Abh. Ber. Naturkundemus. Görlitz	Band 76 Heft 2	S. 117 – 134	2005

ISSN 0373-7586

A proposal of characters for taxonomic identification of *Entomobrya* species (Collembola, Entomobryomorpha), with description of a new species

RAFAEL JORDANA & ENRIQUE BAQUERO

Department of Zoology and Ecology, University of Navarra, Pamplona

Summary

The species of the genus *Entomobrya* have bean traditionally identified using colouration. Only some authors have considered a small number of morphological characters, in badly mounted or old specimens, as well as chaetotaxical characters (but not used for species identification). The study of a large series of slides from extensive collections of *Entomobrya* species with observation of the complete chaetotaxy has demonstrated that specimens with the same colour pattern can have a very different chaetotaxy, which is related with the geographical origin. On the other hand, specimens with similar chaetotaxy but from distant geographical areas maintain the same colour pattern. The present paper proposes a set of both morphological and chaetotaxical characters as a useful tool for the species identification in the genus *Entomobrya* in connection with the observation of colour pattern. For the selection of this set of characters more than 500 slides from the top-ranking European museums have been studied. Two species of the genus with similar colour pattern but with a different chaetotaxy are used as models for the methodology: *E. nivalis* (Linnaeus, 1758) and a new species from León (Spain).

Keywords: Collembola, morphological characters, *Entomobrya leonensis* n. sp.

Zusammenfassung

Merkmale zur taxonomischen Bestimmung von *Entomobrya*-Arten (Collembola, Entomobryomorpha) mit Beschreibung einer neuen Art – Die Arten der Gattung *Entomobrya* werden traditionell nach dem Farbmuster bestimmt. Nur wenige Autoren haben einige weitere Merkmale in Betracht gezogen, von denen die morphologischen bei schlecht präparierten oder alten Individuen schwer sichtbar sind und die chaetotaktischen Merkmale nicht zur Artbeschreibung verwendet wurden. Das Studium der kompletten Chaetotaxie an umfangreichen Serien von Präparaten aus großen *Entomobrya*-Sammlungen hat gezeigt, dass Individuen mit demselben Farbmuster eine deutlich unterschiedliche Chaetotaxie haben können, und zwar in Abhängigkeit von ihrer geographischen Herkunft. Andererseits haben Individuen mit einer ähnlichen Chaetotaxie, aber aus geographisch getrennten Gebieten, dasselbe Farbmuster. In dieser Arbeit wird eine Reihe von sowohl morphologischen als auch chaetotaktischen Merkmalen zusammen mit dem Farbmuster als brauchbare Grundlage der Identifikation von *Entomobrya*-Arten vorgeschlagen. Um diese Merkmals-Serie auszuwählen, wurden mehr als 500 Präparate aus führenden euro-

päischen Museumssammlungen untersucht. Zwei Arten dieser Gattung mit einem ähnlichen Farbmuster, aber einer verschiedenen Chaetotaxie, werden als Modell für diese Methodologie vorgestellt: *E. nivalis* (Linnaeus, 1758) und *E. leonensis* n. sp. aus León (Spanien).

1. Introduction

Among the works for the description of the family Entomobryidae, and mainly in the keys for the genera, CHRISTIANSEN (1958), GISIN (1960) and STACH (1963) use easily visible morphological characters. CHRISTIANSEN (1958) uses for the identification of the Nearctic species of *Entomobrya* in particular: retractile bulb (apical vesicle) of the fourth antennal segment, kind of setae »type five«, relative size (length and width) of the head, length of the external setae of the labial appendage, mesonotum length, setae morphology of the male genital plate, shape of the labral papillae, antennal length and longitudinal or transversal colour stripes. CHRISTIANSEN & BELLINGER (1980) use the same characters, but give more importance to colour pattern in the keys and add some chaetotactic details for some segments, following the paper of SZEPTYCKI (1979) on the chaetotaxy of the family Entomobryidae. In this paper, only *Entomobrya nivalis*, *E. muscorum*, *E. puncteola*, *Entomobryoides myrmecophila*, *Homidia similis* and *Drepanura sexmaculata* are studied, as well as some Entomobryomorpha from other families. SZEPTYCKI refers only to the postcephalic chaetotaxy as used by CHRISTIANSEN. GISIN (1960) presents in his work »Collembolenfauna Europas« a key for the genus *Entomobrya* that principally uses the colour pattern.

A critical analysis of the characters used shows that some morphological characters used at the species level are variable with development (SOUTH 1961). These characteristics are: labial appendage, trochanteral organ, colour pattern and measurements and ratios. Some, such as the colour pattern, have been demonstrated to be very variable between specimens from a single population (JORDANA & BAQUERO 1999), but most authors, such as SOUTH (1961) in his key for British *Entomobrya*, almost exclusively use colour for species identification. Without doubt, the key of CHRISTIANSEN & BELLINGER (1980) for the nearctic species is more acceptable.

We must consider that, while being certain that some morphological characters change with development, others are constant but very difficult to see: labial setae triangle, male genital plate, fourth antennal segment (frequently missing) etc.

The preparation of the volume »Fauna Ibérica, Entomobryomorpha« and the revision work of the Palaearctic species of *Entomobrya* have shown that a new simple and reliable system is necessary for the identification of the species. After the study of more than 500 samples, a set of characters has been selected that aims to use constant and relatively easily visible morphological and chaetotactical characters as identification parameters and to avoid the use of colour pattern.

2. Materials and methods

Material studied

We studied more than 500 samples representing 35 species of *Entomobrya* from different museums and collections: NHM (Natural History Museum, London), UUZM (Uppsala University, Zoological Museum), MNHN (Muséum national d'Histoire naturelle, Paris),

MHNG (Museum d'Histoire Naturelle Geneve), SMNG (Saxon State Museum of Natural History Görlitz), PAN (Polish Academy of Sciences, Institute of Systematics and Evolution of Animals, Kraków), MNCN (National Museum of Natural Sciences [CSIC], Madrid), MZNA (Museum of Zoology, University of Navarra) and the Fjellberg collection. The observed material includes specimens from the United Kingdom, France, Spain (including the Canary Islands), Sweden, Norway, Poland, Slovakia, Afghanistan, Iraq, Marocco, Switzerland, Germany, Greece and Iran.

For compiling the list of characters, specimens of the following *Entomobrya* species were studied: *E. albocincta* (Burmeister, 1835), *E. arborea* (Tullberg, 1871), *E. atrocincta* Schött, 1896, *E. corticalis* (Nicolet, 1842), *E. dollfusi* Denis, 1924, *E. handschini* Stach, 1922, *E. lanuginosa* (Nicolet, 1842), *E. lindbergi* Stach, 1960, *E. marginata* (Tullberg, 1871), *E. multifasciata* (Tullberg, 1871), *E. muscorum* (Nicolet, 1842), *E. myrmecophila* (Reuter, 1886), *E. nicoleti* (Lubbock, 1868), *E. nivalis* (Linnaeus, 1758), *E. pazaristei* Denis, 1936, *E. puncteola* Uzel, 1891, *E. pulchella* (Ridley, 1881), *E. quinquelineata* Börner, 1901, *E. schoetti* Stach, 1922, *E. superba* (Reuter, 1876), *E. unostrigata* Stach, 1930, as well as 9 undescribed taxa.

