Limnetica, 39(1): 93-111 (2020). DOI: 10.23818/limn.39.07
 ISSN: 0213-8409

Checklist of Collembola (Hexapoda: Entognatha) from "malladas" of the Devesa and Racó de l'Olla (Albufera Natural Park, Valencia, Spain) with a description of a sp. nov.

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Received: 27/09/18 Accepted: 14/06/19

ABSTRACT

Checklist of Collembola (Hexapoda: Entognatha) from "malladas" of the Devesa and Racó de l'Olla (Albufera Natural Park, Valencia, Spain) with a description of a sp. nov.

In aquatic macroinvertebrate sampling campaigns carried out between 2004 and 2008 in the malladas (inter-dune depressions that receive rainwater or are fed from a local aquifer) of the Devesa and Racó de l'Olla of the Albufera Natural Park of Valencia (Spain), 18 taxa of Collembola were collected and distributed among seven families of Poduromorpha, Entomobryomorpha and Symphypleona. *Entomobrya benaventi* sp. nov., is present in the vegetation associated with different samples "malladas" (Ra01b, Ra04, Sa04, Sa03/04, etc.) and showed sexual dimorphism different from other species of the genus. The sampling also included the first citation for the Iberian Peninsula of *Jordanathrix articulata articulata* (Ellis, 1974). Springtails are part of the fauna studied in the malladas and provide increased knowledge of the existing biological diversity in a restored and protected environment.

Key words: *Entomobrya*, *Jordanathrix*, malladas, Devesa, Albufera, Spain

RESUMEN

Listado de Collembola (Hexapoda: Entognatha) de las malladas de la Devesa y Racó de l'Olla (Parque Natural de l'Albufera, Valencia, España) con la descripción de una especie nueva

En campañas de muestreo de macroinvertebrados acuáticos realizadas entre 2004 y 2008 en las malladas de la Devesa y el Racó de l'Olla (depresiones inter-dunares que reciben agua de lluvia o que se alimentan de un acuífero local) del Parque Natural de la Albufera de Valencia (España), se recogieron 18 taxones de Collembola, distribuidos entre siete familias de Poduromorpha, Entomobryomorpha y Symphypleona. Entomobrya benaventi *sp. nov., está presente en la vegetación asociada a diferentes malladas muestreadas (Ra01b, Ra04, Sa04, Sa03/04, etc.) y mostró un dimorfismo sexual diferente al de otras especies del género. También se describe, como primera cita para la Península Ibérica,* Jordanathrix articulata articulata *(Ellis, 1974). Los colémbolos son parte de la fauna estudiada en este lugar y proporcionan un aumento del conocimiento de la diversidad biológica existente en un entorno restaurado y protegido.*

Palabras clave: Entomobrya, Jordanathrix*, malladas, Devesa, Albufera, España*

INTRODUCTION

The Devesa of the Albufera Natural Park (PNA) covers an area of approximately 610 ha within the 21 120 ha of the PNA itself. The Racó de l'Olla extends around 62 ha (Dies-Jambrino & Fernández-Anero, 1997). Currently, the PNA has several types of protection: it was declared a Natural Park on July 8, 1986 (DOGV, 1986, 1993); it was added to the list of Wetlands of International Importance on May 8, 1990, at the Ramsar Conference (BOE, 1990); a Special Protection Area for Birds (SPA) was declared on September 1, 1994 (CEE, 1979; 1994); its Natural Resources Management Plan (NRMP) (DOGV, 1995) was approved on May 16, 1995 and its Master Plan for Use and Management (MPUM) was adopted on November 19, 2004 (DOGV, 2004). During the 1970s and 80s, however, both the Devesa and the Racó de l'Olla were on the verge of disappearing due to urban pressure. "La Devesa" was completely transformed (Fig. 1): the "malladas" (inter-dune depressions that receive rainwater or are fed from a local aquifer) were filled with sand removed from the first dune cord, and a racecourse was built in the Racó (Dies-Jambrino & Fernández-Anero, 1997) (Fig. 2). After the completion of multiple recovery projects (Life Dunas, Life Enebro; Benavent *et al.*, 2004), both areas have now been restored to near pre-urbanisation conditions. The concept of "meta-community" refers to the coexistence of species within the same trophic level. The relationship between species within the meta-community nutritional network is becoming one of the new tools for understanding the spatial structure of ecosystems (Holt *et al.*, 2005). The present study focuses on springtail organisms that were collected from the malladas (Rueda, 2015); springtails are one of the many faunal groups that are part of the nutritional network of the malladas. The biological scenario of a previously published study focused mainly

