdei Baquero & Jordana n. sp. and Pseudosinella gonzaloi Baquero & Jordana n. sp. Entomobrya intermedia Brook, 1884 (England) is discussed and a new name Entomobrya katzi Jordana & Baquero n. sp. is proposed for E. intermedia sensu Katz et al. (2015) based on the American specimens.
INTRODUCTION

Entomobryomorpha Börner, 1913 are Collembola Lubbock, 1870 with an elongated body and conspicuous segmentation, three thoracic and six abdominal segments (some Isotomidae have four or five abdominal segments), prothorax not developed and without tergal chaetae. There are some habitual dwelling inhabitants of the ground and litter, but less specialized than Poduromorpha Börner, 1913. While more than 265 species have been found in the entire Iberian Peninsula since the publication of the catalogue by Jordana et al. (1990), five families with 21 genera and 59 species – seven of which were originally described in the Sierra de Guadarrama – have been found in the study area. This information is shown in 12 publications published between 1929 and 1995 (Cassagnau 1954; Steiner 1955; Selga 1961, 1962a, b, 1966a, 1966b, 1971; Simón 1971; Simón & Selga 1977 [Somosierra]; Acón 1980). All those researchers worked intensely in the area because of the proximity of the National Museum of Natural Sciences and major university centers in Madrid.

The milieu souterrain superficiel or mesovoid shallow substratum (MSS), consists of a network of interstices and fissures in the subsoil, and harbors diverse epigean species of a stenoic nature, and strictly hypogean species that permanently inhabit this environment (Gers 1992; Ortúzar et al. 2013). Previous studies focused on ecology (Juberthie et al. 1980; Ledesma et al. 2020), while others explored some faunal aspects (Růžička et al. 1995; Nitzu et al. 2010; Jiménez-Valverde et al. 2015). This paper is a continuation of two previously published papers that study the biodiversity of the MSS collembolan fauna of the Sierra de Guadarrama (Baquero et al. 2017; Jordana et al. 2020). All these studies document the importance of the MSS biocenosis, demonstrating the enormous potential of this subterranean habitat as a refuge for fauna, and constitute a good tool for the management of natural spaces.

MATERIAL AND METHODS

SITE

The sampling was conducted in the Sierra de Guadarrama National Park, which is in the eastern half of the Central System (i.e., the Iberian Peninsula) and consists of an area of 33,960 hectares, surrounded by a peripheral buffer zone of 62,687.26 hectares (MAPAMA 2017). The mountain range on which the Sierra de Guadarrama National Park is located, is formed by three mountainous axes (Siete Picos, La Mujer Muerta, Montes Carpetanos, and Cuerda Larga and associated mountainous complex) that converge at two mountain passes, those of Navacerrada and Los Cotos (Fig. 1A). The lithology is dominated by the presence of orthogneiss (Vialette et al. 1987; PNSG a), a metamorphic rock. In the Sierra de Guadarrama, the fragmentation and accumulation of these rocks originated from glacial (Pedraza & Carrasco 2005) and periglacial events (Sanz 1986). Almost the entire study area has numerous scree slopes that allow the development of the MSS. The climate is Mediterranean, with marked continentality. As a general rule, summers are cool and dry, and winters are cold. However, the diverse topography of the mountains favors a considerable variety of microclimates (PNSG b; Salazar Rincón & Vía García 2003; JCL & CAM 2010; Palomo Segovia 2012). The study area is divided into three bioclimatic zones: supra-Mediterranean, oro-Mediterranean and cryo-Mediterranean (Rivas-Martínez 1984; Rivas-Martínez et al. 1987). The most outstanding char-

RÉSUMÉ

Communautés distinctes de collemboles dans le milieu souterrain superficiel : Entomobryomorpha du parc national de la Sierra de Guadarrama (centre de l’Espagne).

Le matériau de cette étude a été obtenu après un échantillonnage intensif dans le milieu souterrain superficiel colluvial (ou substrat mésovoïde peu profond) du parc national de la Sierra de Guadarrama, à l’aide de 33 pièges d’échantillonnage souterrain (SSD). Les données ont été obtenues à partir de la première extraction des pièges entre mai et octobre 2015. Cet article présente les résultats pour les Entomobryomorpha Börner, 1913, qui font partie des collemboles capturés. 21 espèces ont été identifiées, dont huit nouvelles. Quatre familles et 12 genres ont été étudiés, i.e., Isotomidae Schäffer, 1896 (Folsomia Willem, 1902, Tetracanthella Schött, 1891, Uzelia Absolon, 1901, Folomoides Stach, 1922, Isotomurus Börner, 1903, Parisotoma Bagnall, 1940, Pseudotoma Handschin, 1924 et Pachyotoma Bagnall, 1949), Orchesellidae Börner, 1906 (Orchesella Templeton, 1835 et Heteromurus Wankel, 1860), Entomobryidae Schäffer, 1896 (Entomobrya Rondani, 1861) et Lepidocyrtidae Wahlgren, 1906 (Lepidocyrtus Bourel, 1839 et Pseudosinella Schäffer, 1897). Les espèces d’Orchesella ont été étudiées dans un article précédent (Baquero et al. 2017). La richesse de l’habitat échantillonné est définie par 21 espèces, dont huit sont nouvelles : Pachyotoma penalarensis Baquero & Jordana n. sp., Entomobrya guadarramensis Jordana & Baquero n. sp., Entomobrya ledesmai Jordana & Baquero n. sp., Lepidocyrtus lakynthithi Baquero & Jordana n. sp., Lepidocyrtus paraligurosum Baquero & Jordana n. sp., Lepidocyrtus purgatori Baquero & Jordana n. sp., Pseudosinella valverdei Baquero & Jordana n. sp. et Pseudosinella guadarranensis Jordana & Baquero n. sp. Entomobrya intermedia Brook, 1884 (Angleterre) est discuté et un nouveau nom Entomobrya katzi Jordana & Baquero n. sp. est proposé pour E. intermedia sensu Katz et al. (2015) sur la base des spécimens américains.

MOTS CLÉS

Milieu souterrain superficiel (MSS), trappes d’échantillonnage souterrain, écologie, espèces nouvelles.
Fig. 1. — A, basicography of the Sierra de Guadarrama National Park; B, location of the subterranean sampling devices (SSD) in the Sierra de Guadarrama National Park; C, collection sites of the species collected with the SSDs; D, relative abundance of Entomobryomorpha Börner, 1913 species (excluding Orchesella Templeton, 1835); E, relative abundance by SSDs; F, species richness by SSD. Abbreviations: ex, specimens; spp, species. Species authorships: see Index of species.
Abbreviations: SSD, subterranean sampling devices; TSP, traps in a slope, pitfall.

Thirty three sampling points were established (Fig. 1B). The Methodology areas that conserve snowfields for many months. and oro-Mediterranean scrub supra-forest zones, especially in form of snow, which is more intense in the cryo-Mediterranean (JCL & CAM 2010). Also of importance is precipitation in the plant and lichen species communities acquire special relevance in Ortuño rama and their most conspicuous vegetation are summarized characteristics of these bioclimatic zones in the Sierra de Guadarrama and associated mountainous complexes.

Table 1 — Location of the traps in the mountain areas of the Sierra de Guadarrama. Values: depth: meter; UTM coordinates: 100 × 100 m; altitude: m a.s.l.

| Mountain areas | Code | Depth | UTM Coordinates | Toponymy/Province | Date of trap installation/recovery | Orientation |
|----------------|------|-------|-----------------|-------------------|-----------------------------------|-------------|
| Siete Picos-La Mujer Muerta | SSD-1 | 30 | T 4081 45204 | 1606 | Cancho del Río Peces/Segovia | 20.V.2015 17.IX.2015 | North |
| SSD-1 (0.5) | 0.5 | | | | | |
| SSD-2 | 30 | T 4100 45166 | 1818 | Corrales de la Majada Mingüete/Segovia | 20.V.2015 17.IX.2015 | Northeast |
| SSD-2 (0.5) | 0.5 | | | | | |
| SSD-3 | 30 | T 4088 45192 | 1622 | Umbria de la Mujer Muerta/Segovia | 21.V.2015 17.IX.2015 | North |
| SSD-3 (0.5) | 0.5 | | | | | |
| SSD-4 | 30 | T 4056 45181 | 1685 | Majada Conejo/Segovia | 21.V.2015 17.IX.2015 | Northwest |
| SSD-4 (0.5) | 0.5 | | | | | |
| SSD-11 | 30 | T 4108 45161 | 1876 | Cerro Ventoso/Madrid | 09.VI.2015 17.IX.2015 | East |
| Puerto de los Cotos-Puerto de Navacerrada | SSD-5 | 30 | T 4166 45159 | 1923 | Arroyo Seco/Segovia | 27.V.2015 22.IX.2015 | Northwest |
| SSD-6 | 30 | T 4179 45185 | 1787 | La Pedriza/Segovia | 27.V.2015 22.IX.2015 | Northwest |
| Montes Carpetanos | SSD-7 | 30 | T 4185 45229 | 1994 | Majada Hambrienta/Segovia | 02.VI.2015 17.IX.2015 | Northeast |
| SSD-8 | 30 | T 4190 45231 | 2071 | Majada Aranguez/Segovia | 02.VI.2015 17.IX.2015 | Northwest |
| SSD-9 | 30 | T 4187 45211 | 2208 | Dos Hermanas/Madrid | 03.VI.2015 05.X.2015 | East |
| SSD-10 | 30 | T 4191 45213 | 2049 | Hoya de la Laguna Grande/Madrid | 03.VI.2015 05.X.2015 | East |
| SSD-16 | 30 | T 4334 45389 | 1956 | Las Revueltas-Los Horcos/Segovia | 23.VI.2015 07.X.2015 | West |
| SSD-17 | 30 | T 4347 45414 | 1976 | Peña del Buirte/Segovia | 23.VI.2015 07.X.2015 | Northeast |
| SSD-18 | 30 | T 4373 45438 | 1886 | Los Loberos/Segovia | 23.VI.2015 07.X.2015 | Southwest |
| SSD-19 | 30 | T 4224 45307 | 1866 | La Gelecha-La Flecha/Madrid | 24.VI.2015 06.X.2015 | Southeast |
| SSD-20 | 30 | T 4226 45332 | 1937 | Cerro de Navahonda/Segovia | 24.VI.2015 06.X.2015 | Northeast |
| SSD-21 | 30 | T 4211 45247 | 1891 | El Paredón/Madrid | 24.VI.2015 06.X.2015 | Northeast |
| SSD-22 | 30 | T 4304 45376 | 1995 | Alto del Puerto/Segovia | 24.VI.2015 22.IX.2015 | North |
| SSD-23 | 30 | T 4288 45367 | 2144 | Circo del Pico Nevaro/Madrid | 25.VI.2015 06.X.2015 | Southwest |
| SSD-24 | 30 | T 4274 45357 | 2042 | Peñacabra/Madrid | 25.VI.2015 22.IX.2015 | East |
| SSD-25 | 30 | T 4249 45407 | 1731 | Arroyo del Charco (La Cepa)/Segovia | 02.VII.2015 22.IX.2015 | Northwest |
| TSP-1 | 0.8 | 30 | T 4314 45376 | 1780 | Puerto de Navafria/Segovia | 24.VI.2015 22.IX.2015 | North |
| TSP-2 | 0.8 | 30 | T 4314 45376 | 1780 | Puerto de Navafria/Segovia | 24.VI.2015 22.IX.2015 | North |
| Cuerda Larga and associated mountainous complex | SSD-12 | 30 | T 4180 45138 | 2102 | Collado del Piorial/Madrid | 09.VI.2015 22.IX.2015 | North |
| SSD-13 | 30 | T 4179 45135 | 2113 | Los Almarones-Las Buiteras/Madrid | 10.VI.2015 22.IX.2015 | Northwest |
| SSD-14 | 30 | T 4274 45224 | 1406 | El Purgatorio/Madrid | 18.VI.2015 05.X.2015 | West |
| SSD-15 | 30 | T 4273 45224 | 1375 | Hueco de los Angeles/Madrid | 18.VI.2015 05.X.2015 | West |
| SSD-26 | 30 | T 4309 45186 | 1890 | La Najarra-Cuatro Calles/Madrid | 02.VII.2015 30.X.2015 | East |
| SSD-27 | 30 | T 4270 45185 | 2101 | Bailaderos/Madrid | 02.VII.2015 30.X.2015 | North |
| SSD-28 | 30 | T 4193 45164 | 2156 | Collado de Valdemartín/Madrid | 03.VII.2015 06.X.2015 | North |
| SSD-29 | 30 | T 4211 45168 | 2301 | Cabeza de Hierro Mayor Menor | 03.VII.2015 06.X.2015 | Crest |
| SSD-30 | 30 | T 4227 45170 | 2233 | Collado de Peña Vaqueros (Loma de Pandoasco)/Madrid | 03.VII.2015 06.X.2015 | Crest |
| SSD-31 | 30 | T 4288 45184 | 1946 | Collado de la Najarra/Madrid | 09.VII.2015 22.X.2015 | North |
| SSD-32 | 30 | T 4285 45187 | 1948 | Arroyo de La Najarra/Madrid | 09.VII.2015 22.X.2015 | Northeast |
| SSD-33 | 30 | T 4286 45188 | 1819 | Arroyo de La Najarra/Madrid | 09.VII.2015 22.X.2015 | North |

acreristics of these bioclimatic zones in the Sierra de Guadarrama and their most conspicuous vegetation are summarized in Ortuño et al. (2019). On the scree slopes, the rupicolous plant and lichen species communities acquire special relevance (JCL & CAM 2010). Also of importance is precipitation in the form of snow, which is more intense in the cryo-Mediterranean and oro-Mediterranean scrub supra-forest zones, especially in areas that conserve snowfields for many months.

Methodology
Thirty three sampling points were established (Fig. 1B). The details describing the placement of the traps and the rest of the methodology for sampling the animals have already been described in Baquiero et al. (2017). The UTM coordinates (datum WGS84) are given in Table 1, and in the typical localities of the new species described. The authors who performed the sampling included a team that consisted of V. M. Ortuño, E. Ledesma, J. D. Gilgado, A. Jiménez-Valverde, G. Pérez-Suárez and E. Baquiero. Permits to collect samples were obtained from the appropriate authorities (General Directorate of Environment of the Community of Madrid and Territorial Service of the Environment of the Junta de Castilla y León). The traps (Table 1) were placed between 20 May 2015 and 9 July 2015, and the first series of samples was obtained between 17 September 2015 and 6 November 2015. The term “activity” is sometimes used in
the study instead of “abundance”, as it better characterizes a quantitative community parameter obtained by the capture method, pitfall trapping. It means that more active forms of Collembola tend to be caught in traps, thus covering only a part of the species pool that occupies the MSS.

After the preliminary triage to separate the Collembola Entomobryomorpha from the sampling fauna within the SSDs, some specimens were selected and mounted in Hoyer’s medium for observation under a compound microscope in a phase contrast and DIC. Some specimens were cleared in Nesbitt’s fluid. The remaining samples were stored in 70% ethyl alcohol.