Preparation methods

The specimens from MZNA, and some specimens remounted with permission of the museums or collembologists, were mounted in slides with Hoyer medium and sometimes cleared with Nesbitt solution. Observation of the slides was done under an Olympus BX51-TF microscope with a multi-viewing system and phase contrast, and an Olympus BX50-F4 with differential interference contrast (DIC). In some old thick slides, the specimens could not be studied at more than 400x magnification. Specimens mounted with Gisin solution do not permit a clear observation of the chaetotaxy.

Methods of measuring

For the measurements a U-DA drawing attachment UIS (Universal Infinity System) and a scale calibrated with a slide of Graticules Ltd. (1 mm/0.01 div) were used.

3. Results

Description of characters

Chaetotaxy

Figure 1A-E shows the generalised chaetotaxy of *Entomobrya*, with a double nomenclature on abdominal tergite IV. The head chaetotaxy is from Soto-Adames (personal communication) and Mari-Mutt (1978). On the head only five chaetotactic areas (H1-5) have been considered, where variation between species and constancy along specimens from the same species from different geographic areas have been found. In these groups of setae, the presence/absence of an actual seta has not been considered, only the total number. This is expressed in Fig. 1A and Tab. I.

On the Th II, the mesonotal disc has a specific significance. Two areas have been considered: T1 (central) and T2 (lateral) (Fig. 1B). These characters can vary among species with plurichaetosis, but it is constant for the majority of the studied species. The pseudopora of the thoracic tergite III are used as a reference point for setae position.

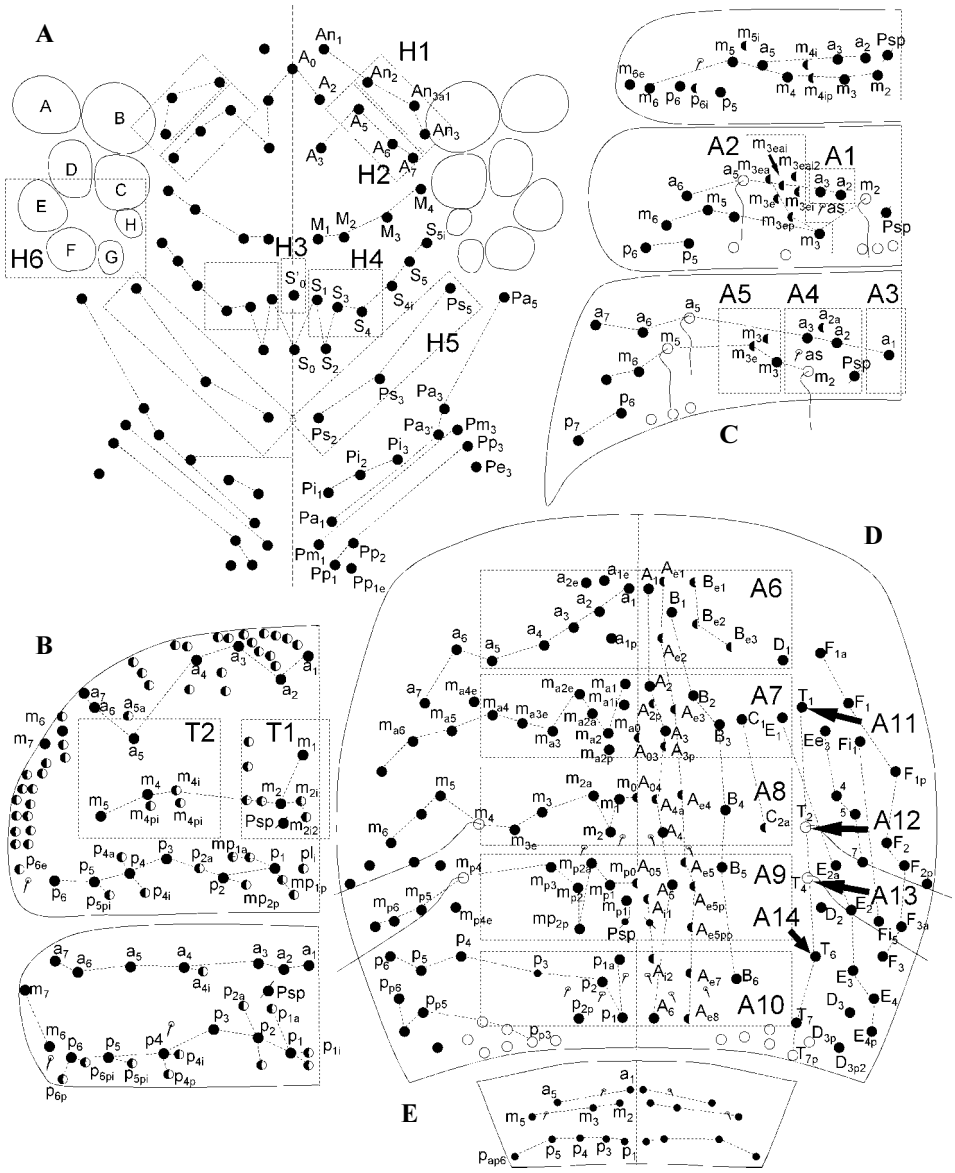


Fig. 1 Generalised chaetotaxy for *Entomobrya* after Szeptycki (1979), Soto-Adames (personal communication), Mari-Mutt (1978). A head; B thoracic tergites II and III; C abdominal tergites I – III; D abdominal tergite IV; E abdominal tergite V. Signature of insertion points of setae: full circle: primary setae; half shaded circle: secondary setae; open circle: additional setae; circle with diagonal line: pseudoporus; circle with long fine line: trichobothrium.

The thoracic tergite III and abdominal tergite I were not presently considered for the set of characters, because they have shown only a slight variability along the studied species. However, CHEN (1998) described the complete macrochaetotaxy for *E. huangy* and showed variation within the metanotum and abdominal tergite I compared with the European species.

The presence and disposition of setae on abdominal tergite II (Fig. 1C) has been considered only for two chaetotactic areas: A1, where the number of a-setae is considered, and A2, the same for m-setae. For this segment, CHRISTIANSEN (1980) gives importance to the presence of some specific setae. Nevertheless, in the present paper, only the number in specific areas has been considered, due to the difficulty of assigning setae to an exact position because of variability and difficulties in observing badly mounted specimens.

On the abdominal tergite III, three areas have been defined: A3: absence or presence of the seta a_1, A4: number of setae above trichobothrium m_2, and A5: seta m_3 and its accessory setae.

On the abdominal tergite IV (Fig. 1D) five areas are defined, situated at the levels of the a-, ma-, m-, mp- and p-rows (at the right Szeptycki's chaetotaxy for this segment is shown). Only the medial setae (situated between two imaginary lines that join the trichobothria of each side) are considered. For the exact placement of the areas, the position of the pseudopore at the basal part of A9 (usually at the level of T4 trichobothrium) is considered. Anteriorly is area A8, usually with the T2 trichobothrium at this level. More anteriorly are the areas A7 and A6, the last one frequently without a macroseta. The area A10 usually has two setae, one basal and medial (A_6) and the other one more lateral and anterior (B_6).

The species of *Entomobrya* always have two trichobothria on the abdominal segment IV, but in different positions depending on the species. To use this variability as a useful character, the formula absence or presence of a trichobothrium in the four possible positions (T1, T2, T4 or T6) has been considered (characteristics A11 – A14).