Figure 1. Aerial photograph of the northern area of the Devesa in August 1970 (Photo courtesy of the Devesa Albufera Service, City of Valencia). *Fotografía aérea de la zona norte de la Devesa realizada durante el mes de agosto de 1970 (Foto cedida por el Servicio Devesa Albufera, Ayuntamiento de Valencia).*

Figure 2. A: The racecourse built on the malladas of Racó de l'Olla (Photo courtesy of the Devesa Albufera Service, City of Valencia). B: A current photograph after its subsequent restoration (Photo: Google Earth). *A: El hipódromo construido sobre las antiguas malladas del Racó de l'Olla (Foto: Servicio Devesa Albufera, Ayuntamiento de Valencia). B: una visión actual tras su posterior restauración (Foto: Google Earth).*

on the sampling of aquatic macroinvertebrates and sought the greatest possible diversity. The subphylum Mandibulata Snodgrass, 1938 covers three classes: Collembola Lubbock, 1870; Diplurata Boudreaux, 1979; and Myrientomata Berlese, 1909. As only Collembola (one of the lesser-known groups of invertebrates in malladas) were found in the samples collected for this study, this paper deals exclusively with that class. Springtails are part of the fauna studied in the "malladas" area and provide increased knowledge of the existing biological diversity in a restored and protected environment. Some organisms are strictly aquatic, and some semi-aquatic because they resided on the surface of the water or have linked to riverbank vegetation (Hilsenhoff, 2001; Jordana *et al.*, 1997). A checklist and some species descriptions are provided.

MATERIALS AND METHODS

Study area

The malladas on the Devesa de l'Albufera (Valencia) that were studied are located in an area of just over 610 ha. The Devesa is located in the central eastern area of the Iberian Peninsula, south of the city of Valencia and within its municipal area (Fig. 3). Its limits correspond to the district of El Saler to the north, the Gola del Perellonet to the south, the Albufera to the west and the Mediterranean Sea to the east. This coastal strip is the result of the growth and emersion of a sandy bar or "restinga" 30 km in length (Santisteban *et al.*, 2009) that isolates the Albufera from the sea and on which a subfossil dune complex later developed. The Devesa has a developed vegetation cover (Robles *et al.*, 1985; Robles, 1990) and two water communication channels travel through it: the Pujol and the Perellonet. These channels connect the Lagoon of l'Albufera to the Mediterranean Sea and allow the flooding of rice fields by closing their floodgates. The Pujol is located in the middle of the lake almost perpendicular to the beach line. The Perellonet is located at the southern edge of the Devesa and communicates with the sea by forming an angle of approximately 40 º. However, its waters do not penetrate or evacuate water into any malladas system. Silty soils predominate in the malladas, which allow

flooding via rains and the formation of salt crusts after water evaporation during the summer.

Sampling

2004 operated as a preliminary study and was dedicated to searching for all of the water points or malladas distributed by the Devesa and Racó de l'Olla; quarterly samplings were made. In 2005, monthly samples were taken only from the Devesa; in 2006, samples were only taken from the Racó de l'Olla. Samplings were taken less frequently during 2007 and 2008. A complete map of the sampling points is provided in Figure 3. Because the benthic organisms of the malladas normally reside in shallow habitats, their sampling did not necessarily have to be carried out in the littoral zone as is suggested in sampling and analysis protocols for