In addition to the simplified formula of Jordana & Baquero (2005) as simplification of the dorsal macrochaetotaxy defined originally by Szepycki (1979), the general color pattern (Katz et al. 2015) and some selected morphological characters (labral papilla shape, claw and empodium form, and mucro shape (Christiansen 1958; Christiansen & Bellinger 1980; Soto-Adames et al. 2008; Jordana 2012) have been used for the identification of the Entomobrya species. The macrochaetotaxy for Pseudosinella follows Gisin & Da Gama (1969), Szepycki (1979), Mateos (2008) and Soto-Adames (2010). The characters defined by Christiansen et al. (1990) for Pseudosinella, and those used in a Delta key by Christiansen in Jordana et al. (2018), were used for identification and descriptions.

**ABBREVIATIONS**

- **a.s.l.** above sea level;
- **abd** abdomen or abdominal segment I-VI;
- **accp** accessory posterior row sensillum;
- **al** anterolateral s-chaeta;
- **am** anteromedial s-chaeta;
- **ant** antennal or antenna/ae;
- **Mc** macrochaeta/ae;
- **ms** microsensillum;
- **mc** microchaeta;
- **PAO** postantennal organ;
- **psp** pseudopore;
- **s** sensillum;
- **SSD** subterranean sampling devices;
- **Th** thorax, or thoracic segments II-III;
- **UTM** Universal Transverse Mercator coordinate system.

**Institutions**

- **CAM** Comunidad de Madrid;
- **JCL** Junta de Castilla y León;
- **MNHN** Muséum national d’Histoire naturelle, Paris;
- **MZNA** Museum of Zoology at the University of Navarra, Pamplona.

**GRAPHICS**

The spatial distribution, and relative activity of the species were assessed based on samples obtained from the 33 sampling points (Table 1; Figs 1; 2) from the use of 33 SSDs of COLLEMBOLA COLLECTED IN THE MSS 42745, 100%
1 m depth, and four SSDs of 0.5 m that accompanied SSD-1, SSD-2, SSD-3 and SSD-4 (Table 1). The relative activity has been calculated, and expressed in two different ways in order to be able to compare, in percentage terms, the prominence of each of the species under the taxonomic perspective of order (excluding the Orchesella Templeton, 1835 genus, subject of another study: Baquero et al. 2017) (Fig. 1D) and family (Fig. 2).

Fig. 3. — Places where new species have been collected more abundantly: A, C, E, G, photos of the sampled biotopes; B, D, F, H, exact installation point and brief card of the SSDs (location and collecting species of Entomobryomorpha Börner, 1913, excluding Orchesella Templeton, 1835). Species authorships: see Index of species.
Each of the 33 sampling points has been analyzed in terms of activity and specific diversity (Fig. 1E, F), and for this purpose, the following correspondence was established: sampling point = SSD (1 m). Data on the presence of a species registered in an SSD (0.5 m) were incorporated in only one case because in the corresponding SSD (1 m) the species did not occur, and given the evidence of presence at the site, it could not be excluded from the calculations of specific diversity.
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RESULTS

In the total number of samples analyzed, the Entomobryomorpha taxon (Orchesella excluded) accounted for 52.4% of the Collembola captured in the traps. Specimens of 22 species belonging to two families were captured: Isotomiidae and Entomobryidae.

SYSTEMATICS

Class COLLEMBOLA Lubbock, 1870
Order ENTOMOBRYOMORPHA Börner, 1913, sensu Soto-Adames et al. 2008
Family ISOTOMIIDAE Schäffer, 1896
Subfamily ANUROPHORINAE Börner, 1901
Genus Folsomia Willem, 1902
Folsomia trisetata Jordana & Ardanaz, 1981 (Fig. 5)
Folsomia sexoculata trisetata Jordana & Ardanaz, 1981: 41.

Material examined. — Spain • 1 ♀, 1 ♂ on slide; SSD-30, slide 03; Ortuño et al. leg.; MZNA.

Remarks
Species cited so far only in the Atlantic Pyrenees (France and Spain, between 600 and 2350 m), and also in the pre-Pyrenean area of Navarra, usually in beech forests at a certain altitude (400 m) (Deharveng 1987). In this study, it has been found in the Sierra de Guadarrama at an altitude of around 2000 m.

Genus Tetracanthella Schött, 1891
Tetracanthella orbaicetensis Cassagnau, 1959
Tetracanthella tuberculata ssp. orbaicetensis Cassagnau, 1959: 230.

Material examined. — Spain • 2 specimens; SSD-1, slide 04; Ortuño et al. leg.; MZNA • 18 specimens on slide and 158 in ethyl alcohol; SSD-2, slides 01, 02, 05, 07 and 12-14; same data; MZNA • 7 specimens; SSD-6, slides 04, 06 and 09; same data; MZNA • 1 specimen on slide and 27 in ethyl alcohol; SSD-25, slide 07; same data; MZNA • 1 juvenile; SSD-10, slide 05; same data; MZNA • 1 specimen; SSD-11, slide 16; same data; MZNA.

Remarks
Originally described from the Sierra de Guadarrama (Steiner 1955), according to Deharveng (1987), its distribution extends from the south of the Ebro River (Iberian Peninsula) to the Atlas Mountains in Morocco. Throughout Europe (de Jong et al. 2014), it is present from Bulgaria, North Africa, Portugal (mainland), Spain (mainland) and Ukraine. The citations of Cassagnau (1959) and Selga (1966a, 1971) probably refer to the nearby species T. similis Deharveng, 1987.
Fig. 5. — Folsomia trisetata Jordana & Ardanaz, 1981: A, antenna with detail of two sensilla; B, head chaetotaxy; C, body chaetotaxy (the arrow on segment IV-VI points to a sensillum on posterior side); D, furcula: manubrium and dens, anterior view; E, ♂ genital plate; F, body sensillar pattern. Abbreviations: see Material and methods. Scale bars: A, B, D, E, 0.02 mm; C, 0.05 mm.
Genus *Uzelia* Absolon, 1901

**Uzelia kuehnelti** Cassagnau, 1954

*MateriAl exAMined*. — Spain • 1 juvenile; SSD-3, slide 07; Ortuño et al. leg.; MZNA • 1 ♀; SSD-4, slide 03; same data; MZNA.

**Remark**
Originally described in Cádiz (South of the Iberian Peninsula) (Cassagnau 1954), it had already been cited in the Sierra de Guadarrama by Simón (1971).

Subfamily Proisotominae Stach, 1947

Genus *Folsomides* Stach, 1922

**Folsomides portucalensis** da Gama, 1961

*MateriAl exAMined*. — Spain • 2 ♀; SSD-7, slides 07 and 10; Ortuño et al. leg.; MZNA.

**Remark**
Only two specimens have appeared and in a single trap. The species seems to have a European distribution (de Jong et al. 2014).

Subfamily *Isotominae* Schäffer, 1896

Genus *Isotomurus* Börner, 1903

*MateriAl exAMined*. — Spain • 2 juveniles; SSD-9, slides 07 and 10; Ortuño et al. leg.; MZNA • 1 juvenile; SSD-29, slide 08; same data; MZNA • 1 juvenile; SSD-32, slide 03; same data; MZNA.

**Remarks**
By having only juvenile specimens, which appear to belong to the genus *Isotomurus* (fallen bothriotricha have been seen in two of the specimens), a reliable identification has not been possible.

Genus *Parisotoma* Bagnall, 1940

**Parisotoma notabilis** (Schäffer, 1896)

*Isotoma notabilis* Schäffer, 1896: 187.

*Isotoma menotabilis* – Börner 1903: 142.

*Isotoma delicatula* Brown, 1929: 425.

*Isotoma eunotabilis* Folsom, 1937: 92.

*MateriAl exAMined*. — Spain • 1 specimen; SSD-6, slide 09; Ortuño et al. leg.; MZNA.

**Remarks**
Already cited in the Sierra de Guadarrama by Acón (1980). Originally described in Germany (Schäffer 1896), it is considered a Holarctic species (Potapov 2001). In this study, only one specimen has been collected and it therefore appears to be occasional in the MSS.

Genus *Pseudisotoma* Handschin, 1924

**Pseudisotoma monochaeta** (Kos, 1942)

*Isotoma sensibilis var. monochaeta* Kos, 1942: 125.

*Pseudisotoma unipila* Stach, 1947: 321.

*MateriAl exAMined*. — Spain • 10 specimens; SSD-1, slides 05, 07, 09 and 10; Ortuño et al. leg.; MZNA • 2 specimens on slide and 6 in ethyl alcohol; SSD-2, slides 04 and 09; same data; MZNA • 1 specimen; SSD-8, slide 08; same data; MZNA • 1 specimen; SSD-7, slide 08; same data; MZNA • 3 specimens; SSD-17, slide 04; same data; MZNA • 10 specimens; SSD-18, slides 03 and 04; same data; MZNA • 4 specimens; SSD-20, slide 05; same data; MZNA • 2 specimens on slide and 9 in ethyl alcohol; SSD-22, slide 03; same data; MZNA • 2 specimens; SSD-11, slide 13; same data; MZNA • 1 specimen; SSD-12, slide 09; same data; MZNA • 1 specimen; SSD-27, slide 04; same data; MZNA • 5 specimens; SSD-29, slide 08; same data; MZNA • 1 specimen; SSD-30, slide 05; same data; MZNA • 3 specimens; SSD-31, slides 11 and 14; same data; MZNA.

**Remarks**
It had already been cited in the Sierra de Guadarrama by Cassagnau (1954). Originally described in Slovenia (East of Julian Alps, 2350 m) (Kos 1942), it has been cited in mountainous areas throughout Europe, excluding Great Britain, Norway, Sweden and Finland. Cited in Ireland, Russia (Urals, Caucasus) and Japan (Potapov 2001).

Subfamily Pachyotominae Potapov, 2001

Genus *Pachyotoma* Bagnall, 1949, sensu Deharveng 1977

**Pachyotoma penalarensis** Baquero & Jordana n. sp.

(Figs 6A; 7; Table 2)

*Type material*. — Holotype. Spain • ♀; Segovia, Sierra de Guadarrama, Majada Aranguez (Northwest); 30T4190-45231; 2071 m a.s.L; 17.XI.2015; Ortuño et al. leg.; pitfall SSD (since 20.V.2015); MZNA SSD-8 (slide 16).

*Paratypes*. Spain • 2 ♀ and 1 ♂; slide 16; same data as for holotype; MZNA • 1 ♂ (subadult) and 1 ♀; slide 02; same data as for holotype; MZNA • 11 juveniles on slide and approximately 500 in ethyl
Fig. 6. — Pachyotoma penalarensis Baquero & Jordana n. sp.: A, head chaetotaxy; B, antenna, with detail of organite (C); D, maxillary palp; E, tibiotarsus, claw and empodium of leg 3; F, furcula, left – anterior side, right – posterior side; G, tenaculum. Scale bars: A, B, E, F, 0.02 mm; D, G, 0.01 mm.
Table 2. — Group of characters traditionally used for the identification of the species of the Proisotominae Stach, 1947 s.l., and to establish some of the proposed subfamilies, for the species that share with Pachytonoma penalaris Baquero & Jordana n. sp. (in combination) the number of eyes, the absence of lateral eyes, and a similar shape for the PAO, that are: Ballistura excavata Folsom, 1937 (N America, Africa), Clavisotoma africana (Womersley, 1934) (South Africa), Clavisotoma fatoinei (Rapoport, 1959) (Europe, Neotropical), Ballistura laticauda Folsom, 1937 (as Clavisotoma in Bellinger et al. 1996-2019) (USA, Azores), Coloburella cassagnaii Rusek, 1972 (Europe), Coloburella linnaniemii (Denis, 1926) (Europe), Folsomides centralis (Denis, 1931) (Costa Rica), Folsomides delamarei (Schött, 1927) (Cameroon), Folsomides delamarei Thibaud, Naj & Jaquemart, 1994 (Galgapagos), Folsomides denisi (Womersley, 1939) (Australia), Folsomides deserticole Wood, 1970 (Australia), Folsomides nepalicus Yosi, 1971 (Nepal), Pachytonoma pseudecreta (Haybach, 1972) (Europe), Proisotoma andina Rapoport & Rubio, 1968 (Neotropical), Proisotoma beta Christiansen & Bellinger, 1980 (Neotropical), Proisotoma muscicola Stach, 1965 (South East Asia), Pachytonoma santosorum Palacios/Vargas & Arbaa, 2009 (Caribe) and Weberacantha beckeri Stebebaa, 1966 (Russia).

Legend for the headers of the columns: Head: Y/E, eye number; PAO: form: b, broad; e, elliptical; l, long (lobulated); i, long with central indentation; c, oval (almost circular); PE: form in PE; PAO/eye ratio. Legs: CL, claw tooth: 0, absent; 1, present. Furca: ETF, empodial terminal filament: 0, absent; 1, short; 2, long (as claw); MA, anterior manubrium chaetae number; MP, posterior manubrium chaetae number; DA, anterior dens chaetae number; DP, posterior dens chaetae number; TT, tenent tubercle number; TC, tenent tubercle number; MT, micro teeth number and shape: 9, absent; 8, fused to dens; 0, no dentate; 1, unidentate or falcate; 2, bidentate; 3, tridentate; 4, quadridentate. General abbreviations: n, numerous, U, unknown.

| Subfamily        | species     | EYE | PAO PE | CL | ETF | MA | MP | DA | DP | TT | TC | MT |
|------------------|-------------|-----|--------|----|-----|----|----|----|----|----|----|----|
| Proisotominae    | B. excavata | 6+ 6 | e      | 1.2-1.5 | 0 1 0 | U | 1-5 | 12 | 4+4 | 1 | 2 |
| Proisotominae    | C. africana | 6+ 6 | o      | 1.2   | 1 1 U | 1 1 12 | 3+3 | U 2 |
| Proisotominae    | C. fatoenii | 6+ 6 | o      | 1.5-2 | 1 0 0 | n | 1   | 13-15 | 4+4 | 1 | 2 |
| Proisotominae    | C. filifera | 6+ 6 | e      | 1.5   | 1 2 0 | U | 2-3 | 16-17 | 4+4 | 1 | 2 |
| Proisotominae    | C. laticauda| 6+ 6 | o      | 2.5-3 | 1 2 0 | U | 2-3 | 16-17 | 4+4 | 1 | 2 |
| Pachytonominae   | C. cassagnai| 5+5-6+6 | e   | 2.0   | 0 0 0 | 11 11 | 4 | 4+4 | 1 | 8 |
| Pachytonominae   | C. linnaniemii| 6+ 6 | e    | 2.0   | 0 0 0 | 26 30 | 4 6 | 4+4 | 1 | 8 |
| Proisotominae    | F. centralis| 6+ 6 | e    | 3     | 0 1 0 | U | U | U | U | 4+4 | 1 | 2 |
| Proisotominae    | F. deflexus | 6+ 6 | o    | 3     | 0 1 0 | U | U | U | U | 4+4 | 1 | 2 |
| Proisotominae    | F. delamarei| 6+ 6 | e    | 2     | 0 2 0 | 12 1 1 | 3 | 3+3 | 1 | 9 |
| Proisotominae    | F. delamarei| 6+ 6 | e    | 2     | 0 2 0 | 12 1 1 | 3 | 3+3 | 1 | 9 |
| Proisotominae    | F. denisi   | 6+ 6 | e    | 4     | 0 1 0 | U | 16 1 | 6 | 3+3 | 1 | 2 |
| Proisotominae    | F. deserticola| 6+ 6 | e   | 4     | 0 1 0 | U | 16 1 | 6 | 3+3 | 1 | 2 |
| Proisotominae    | F. nepalicus| 6+ 6 | b    | 2     | 0 1 0 | 12 1 0 | U | 4+4 | 1 | 2 |
| Pachytonominae   | P. pseudecreta| 6+ 6 | e    | 1.7   | 0 0 4 | U | 40 30 | 4+4 | 1 | 0 |
| Pachytonominae   | P. penalaris Baquero & Jordana n. sp. | 6+ 6 | q 2.0 | 0 0 0 | 30 40 49 | 4+4 | 1 | 2 |
| Proisotominae    | Pr. andina  | 6+ 6 | e    | 1.1   | 0 1 0 | U | 2 6 4 | 10 5 | 4+4 | 5 | 4 |
| Proisotominae    | Pr. beta    | 6+ 6 | b    | 1     | 1 0 3 | U | 23-26 | 8-9 | 4-4 | 2-3 | 3 |
| Proisotominae    | Pr. muscicola| 6+ 6 | e    | 4     | 0 0 12 | 1 1 1 | 5 | 4+4 | 1 | 2 |
| Proisotominae    | Pr. santosorum| 6+ 6 | o    | 2.5-3 | 0 0 2 | 24-26 | 6 5 | 3+3 | 1 | 3 |
| Proisotominae    | W. beckeri  | 6+ 6 | i U   | 1 U 4 | 18 2 5 | 4+4 | 1 | 2 |

alcohol; slide 13; same data as for holotype; MZNA • 10 specimens in ethyl alcohol; Segovia, Sierra de Guadarrama, Majada Aranguez (Northwest); 30°41’00.45231; 2071 m a.s.l.; 17.XI.2015; Ortuño et al. leg.; pitfall SSD (since 20.V.2015); MNHN.