In some species of the *E. muscorum* group, which are large and have a very extended abdominal segment IV, plurichaetosis is frequent. In this case the character state has a constant-fixed value (the maximum for the series) when the area has a number of setae that is above the maximum elected for this character.

Morphological characteristics

In the head the relative size of the eyes GH in relation to EF (Fig. 1A) and the shape of the labral papillae (Fig. 4G, H) are considered. In the antenna the absence, presence and shape of the apical vesicle on the fourth antennal segment is used (Fig. 4B, 7A). Although variable among specimens, the antenna/head ratio has some value for the identification of some species, but frequently these data, as well as for the tip of antenna 4, are impossible to obtain due to the absence or aberrant growth after a break.

The presence-absence of the characteristic mane of *Entomobrya* (character 10, Tab. 1) is considered in the set because it is useful for the identification of some subgenera (*Prodrepanura* Stach, 1963).

Tab. 1 Set of characters used for the identification of species of *Entomobrya* s.l. and values for *E. nivalis* and *E. leonensis* n. sp.

Character	Location	Description	Value	*E. nivalis*	*E. leonensis* n. sp.
Ch.1	H1 (Head)	An_2-An_3	1-6	3	3
Ch.2	H2	A_5-A_7	1-3	1	3
Ch.3	H3	S'_0	0-1	0	0
Ch.4	H4	S_1-S_3-S_4	0-3	3	3
Ch.5	H5	Ps_2-Ps_3-Ps_5	0-3	2	2
Ch.6	Labral papillae	simple and smooth papillae (1) wrinkled or with some projections (2) a setae-like projection (3)	1-3	2	2
Ch.7	eyes G&H size	= E&F (1), < E&F (2)	1-2	2	2
Ch.8	apical antennal retractile bulb	no bulb (0), lobe simple (1), bilobate (2), trilobate (3)	0-3	2	2
Ch.9	Ratio Ant./Head	> or = 3 (1), > or = 2 < 3 (2), < 2 (3)	1-3	1	1
Ch.10	anterior dorsal mane Th II macrosetae (Ms)	with (Ms) type 1 (1), without (Ms) or type 2 (2)	1-2	1	1
Ch.11	T1	setae number m_1-m_{2i2} or >4 (5)	0-5	4	4
Ch.12	T2	setae number a_5, m_4-m_5 or >8 (9)	0-9	4	4
Ch.13	Smooth setae on tibiotarsi	none or 1 in tibiotarsi III = 0, double file = 1	0-1	0	0
Ch.14	Claw internal teeth	1(1), 2(2), 3(3), 4(4)	1-4	4	4
Ch.15	Claw dorsal tooth	basal = 1, internal teeth level = 2	1-2	1	2
Ch.16	Claw internal edge	without ciliation (0), with ciliation (1)	0-1	0	0
Ch.17	External empodium	smooth (0), serrate (1)	0-1	0	1
Ch.18	A1 Abd. II	a_2-a_3	0-2	2	2
Ch.19	A2 Abd. II	m_3 series setae number	0-7	3	3
Ch.20	A3 Abd. III	a_1	0-1	1	1
Ch.21	A4 Abd. III	above m_2 setae number	0-3	0	0
Ch.22	A5 Abd. III	m_3-m_4 series setae number	0-4	1	1
Ch.23	A6 Abd. IV	a_1-a_5 (A_1-D_1) setae number; >8 (9)	0-9	0	0
Ch.24	A7 unpair seta	ma_0 (A_{03})	0-1	0	0
Ch.25	A7 Abd. IV	ma_1-ma_4 (A_2-E_1) setae number; >9 (10)	0-10	3	3
Ch.26	A8 unpair seta	m_0 (A_{04})	0-1	0	0
Ch.27	A8 Abd. IV	m_1-m_3 (A_{4a}-C_{2a}) setae number; >5 (6)	0-6	0	2
Ch.28	A9 unpair seta	mp_0 (A_{05})	0-1	0	0
Ch.29	A9 Abd. IV	mp_1-mp_3 (A_5-B_5) setae number; >6 (7)	0-7	2	2
Ch.30	A10 Abd. IV	p_{1a}-p_3 (A_6-B_6) setae number; >5 (6)	0-6	2	2
Ch.31	A11 Abd. IV	T_1 (ma_{4c}) as trichobothrium	0-1	0	0
Ch.32	A12 Abd. IV	T_2 (m_4) as trichobothrium	0-1	1	1
Ch.33	A13 Abd. IV	T_4 (mp_4) as trichobothrium	0-1	1	1

Ch.34	A14 Abd. IV	T_6 (p_4) as trichobothrium	0-1	0	0
Ch.35	Ratio Abd.IV/Abd.III	2 < R < 4 (1), R > 4 (2)	1-2	1	1
Ch.36	Manubrial plate	setae number; >10 (11)	0-11	3	5
Ch.37	Manubrial plate	pseudopores 1-2	1-2	2	2
Ch.38	Mucro	subapical tooth without (0), normal (1), big (2)	0-2	1	1
Ch.39	Mucro	basal spine	0-1	1	1

On the legs are considered: the presence of special setae on the inner side of the tibiotarsus; the number of teeth on the internal edge, the position of the dorsal tooth and the shape of internal edge (sometimes serrate) of the claw, and the external edge (smooth or clearly serrate) of the empodium.

The relative length of the abdominal segments III and IV (ratio IV/III) is frequently used, even at suprageneric level, among Entomobryomorpha. The telescopic movement between the segments and the necessity of studying in different development degrees complicate the standardisation of this character. The selected method segregates only the species with an abdominal segment IV clearly extended, more than four times the segment III.

The furca is very similar in all species. Only the number of setae and pseudopores on the manubrial plate (Fig. 4C, 7C), and the absence or the presence of a normal or big subapical tooth and mucronal spine have been considered. The last two are characteristic of some other subgenera of *Entomobrya*.

Table 1 presents 39 characters considered to be sufficient for the identification of the *Entomobrya* species. This table can be extended or modified after having studied and described more species following this methodology.

As examples of this methodology, the descriptions of *E. nivalis* (Linnaeus, 1758), sensu SZEPTYCKI (1979), and a new species, *E. leonensis* n. sp., follow here. These species have a similar colour pattern, different chaetotaxy and some morphological features.

***Entomobrya nivalis* (Linnaeus, 1758)**

Basonym:

Podura nivalis Linnaeus, 1758. (Systema Naturae, Editio Decima, Tomus I.)

Synonyms:

Podura annulata Fabricius, 1775. (Systema Entomologiae, Flensburgi et Lipsiae: 301 – 303)

Podura nigromaculata Templeton, 1835. (Trans. Ent. Soc. London, 1(2): 89 – 98)

Podura variegata Guerin & Percheroin, 1836. (Collembola in: Genera des Insectes, *Paris*. 5e, n° 6)

Podura minuta Burmeister, 1838. (Handbuch der Entomologie, **2** (2): 445 – 458)

Isotoma fusiformis Bourlet, 1839. (Mém. Soc. Sc. Agric. Lille, **1**: 377 – 417)

Podura simplex Koch, 1840. (Naturh. Topographie Regensburg, **3**: 353 – 359)

Podura striata Koch, 1840. (Naturh. Topographie Regensburg, **3**: 353 – 359)

Deegeria nivalis (L.); Nicolet, 1842. (Nouv. Mém. Soc. Helvet. Sci. Nat., **6**: 1 – 88)

Mydonius nivalis (L.); Gistl, 1848. (Naturgeschichte des Tierreichs für höhere Schulen. Stuttgart, 16, 216 pp.)