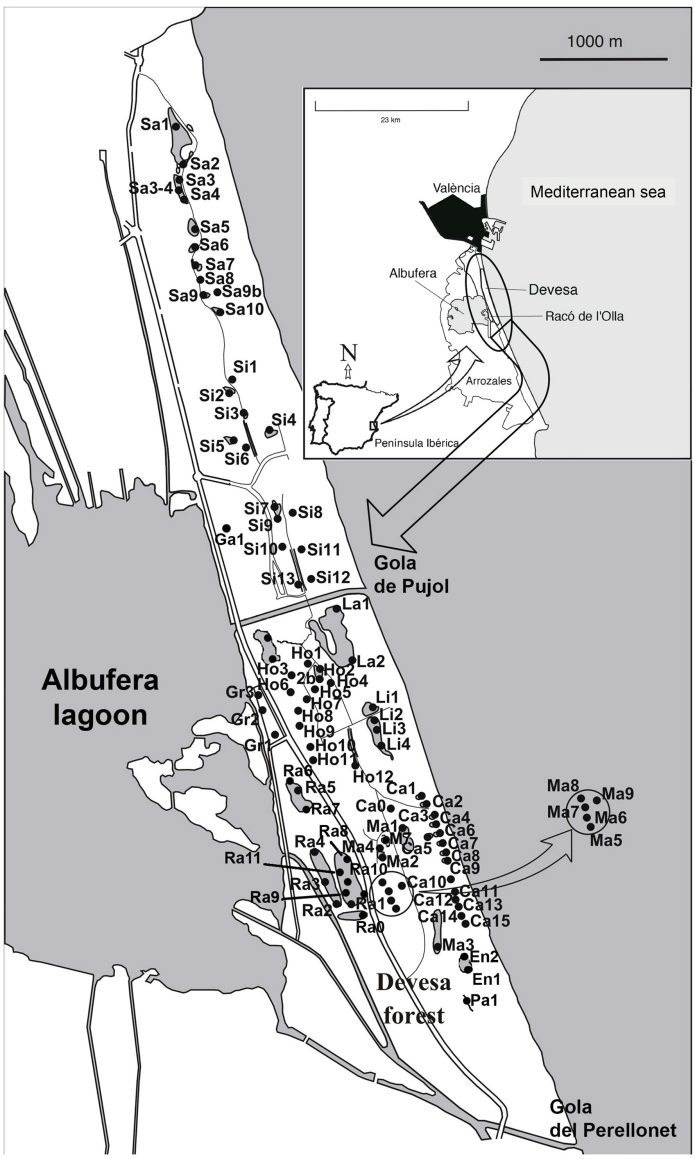

Figure 3. Location of sampling ponds in Albufera Park (Spain). *Situación de las malladas muestreada en el PN de la Albufera de Valencia (España).*

aquatic invertebrates in lakes (CHE, 2005). Therefore, we endeavored to approximate the type of sampling normally conducted in rivers according to the method proposed by Jáimez-Cuéllar *et al.* (2002) that is based on the sampling procedures followed by the American Environmental Protection Agency (Plafkin *et al.*, 1989; Barbour *et al.*, 1999). This type of sampling has been used in different basins of the Iberian Peninsula (CHE, 2005) and consists of a semiquantitative multi-habitat sampling of 20 kicks per half meter (or 10 per meter) on a route, distributed among the different types of habitats of the environment to be studied. Each kick corresponded to the passage of a square hand net with 25 cm sides and 250 μm pores. The material obtained was deposited into a plastic tray 30 cm × 40 cm. Then, this material was placed into a polyethylene container, fixed with 4 % formaldehyde and labelled. The place, date and time of sampling were noted. Next, the samples were processed under an extraction hood. The water was removed with formaldehyde, and the sample was thoroughly washed with water in a 250 μm sieve. Subsequently, the sample was re-packaged in 70 % alcohol until the organisms were separated and identified. Normally the complete washing of all samples was carried out approximately ten days after sampling. The organisms were separated into a plastic tray; they were isolated, and all larger organisms (greater than 10 mm) were counted. Later, fractions of the homogenised sample were extracted for observation, separation and counting of the invertebrates with a binocular magnifying glass until at least 400 individual organisms were found. The description and chaetotaxy of *Entomobrya* follow Jordana and Baquero (2005); the description and chaetotaxy of *Jordanathrix* follow Bretfeld (1999).

Abbreviations. Abd–abdomen or abdominal segments I–VI; Ant–antenna or antennal segment I–IV; Mc–macrochaeta/ae; MZNA–Museo de Zoología Universidad de Navarra; Th– thorax or thoracic segments II or III.

RESULTS

The Collembola class found in the malladas belonged to three orders: Poduromorpha, Entomobryomorpha and Symphypleona. The collected specimens fed on fungus and decomposing detritus deposited on their surface or on riverbank vegetation. Eighteen taxa were found, including a new species, *Entomobrya benaventi* sp. nov. and the first cite of *Jordanathrix articulata articulata* (Ellis, 1974) that are described in this paper. The most abundant genus was *Isotomurus* Börner, 1903, which produced about 150 collected specimens. Collembola were detected in 62 of the 239 samples obtained from both temporary and permanent malladas. Their numbers did not exceed 0.3 % of the total abundance of invertebrates collected. The collection sites (Table 1) are reflected in Figure 3, and all materials were collected by Juan Rueda, who legitimizes their localities (Leg.).