Type Locality. — Spain, Segovia, Sierra de Guadarrama, Majada Aranguez (Northwest); 30°41’00.45231; 2071 m a.s.l.

Etymology. — The specific epithet ‘penalaris’ refers to the presence of this species in the Peñalara massif, which boasts the highest peak of the Sierra de Guadarrama.

Diagnosis. — Cylindrical dens, micro present and bidentate. PAO with four lobes. Ant III sensory organ with the two central sensilla more or less spherical and number of sensilla on tergites at about 10,10/6,6,6,9,7.

Description

Body

Size 0.72-0.80. Color dark blue. Integument granulated without reticulation. 6 + 6 to 8 + 8 eyes (sometimes eyes G and H disappear, but it is possible to see the refringent structures below). PAO with four lobes, two eyes A (Fig. 6A). Antenna as in Figure 6B, C; Ant III sensory organ with the central sensilla more or less spherical; Ant IV with seven sensilla, six dorsoexternal and one dorsointernal. Maxillary outer lobe bifurcated and four sublobar hairs (Fig. 6D). Labral formula 4/5,5,4 (labral chaetae papillated). Labium with four basomedial, three proximal and five basolateral chaetae and, as common for the family, with 16 guard chaetae.

Legs

Tibiotarsus tenent hairs all pointed. Claw without tooth; empodium short with lamella but without terminal filament (Fig. 6E).

Abdomen

Collophore with 5 + 5 (or 6 + 6) laterodistal, and five posterior chaetae. Furca: manubrium with 28-30 posterior and without anterior chaetae; dens with nine posterior (three groups: three basal, two medial and four distal) and four distal anterior chaetae; mucro with two poorly developed teeth, and two lamellae (Fig. 6F). Tenentum with four teeth and without chaeta on corpus (Fig. 6G).

Chaetotaxy

Body chaetae short and without macrochaetae (see Figure 7 for number of rows and axial chaetae). Thoracic medial s-chaetae in front of p-row; abdominal medial s-chaetae in p-row (Abd IV-V with three and four respectively additional ones before p-row); s-chaetae formula (c. 10,10/6,6,6,9,7 for half tergite). Ms-chaetae formula 1.0/0.0,0.0 (Fig. 7).

Ecology

So far, this species has only been located in the MSS of the Peñalara massif, in SSD-8, installed in the Canchal de la Majada Aranguez (Figs 1A, C; 3A, B). This site is located at altitudes that exceed 2000 m a.s.l., and is part of the
supraforestal strip of the oro-Mediterranean bioclimatic zone. Extensive slopes dominate the landscape with a moderate slope, where there is very little vegetation, highlighting small stands of Juniperus communis alpina (Suter) Celak. (Fig. 3A). Pachyotoma penalarensis Baquero & Jordana n. sp. share their habitat with at least four other Collembola species, of which three are also new (Figs 1F; 3B). As a whole, the syntopy of the five species at this site has provided an average relative activity that does not reach a thousand specimens (Fig. 1E). This species only represents 2% of the total Entomobryomorpha studied in this paper (Fig. 1D), but accounts for 65% of the total Isotomidae collected (Fig. 2A, C).

**Remarks**
Considering the group of characters for the family, the 6 + 6 ocelli and a very specific PAO are enough to establish the specimens found as a new species, assigned to the Pachyotominae subfamily due to the absence of anal spines, the presence of furca, fewer than four chaetae in the anterior part of the manubrium, granulation of the body, abundant sensory chaetotaxy, dens with teeth and absence of Mc. The new species really has an extraordinary shape of PAO compared with congeners and Isotomidae as a whole. The characters that are used for the separation of the different genera of the Proisotominae s.l. seem to have a low diagnostic value. It is probable that all this taxonomy is artificial and it will take further work to update definitions of the genera and probably also the subfamilies of all Isotomidae. The separation of the specimens of this sampling into a new species according to the number of eyes, PAO and presence or not of the tenent hair on the tibiotarsus can be seen in Table 2, which includes the eye number, PAO shape, PAO/eye ratio, empodial terminal filament presence and shape, anterior manubrium chaetae number, posterior manubrium chaetae number, anterior dens chaetae number, posterior dens chaetae number, tenaculum teeth number, tenaculum chaetae number and mucro teeth number and shape. This table is an example of the absence of differential generic characters for the subfamily Proisotominae s.l.

Family ORCHESELLIDAE Börner, 1906
Subfamily HETEROMURINAE Absolon & Kseneman, 1942 *sensu* Zhang & Deharveng 2015
Genus Heteromurus Wankel, 1860

*Heteromurus major* (Moniez, 1889)

*Templetonia major* Moniez, 1889: 26.

*Podura teres* Linnaeus, 1746: 342.

*Podura plumbea* Linnaeus, 1761: 473.

*Podura* (*Longæ* plumbea Geoffroy, 1762: 610.

*Podura* (*Longæ* violacea Geoffroy, 1762: 611.

*Heteromurus major* – Börner 1901: 78.

*Heteromurus caerulescens* Börner, 1903: 156.

*Heteromurus melitensis* Stach, 1924: 115.

*Heteromurus mexicanus* Handschin, 1928: 545.

*Lepidocyrtus lundbladi* Agrell, 1939: 5.

*Heteromurus caucasicus* Tshelnokov, 1974 in Martynova et al. 1974: 70.

**Material Examined.** — Spain • 6 specimens; SSD-1 (0.5 m depth), slides 05-07; Ortuño et al. leg.; MZNA • 13 specimens; SSD-1 (1 m depth), slides 06, 09 and 10; same data; MZNA • 8 specimens on slide and 13 in ethyl alcohol; SSD-2 (0.5 m depth), slides 04 and 09; same data; MZNA • 1 specimen on slide and 70 in ethyl alcohol; SSD-2 (1 m depth), slide 17; same data; MZNA • 2 specimens on slide and 28 in ethyl alcohol; SSD-3 (1 m depth), slides 02 and 11; same data; MZNA • 2 specimens on slide and
10 in ethyl alcohol; SSD-4, slide 07; same data; MZNA • 1 specimen on slide and 50 in ethyl alcohol; SSD-5, slide 08; same data; MZNA • 1 specimen on slide and 11 in ethyl alcohol SSD-07, slide 11; same data; MZNA • 3 specimens; SSD-8, slide 08; same data; MZNA • 1 specimen on slide and 200 (approximately) in ethyl alcohol; SSD-16, slide 09; same data; MZNA • 4 specimens; SSD-20, slide 07; same data; MZNA • 1 specimen on slide and 74 in ethyl alcohol; SSD-9, slide 05; same data; MZNA • 1 specimen on slide and 18 in ethyl alcohol; SSD-10, slide 04; same data; MZNA • 8 specimens on slide and 213 in ethyl alcohol; SSD-11, slides 08, 11 and 17; same data; MZNA • 1 specimen on slide and 200 (approximately) in ethyl alcohol; SSD-12, slide 06; same data; MZNA • 2 specimens; SSD-13, slide 05; same data; MZNA • 4 specimens on slide and 89 in ethyl alcohol; SSD-14, slide 09; same data; MZNA • 11 specimens in ethyl alcohol; SSD-15; slide 04; same data; MZNA • 1 specimen on slide and 20 in ethyl alcohol; SSD-19, slide 05; same data; MZNA • 90 specimens in ethyl alcohol; SSD-21; same data; MZNA • 2 specimens on slide and 33 in ethyl alcohol; SSD-24, slide 03; same data; MZNA • 1 specimen; SSD-27, slide 05; same data; MZNA • 3 specimens on slide and 55 in ethyl alcohol; SSD-28, slide 06; same data; MZNA • 1 specimen on slide and 16 in ethyl alcohol; SSD-29, slide 06.

**Material Examined.** — Spain • 1 specimen on slide and 6 in ethyl alcohol; SSD-14, slide 02; Ortuño et al. leg.; MZNA • 13 specimens in ethyl alcohol; SSD-15; same data; MZNA • 4 specimens in ethyl alcohol; SSD-09; same data; MZNA.

**Remark.**

Already cited in the Sierra de Guadarrama by Selga (1971). It seems to have a wide distribution in the west of the palearctic region, with corticicolous species inhabiting forest canopy. It is found in the ground when it falls from the trees (Jordana 2012).

**Entomobrya guadarramensis**

Jordana & Baquero n. sp. (Figs 8A; 9; Table 3)

**REMARK.**

Present in the south-west part of the palearctic region. In this study, it is present in almost all samples.

**Family Entomobryidae**

Schäffer, 1896

**Subfamily Entomobryinae**

Schäffer, 1896

*senus* Zhang & Deharveng 2015

*Genus Entomobrya* Rondani, 1861

**Entomobrya albocincta** (Templeton, 1835)

*Podura albocincta* Templeton, 1835: 95.

*Degerea albocincta* – Nicoler 1847: 370.

*Degerea cincta* – Lubbock 1862: 594.

*Entomobrya albocincta* – Brook 1884: 279.

**Type Material.** — Holotype. Spain • 9; Segovia, Sierra de Guadarrama, Majada Hambrienta (Northeast); 30°7 4157 45229; 1994 m.a.s.l.; 17.XI.2015; Ortuño et al. leg.; pitfall SSD (since 2.VI.2015); MZNA SSD-7 (slide 06).

**Paratypes.** Spain • 19 specimens in ethyl alcohol; same data; MZNA as for holotype; Ortuño et al. leg.; MZNA • 4 specimens on slide and 78 in ethyl alcohol; SSD-6, slides 10 and 11; same data; MZNA • 5 specimens on slide and 24 in ethyl alcohol; SSD-8, slides 01 and 05; same data; MZNA • 4 specimens; SSD-10, slide 02; same data; MZNA • 2 specimens on slide and 10 in ethyl alcohol; SSD-8, slides 14 and 15; same data as for holotype; Ortuño et al. leg.; MNHN.

**Type Locality.** — Spain, Segovia, Sierra de Guadarrama. Majada Hambrienta (Northeast); 30°7 4157 45229; 1994 m.a.s.l.

**Etymology.** — The specific epithet refers to the presence of this species in the Sierra de Guadarrama.

**Additional Material.** — Spain • 24 specimens on slide and 212 in ethyl alcohol; SSD-1 (0.5 m depth), slides 03-07; Sierra...
de Guadarrama, Segovia; Ortuño et al. leg.; MZNA • 27 specimens; SSD-1 (1 m depth), slides 05, 06 and 08-09; same data; MZNA • 5 specimens; SSD-2 (0.5 m depth), slides 03, 05 and 09; same data; MZNA • 3 specimens on slide and 210 in ethyl alcohol; SSD-3 (0.5 m depth), slides 02, 03; same data; MZNA • 4 specimens; SSD-3 (1 m depth), slides 10, 11; same data; MZNA • 2 specimens on slide and 60 in ethyl alcohol; SSD-4 (0.5 m depth), slides 03, 04; same data; MZNA • 1 specimen on slide and approximately 1000 in ethyl alcohol; SSD-4 (1 m depth), slide 05; same data; MZNA • 5 specimens; SSD-5, slide 04; same data; MZNA • 1 specimen on slide and 30 in ethyl alcohol; SSD-16, slide 03; same data; MZNA • 12 specimens on slide and 562 in ethyl alcohol; SSD-17, slides 05 and 07; same data; MZNA • 2 specimens on slide and 158 in ethyl alcohol; SSD-18, slides

Fig. 8. — Habitus and color patterns of some species: A, Entomobrya guadarramensis Jordana & Baquero n. sp.; B, Entomobrya ledesmai Jordana & Baquero n. sp.; C, Lepidocyrtus labyrinthi Baquero & Jordana n. sp.; E, Lepidocyrtus purgatorii Baquero & Jordana n. sp.; F, Lepidocyrtus paralignorum Baquero & Jordana n. sp.; G, Pseudosinella valverdei Baquero & Jordana n. sp.; H, Pseudosinella gonzaloi Baquero & Jordana n. sp. Scale bar: 0.25 mm.
Fig. 9. — Entomobrya guadarramensis Jordana & Baquero n. sp.: A, head chaetotaxy; B, maxillary palp and outer maxillary lobe; C, sensory organ of antennal segment III; D, ThII dorsal macrochaetotaxy; E, Abd-I-III dorsal macrochaetotaxy; F, Abd-IV-V dorsal macrochaetotaxy; G, chaetae from central area of Abd-II; H, trochanteral organ; I, claw and empodium; J, tip of furcula showing the nonringed area of dens, mucro and mucronal spine. Abbreviations: see Material and methods. Symbols: ●: Mc; ○: mes; ▲: sensilla. Scale bars: A, D-F, 0.05 mm; B, H-I, 0.02 mm; C, G, J, 0.01 mm.
04 and 06; same data; MZNA • 3 specimens on slide and 124 in ethyl alcohol; SSD-20, slide 04; Madrid; same data; MZNA • 2 specimens on slide and 19 in ethyl alcohol; SSD-22, slide 05; same data; MZNA • 1 specimen on slide and 371 in ethyl alcohol; SSD-25, slide 04; Madrid; same data; MZNA • 136 specimens in ethyl alcohol; SSD-11; same data; MZNA • 12 specimens in ethyl alcohol; SSD-12; same data; MZNA • 13 specimens; SSD-13, slides 03 and 05; same data; MZNA • 180 specimens in ethyl alcohol; SSD-14; same data; MZNA • 106 specimens in ethyl alcohol; SSD-15; same data; MZNA • 4 specimens on slide and 152 in ethyl alcohol; SSD-19, slides 05 and 06; same data; MZNA • 194 specimens in ethyl alcohol; SSD-21; same data; MZNA • 7 specimens; SSD-23, slide 03; same data; MZNA • 2 specimens on slide and 81 in ethyl alcohol; SSD-26, slide 02; same data; MZNA • 7 specimens on slide and 1027 in ethyl alcohol; SSD-27, slide 05; same data; MZNA • 1 specimen; SSD-29, slide 11; same data; MZNA • 4 specimens on slide and 180 in ethyl alcohol; SSD-31, slides 09 and 12; same data; MZNA • 5 specimens; SSD-32, slide 03; same data; MZNA • 3 specimens on slide and 64 in ethyl alcohol; SSD-33, slide 08; same data; MZNA.