Entomobrya nivalis (L.); Rondani, 1861. (Dipterologiae Italicae Prodromus, **4**: 40)

After SALMON (1964), the type material was at the Lab. Zool. Fac. Sci. Dijon (France). This material was transported to the MNHN (Paris), but were not found in the collection studied from this museum.

Material examined: NHM: slides labelled as: »*E. nivalis* Enniv.36 Lichen on trees. Ireland, Mayo, Cong. 16.i.1954 T. Clay. 223 Brit. Mus. 1954 – 63«; »*Entomobrya muscorum*? *nivalis* Ennniv. 37 Killa … m Upper … *Ulex* 11.8.43 – R. S. Bagnall Coll. Brit. Mus. 1959 – 591«; »*Entomobrya marginata* Tllbg. Det. F. G. M. W. Kent: Romney Marsh Aug. 1926 A. H. Bishop Berlese fluid British Museum (Nat. Hist. ENmar. 3)«; »*Entomobrya nivalis* L. C. H. Jackson det. & coll. Brit. Mus. 1964 – 266 Wicken Fen 4.11.25 Under wood of fence post in fields. Two slides: ENniv.9 and ENniv.10«. Fjellberg Coll.: »*E. nivalis*, Norway, Fellberg det.«. Two tubes with 8 specimens, two forms: one small and green; other big with normal colour. MZNA: Irati, Navarra (code: HYEI; thousands of specimens captured with a Malaise trap; Navarra, ex *Pinus nigra* repoblation (codes: IIbPT-62, IIICPT62.; MHNG: slides labelled as: »Zuoz, 1975 Juli Auenwald 1670 m (E) leg. W. Santer PVLP 209 *Entomobrya nivalis* (L.) det. C. Lienhard«; »Helv. ZH 22.8.76 Albis (Girstel) bei Zürich (Wald) leg C.L. PVLP 183 *Entomobrya nivalis* (Linné) det. C. Lienhard«; »NP 7.7.76 11 – Munt la Schera 2300 m, *Dryas* leg. C. Lienhard Hoyer – 57 *Entomobrya nivalis* (L.) det. C. Lienhard«; »NP 3.8.76 1 – JI Fuorn *Erico-Mugetum* 1800 m leg. C. Lienhard – PVLP – 155 – *Entomobrya nivalis* (L.) det. C. Lienhard«; »3.8.76 2 – JI Fuorn *Erico-Mugetum* – 1800 m leg. C. Lienhard – PVLP – 164 – *Entomobrya nivalis* (L.) det. C. Lienhard«; »*E. nivalis* f.p. HS28-??-Ge23-He196-He236-Hs28, Gisin Col.«; »*Entomobrya nivalis* f.p. Ca27-Ca27-Cn25-Ga58(7-8)-Cn8-Aa19, Gisin Col.«; »*Entomobrya nivalis* f.p. He288-He288-He339-Ga6-He284, Gisin Col.«; »*Entomobrya nivalis* f. claires Kc40-?-Fw24-Hs33 f.p. f.imm.-Ga56(31.3), Gisin Col.«; »*Entomobrya nivalis* Ka6-If41-If50-Ga129-Kb1-Ht16, Gisin Col.; *Entomobrya nivalis* Ix11«. MNHN: slides labelled as: »*Entomobrya nivalis* Bois de Serres, chênes et chataign. Com. d'Ecully banl. W. de ? Lyon 7.Xi.41 Bolland.«; »Barber Compost I Entomobryidae *Entomobrya nivalis*, 3 ejs.«; »*E. nivalis* Pologne ? 1923 7 ejs. SMNG: two slides labelled as »Nat. Mus. Görlitz Halle, Saxony-Anhalt (Germany) Traps, 1997 leg. Schnitter. *Entomobrya nivalis*«.

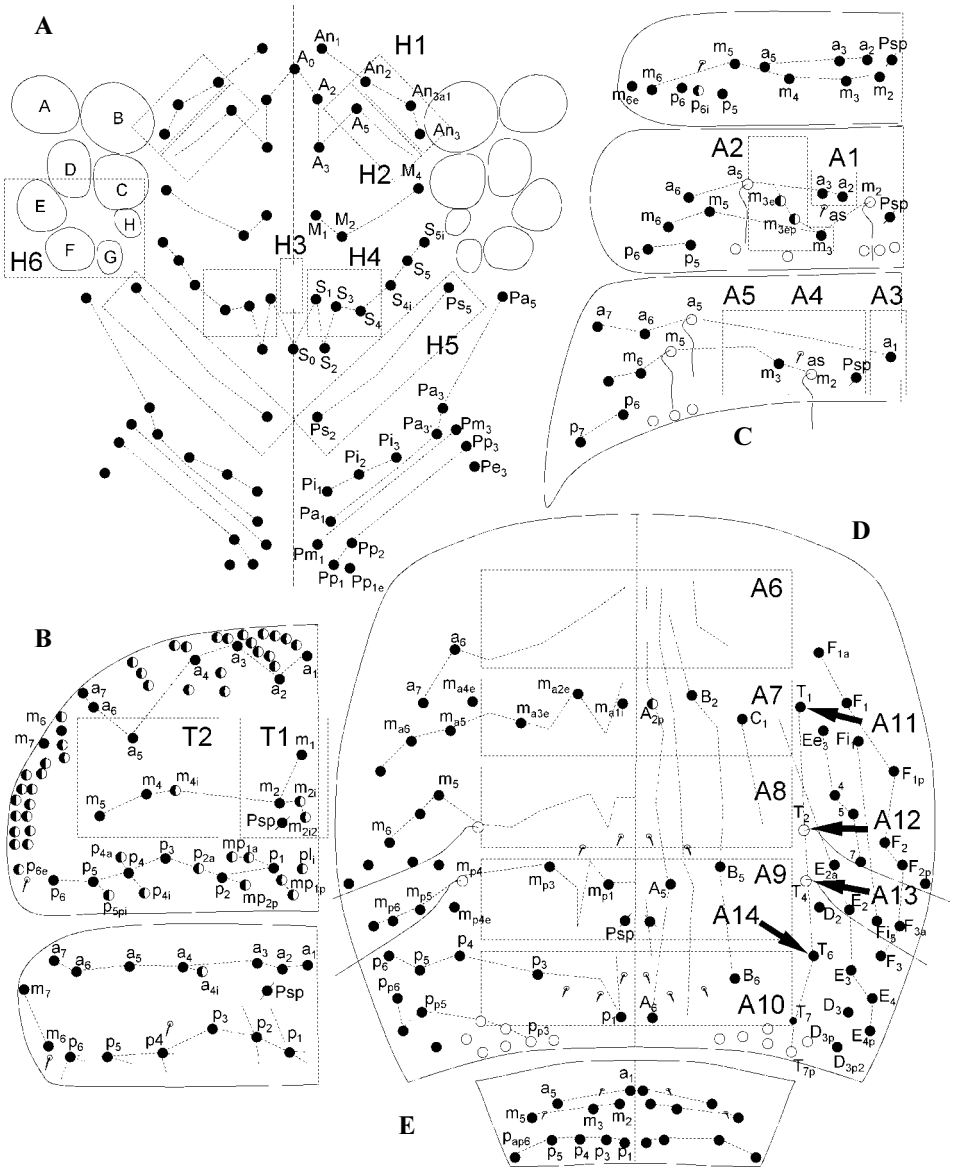


Fig. 2 *E. nivalis*: chaetotaxy. A head; B thoracic tergites II and III; C abdominal tergites I – III; D abdominal tergite IV; E abdominal tergite V.