Class Collembola Lubbock, 1870
Order Poduromorpha Börner, 1913
Family Hypogastruridae Börner, 1906

1. *Xenylla mediterranea* da Gama, 1964

Malladas (Si01), 7-IV-2004, 2 sp.; Malladas (Sa08), 6-IV-2004, 2 sp.; Devesa (Sa09b), 17-XI-2005, 2 sp.

2. *Xenylla maritima* Tullberg, 1869

Devesa (Ca11), 16-XI-2005, 1 sp.

Family Neanuridae Börner, 1901

3. *Friesea ladeiroi* da Gama, 1959

Malladas (Ho04), 28-IV-2004 (1 sp).

4. *Pseudachorutes* cf. *parvulus*

Mallada (Ho08), 1 sp. 28-IV-2004.

Order Entomobryomorpha
Family Isotomidae Schäffer, 1896

5. *Ballistura schoetti* (Dalla Torre, 1895)

Malladas (Sa09), 28-IV-2004, 2 sp.

Table 1. Geographical location of the places from which the springtails have collected. *Situación geográfica de los sitios en los que se recolectaron colémbolos.*

Código	Lugar	Municipio	UTM
Ca08	Devesa	Valencia	30 S 732306/4357060
Ca09	Devesa	Valencia	30 S 732357/4356984
Ca11	Devesa	Valencia	30 S 732441/4356703
Ca12	Devesa	Valencia	30 S 732473/4356645
Gr02	Devesa	Valencia	30 S 730870/4358123
Ho02	Devesa	Valencia	30 S 731313/4358457
Ho03	Devesa	Valencia	30 S 730993/4358447
Ho04	Devesa	Valencia	30 S 731248/4358303
Ho05	Devesa	Valencia	30 S 731248/4358303
Ho07	Devesa	Valencia	30 S 731246/4358195
Ho08	Devesa	Valencia	30 S 731065/4358263
La01	Devesa	Valencia	30 S 731433/4358991
Li02	Devesa	Valencia	30 S 731680/4358030
Li03p	Devesa	Valencia	30 S 731745/4357982
Ma01	Devesa	Valencia	30 S 732015/4356960
Ma03	Devesa	Valencia	30 S 732293/4356238
Ra00	Racó de l'Olla	Valencia	30 S 731630/4356462
Ra01b	Racó de l'Olla	Valencia	30 S 731640/4356568
Ra02	Racó de l'Olla	Valencia	30 S 731482/4356528
Ra03	Racó de l'Olla	Valencia	30 S 731320/4356775
Ra04	Racó de l'Olla	Valencia	30 S 731179/4357239
Ra06	Racó de l'Olla	Valencia	30 S 731064/4357642
Ra08	Racó de l'Olla	Valencia	30 S 731323/4357196
Sa03/04	Devesa	Valencia	30 S 730169/4362360
Sa04	Devesa	Valencia	30 S 730193/4362311
Sa05	Devesa	Valencia	30 S 730285/4362060
Sa08	Devesa	Valencia	30 S 730374/4361479
Sa09	Devesa	Valencia	30 S 730416/4361476
Sa09b	Devesa	Valencia	30 S 730499/4361464
Sa10	Devesa	Valencia	30 S 730474/4361198
Si01	Devesa	Valencia	30 S 730599/4360852
Si02	Devesa	Valencia	30 S 730632/4360660
Si03	Devesa	Valencia	30 S 730704/4360595
Si04	Devesa	Valencia	30 S 730836/4360403
Si06	Devesa	Valencia	30 S 730749/4360341
Si08	Devesa	Valencia	30 S 731048/4359664
Si11	Devesa	Valencia	30 S 731141/4359394

6. *Isotomurus palustris* (Müller, 1776)