**Diagnosis.** — White species, with lateral pigmentation, 2-4 Mc on areas T1-T2 on Th II, 2-5/1-2(1) Mc on areas A1-A5 on Abd II-III, and abundant Mc on Abd IV. The unequivocal identification of the species can only be done using the abbreviated formula that, for this species, is: 3-1-0-3-2/2-4/2-5/1-2-1(2)/7-4-2/4-1-2-2 (following Jordana & Baquero 2005).

**Description**

*Size and color*

Body length (excluding antennae): 2.60 mm (n = 10), up to 2.84 mm (holotype 2.66 mm). Ground color white or very pale yellow, with pigment on lateral body, dorsolateral head and vertex, transversal stripes on some posterior tergites, and two patches with more or less development and intensity on Abd II-IV (Fig. 8A).

*Head*

Eight eyes, GH smaller than EF. Antennae length 1.36 mm, 2.08-2.92 times the length of the head (n = 4; the antennae have suffered the sampling method by the time the specimens have been in the polyethylene glycol); Ant IV with simple apical vesicle and pin chaetae present; sensory organ of Ant III with the special rod-like sensilla, and three additional guard sensilla (Fig. 9C); relative length of Ant I/II/III/IV = 1/2.08/1.95/1.89 (n = 3). Prelabral chaetae ciliated. Labral papillae multispinose. Lateral process of labial papilla E 1/3 shorter than the papilla, not reaching their apex. Maxillary palp bifurcated, with three sublobal chaetae (Fig. 9B).

*Body and legs*

Length ratio of Abd IV/III = 5.30 (between 3.85-6.43; n = 10). Trochanteral organ with approximately 35 chaetae (Fig. 9H). Tibiotarsus not sub-segmented, without smooth chaetae, except for smooth terminal chaeta on legs III. Claw with four teeth: paired at 50% and first unpaired at 75% from base; dorsal teeth not basal (Fig. 9I). Empodium lanceolate, with smooth external lamella (pe) in leg III. Tenent hair clavate. Length of manubrium and dens 0.53 and 0.66 mm, respectively (average for n = 9). Manubrial plate with four or five chaetae and two pseudopores. Mucro with teeth similar in size, mucronal spine reaching the tip of the subapical tooth (Fig. 9J); non-crenulated area of dens two times the length of micro. Body chaetae as in Figure 9G.

**Macrochaetotaxy (Fig. 9A, D-F)**

Simplified Mc formula: 3-1-0-3-2/2-4/2-5/1-2(1)/7-4-2/4-1-2-2. Head: H1 area with Mc An2, An3a1 and An3; H2 area with one Mc (A3), and A6-A7 more or less developed to Mc in some specimens; H4 area with three Mc (S1, S3 and S4); S4p always present); H4' area with three Mc (S5, S5i and S4); H5 area with Ps2 and Ps3 Mc. Mesothorax: area T1 habitually with two Mc (m1 and m2), sometimes m2 or m21 instead m21; T2 with four Mc (m1, m2i, a5 and a5'). Abdomen: Abd II area A1 with two Mc (a2 and a3; sometimes and additional mes or Mc above them), area A2 with five Mc, between three and seven (m3, m3i and m3ei); m3a instead m2i; T2 with four Mc (m4, m4i, a5 and a5'). Abd 3 area A1 with Mc (m1) and sometimes and additional mes or Mc above them), area A2 with four Mc, one or two Mc (m2i and m3). Abd IV area A1-A3 (a1-3) and A6-A7 more or less developed to Mc in some specimens; area A8 with Ps2 and Ps3 Mc. Abd III area A1-A3 (a1-3) and A6-A7 more or less developed to Mc in some specimens; area A8 with Ps2 and Ps3 Mc. Abd III area A1-A3 (a1-3) and A6-A7 more or less developed to Mc in some specimens; area A8 with Ps2 and Ps3 Mc.

**Ecology**

Species widely distributed in the three mountain ranges (Fig. 1B, C). It is present in the MSS of the three bioclimatic zones and its overwhelming implantation in the subsoil, and the fact that it has never been registered as epigeous, suggests that it is a regular inhabitant of this habitat. It was extraordinarily abundant in SSD-27 of the Canchal de Bailanderos (Figs 1B, C; 3C, D), located in the Iberian Peninsula. At this site 1034 specimens of *E. guadarramensis* Jordana & Baquero n. sp. were collected; thus, almost all of the Entomobryomorpha (1039 not including *Orchesella*) found from SSD-27 (Fig. 1E) evidence the dominance of this species over the other three species of sympatric Entomobryomorpha (Figs 1F; 3D).

**Remarks**

If we consider the dorsal macrochaetotaxy of the abdominal tergites Abd II-III using the simplified formula, 2-5/1-2-1(2), it differs from all the *Entomobrya* species described except for *E. ariamii* Baquero & Jordana, 2018, *E. dorsalis* Uzel, 1891, *E. icoae* Baijal, 1958 (*E. longisticta* Baquero & Jordana, 2018 and *E. baqueroi* Jordana, Schulz & Baquero, 2018). The differences among these species and the new species can be seen in Table 3, showing 6, 15, 15, 7 and 9 different chaetotaxic characters. Highly abundant species in the MSS of the Sierra de Guadarrama, accounting for 24% of the total Entomobryomorpha studied in this work (Fig. 1D), and 25% of the Entomobryidae (not including *Orchesella*) (Fig. 2A, B).
The unequivocal identification of the species can only be done using the abbreviated formula that, for this species, is: 3-1-0-2-2/2-4/2-2/1-0-1/0-3-0-1-0-2-2. Head: Mt on series sd'4-sd'4, (An1-An3), total number; H2, Mc on series sd3-sd3, total number; H3, Mc on series d1-d1, total number; H4, Mc on series d2-d2, (S1-S1, S2-S2), total number; H5, Mc on series v1-v3, (Ps2-Ps2, Ps3-Ps3), total number; L1, labral papilla presence and shape: 1, without; 2, simple, smooth papilla; 3, multispinose; 4, a chaetalike projection. ThII: T1, Mc on series m1-m1, total number, 5 if > 6. E1, empodium, shape of external lamella (pe) of leg 3: 1, smooth; 2, serrated; 3, with teeth. AbdII: A1, Mc on series a2-a2, total number, A2, Mc on series m2-m2, total number; A3, Mc on series a1-a1, total number; A4, Mc on series above m0, total number; A5, Mc on series m1-m1, series total number. Abd IV: A6, Mc on series above a2 (An1-a1), total number; 9 if > 8. A7, unpaired Mc on series m0 (A01), total number; A7, Mc on series m1-m1 (A02-C01), total number; 8 if > 5. A8, Mc on series m0-m0 (A01-A01), total number; 6 if > 5; A10, Mc on series p5-p5 (A01-B01), total number; 6 if > 5; M1, micro, sub-apical tooth; 1, without; 2, normal; 3, bigger than apical; 4, smaller than apical. Abbreviations and symbols: * difference for the character with the new species; D, total number of differences between the species and the new species; U, unknown.

### Table 4

- **Group of species of Entomobrya Rondani, 1861 that share with E. ledesmai Jordana & Baquero n. sp. the dorsal macrochaetae formula for tergites AbdII-III: 2-1-0-1-1: E. katsi Jordana & Baquero n. sp. (USA), E. lawrencei Baquero & Jordana, 2006 (Spain), E. nicoleti (Lubbock, 1868) (British Isles), Spain, Switzerland, France, Sweden, Germany, Russia, Egypt), E. rubella Baquero, 1988 (British Isles, Spain), E. siciliana Jordana & Baquero, 2011 (Sicilia, Italy), and E. katzi Jordana & Baquero, 2011 (Spain).**

| Species                  | H1 | H2 | H3 | H4 | H5 | L1 | T1 | T2 | E1 | A1 | A2 | A3 | A4 | A5 | A6 | A7* | A8* | A9* | A10 | M1 | D |
|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| E. katsi Jordana & Baquero n. sp. | 3  0  2  2  2  2  3  1  0  1  0  1  0  4  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. lawrencei              | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. luquei                 | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. nicoleti               | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. rubella                | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. siciliana              | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |
| E. ledesmai Jordana & Baquero n. sp. | 3  0  1  0  2  2  3  1  0  1  0  1  0  1  0  0  0  0  0  0  0  0 | 2  2  2  6 |

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**Entomobrya ledesmai** Jordana & Baquero n. sp. (Figs 8B; 10; Table 4)

*urn:lsid:zoobank.org:act:689294BD-51C9-4D4D-9E44-948B53C2F0C2*

**Type material.** — Holotype, Spain • 9; Madrid, Sierra de Guadarrama, Cuéda Larga and associated mountainous complex, Cabeza de Hierro Mayor Menor (crest); 30T4211 45168; 2301 m a.s.l.; 6.XL2015; Ortuño et al. leg.; pitfall SSD (since 3.VII.2015); MZNA SSD-29 (slide 13).

**Paratypes.** Spain • 4 specimens; same data as for holotype, slide 09; Ortuño et al. leg.; MZNA • 1 juvenile and approximately 4000 in ethyl alcohol; same data, slide 12 • 2 specimens; SSD-2 (1 m depth) on slide 02; same data; MZNA • 1 specimen; SSD-30 on slide 04; same data; MZNA • 10 specimens in ethyl alcohol; SSD-29; same data; MNHN.

**Type locality.** — Spain, Madrid, Sierra de Guadarrama, Cuéda Larga and associated mountainous complex, Cabeza de Hierro Mayor Menor (crest); 30T4211 45168; 2301 m a.s.l.

**Etymology.** — This species is dedicated to the biologist Enrique Ledesma, a very active participant in the sampling of the mesovoid shallow substratum.

**Diagnosis.** — White species, with patches of pigmentation not only transversal, 2-4 Mc on areas T1-T2 on ThII, 2-2/1-0-1 Mc on areas A1-A5 on AbdII-II, and without Mc on A8 on AbdIV. The unequivocal identification of the species can only be done using the abbreviated formula that, for this species, is: 3-1-0-2-2/2-4/2-2/1-0-1/0-3-0-1-0-2-2.

**Description**

**Size and color.**

Body length: 2.12 mm, up to 2.33 mm (n = 7), excluding antennae. Ground color white or very pale yellow, with pigment as small patches as in Figure 8B; head with pigment between eyes and vertex, and on antennae on internal AntI and from AntII to IV.

**Head.**

Eight eyes, GH smaller than EF. Antennae length 1.10-1.43 mm, 3.20 times the length of the head; relative length of AntI/III/III/IV = 1.64/2.40/2.37 (n = 7); sensory organ of AntIII with the special rod-like sensilla, and three additional guard sensilla (Fig. 10B); AntIV with apical vesicle bilobed. Preabdominal chaetae ciliated. Labral papillae multispinose (Fig. 10C). Lateral process of labial papilla E not reaching the apex of the papilla. Labral chaetae ciliated: only one M, and R half of a M.

**Body and legs.**

Length ratio of AbdIV/III = 4.27 (n = 7). Microchaetae on body relatively broadened (Fig. 10G). Tibiotarsus sub-segmented, without smooth chaetae, except for smooth terminal chaeta on legs III. Claw with four teeth: paired at 50% and first unpaired at 70% from base; dorsal teeth not basal, in an intermediate position between base and paired internal teeth (Fig. 10H). Empodium lanceolate, with serrate external lamella (pe) in leg III. Tenent hair clavate. Trochanteral organ with approximately 22 chaetae (Fig. 10I). Length of manusbrium and dens 0.44 and 0.55 mm, respectively. Manusbrium plate with four chaetae and two pseudopores. Non-ringed part of dens two times the length of mucro; mucro with teeth similar in size, mucronal spine reaching the tip of the subapical tooth.

**Macrochaetotaxy (Fig. 10A, D-F).**

Simplified Mc formula: 3-1-0-2-2/2-4/2-2/1-0-1/0-3-0-1-0-2-2. Head: H1 area with Mc An3, An3a, and An5; H2 area with one Mc (A3); H4 area with two Mc (S1 and S3); H4 area with three Mc (S1, S3, and S5); H5 area with Ps and Ps5. Mesothorax: area T1 with two Mc (m1 and m3), T2 with four Mc (m4, m5, a5, and m3). Abdomen: AbdII area A1 with two Mc (a2 and a3), area A2 with two Mc (m1 and m3); AbdIII with one Mc each on areas A3 (a1) and A5 (m3); AbdIV with three Mc on A7 area (A3, B3 and C1), three Mc on A9: one unpaired (A05), A3 and B3, and two on A10 (A6 and B6).
Fig. 10. — *Entomobrya* ledesmai Jordana & Baquero n. sp.: A, head chaetotaxy; B, sensory organ of antennal segment III; C, labral papillae; D, ThII dorsal macrochaetotaxy; E, Abd-III dorsal macrochaetotaxy; F, Abd-IV dorsal macrochaetotaxy; G, chaetae from central area of Abd-II; H, tibiotarsus of leg3; I, trochanteral organ. Abbreviations: see Material and methods. Symbols: ●, Mc; ○, mes; ▲, sensilla. Scale bars: A, D-F, 0.05 mm; H-I, 0.02 mm; B, C, G, 0.01 mm.
and scales: 0, without scales; 1, scales on Ant I; 2, scales on Ant I-II; 3, scales on Ant I-III; 4, scales on Ant I-IV;

and Jordana, Giuga & Baquero, 2011. (Europe), (USA) and ascribed the specimen to E.

Handschin, 1924

of the United Kingdom sent to Rafael Jordana by Peter Shaw)

E. luquei Baquero & Jordana, 2008,

If we consider the dorsal macrochaetotaxy of the abdominal 4192 specimens (Fig. 1E), with a dominance of 98%.

other seven syntopic species (Figs 1C, F; 3F) with a total of n. sp. is the most abundant species at this site compared to mineral substrate.

Jordana & Baquero

communis alpina J.

in the Canchal between Cabeza de Hierro Mayor and Menor

Using reasonable interpolation, it is most likely also found in the oro-Mediterranean zone and in the cryo-Mediterranean.

in two mountain ranges (Fig. 1B, C), in the forest strip of Jordana & Baquero n. sp., do not correspond to wide distribu-

Unlike what was observed with E. guadarranensis Jordana & Baquero n. sp., the high activity values shown by E. ledesmai Jordana & Baquero n. sp., do not correspond to wide distribution. It has been found in the MSS of only three sites, located in two mountain ranges (Fig. 1B, C), in the forest strip of the oro-Mediterranean zone and in the cryro-Mediterranean. Using reasonable interpolation, it is most likely also found in the supraforestal area of the Mediterranean. Almost all of the specimens (4106 of 4109) come from SSD-29, installed in the Canchal between Cabeza de Hierro Mayor and Menor (Fig. 3E, F), an extreme climate site that shows very little vegetation cover (J. communis alpina) and an eminently mineral substrate. Entomobrya ledesmai Jordana & Baquero n. sp. is the most abundant species at this site compared to other seven sympatric species (Figs 1C, F; 3F) with a total of 4192 specimens (Fig. 1E), with a dominance of 98%.