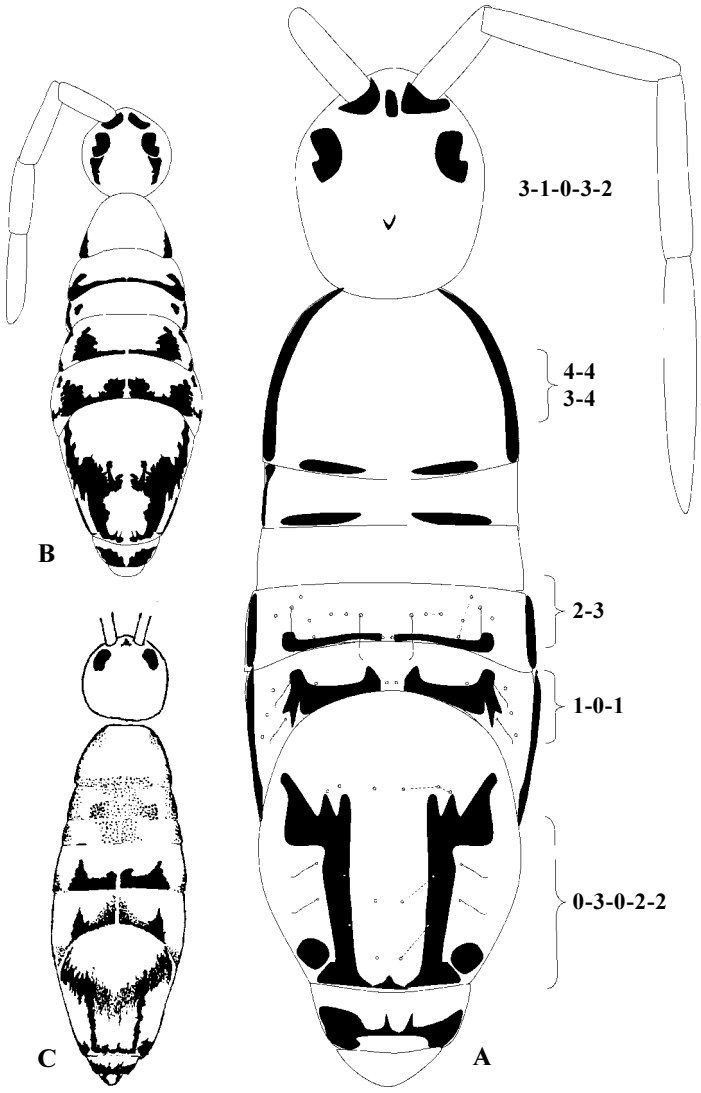


Fig. 3 *E. nivalis*. A colour pattern and abbreviated chaetotactic formula; B colour pattern of specimens from Saxony-Anhalt (Germany) from SMNG; C color pattern after STACH (1963).

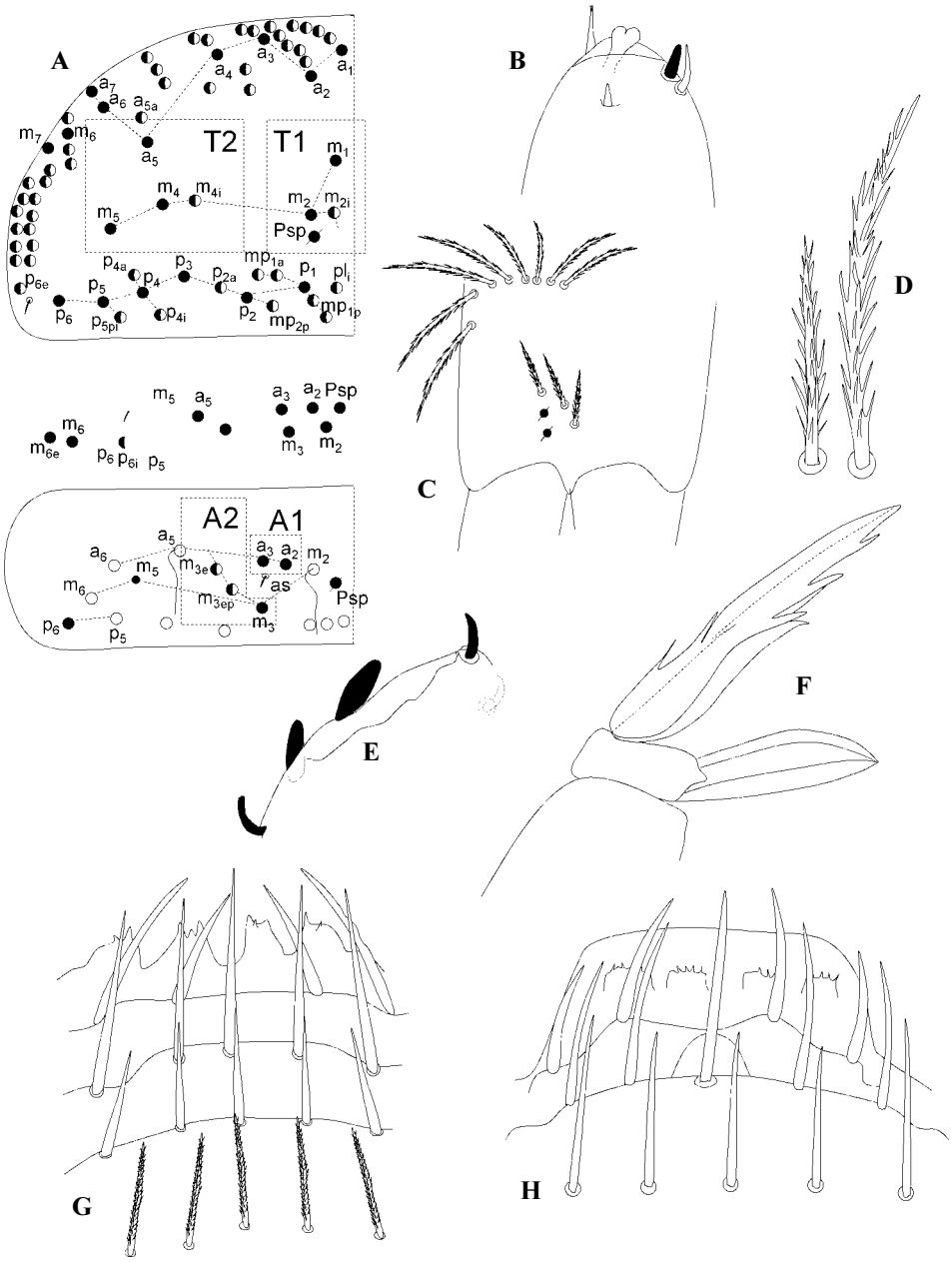


Fig. 4 *E. nivalis*. A chaetotaxy (thoracic tergite III, abdominal tergites I and II) of individuals from Saxony-Anhalt (Germany SMNG); B tip of antennal segment IV; C manubrial plate; D common short setae (»type five«); E sensory organ of antennal segment III; F claw and empodium; G and H labral papillae of specimens from Irati (Spain) and Norway respectively.