Remarks

If we consider the dorsal macrochaetotaxy of the abdominal tergites Abd II-III using the simplified formula, 2-2/1-0-1, it is close to E. intermedia sensu Katz et al. (2015), E. lawrencei Baquero & Jordana, 2008, E. luguei Jordana & Baquero, 2006, E. nicoloi (Lubbock, 1868), E. rubella Latzel, 1918 and E. siciliana Jordana, Giuga & Baquero, 2011.

Katz et al. (2015) found an Entomobrya captured in Chester (USA) and ascribed the specimen to E. intermedia. Some species of E. intermedia from England were studied for the review of the palearctic Entomobryinae (species from different parts of the United Kingdom sent to Rafael Jordana by Peter Shaw) (Jordana 2012). The coloration of both populations is similar but the macrochaetotaxy is different: H4 (Jordana & Baquero 2005) has three chaetae in the specimens from England, one (sometimes an additional mes) in the American specimen; A2 has four Mc in the English form (m1, m1sp, m3a and m3l), two in the American form (m1 and m3a); A7 has more Mc in the English form than in the American form; in addition, the labral papillae are smooth in the English species and multisinate in the American specimen. Given these differences and the geographical origin of the specimens, we consider E. intermedia sensu Katz et al. (2015) to be a new species of Entomobrya from the USA, denominated Entomobrya katzi Jordana & Baquero n. sp., with an abbreviated formula 3-2-0-1-2/3-5/2-2/1-0-1/0-4-0-2-2.

Table 4 shows that the new species differs by multiple characters from the species with which it shares the simplified formula of Abd II-III.

Entomobrya ledesmai Jordana & Baquero n. sp. represented 18% of the total Entomobryomorpha studied in this work, (Fig. 1D), and 19% of Entomobryidae (not including Orchesella) (Fig. 2A, B), i.e., it is the third species in the dominance rank.

Entomobrya nicoloi (Lubbock, 1868)

Degeeria nicoloi Lubbock, 1868: 299.

Entomobrya multifasciata var. nicoloi Brook, 1884: 278.

Entomobrya nicoloi – Börner 1901: 68.

Entomobrya aurantiaca Stach. 1922. — Jordana 2012: 149.

Entomobrya bimaculata Stach, 1963. — Jordana 2012: 149.
Material examined. — Spain • 1 specimen; SSD-22, slide 04; Ortuño et al. leg.; deposited at MZNA.

Remarks
This is the first record for Guadarrama.

Family Lepidocyrtidae Wahlgren, 1906
sensu Zang et al. 2015
Subfamily Lepidocyrtinae Wahlgren E, 1906
Genus Lepidocyrtus Bourlet, 1839

Lepidocyrtus lusitanicus nigrus
Simón-Benito, 2007

Lepidocyrtus lusitanicus nigrus Simón Benito, 2007: 322.

Material examined. — Spain • 6 specimens on slide and 12 in ethyl alcohol; SSD-7, slides 07 and 12; Ortuño et al. leg.; MZNA • 1 specimen; SSD-29, slide 08; same data; MZNA.

Remarks
L. lusitanicus is present in Portugal, Spain and France. Different types of coloration that have been elevated to the rank of subspecies by different authors (Simón-Benito 2007; Mateos 2008). The specimens found in this study, based on their coloration, would belong to the subspecies L. lusitanicus nigrus, which is cited in Navarra, Zaragoza, Madrid and Pontevedra (Spain).

Lepidocyrtus labyrinthi Baquero & Jordana n. sp.
(Figs 8C, D; 11; 12; 13; Table 5)

Type material. — Holotype. Spain • 9; Segovia, Sierra de Guadarrama, Montes Carpetanos, Majada Aranjuez (Northwest); 30T 4190 45231; 2071 m a.s.l.; 17 XI.2015; Ortuño et al. leg.; pitfall SSD (since 2.VI.2015); MZNA SSD-8 (slide 04).

Paratypes. Spain • 5 specimens on slide and 70 in ethyl alcohol; SSD-6, slides 05 and 11; Ortuño et al. leg.; MZNA • 6 specimens;
SSD-7, slide 09; same data; MZNA • 11 specimens on slide and 20 in ethyl alcohol; SSD-9, slide 06; same data; MZNA • 1 specimen; SSD-29, slide 08; same data; MZNA • 10 specimens in ethyl alcohol; SSD-6; same data; MNHN. 

**Diagnosis.** — Body violet more or less pigmented, ocular spot black, and antenneae and body violetblue, with darker pigment dorsally, especially on tergites Th II-Abd III and distal part of the head; antennea with distal area pigmented and Ant IV totally pigmented; some specimens with posterior Th III and Abd I paler (Fig. 8C, D). Head Mc Pa5 present; A0, A2 and A3 as Mc, and A2a as mes; posterior labial row with M1, M2, R*, E, L1 and L2 ciliated Mc (R half to two thirds of M; sometimes M 1 absent and usually asymmetric); Th II a little projected overhead, i.e., not pointed completely downward; Th II-III without Mc; Abd II with chaeta a2p present, a3 forward from ‘a’ sensilla and only m3 as ciliated Mc, Abd IV with four median ciliated Mc (C1, B4-6), three non-fan-shaped ciliated mic behind anterior bothriotrichum and bothriothrichal complex mic D1p present; claw with four internal teeth: two basal and two unpaired; empodium acuminate; manubrial plate with three internal and 5-8 external chaetae. 

**Description**

**Size and color**

Body length up to 2.00 mm, including head (mean 1.64 mm, n = 17 adults), excluding antenneae (holotype: 1.80 mm). Color variable, from pale to dark violet almost whole body except last two abdominal segments and furcula; all specimens maintain transversal bands on Th II-Abd III; blue pigment on vertex of head and ocular patches Ant IV and tip of Ant II-III pigmented. Scales present on Ant I-II, ventral and dorsal head, thorax and abdomen dorsally, coxae I-III and femora-tibiotarsus I-III, dorsally and ventrally on manubrium and only dorsally on dens; manubrium and dens similar in length (0.37 mm, n = 15); non-anneulated part of dens three times the length of micro. 

**Head**

Antennal head ratio 1.58 (n = 6). Ant IV without apical bulb, apical organite and accessory sensilla as in Figure 11B. Ant III sense organ with two curved and expanded sensilla, one of them bigger than the other (Fig. 11C) three spiny guard sensilla, one of them blunt; on Ant II one distal similar but straight to Ant III expanded sensilla; Head Mc Pa5 present, A0, A2 and A3 as ciliated Mc, A2a as mes; t, s and p chaetae present on ocular well (p as mes, bigger than the other), three scales in the area; head dorsal chaetotaxy as in Figure 11A with 5-8 antennal (An) ciliated Mc basomedian labial fields chaetae smooth. Four prelabral ciliated chaetae; labrum with three rows, ‘a’ row with four apically ciliated chaetae, ‘m’ and ‘p’ with five smooth chaetae (Fig. 11D). Four labral papillae, conical or with a pinelike chaeta. Maxillary palp bifurcated with three smooth appendages (Fig. 11E). Labial palp (l.p.) E with finger-shaped process not reaching at base of apical appendage (Fig. 11F). Labial row with M1, M2, R*, E, L1 and L2 ciliated...
Mc (R half to two-thirds of M; M₁ sometimes absent and usually asymmetric) (Fig. 11G). Postlabial chaetotaxy with 3 + 1 ciliated central Mc along the groove. 12 + 12 spinelike chaetae on posterior dorsal head.

Thorax chaetotaxy (Fig. 12)
Th II and Th III without Mc; Th II with 's' and 'ms' in posterolateral position at level of m row; Th III with two 'a' mic before psp, a₂, a₃, a₅, a₆, m₂ (above psp), m₃, m₄, p2-p₆ and on lateral tergite a mes with the lateral sensilla (sl) interiorly.

Abdomen chaetotaxy (Figs 12; 13)
Abd I with a₁ before psp; m₁ beside psp; a₁, a₆, m₃, m₄, m₆ and p₅ (with the 'ms' near a₃). Abd II, mi and ml chaetae present over bothriotrichum (m₂); a₂ₚ (p) present as smooth
mic; $a_2$ (a) as smooth mic; $m_3$ (B) present as ciliated Mc; ‘as’ over $m_3$ and $a_3$ upside over $a_2$ (two times its length); $m_{se}$ and $p_1$ (q1 and q2) present as smooth mic; $l m$ and $l l$ present as pointed ciliated mic over bothriotrichum ($a_4$: $a_6$ and $m_6$ and $p_5$ as smooth mic; $m_3$ as Mc. Abd III, $m_l$, $m_l$, and $a_2$ as pointed ciliated mic over bothriotrichum ($m_3$): ‘as’ between $a_2$ and $m_3$; $m_4$ as smooth mic; $a_3$ very up; $p_1$ below $m_1$, and $m_4$ as smooth mic; $l m$, $l l$, and $a_6$ as ciliated pointed mic surrounding bothriotrichum ($a_3$); $m$, and $e m$ as small ciliated mic over $m_3$ bothriotrichum; $p_{3m}$ and $p_6$ as ciliated Mc with $d_3$ between them; ‘ms’ near $p_3$ as smooth mic; $p_{8p}$ as ciliated mic; $a_7$, $a_8$, $m_7$, $m_8$, $p_7$ and $p_8$ as smooth mic. Abd IV with four median mac ($C_1$, $B_4$, $G_0$; ratio between $C_1$-$B_4$/B_3-B_6 0.60-0.74, $n = 3$), and 6 lateral Mc (E_2-A, F_1, $T_5$ as mic, $D_5$, $T_6$ and $T_7$ as mes ($D_3$ as Mc in some specimens); before $T_2$ bothriotrichium, usually, three pointed ciliated mic ($a$, $m$, and $D_1$), with a supplementary ‘s’ chaeta present in only one specimen ($σ$ and asymmetric (Fig. 13).

Legs
Scales on legs (including all coxae). Trochanteral organ V-shaped with about 14-19 spine-like chaetae (n=3). Claw with four teeth on inner edge: basal pair at 50%, an unpaired median at 65%, and one minute unpaired subapical; two lateral teeth intermediate to base and paired, and one more basal dorsal tooth. Empodium acuminate, all with pe lamella serrated, other lamellae smooth (ae, ai, p1). claw:empodium ratio = 1:0.8. Tibiotarsus III distally with one inner smooth chaeta similar in size to empodium; tenent hairs spatulated, smooth, similar in size to claw (Fig. 11H).

Furcula
Manubrium with scales dorsally and ventrally. Dens with scales only dorsally; manubrium and dens similar in length; manubrial plate (dorsally) with three internal ciliate Mc, between 5 and 8 (n=3) external chaetae, and 2 psp. Non-ringed area of dens three times the length of mucro (0.002 mm) (Fig. 11I).

Macrochaetotaxy
Reduced formula (from Gisin 1965, 1967a, b): $R_9R_5R_3001/00/00101+3/0$, $p_Bq_1q_2$, $M1M2R^*EL1L2$ (**½ to 2/3 of M).

Ecology
Species widely distributed in the three mountain ranges, found in the MSS of more than half of the sampling points (Fig. 1A-C). Although it is present in the three bioclimatic zones, given the average catch and its frequent occurrence, it is more common with increasing altitude. Nevertheless, its greatest activity was recorded in SSD-6 of Canchal La Pedritza (Fig. 3G, H), located in the oro Mediterranean forest zone, and accounts for 32% of the 234 Entomobryomorpha (not including Orchaeella) collected there (Fig. 1E). At this site, L. labyrinthini Baquero & Jordana n. sp. is syntopic with seven other species (Figs 1F; 3H) of the group analyzed in this study.

Remarks
Winkler (2016) and Mateos (2011) defined the L. lignorum group as the species with the formula $R_9R_5R_3001/00/00101+3$ (with or without cephalic Mc $S_6$, also called $P_a$) and scales on antennae and legs, which currently includes the species: L. barbulus Mateos 2011, L. instans Rusek, 1924, L. juliae Mateos, 2011, L. lignorum (Fabricius, 1775), L. peisonis Traser & Christian, 1992, L. ruber Schött, 1902, L. tellecheae Arbea & Jordana, 1990, L. traseri Winkler, 2016, L. uzeli Rusek, 1985, L. violaceus ([Geoffroy, 1762] Fourcroy, 1785). According to this definition, this new species belongs to this group. The species that share the traditional dorsal body macrochaetotaxy formula of Gisin (1965, 1967a, b) with this species include L. barbulus, L. instans, L. juliae, L. lignorum, L. peisonis, L. traseri, L. tellecheae, L. uzeli and L. violaceus.

Lepidocyrtus barbulus is differentiated by the labial formula; it also has a pale color. Lepidocyrtus tellecheae has scales in the antennal segments I-III, claw with three teeth and row ‘a’ of the labral series with pointed chaetae. Lepidocyrtus juliae, L. lignorum and L. violaceus have labial papillae multispinatae; L. juliae also has a characteristic coloration, with only four spots and L. lignorum has no pigment. Lepidocyrtus peisonis has smooth labial papillae and row ‘a’ of labral chaetae pointed. Lepidocyrtus traseri has three teeth on the claw and outer lamella of the empodium smooth. Lepidocyrtus traseri also has the outer lamella of the empodium smooth, in addition labral chaetae of row ‘a’ are bifurcated. Lepidocyrtus uzeli has the claw with only two teeth. Lepidocyrtus juliae, L. lignorum, L. traseri and L. violaceus have the row ‘a’ of labral chaetae bifurcated (Table 5).

The wide distribution of L. labyrinthini Baquero & Jordana n. sp. does not correspond to the activity records, since it represents only 1% of the Entomobryomorpha and Entomobryidae, studied in this work, (Figs 1D; 2A, B).

Lepidocyrtus paralignorum
Baquero & Jordana n. sp.
(Figs 8F; 14A-F; 15A-E; 16; Table 5)

um:tsid.zoobank.org:act:C3480E16-3903-4E20-83C6-807916103607

Type Material. — Holotype. Spain • 9; Madrid, Sierra de Guadarrama, Cuerna Larga and associated mountainous complex, Collado de Peña Vaqueros (Loma de Pandasco); 30 T 4227 45170; 2233 m a.s.l.; 6.XI.2015; Ortuño et al. leg.; pitfall SSD (since 3.VI.2015); MZNA SSD-30 (slide 06).

Paratypes. Spain • 4 specimens on slide and 10 in ethyl alcohol; SSD-12, slide 10; Ortuño et al. leg.; MZNA • 1♂ and 2 juveniles on slide and 44 in ethyl alcohol; SSD-28, slide 05; same data; MZNA • 1♂ on slide and 50 in ethyl alcohol; SSD-29, slide 07; same data; MZNA • 10 specimens in ethyl alcohol; SSD-29; same data; MNHN.

Type Locality. — Spain, Madrid, Sierra de Guadarrama, Cuerna Larga and associated mountainous complex, Collado de Peña Vaqueros (Loma de Pandasco); 30 T 4227 45170; 2233 m a.s.l.