Body length up to 2.7 mm without antennae.

Ground colour pale yellow. Eye patches and antennal basis dark blue, and an unpaired small patch of diffuse blue pigment between the eyes. Sometimes another small patch of diffuse blue pigment appears in the middle of the head. Antennae with homogeneous-uniformly pale aspect, with the apical area of the first three segments darker. Among the studied material a large variation in colour has been found, from pale to very dark specimens, but always with an invariable pattern on abdominal segment IV: two longitudinal patches that run towards the antero-lateral part from the middle of the segment (Fig. 3A-C). From abdominal segment IV to thoracic segment II, the colour is reduced, the mesonotal disc being without pigment. On the thoracic segment III and abdominal segments I to III there are patches, more or less transversal, with a clear interruption along the longitudinal axis of the segment (Fig. 3A-C).

Antennae very long, always longer than half of the body. Apical vesicle bilobed (Fig. 4B). Sensory organ of antennal segment III as in Fig. 4E. Head chaetotaxy as in Fig. 2A, constant among the studied specimens. Head trichobothrium present. As in the rest of *Entomobrya* species, the labral setae have the formula 5 5 4, and are smooth. Labral papillae with small projections (2 to 6) (Fig. 4G-H). Trochanteral organ similar as described and drawn by STACH (1963). There are no differentiating setae on the tibiotarsus, with the exception of the presence of the smooth setae characteristic for the genus. Claw as in the Fig. 4F. Empodium lanceolate, with a smooth outer edge. Macrochaetotaxy in Fig. 2A-E, with a simplified formula (head areas: H1-H5 / thoracic tergite III: T1-T2 / abdominal tergite II: A1-A2 / abdominal tergite III: A3-A5 / abdominal tergite IV: A6-A10): 3-1-0-3-2/ 3(4)-4/ 2-3/1-0-1/ 0-3-0-2-2. T1 has usually 3 macrochaetae, but on the specimens from Saxony-Anhalt there are four. In addition, there are slight differences between the lateral macrochaetotaxy of these specimens and the rest of the European specimens. Manubrial plate with three setae and two pseudopores (Fig. 4C).

***Entomobrya leonensis* n. sp.**

Holotype: Spain, Ruiforco de Torío (León), nest of *Lanius collurio* on *Rubus* sp., 0,54 m over soil surface, altitude 1.000 m, 6-IX-1988, Vidal and Hernández leg., female (sample MZNA-LC-1, slide nº 01). Paratypes: MZNA-LC-1, slide nº 02, one male and five juveniles.

Other material: Spain, Ruiforco de Torío (León), nest of *Lanius collurio*, on *Prunus* sp., 0,40 m over soil surface, altitude 1.000 m, 11-IX-1988, Vidal and Hernández leg., one female (subadult) and one juvenile (sample MZNA-LC-16 slide nº 01).

All specimens are deposited at the Museum of Zoology, University of Navarra (MZNA).

Derivatio nominis. The species name refers to the region (León, Spain) where the specimens were captured.

Body length up to 2.0 mm without antennae.

Ground colour pale yellow. Eye patches and antennal basis dark blue, with an unpaired patch between the eyes. On the middle of the head are a longitudinal patch of diffuse blue pigment as well as another transversal one more posteriorly (Fig. 6A). Antennae uniformly and slightly pigmented like the second abdominal segment. The colour pattern of the abdominal segment IV is formed by two longitudinal patches that run towards the antero-

lateral part from the base of the segment (Figs. 6A, 6B). The antero-lateral edges of the abdominal segment IV are strongly pigmented. From the abdominal segment IV to thorax segment II are two extended patches, two lateral and continuous and two situated between the longitudinal axis and the lateral, narrowing at the anterior part of the segment, together forming a longitudinal but discontinuous patch along the body. Very conspicuous is the interruption of pigmentation along the longitudinal axis as a white line, and with the same pattern as in *E. nivalis*.

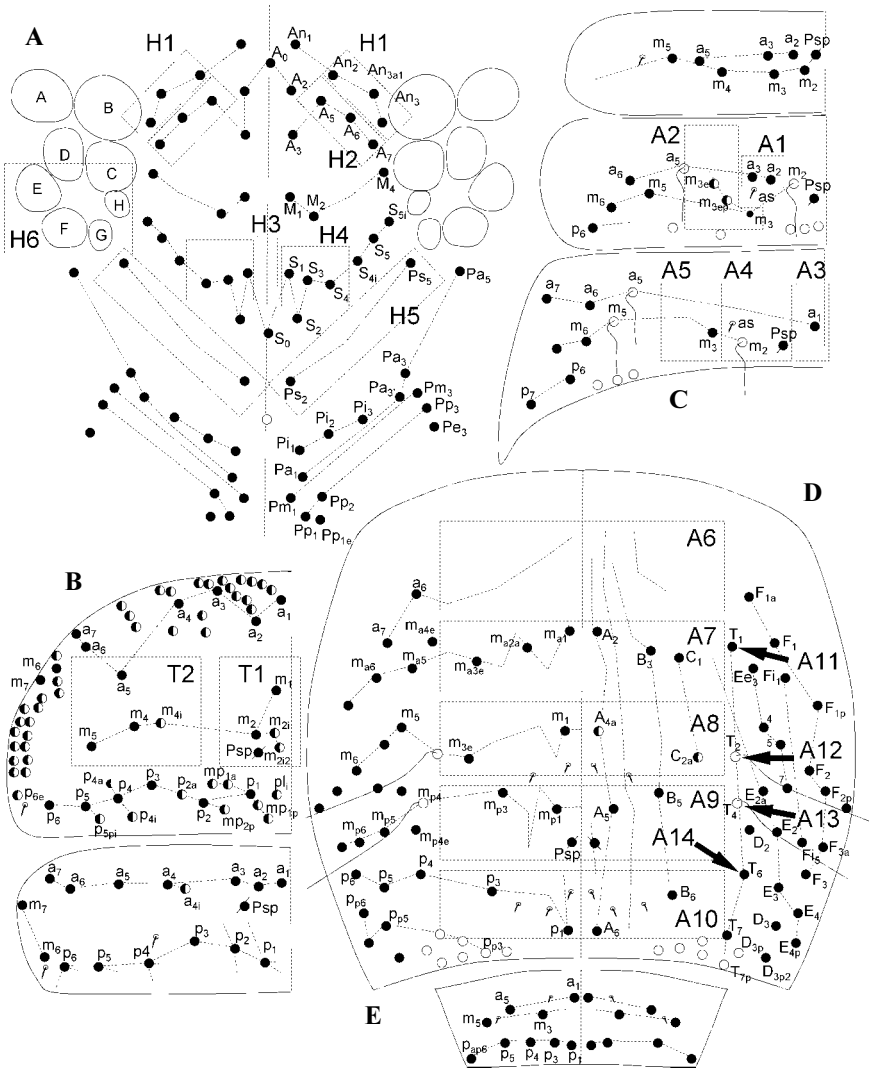


Fig. 5 *E. leonensis* n. sp.: chaetotaxy. A head; B thoracic tergites II and III; C abdominal tergites I – III; D abdominal tergite IV; E abdominal tergite V.