Etymology. — The specific epithet contains the prefix “para” (outside of…) of Greek origin. This indirectly conveys the idea that it is a species close to L. lignorum.
Additional material.— Spain • 3 specimens; SSD-1 (0.5 m depth), slide 05; Sierra de Guadarrama, Segovia; Ortuño et al. leg.; MZNA • 3 specimens on slide and 210 in ethyl alcohol; SSD-2 (0.5 m depth), slides 09 and 10; same data; MZNA • 8 ♀, 5 ♂ and 6 juveniles on slide and 22 in ethyl alcohol; SSD-2 (1 m depth), slides 04, 13 and 22; same data; MZNA • 2 ♀, 1 ♂ and 5 juveniles; SSD-3 (1 m depth), slides 11 and 13; same data; MZNA • 3 specimens on slide and 29 in ethyl alcohol; SSD-4; 1 m depth; slide 06; same data; MZNA • 1 ♂ subadult and 1 juvenile on slide; SSD-5, slide 07; same data; MZNA • 13 specimens; SSD-6, slides 11 and 12; same data; MZNA • 4 specimens; SSD-7, slide 09; same data; MZNA • 1 ♀ and 3 juveniles on slide and 16 in ethyl alcohol; SSD-8, slide 09; same data; MZNA • 1 ♀ and 5 juveniles on slide and 68 in ethyl alcohol; SSD-11, slide 07; same data; MZNA • 1 ♀ and 3 juveniles on slide and 32 in ethyl alcohol; SSD-17, slide 06; same data; MZNA • 5 ♀ and 2 juveniles on slide and 60 in ethyl alcohol; SSD-18, slides 09 and 10; same data; MZNA • 4 juveniles; SSD-20, slide 06; same data; MZNA • 1 ♀ and 11 juveniles on slide and approximately 1800 in ethyl alcohol; SSD-22, slides 05 and 07; same data; MZNA • 4 specimens on slide and 150 in ethyl alcohol; SSD-25, slide 12; same data; MZNA • 1 ♀ and 3 juveniles on slide and 26 in ethyl alcohol; SSD-26, slide 05; Madrid; same data; MZNA • 3 specimens; SSD-27, slide 05; same data; MZNA • 2 ♀ and 1 ♂ on slide and 71 in ethyl alcohol; SSD-31, slide 10; same data; MZNA.

Diagnosis.— Body without pigment, except for head vertex, ocular spot and antennae (final part of Ant II, whole Ant II-IV); Ant I- II and legs I-III scaled (except coxa I). Head Mc Pa5 present; A0, A2 and A3 as Mc, A2a as ciliated mes; posterior labial row with M1, M2, R*, E, L1 and L2 ciliated Mc. Th II projecting over head, i.e., pointed downward; Th II-III without Mc; Abd II with chaeta a2p present, a3 very forward from ‘as’ sensilla and only m4 as ciliated Mc; Abd IV with four median mac (C1, B4-6), three or four non-fan-shaped ciliated mic behind anterior bothriotrichium and bothriotrichial complex mic D1p present; claw with four internal teeth: two basal and two unpaired; empodium acuminate; manubrial plate with 3 internal and 5-8 external chaetae.

Description
Size and color
Body length up to 2.40 mm including head (mean 1.57 mm, n = 27 adults), excluding antennae (holotype: 2.10 mm). Color white with blue pigment on Ant III-IV and tip of Ant II; blue pigment on vertex of head and ocular patch (Fig. 8F). Scales present on Ant I-II, ventral and dorsal head, thorax and abdomen dorsally, coxae II-III and femora-tibiotarsus I-III, and furcula dorsally and ventrally.

Head
Antennal head ratio 1.5 (n = 4). Ant IV without apical bulb, four types of sensilla (Fig. 14A), and apical organite and accessory sensilla as in Figure 14B; Ant III sense organ with two expanded sensilla, three spiny guard sensilla, s-blunt sens, ciliated and weakly ciliated chaetae (Fig. 14C); on Ant II two distal similar to Ant III expanded sensilla. Head Mc Pa5 present; A0, A2 and A3 as Mc, A2a as ciliated mes; 5-8 antennal (An) ciliated Mc; s, t and p chaetae present on ocular well (p as mes) (Fig. 14D); basomedian labial fields chaetae smooth. Four prelabral ciliated chaetae (only one
Fig. 15. — Lepidocyrtus paralignorum Baquero & Jordana n. sp.; A, Th II dorsal chaetotaxy with detail of the area with the lateral sensilla and microsensilla (B); C, Th III-Abd I dorsal chaetotaxy; D, Abd II-Abd III dorsal chaetotaxy; E, Abd V dorsal chaetotaxy. Abbreviations: see Material and methods. Symbols: ●, Mc; ○, mes; ●, pseudopores; ●, bothriotricha. Scale bar: 0.02 mm.
Fig. 16. — *Lepidocyrtus paralignorum* Baquero & Jordana n. sp., Abd IV dorsal chaetotaxy. Symbols: ●, ciliated Mc, size proportional to reality; ○, mes; □, pseudopores; ▲, bothriotricha; ▲, accessory chaetae. Abbreviations: see Material and methods. Scale bar: 0.05 mm.
Labrum with three rows, 'a' row with four bifurcate chaetae, 'm' and 'p' with five smooth chaetae. Four labral papillae, mono to three spinulated (small projection, not a relatively large chaeta-like projection). Maxillary palp bifurcated with three smooth appendages. Labial papilla (l.p.) E with finger-shaped process not reaching base of apical appendage. Labial row with M₁, M₂, R*, E, L₁ and L₂ ciliated Mc (R half to two thirds of M₁; sometimes M₁₄ or M₃₇ present and usually asymmetric). Postlabial chaetotaxy with 3 + 1 ciliated central Mc along the groove.

**Thorax chaetotaxy** (Fig. 15A, B)
Th II and Th III without Mc; Th II with s and ms in postero-lateral position at level of m row; Th III with a₁ before psp, a₂, a₄, a₆, m₂, m₄, m₅ and m₆, p₂, p₃, p₄, p₅ and p₆, two lateral mes with the lateral sensilla (s) between them, and four Mc in front of the sensilla.

**Abdomen chaetotaxy** (Figs 15C-E; 16)
Abd I with a₁ before psp, and a₂; a₃ as; m₂, m₃, m₄, m₅ and m₆; p₅ and p₆ a sensilla in front of p₅ and m₆, and three lateral mes. Abd II, mi and ml chaetae present over bothriotrichum (m₃); a₂, (p) present as smooth mic; a₃ (a) as smooth mic; m₁ (B) present as Mc; ‘a’ over m₁ and a₁ very up; m₃, and p₄ (q₁ and q₂) present as slightly ciliated mic; li, lm and ll present as pointed ciliated mic over bothriotrichum (a₂); a₅, m₆ and p₆ as smooth mic; m₄ as slightly ciliated mic; m₂ as Mc. Abd III, mi, ml and a₆ as pointed ciliated mic over bothriotrichum (m₂); m₁ and m₃ as slightly ciliated pointed mic; ‘a’ before m₃; a₁ very up; p₃ below m₃ as smooth mic; lm, li, ll and a₆ as ciliated pointed mic surrounded bothriotrichium (a₃); im and em as small ciliated mic under a₅ bothriotrichium; am₆ as ciliated pointed mic over bothriotrichium (m₃); pm₆ and p₈ as ciliated Mc with d₃ between them; ‘ms’ near p₅ smooth mic; m₁₄ and p₈ as ciliated mes; m₂₄, m₅₈, p₇ and p₈ as smooth mic. Abd IV with four median mac (C₁, B₄₋₆; ratio between C₁-B₄/B₄₊₋₆ mac); and 7 lateral mac (D₃, E₂₋₄, F₁₋₃); T₅ as mic, T₆ and T₇ as ciliated mes; before T₅ bothriotrichium, there are usually three pointed ciliated (a, m and D₃); in a 20% is present the supplementary ‘s’ chaeta. Abd V as in Figure 15E.

**Legs**
Scales on legs except coxa I. Trochanteral organ V-shaped with about 13 spinelike chaetae (n = 37, between 10-17; 30 in a specimen with 2.4 mm in length). Claw with four teeth on inner edge: basal pair at 50%, an unpaired median at 65%, and one minute unpaired subapical; two lateral teeth intermedial to base and paired, and one more basal dorsal tooth. Empodium acuminate, all with pe lamella serrated, other lamellae smooth (ae, ai, pl); claw: empodium ratio = 1 : 0.70. Tibiotarsus III distally with one inner smooth chaeta 1.10 longer than empodium; tenent hairs spatulated, smooth, and 0.88 shorter than claw (Fig. 14E).

**Macrochaetotaxy**
Reduced formula (from Gisin 1965, 1967a, b): R₉R₉R₀/₀₀₀₀₀₀₀₀₀₀₀₁₃ₐ₀, pBq₁₄₁₂, M₁*M₂*R*EL₁L₂ (* in a 28% M₁ is duplicate with a smaller chaeta; ** 1/2 to 2/3 of M). No significant relationship between the duplication of the M₁ and the presence of the supplementary chaeta ‘s’ over the Abd IV bothriotrichum. Furcula: manubrium and dens with scales dorsally and ventrally; manubrial plate (dorsally) with seven external (between 5 and 12, n = 36), three (exceptionally two) internal ciliate Mc, and 2 psp. Non-ringed part of dens two times the length of micro, with subapical tooth a little smaller than the apical tooth. (Fig. 14F).

**ECOLOGY**
Species widely distributed in the three mountain ranges (Fig. 1A-C), and present in the three bioclimatic zones. Only surpassed in distribution by *E. guadarramensis* Jordana & Baquero n. sp., and almost at the same time as *H. major*. From an altitudinal perspective, the average of collections per bioclimatic zone shows that the activity of *L. paralignorum* Baquero & Jordana n. sp. increases with altitude. However, this is due to the bias provided by two sampling points: 1812 specimens (SSD-22) and 3708 specimens (SSD-30), respectively, for this new species. La Loma de Pandasco (SSD-30), in the cryo-Mediterranean zone, is one of the places with the most extreme environmental conditions (Fig. 4A, B). At this site *L. paralignorum* Baquero & Jordana n. sp. represents 99% of the total collected specimens (Fig. 1E), being syntopic with other four Entomobryomorpha species (excluding *Orchesella*) (Fig. 1F; 4B) that were poorly represented.

**REMARKS**
*Lepidocyrtus paralignorum* belongs to the *L. lignorum* group as the previous species. With regard to the shape of the labral papillae, it is separated from *L. poenonis* and *L. ruber* by smooth papillae, and from *L. traseri*, *L. tellecheae* and *L. uzei* because they have a chaeta-like projection. *Lepidocyrtus barbulus* is separated from the remaining species by having the labral chaetae of row ‘a’ pointed instead of bifurcated, and, in addition to the chaetae, M₁, M₂ and R are duplicated or triplicated, something not found in any other species of the group. *Lepidocyrtus instratus* and *L. violaceus* have only three teeth on the inner border of the claw (the last unpaired tooth missing). *Lepidocyrtus juliae* has a particular color pattern, with four dorsal spots on Abd II and Abd IV; it also has intracocular ‘q’ chaeta, and four scales in the area: *Lepidocyrtus juliae* does not have the chaeta d₃ in Abd III, and does not have ml in Abd II. *Lepidocyrtus lignorum* has all chaetae over bothriotricha fan-shaped and external lamella of empodium smooth. See Table 5.

It is the most abundant species, with capture records that account for 29% of the Entomobryomorpha studied here (Fig. 1D), and 30% of the Entomobryidae (not including *Orchesella*) (Fig. 2A, B).
Lepidocyrtus purgatori Baquero & Jordana n. sp. (Figs 8E; 17; 18; 19)

Type Material. — Holotype. Spain • 9; Madrid, Sierra de Guadarrama, Cuerda Larga and associated mountainous complex, El Purgatorio; 30T 4274 45224; 1406 m a.s.l.; 5.V.2015; Ortuño et al. leg.; pitfall SSD (since 18.VI.2015); MZNA SSD-14 (slide 04).

Paratypes. Spain • 5 specimens on slide and 11 in ethyl alcohol; same data as for holotype, slide 08; Ortuño et al. leg.; MZNA • 5 specimens in ethyl alcohol; SSD-29; same data as for holotype; MNHN.

Type Locality. — Spain, Madrid, Sierra de Guadarrama, Cuerda Larga and associated mountainous complex, El Purgatorio; 30T 4274 45224; 1406 m a.s.l.

Etymology. — The specific epithet “purgatorium” (purgatory), refers to the presence of this species in a beautiful place from the Sierra de Guadarrama, known as ‘Cascada de El Purgatorio’.

Diagnosis. — Body pale violet-blue, ocular spot black, antennae partially bluish from distal part of Ant I to tip, dorsal head slightly pigmented, Th II-Abd III with bluish bands (darker on Abd II-III), and an oval spot with a pale interior area on lateral Abd IV. Head: A0, A2, A3, M1, S3 and Pa3 as Mc; A2a as mes; basomedian labial
fields chaetae smooth; posterior labial row with M₂, R*, E, L₁ and L₂ ciliated Mc (*R half to two thirds of M); one ciliated and two smooth postlabial Mc. Th II a little projected over head, i.e., not pointed completely downward, and with one Mc; Th III without Mc; Abd II without chaeta a₂ p, a₂ and m₃ as ciliated Mc; Abd IV with four median Mc (C₁, B₄-6), three non-fan-shaped ciliated mic behind anterior bothriothrichum and bothriothrichal complex mic D₁ present; claw with four internal teeth: two basal and two unpaired; empodium acuminate; manubrial plate with 2 internal and 0-3 external chaetae.

DESCRIPTION

Body
Body length up to 1.25 mm (holotype), head included (mean 1.05 mm, n = 6 adults), excluding antennae. Body pale violet blue, ocular spot black, antennae partially bluish from distal part of Ant I to tip, dorsal head slightly pigmented, Th II-Abd III with bluish bands (darker on Abd II-III), and an oval spot with a pale interior area on lateral Abd V (Fig. 8E). Scales absent on antennae, present on coxa, ventral and lateral manubrium, ventral dens, thorax, and abdomen; manubrium and dens similar in length (0.27 mm, n = 5); not annulated part of dens 4-5 times the length of mucro. Microchaetae on body with a particular aspect (Fig. 17J).

Head
Antennal head ratio 2.40 (n = 5). Ant IV with simple apical bulb, apical organite not capitate and accessory sensilla as in Figure 17A; Ant III sense organ with two curved and expanded sensilla (Fig. 17B) three spiny guard sensilla, one of them blunt. Four prelabral chaetae, lateral ciliated and central bifurcated and ciliated; labrum with three rows, ‘a’ row with four apically bifurcated chaetae, ‘m’ and ‘p’ with five smooth chaetae (Fig. 17C). Four labral papillae not visible or absent. Maxillary palp bifurcate with three smooth appendages. Labial papilla (l.p.) E as in Figure 17D with finger-shaped process reaching toward base of apical appendage. Labial row with M₂, R*, E, L₁ and L₂ ciliated Mc (R half to two thirds of M). Postlabial chaetotaxy with one ciliated and two smooth central Mc along the groove (Fig. 17F). Head dorsal chaetotaxy with four antennal (An) ciliated Mc. A₀, A₂, A₃, S₂ and Pa₅ as Mc; R₁s (A₂a) as mes; 4-5 Mc on series An (Fig. 17E); interocular chaetotaxy not seen.

Thorax chaetotaxy (Fig. 18)
Th II with one Mc (p₃), with ‘s’ and ‘ms’ in posterolateral position at level of m row; a₂ s, m₁, m₃, p₁-p₃ (Mc), p₅-p₆ (p₆ more spiniform); Th III without Mc, with two mic before psp (a₂ and p₁), and a₃, a₄, m₂ (near psp), m₃-m₆ p₅-p₆ an ‘al’ sensilla near a mes up to m₆ (Fig. 18).

Abdomen chaetotaxy (Figs 18, 19)
Abd I with a₁ before psp; a₂-a₃, a₅-a₆ (‘ms’ near and external to a₃); m₃ (next to psp), m₃-m₆ p₅-p₆. Abd II, mi and ml chaetae present over bothriothrichum (m₃); a₃, p₄ (absent); a₂ and m₁ (B) present as ciliated Mc; ‘as’ over m₃ and a₃ upside over a₂ (1.5 times the length of as); m₃e and p₄ (q₁ and q₂) present as smooth mic; lm and II present as pointed ciliated.
mic over bothriotrichum (a₃); a₆, m₄, m₆ and p₅ as smooth mic; m₅ as a very big ciliated Mc. Abd III, mi, ml and a₂ as pointed ciliated mic over bothriotrichum (m₃); ‘as’ between a₂ and m₃, next to m₃ as ciliated mic; a₃, m₃ and p₃ equidistant; p₃ below m₃, and m₄ as mes; lm, ll and a₆ apparently as ciliated mic surrounding bothriotrichum (a₅); im, em and am₆ as small ciliated mic over m₅ bothriotrichum; pm₆ and p₆ as very long and pointed ciliated Mc; d₃ absent; ‘ms’ near p₅ as smooth mic; m₈ as ciliated mes; m₇ and p₇ as smooth mic. Abd IV with four median mac (C₁, B₄₋₆; ratio between C₁-B₄/B₄-B₆ 0.46, n = 5), and 7 lateral mac (D₃, E₁-₄, F₂₋₃; E₂ missing in a ♂); T₅ as mic, T₆ and T₇ as mes; before T₂ bothriotrichum, usually, there are three pointed ciliated mic (a, m and D₁) (Fig. 19).

Fig. 19. — Lepidocyrtus purgatorii Baquero & Jordana n. sp., A, Abd IV dorsal chaetotaxy; B-E, detail of some chaetae of Abd III and IV: B, bothriotrichum lateral of Abd III; C, T₆ chaeta of Abd IV, D, M₃ chaeta, lateral, of Abd III; E, B₄ chaeta of Abd IV. Abbreviations: see Material and methods. Symbols: ●, Mc; ○, mes; ◆, pseudopores; ◄, bothriotricha; ▲, special chaetae. Scale bars: 0.05 mm for tergite, 0.02 mm for chaetae.
Lepidocyrtus purgatori Baquero & Jordana n. sp. is, of all the species of Entomobryomorpha, the one with the lowest abundance, with only 22 specimens collected (Figs 1D; 2F).

**Remarks**
This species does not share the reduced formula of Gisin (1965, 1967a, b) with any other species (R111/10/0201 + 3/0, Abq4q3). The closest species belong to the *L. lusiaticus* group with a characteristic three Mc on Abd II, but are different in many other characters: prelabral chaetae, absence of labral papillae, length of the antennae and, in the case of *L. lusiaticus*, the color pattern.

**Lepidocyrtus tellecheae** Arbea & Jordana, 1990

**Material Examined.** — Spain • 3 specimens; SSD-3, slide 11; Oritoño et al. leg.; MZNA • 3 specimens on slide and 180 in ethyl alcohol SSD-14, slide 06; same data; MZNA • 2 specimens on slide and 63 in ethyl alcohol; SSD-15, slide 08; same data; MZNA • 2 specimens on slide and 63 in ethyl alcohol; SSD-19, slide 04; same data; MZNA • 4 specimens on slide and 27 in ethyl alcohol; SSD-26, slide 08; same data; MZNA.

**Remarks**
Present in several localities in the north of Navarra (Spain), where it was originally described (Arbea & Jordana 1990). It has been subsequently cited in Barcelona (Mateos et al. 2018).

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**Table 6** — Group of species of Pseudosinella Schäffer, 1897 that share the Gisin’s reduced formula (1965, 1967a, b): *P. styriaca* Neuherz & Nosek, 1975 (Austria, cave), *P. subcentrals* da Gama, 1985 (Majorca, cave), *P. valverdei* Baquero & Jordana n. sp. and *P. gonzaloi* Baquero & Jordana n. sp. Legend for the headers of the columns: **Head:** EN, eyes number; **S**, dorsal cephalic macrochaetae **S**1, **S**2 or **S**3: 1, absent; 2, present; **P**, dorsal cephalic macrochaetae **P**1, absent; 2, present; **M**, ventral labial chaeta: 0, absent; 1, smooth macrochaeta; 2, smooth macrochaeta; 3, ciliated macrochaeta or mesochaeta; 4, ciliated macrochaeta; 5, smooth macrochaeta with supplementary seta; 6, ciliated macrochaeta with supplementary chaeta; **M**2, ventral labial chaeta: same as for **M**1; **R**, ventral labial chaeta: 0, absent; 1, smooth macrochaeta; 2, smooth macrochaeta; 3, ciliated macrochaeta or mesochaeta; 4, ciliated macrochaeta; 5, smooth macrochaeta with supplementary seta; 6, ciliated macrochaeta with supplementary chaeta; **T**, dorsal labial chaeta: 1, absent; 2, present; **a**, a2 chaeta shape (Abd II): 0, absent; 1, smooth microchaeta; 2, ciliated microchaeta; 3, smooth macrochaeta; 4, ciliated macrochaeta; **b**, m3 chop shape (Abd II): same as for the anterior character; **c**, m3 macrochaeta (Abd II): same as for the anterior character; **d**, m3a macrochaeta (Abd II): 1, absent; 2, present; **e**, medial (M or B) Abd IV dorsal macrochaetae number; **f**, c-shaped microchaeta (Abd II): 1, absent; 2, present; **g**, claw teeth number and shape: 1, 0/2, 2 only paired/ 3, 2 paired + 1 unpaired/ 4, 2 paired + 2 unpaired/ 5, 2 pairs (2 + 2) + 1 unpaired; **CP**, color pattern. Abbreviations and symbols: *, difference for the character with *P. valverdei* Baquero & Jordana n. sp.; °*, difference for the character with *P. gonzaloi* Baquero & Jordana n. sp.; **D**, total number of differences between the species and *P. valverdei* Baquero & Jordana n. sp.; **U**, unknown.

| species                  | EN | S   | T   | P   | M1 | M2 | R   | L1 | L2 | T2 | P   | a   | b   | q1 | q2 | C1 | B  | s   | TH | CL | CP | D1 | D2 |
|--------------------------|----|-----|-----|-----|----|----|-----|----|----|----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| *P. styriaca*            | 0° | 1   | U   | U   | U   | U   | U   | U   | U   | U   | U   | U   | U   | U   | U   | 2  | 2  | 1° | 1° | 2  | 1° | 2  |
| *P. subcentrals*         | 0° | 1   | U   | 2/4 | 2° | 1° | 2° | 2° | 4° | 3° | 1° | 2   | 4   | 4   | 1   | 1   | 2  | 2  | 2   | 1° | 2  | white | 2  |
| *P. valverdei* Baquero & Jordana n. sp. | 0° | 1   | 1   | 1   | 2   | 2° | 2° | 2° | 2° | 2° | 0   | 2   | 2   | 2   | 4   | 1   | 1   | 2  | 2  | 2   | 2   | 2   | 2  |
| *P. gonzaloi* Baquero & Jordana n. sp. | 0° | 1   | 1   | 1   | 1   | 4° | 3° | 4° | 4° | 4° | 0   | 2   | 4   | 4   | 1   | 1   | 2  | 2  | 2   | 2   | 2   | 2   |

**Legs**
Scales only on coxae, not on rest of appendage. Trochanteral organ V-shaped with about 7 spine-like chaetae (n = 5) (Fig. 17G). Claw with four teeth on inner edge: basal pair at 50%, a unpaired median at 65% (highly developed), and one minute unpaired subapical; two big lateral teeth intermedial to base and paired, and dorsal at level of lateral. Empodium acuminate, 0.66 times the length of claw, with pe lamella serrated and other lamellae smooth (ae, ai, pi). Tibiotarsus III distally with one inner smooth chaeta reaching the tip of empodium and same size than claw; tenent hair spatulated, smooth, similar in size than claw (Fig. 17H).

**Furcula**
Manubrium with scales dorsally and laterally; dens with scales only dorsally; manubrium and dens similar in length; manubrial plate (dorsally) with between 1-2 (n = 3) internal chaetae, 0-3 external ciliate Mc, and 2 psp. Non-ringed area of dens 4-5 times the length of mucro (0.015 mm) (Fig. 17I).

**Macrochaetotaxy**
Reduced formula (from Gisin 1965, 1967a, b): R2R1R2111/10/0201+3/0, Abq1q3, M2R*EL1L2 (*½ to 2/3 of M).

**Ecology**
Species only found in the MSS of the site of El Purgatorio (Fig. 1A, C). The sampling point (SSD-14) is at the lower limit of the supra-Mediterranean bioclimatic zone and is located in the ‘Garganta del Arroyo Aguillón’ near large rocky walls (Fig. 4C, D). In these escarpments, the pine forest (*Pinus sylvestris*) loses distribution and gives way to *Quercus pyrenaica*, *Acer monspessulanus*, *Sorbus aucuparia* and *Rhamnus frangula*. *Lepidocyrtus purgatori* Baquero & Jordana n. sp. is syntopic with five other species (Figs 1F; 4D), three of which outnumber its activity (*E. guadarramensis* Jordana & Baquero n. sp., 180 specimens; *H. major*, 93 specimens; and *L. tellcheae*, 183 specimens).

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References

Endo, R. & A. Oritoño, 1973: *Lepidocyrtus purgatori* Baquero & Jordana n. sp. (Entomobryomorpha: Isotomidae) from north of Navarra (Spain). *Rev. Hidrol.* 6: 91-95.

Jordana, E. & E. Baquero, 1985: *Lepidocyrtus purgatori* Baquero & Jordana n. sp. (Entomobryomorpha: Isotomidae) from north of Navarra (Spain). *Rev. Hidrol.* 6: 91-95.
Genus *Pseudosinella* Schäffer, 1897

*Pseudosinella valverdei* Baquero & Jordana n. sp. (Figs 8G; 20; 21; 22; Table 6)

**Type material.** — **Holotype.** Spain • 9: Madrid, Sierra de Guadarrama, Montes Carpetanos, Hoya de la Laguna Grande (east); 30 T 4191 45213; 2049 m a.s.l.; 5.X.2015; Ortuño et al. leg.; pitfall SSD (since 3.VI.2015); MZNA SSD-10 (slide 06).

**Paratypes.** Spain • 10 specimens on slide and 15 in ethyl alcohol; same data as for holotype, slides 06 and 07; Ortuño et al. leg.; MZNA • 5 specimens on slide and 40 in ethyl alcohol; SSD-6, slides 03 and 11; same data; MZNA • 5 specimens in ethyl alcohol; SSD-6; same data; MNHN.

**Type locality.** — Spain, Madrid, Sierra de Guadarrama, Montes Carpetanos, Hoya de la Laguna Grande (east); 30 T 4191 45213; 2049 m a.s.l.

**Etymology.** — This species is dedicated to the biologist Alberto Jiménez-Valverde, member of the research team of this project and active participant in the sampling of the mesovoid shallow substratum.

**Additional material.** — Spain • 2 juveniles; SSD-1 (0.5 m depth), slides 05 and 06; Sierra de Guadarrama, Segovia; Ortuño et al. leg.; MZNA • 2 specimens; SSD-2 (0.5 m depth), slide 09; same data; MZNA • 8 specimens on slide and 393 in ethyl alcohol; SSD-2 (1 m depth), slides 05, 06 and 08; same data; MZNA • 2 juveniles on slide and 56 in ethyl alcohol; SSD-1 (0.5 m depth), slide 09; same data; MZNA • 1 juvenile; SSD-18, slide 07; same data; MZNA • 1 juvenile; SSD-25, slide 06; Madrid; same data; MZNA • 10 specimens on slide and 1103 in ethyl alcohol; SSD-11, slides 05-07; same data; MZNA • 7 juveniles on slide and 589 in ethyl alcohol; SSD-21, slides 03 and 05; same data; MZNA.

**Diagnosis.** — Body with blue pigment, including antennae and first leg segments. Head with 5 + 5 eyes (A-E); A2, A3, and A4 as Mc, A5 absent; basomedian labial fields chaetae smooth; posterior labial row with M1, M2, R*, e, l1, and L1 Mc (R half to two-thirds of M; sometimes M2 and L2 ciliated, and usually asymmetric); three plus one anterior postlabial chaetae as ciliate Mc. Th II-III without Mc; Abd II with chaeta a2p present, a3 forward from ‘as’ sensilla; a2 as mes...
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or short Mc, and m3 as ciliated Mc; Abd IV with three median mac (C1, B5-6), four ciliated mic behind anterior bothriotrichum and bothriotrichial complex mic D1p present; claw with four internal teeth: two basal and two unpaired (the last one sometimes almost imperceptible); empodium acuminate; manubrial plate with three internal and 10-13 external chaetae.

**Description**

**Body**

Body length up to 2.40 mm, head included (mean 2.05 mm, n = 11 adults), excluding antennae (holotype: 2.05 mm). Color dark blue, especially on Ant I-IV (except tip of IV), anterior part of the head, and posterior area of the tergites Th II-Abd VI), coxae, and basal manubrium; Th II darker in front area (Fig. 8G). Scales absent on antennae and legs, present on ventral and dorsal head, thorax and abdomen dorsally, and furcula only ventrally.

**Head**

Antennal head ratio 1.65 (n = 6). Ant III sense organ with two rod-shaped sensilla (individually encased in a pit), three spiny guard sensilla, s-blunt sens, ciliated and weakly ciliated chaetae; on Ant II-3 distal similar to Ant III sensilla; Ant IV without apical bulb, apical organite and accessory sensilla as in Figure 20A. S = 5 + 5 eyes (A-E). Head dorsal chaetotaxy with 8-12 antennal (An) ciliated Mc; s or t and p chaetae present (p as Mc); 4/554 smooth prelabral and labral chaetae (Fig. 20B). Labral papillae absent. Maxillary palp bifurcate with three smooth sublobal chaetae. Labial papilla (l.p.) E with finger-shaped process reaching the base of apical appendage. Labial row with M1, m2, R*, e, l1 and l2 Mc (R half to two-thirds of M; sometimes M2 and L2 ciliated, and usually asymmetric). Postlabial chaetotaxy with 3 + 1 ciliated central Mc along the groove (Fig. 20C).

**Thorax chaetotaxy (Fig. 21)**

Th II and Th III without Mc; Th II with s and ms in anterolateral position; Th III with a1 before psp, a3, a4, a6, m2, m4, m5 and m6, p2, Pp, p3, and p6, two lateral mes with the lateral sensilla (s) between them, and four Mc in front of the sensilla.