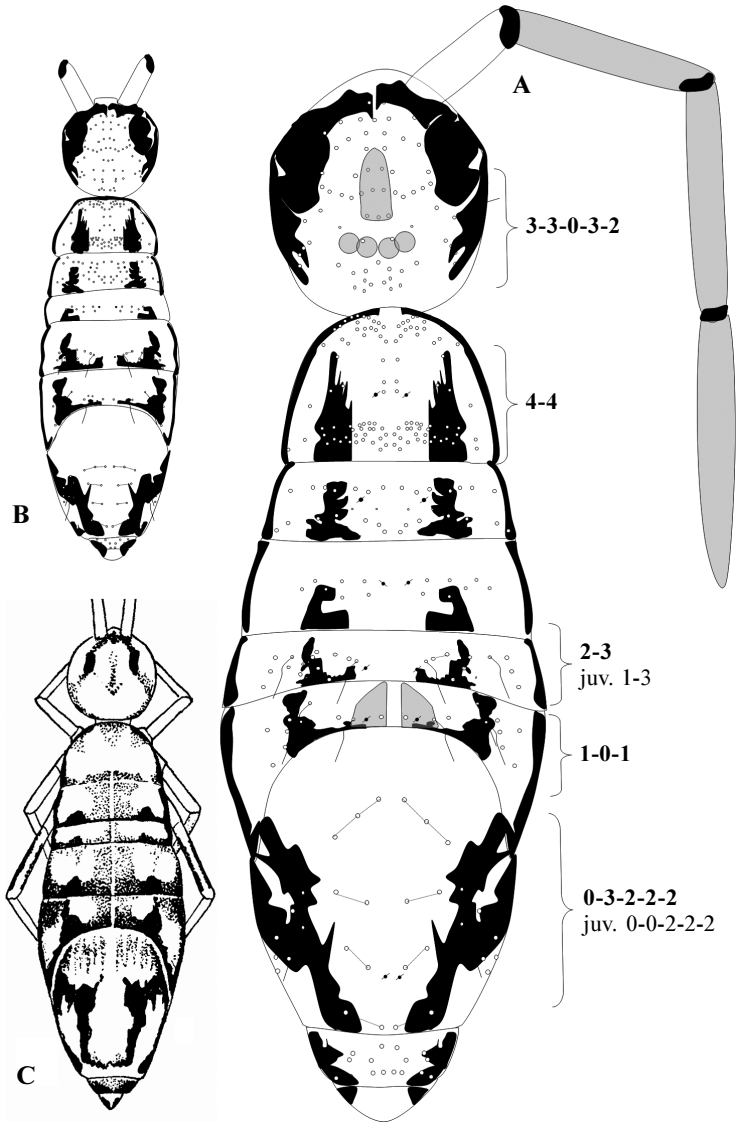
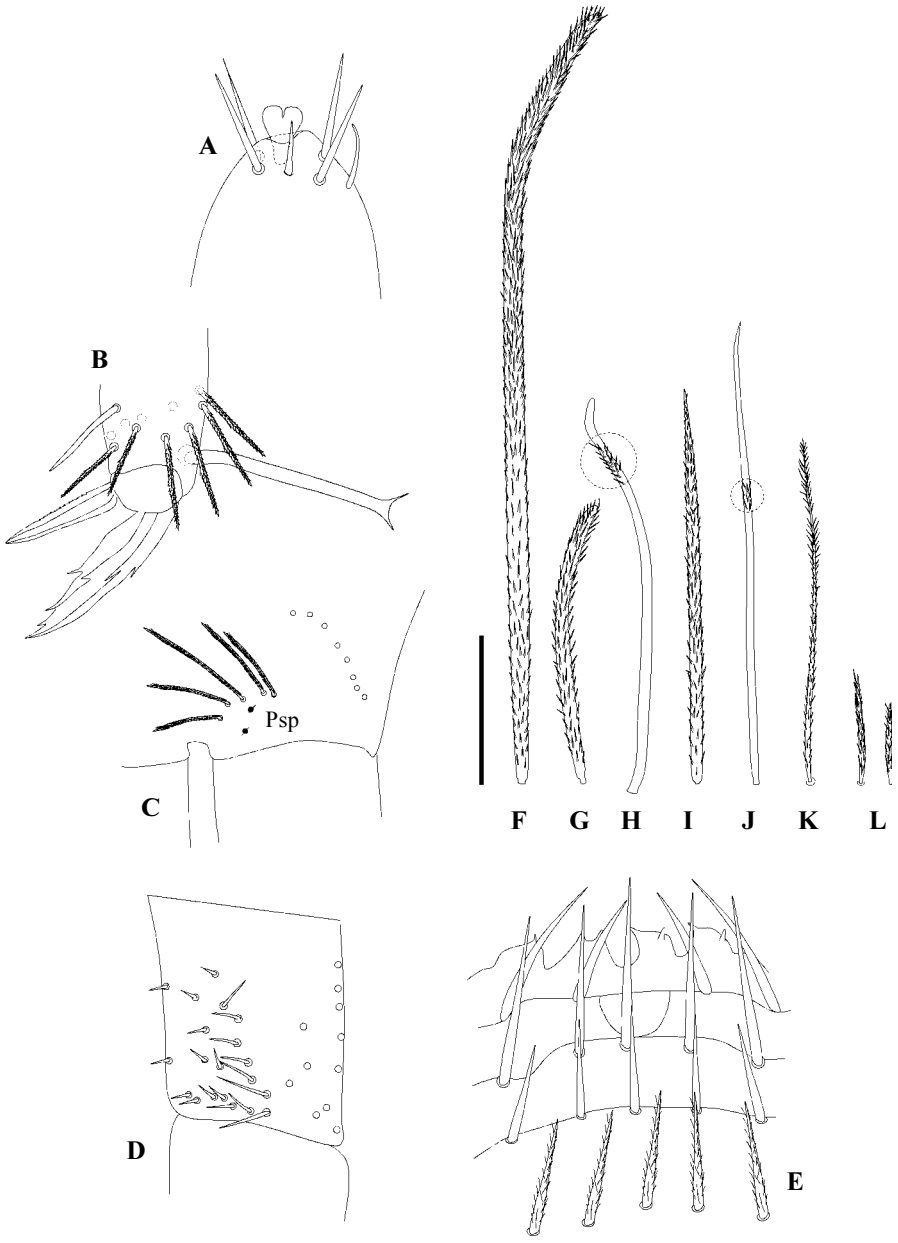


Fig. 6 *E. leonensis* n. sp. A colour pattern and abbreviated chaetotactic formula; B colour pattern; C dark coloured specimen of *E. nivalis* from STACH (1963).



Tab. 7 *E. leonensis* n. sp. A tip of antennal segment IV; B claw and empodium; C manubrial plate; D trochanteral organ; E labral papillae; F-L kind of setae: F thoracic tergite III; G abdominal tergite VI; H manubrial (basal area); I abdominal tergite III (lateral); J leg; K trichobothrium on abdominal tergite IV; L abdominal tergite IV (lateral and dorsal). Bar: 50 micrometres.

Antennae very long, almost as long as the body. Head chaetotaxy as in Fig. 5A. Head trichobothrium present. As in the rest of *Entomobrya* species, the labral setae have the formula 5 5 4. Labral papillae with 1 – 2 small, not setaceous projections (Fig. 7E). Trochanteral organ with approximately 20 setae, similar to *E. nivalis* in the description of STACH (1963) (Fig. 7D). There are no differentiate setae on the tibiotarsus, with the exception of the presence of the smooth setae characteristic for the genus. Claw as in Fig. 7B, with the lateral and dorsal teeth in the middle of the claw. Empodium lanceolate, with a clearly serrate outer edge. Macrochaetotaxy as in Fig. 5A-E, with a simplified formula: 4-4/ 2-3/ 1-0-1/ 0-3-2-2-2. Juveniles have the formula 0-0-2-2-2 on abdominal segment IV. Manubrial plate with 5 setae and two pseudopores (Fig. 7C).