**Abdomen chaetotaxy (Figs 21; 22)**

Abd I with a1, a3 and p1, before psp; a3, a4, a6, m2, m4-m6; p3-p6, a sensilla in front of m6, and some lateral mes. Abd II, mi and ml chaetae present over bothriotrichum (m3) (sometimes an additional mic between ml and a3); a2p (p) present as slightly ciliated mic; a2 (A) as small Mc or mes, but not mic; m1 (B) present as Mc; ‘as’ over m3 and a2, and a3 a little above ‘as’; m2, and P1 (q1 and q2) present as slightly ciliated mic; lm and ll present as slightly broadened at tip ciliated mic over bothriotrichum (a3); m4 as slightly ciliated chaeta; m5 as mes. a6 (smooth), a7-8, m6, p5-p8 (slightly ciliated) as mic; Abd III, mi, ml and a2 as slightly broadened ciliated mic over bothriotrichum (m3); ‘as’ before m3 that is apparently smooth; a3, m4 and p3 as slightly pointed ciliated mic; a4 very up; im, li, lm and a6 as ciliated pointed mic surrounding bothriotrichum (a3); em, am6 and a7 as small ciliated mic under a5 bothriotrichum (sometimes an additional mic near a3); pm6 and p6 as Mc with d3 between them (d3 not always present, and duplicated in one specimen); ‘ms’ (d3) near p9 as smooth mic; m9 and p9 as mes; m7-m9, p7 and p9 as smooth mic. Abd IV with three median mac (C1, B5-6; ratio between C1-B5/B5-6 1.00, n = 9), and 7 lateral mac (D3, E2-4, F1-3): T5 as mic, D2, Dc3, E4p, F5p, T6 and T7 as mes; before T2 bothriotrichum four ciliated mic (a, m, s and D1) as in Figure 22;/pi and pe as ciliated fan-shape mic.

**Legs**

Legs without scales. Trochanteral organ with near 40 spine-like chaetae. Claw with four teeth on inner edge: basal pair at 40% and 50% with respect to the internal claw edge length, respectively, first unpaired median at 70%, and one minute (sometimes imperceptible) unpaired subapical at 90%; two lateral teeth at 20%, and one more basal dorsal tooth. Empodium acuminate, all with non-serrated pe lamella (but with a small tooth on first third of all legs, and a minute serration.
Fig. 22. — *Pseudosinella valverdei* Baquero & Jordana n. sp., Abd IV dorsal macrochaetotaxy and detail of chaetotaxy lateral to anterior mac C1. Abbreviations: see Material and methods. Symbols: ●, Mc; ○, mes; ◊, pseudopores; ▲, bothriotricha; ▲, special chaetae. Scale bars: 0.05 mm for whole tergite, 0.025 mm for detail.
on legs 1 and 2), other lamellae smooth (ae, ai, pi); claw: empodium ratio = 1:0.65. Tibiatarsi III distally with one inner smooth chaeta 0.50 longer than claw; tenent hairs capitate, smooth, and 0.90 shorter than claw (Fig. 20E).

**Furcula**

Manubrium and dens with scales only ventrally, and with the same length; manubrial plate (dorsally) with three internal, approximately thirteen external ciliated Mc, and 2 psp (Fig. 20D). Non-ringed area of dens 2-3.5 times the length of micro, with subapical tooth a little smaller than apical tooth (Fig. 20F).

**Macrochaetotaxy**

Reduced formula (from Gisin 1965, 1967a, b): $R_2 R_4 R_8 0000/00201+2/s, pABqR^2, M_1 M_2 R^* e1 e2 (* 1/2 to 3/5 of $M$; sometimes $M_3$ and $L_2$ ciliated, and usually asymmetric).

**Ecology**

Species widely distributed in MSS of Montes Carpetanos and Siete Picos-La Mujer Muerta, not detected in Cuerda Larga (Fig. 1A-C). According to the available data (presence and activity), it appears to show a preference for the subsoil of the oro-Mediterranean zone, with dominance in the forest strip. Its presence in the cryo-Mediterranean zone has not been verified and the upper level of this species is 2049 m a.s.l., which corresponds to SSD-10 installed in the Canchal Hoya de la Laguna Grande (supra-forestal strip of the oro-Mediterranean zone). Its greatest activity was recorded in SSD-11 in the Canchal Cerro Ventoso (Fig. 4E, F), exceeding a thousand specimens (more than half of the Entomobryomorpha species) of this site, under the narrow influence of the pine forest (Pinus sylvestris), has revealed itself as one of the most diverse in Collembola, as it contains eight species of Entomobryomorpha (excluding *Orchesella*), has revealed itself as one of the most diverse (Fig. 1E). The MSS of this site, under the narrow influence of the pine forest (Pinus sylvestris), has revealed itself as one of the most diverse in Collembola, as it contains eight species of Entomobryomorpha (excluding *Orchesella*), with *P. valverdei* Baquero & Jordana n. sp. as the dominant species (Figs 1F; 4F).

**Remarks**

The species that share the traditional formula of Gisin (1965, 1967a, b) are, in addition to *P. gonzaloi* Baquero & Jordana n. sp., *P. styriaca* Neuherz & Nosek, 1975, *P. subciliaris* Gama, 1985 and *P. valverdei* Baquero & Jordana n. sp. Table 6 shows the differences between these four species.

In terms of activity, *P. valverdei* Baquero & Jordana n. sp. is the fourth most represented species of Entomobryomorpha (excluding *Orchesella*) in the MSS, with 11% (Fig. 1D), and Entomobryidae with 12% (Fig. 2A, B).

**Pseudosinella gonzaloi** Baquero & Jordana n. sp. (Figs 8H; 23; 24; 25; Table 6)

**Type material.** Holotype. Spain • ♀; Segovia, Sierra de Guadarrama, Siete Picos-La Mujer Muerta, Umbría de la Mujer Muerta (North); MZNA • 1 specimen in ethyl alcohol; SSD-11; same data; MNHN.

**Etymology.** This species is dedicated to the biologist Gonzalo Pérez-Suárez, member of the research team for this project and active participant in the sampling of the mesovoid shallow substratum.

**Additional material.** Spain • 4 juveniles and 600 (approximately) in ethyl alcohol; SSD-16, slide 08; Sierra de Guadarrama, Segovia; Ortuño et al. leg.; MZNA • 8 ♀, 1 ♀ and 19 in ethyl alcohol; SSD-25, slides 05, 06; same data; MZNA • 2 juveniles; SSD-26, slide 09; same data; MZNA.

**Description.** Body with blue pigment, including antennae and first leg segments, as in Figure 8H. Head with 6 + 6 eyes (A-F); Mc $A_0$, $A_1$, and $A_2$ present, $A_5$ present; t and p chaetae present (p as Mc); basomedian labial fields chaetae smooth; posterior labial row with $M_1$, $M_2$, $R^*$, $E$, $L_1$ and $L_2$ Mc (R half to two thirds of M); two or three anterior postlabial chaetae as ciliated Mc. Th II-III without Mc; Abd II with chaeta a2p present, a3 forward from ‘a’s’ sensilla; a2 as mes or short Mc, and $m_3$ as ciliated Mc; Abd IV with three median mac ($C_5$, $B_{5,5}$), four ciliated (some fan-shaped) mic behind anterior bothrotrichum and bothriochiral complex mic $D_3$ present; claw with four internal teeth: two basal and two unpaired; empodium acuminate; manubrial plate with 3 internal and 6-9 external chaetae.

**Body**

Body length up to 1.80 mm, head included (mean 1.55 mm, n = 8 adults), excluding antennae (holotype: 1.40 mm). Color blue dark, especially on Ant I-IV, head vertex, and posterior area of the tergites Abd I-Abd VI, coxae, dorsal and basal manubrium; Th II darker at front area. Scales absent on antennae and legs, present on ventral and dorsal head, thorax and abdomen dorsally, and furcula only ventrally.

**Head**

Antennal head ratio 1.60 (n = 2). Ant IV without apical bulb, apical organite and accessory sensilla present (Fig. 23A); three types of sensilla on Ant I-IV (Fig. 23B). Ant III sense organ with two rod-shaped sensilla, three spiny guard sensilla, slight sens, ciliated and weakly ciliated chaetae; 6 + 6 eyes (A-F). Head dorsal chaetaotaxy with 10-12 antennal (An) ciliated Mc (Fig. 23D). 4/554 prelabral and labral chaetae: prelabral ciliated, labral row ‘a’ ciliated only on the final part, and rows ‘m’ and ‘p’ smooth. Labral papillae absent. Maxillary palp bifurcated with three smooth sublobal chaetae. Labial palpula (l.p.) E with finger-shaped process not reaching the base of appendage. Labial row with $M_1$, $M_2$, $R^*$, $E$, $L_1$ and $L_2$ Mc (R half to two thirds of M). Postlabial chaetaotaxy with 2-3 ciliated central Mc along the groove (Fig. 23C).
Thorax chaetotaxy
Th II and Th III without Mc.

Abdomen chaetotaxy (Figs 24; 25)
Abd II, mi and ml chaetae present over bothriotrichum (m₃) (sometimes an additional mic externally to mi); a₃p (p) present as slightly ciliated mic; a₂ (a) as small Mc or mes, but not mic; m₂ (B) present as Mc; ‘as’ over m₂, and a₁ above a₂ and m₂; m₂e and p₄ (q₁ and q₂) present as slightly ciliated mic; lm and ll present as slightly broadened at tip ciliated mic over bothriotrichum (a₅) (additional mic interior to a₅ bothriotrichum; m₄ as slightly ciliated chaeta; m₆ as mes; a₆ (smooth), a₂–a₅, m₆, p₅–p₈ (slightly ciliated) as mic; Abd III, mi, ml and a₂ as slightly broadened ciliated over bothriotrichum (m₂); a₃, m₃, m₄ and p₃ as smooth mic; li, lm and a₆ as ciliated mic above bothriotrichum (a₅); im and am₆ as small ciliated mic under a₅ bothriotrichum; pm₆ and p₆ as Mc with d₄ as slightly ciliated mic between them; ‘ms’ (dₓ) near p₅ as smooth mic; m₇ and p₈p as mes; p₈ as small ciliated mic; a₈, m₇–m₉ and p₉ as smooth mic. Abd IV with three median mac (C₁, B₅–6; ratio between C₁–B₅/B₅–6 109/99 = 1.10), and 7 lateral mac (D₃, E₂–4, F₁–3); T₅ and D₂ as mic; Dₑ₂, E₄p₂, F₃p₀, Fe₅, T₆ and T₇ as mes; before T₂ bothriotrichum four ciliated mic (a, m, s and D₁); some fan-shaped; pi and pe as ciliated fanshape mic.

Legs
Legs without scales. Trochanteral organ with about 15-20 spine-like chaetae (Fig. 23E). Claw with four teeth on inner edge: basal pair at 60% with respect to the internal claw edge length, respectively, first unpaired median at 75%, and one minute unpaired subapical at 85%; two lateral teeth at 20%, and one more basal dorsal tooth. Empodium acuminate, all with pe lamella serrated, other lamellae smooth (ae, ai, pi); claw : empodium ratio = 1 : 0.65. Tibiotarsus III distally with one inner smooth chaeta 0.50 longer than claw; tenent hairs capitae, smooth, and 0.90 shorter than claw (Fig. 23F).
Furcula
Manubrium and dens with scales only ventrally, and with the same length; manubrial plate (dorsally) with three internal, approximately eight external ciliated Mc, and 2 psp (Fig. 23G). Non-ringed area of dens 3.4 times the length of mucro (2.5-5.33, n = 8), with subapical tooth a little smaller than apical tooth. (Fig. 23H).

Macrochaetotaxy
Reduced formula (from Gisin 1965, 1967a, b): R₀R₁R₂000/00/0201+2/s, pABq₁q₂, M₁M₂R*EL₁L₂ (* ½ to 2/3 of M).

Ecology
Species present in the MSS of the three mountainous ranges (Fig. 1A-C) but only verified from the supra-Mediterranean and oro-Mediterranean bioclimatic zones (in the forest strip), in the latter with records that suggest a more stable population. The largest number of specimens was collected with SSD-16, installed in the Canchal Las Revueltas-Los Horcos (Fig. 4G-H), site with strong influence of the pine forest (*Pinus sylvestris*), and where *P. gonzaloi* Baquero & Jordana n. sp. accounted for 67% of the 895 Entomobryomorpha (excluding *Orchesella*) collected there (Fig. 1E). At this site, where this species is dominant, it is syntopic with four other Entomobryomorpha species (Figs 1F; 4H).

Remarks
The species that share the traditional formula of Gisin (1965, 1967a, b) with this species are, in addition to *P. valverdei* Baquero & Jordana n. sp., *P. styriaca* Neuherz & Nosek, 1975 and *P. subcentralis*. Table 6 shows the differences between these four species.

Of the 22 species of Entomobryomorpha (*Orchesella* excluded), *P. gonzaloi* Baquero & Jordana n. sp. is the sixth most abundant, accounting for 4% of the specimens collected (Fig. 1D).
Pseudosinella simoni

**DISCUSSION**

Of the eight new species described, seven are among the nine most abundant of a total of 22 species analyzed in this work (Figs 1D, 2). Four of them have been collected in thousands of specimens (*L. paradigmorum* Baquero & Jordana n. sp., *E. guadarramensis* Jordana & Baquero n. sp., *E. ledesmai* Jordana & Baquero n. sp., *P. valverdei* Baquero & Jordana n. sp.), and another three collected in hundreds of specimens (*P. gonzaloi* Baquero & Jordana n. sp., *P. penalarensis* Baquero & Jordana n. sp., *L. labyrinthi* Baquero & Jordana n. sp.). The taxonomic analysis of the captures recorded in the different SSDs reveals that five new species are among the nine most widespread species (Fig. 1B, C). Therefore, if we combine activity and distribution, the result may be surprising, as new species are not rare in the prospected territory. This diversity pattern has already been observed with the new species of *Orchesella* collected in the MSS of the Sierra de Guadarrama (Baquero et al. 2017). Moreover, the Sierra de Guadarrama is a mountainous area that has long been studied by eminent collembologists (for example, F. Bonet, D. Selga, W. Steiner, J. C. Simon and M. J. Luciáñez) (Luciáñez & Simón 1989). Regarding *Orchesella*, Baquero et al. (2017) concluded “that this environment has its own assemblage of characteristic species”. All the data indicate that the MSS in the Sierra de Guadarrama contains a wide range of species (of various genera) of Collembola, which are specific or nearly specific to these singular habitats.

Predatory species, particularly of Carabidae, have been found with Collembola regularly and abundantly. Four species stand out for their constancy, activity and distribution in the MSS of the Sierra de Guadarrama (Ortuño et al. 2019): *Leistus (Leistus) constrictus* Schaufuss, 1862, *Nebria (Nebria) vuillefroyi* Chaudoir, 1866, *Trechus (Trechus) schaufussi pandelei* Putzeys, 1870, and *Laemostenus (Eucryptotrichus) pinicola* (Graells, 1851). In particular, specialization in hunting both the imago and larva of Collembola has been recognized in *L. (L.) constrictus*, as well as in other species of the genus. The presence of this species in the MSS, where its larvae are particularly abundant (Ortuño et al. 2019), should be taken into account as a regulator of the Collembola populations in these underground spaces.

The results of this study indicate that the MSS is remarkably heterogeneous in terms of the activity, richness and composition of Entomobryomorpha species (Fig. 1C, E, F). The same is likely to be true of other MSS on the Iberian Peninsula. In the future, new studies to characterize this type of Collembola communities will require the development of extensive sampling protocols.

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