4. Discussion

The colour pattern of *E. leonensis* n. sp. and *E. nivalis* are very similar (Figs. 3A-B, 6A-B): the characteristic patch on abdominal segment IV and the white line on the longitudinal axis. However, despite this, there are some small differences that are to be considered: the patch over the thoracic segment II and a central patch in the middle of the head in *E. leonensis* n. sp. The specimens of the new species had first been identified as *E. nivalis*, but specimens from Irati (Navarra, Spain), also identified as *E. nivalis*, had some morphological differences. The comparison of this two species with the description of SZEPTYCKI (1979), and with specimens from some of the museum collections mentioned above, showed that the specimens from Irati were *E. nivalis*, while the specimens from León possessed some different characters. Differences in the chaetotaxy are the presence of A_6 and A_7 setae (area H2) on the head, and A_{4a} (m_1) and C_{2a} (m_{3e}) on abdominal tergite IV (area A8) in *E. leonensis* n. sp. Thus, the simplified formula for *E. nivalis* is: 3-**1**-0-3-2/ 4(3)-4/2-3/ 1-0-1/ 0-3-**0**-2-2, whereas for *E. leonensis* n. sp. this formula is: 3-**3**-0-3-2/ 4-4/ 2-3/ 1-0-1/ 0-3-**2**-2-2. The dorsal teeth of the claw of *E. nivalis* are situated in a basal position, while in *E. leonensis* n. sp. they are almost at the level of the lateral ones. The external edge of the empodium (leg III) of *E. nivalis* is smooth (although on legs I and II it is slightly serrate), while in *E. leonensis* n. sp. they are clearly serrated on legs I – III. The manubrial plate of *E. nivalis* has three setae and two pseudopores, while *E. leonensis* n. sp. has five setae and two pseudopores. The ringless part of the dens is 2.5 times the mucro length in *E. nivalis*, while in *E. leonensis* n. sp. it is 3.5 times the length. This character seems to be variable and has not been considered in the set of differentiating characters.

Tab. 2 shows comparative measurements for antennal and body segments, and some ratios. From this it becomes clear that there are no significant length differences between the two species. It can only be determined that *E. leonensis* n. sp. has longer antennae than *E. nivalis*.

Tab. 2 Measurements of *E. nivalis* and *E. leonensis* n. sp. from some localities: Norw.s: Norway small specimen; Norw. b: Norway big specimen; Gor: Saxony-Anhalt from SNMG; Irati: Navarra, Spain; 1, holotype; 2, paratype.

	E. nivalis				***E. leonensis* n. sp.**	
Ch	Norw.s	Norw. b	Gor	Irati	1	2
Ant. I	140	250	250	210	210	250
Ant. II	262	450	450	370	350	480
Ant. III	250	400	450	350	400	530
Ant. IV	325	500	575	470	450	650
Ant. length	975	1600	1725	1400	1410	2020
Ratio I/II/III/IV*		1/1.8-1.9/1.7-1.8/2-2.3			1/1.6-1.9/1.9-2.1/2.1-2.6	
Head	375	550	500	480	409	430
Ant./head	2.6	3.2	3.45	2.91	3.5	4.7
Th. II	262	300	350	300	275	280
Th. III	150	175	250	150	140	155
Abd. I	112	150	200	90	115	180
Abd. II	150	200	275	150	115	140
Abd. III	110	200	200	110	115	160
Abd. IV	400	650	750	650	465	550
Abd. IV/III	3.6	3.3	3.8	5.9	3.98	3.43
Abd. V	90	150	250	150	70	115
Abd. VI	75	75	100	110	100	115
Total length (without head)	1725	2450	2875	2190	2028	1910
Furca	650	1100	1170	1030	1115	–
Manubrium	225	500	520	450	530	–
Dens	425	600	650	580	585	–
Zone not annulated	25	60	37	35	30	–
Mucro	11	12	12	12	6	–
Claw	30	47	50	50	40	–
Empodium	20	26	25	30	22	–
Tenent hair of Tita	45	57	75	60	60	–

* minimum and maximum ratio. Measurements in micrometres.

5. Acknowledgements

We are very grateful for the inestimable help of Kenneth Christiansen, his permanent accessibility, his criticism and orientation. The loans of specimens have been possible due to the kind collaboration of Jean-Marc Thibaud (MNHN), Arne Fjellberg (personal collection), Javier Arbea (personal collection), Jürgen Schulz (SNMG), Carolina Martín (MNCN), Wanda Weiner (PAN), Charles Lienhard (MHNG), Paul Brown (NHM) and Hans Mejlon (UUZM). The specimens used for the description of the new species were captured along the pre-doctoral work of Dña. Elena Mª Vidal, and the information of her samples were kindly provided by Dr Juan Antonio Régil (University of León) and Dr Ángel Hernández (University of Valladolid). We are indebted to Prof. Wolfram Dunger for his help and encouragement.

6. References

Chen, J. & M. A. Yitong (1998): A new *Entomobrya* species (Collembola: Entomobryidae) from China. – Entomotaxonomia **20** (4): 235 – 238

Christiansen, K. (1958): The Nearctic members of the genus *Entomobrya* (Collembola). – Bulletin of the Museum of Comparative Zoology **118** (7): 545 pp., 24 pl.

Christiansen, K. & P. Bellinger (1980): Part 3. Family Entomobryidae, The Collembola of North America North of the Rio Grande. – Grinnell College, Iowa: 785 – 1042

Gisin, H. (1960): Collembolenfauna Europas. – Museum d'Histoire Naturelle, Genève, 312 pp.

Jordana, R. & E. Baquero (1999): Redescription of *Entomobrya schoetti* (Collembola, Entomobryidae, Entomobryinae), third record to the world. – Boletin de Sanidad Vegetal, Plagas **25** (1): 99 – 105

Mari-Mutt, J. A. (1978):. A revision of the genus *Dicranocentrus* Schött (Insecta: Collembola: Entomobryidae). – Agr. Exp. Stn. Univ. P. R., Bull. 259, 79 pp.

Salmon, J. T. (1964): An index to the Collembola. – Royal Society of New Zealand, Bulletin **7** (2): 145 – 644

South, A. (1961): The taxonomy of the British species of *Entomobrya* (Collembola). – Transactions of the Royal Entomological Society of London **113** (13): 387 – 416

Stach, J. (1963): The Apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Tribe: Entomobryini. – Polska Akademia Nauk, Kraków, 126 pp., 43 pl.

Szeptycki, A. (1979): Chaetotaxy of the Entomobryidae and its phylogenetical significance. Morpho-systematic studies on Collembola. – IV. Polska Akademia Nauk, Kraków, 218 pp.

Manuscript accepted: 25 May 2005

Authors' adresses

Prof. Dr Rafael Jordana* / Dr Enrique Baquero
Department of Zoology and Ecology
University of Navarra, P.O. Box 177
31080 Pamplona, Navarra, Spain

* corresponding author: rjordana@unav.es