Devesa (Ma01), 27-II-2008, 2 slides, 1 sp. on each; Devesa toros (Si02), 20-V-2008, 2 sp. on slide, 10 sp. in ethyl alcohol; Ma01, 16-XI-2005, 3 sp. in ethyl alcohol; 19-XII-2006, 1 sp. on slide, 4 sp. in ethyl alcohol; Ma03, 19-XII-2005, 2 sp. on slide; Li01, 24-III-2006, 3 sp. in ethyl alcohol; Li02, 20-III-2006, 15 sp. in ethyl alcohol; Li03 P, 12-IX-2005, 1 sp. in ethyl alcohol; 19-XII-2005, 1 sp. on slide, 10 sp. in ethyl alcohol; Ra08, 17-I-2006, 1 sp. on slide, 4 sp. in ethyl alcohol; 13-II-2006, 2 sp. on slide, 5 sp. in ethyl alcohol; Malladas (Sa05), 6-IV-2004, 1 sp. on slide, 40 sp. in ethyl alcohol; Malladas (Si06), 7-IV-2004, 2 sp. in ethyl alcohol; Malladas (Ma01) 13-IV-2004, 1 sp. on slide; Malladas (Ma03), 7-IV-2004, 3 sp. on slide; Malladas (Ca08), 20-IV-2004, 1 sp. on slide, 4 sp. in ethyl alcohol; Malladas (Ca09), 20-IV-2004, 4 sp. in ethyl alcohol; Ca09, 16-XI-2005, 2 sp. on slide; 19-XII-2005, 1 sp. in ethyl alcohol; Ca11, 16-II-2005, 3 sp. in ethyl alcohol; Sa04, 13-I-2005, 2 sp. on slide; Malladas (Ho08), 28-IV-2004, 1 sp. on slide, 64 sp. in ethyl alcohol; Malladas (Si11), 28-IV-2004, 4 sp. in ethyl alcohol; Racó (Ra04), 14-XI-2007, 1 sp. in ethyl alcohol.

7. *Proisotoma minuta* (Tullberg, 1871)

Malladas (Sa08), 6-IV-2004, 2 sp. on slide, 3 sp. in ethyl alcohol.

Family Entomobryidae Schäffer, 1896

8. *Lepidocyrtus* cf. *flexicollis*

In bad conservation: Devesa (Ma01), 30-X-2007, 1 sp. on slide; Malladas (Ho03), 28-IV-2004, 4 sp. on slide; Malladas (Ho08), 28-IV-2004, 3 sp. on slide; Malladas (Ho09), 20-VI-2004, 1 sp. on slide.

9. *Lepidocyrtus lusitanicus* group.

This group of *Lepidocyrtus* is characterised by having three Mc between the bothriotricha in their Abd II; the species described were mainly differentiated by colouration (Mateos, 2008). Only one specimen was found. It was deteriorated and discoloured by its permanence in the water. Its ascription to this group has been determined through Abd II chaetotaxy. Sa09b, 17-XII-2005, 1 sp. (male) on slide.

10. *Seira dollfusi* Carl, 1899

Sa09b, 17-XI-2005, 1 sp.

11. *Entomobrya benaventi* sp. nov.

Material examined.

Holotype: female, Ra04, 11-XII-2006. UTM: 30 731179/4357239.

Paratypes: Ra04, 14-III-2006, 3 sp. in ethyl alcohol, UTM: 30 731179/4357239, 17-I-2005, 3 sp. in ethyl alcohol; Ra06, 1 sp. (male) on slide, 16-X-2006, UTM: 30 731064/4357642; Ra02, 1 sp. (female) on slide, 16-I-2006, UTM: 30 731482/4356528; 22-I-2004, 1 sp. on slide; Ra01b, 1 sp. (female) on slide, 19-I-2006, UTM: 30 731640/4356568; Sa04, 13-I-2005, 1 sp. on slide, UTM: 30 730193/4362311; Sa09b-01, 1 sp. (female) on slide, 17-XI-2005, UTM: 30 730499/4361464, 5 sp. in ethyl alcohol, same locality and date; Sa09b-02, 1 sp. (female) on slide, same locality and date; Sa03/04-01, 2 sp. (female) on slide, 13-I-2005, UTM: 30 730169/4362360; Sa03/04-02, 1 sp. (female) on slide, 13-I-2005, UTM: 30 730169/4362360; Ca09, 10-XII-2005, 1 sp. (female) on slide, UTM: 30 732357/4356984, 7 sp. in ethyl alcohol; Ca09, 16-XI-2005, 2 sp. (male) on slide, UTM: 30 732357/4356984; 2 sp. in ethyl alcohol; Ca11, 19-XII-2005, 4 sp. (female) on slide, UTM: 30 732441/4356703, 1 sp. in ethyl alcohol; Ca11, 16-V-2005, 1 sp. (female) on slide, UTM: 30 732441/4356703; Ca11, 16-V-2005, 3 sp. (female) on slide, UTM: 30 732441/4356703; Malladas (Sa09), 6-IV-2004, 3 sp. (female) on slide, 4 in ethyl alcohol, UTM: 30 730416/4361476; Malladas (Ho03), 28-IV-2004, 30 730993/4358447, 2 sp. on slide, 2 sp. in ethyl alcohol.

All from the Devesa de la Albufera, Valencia. Juan Rueda Leg. Deposited at MZNA.

Diagnosis: Body length 1.66 mm (n = 17).

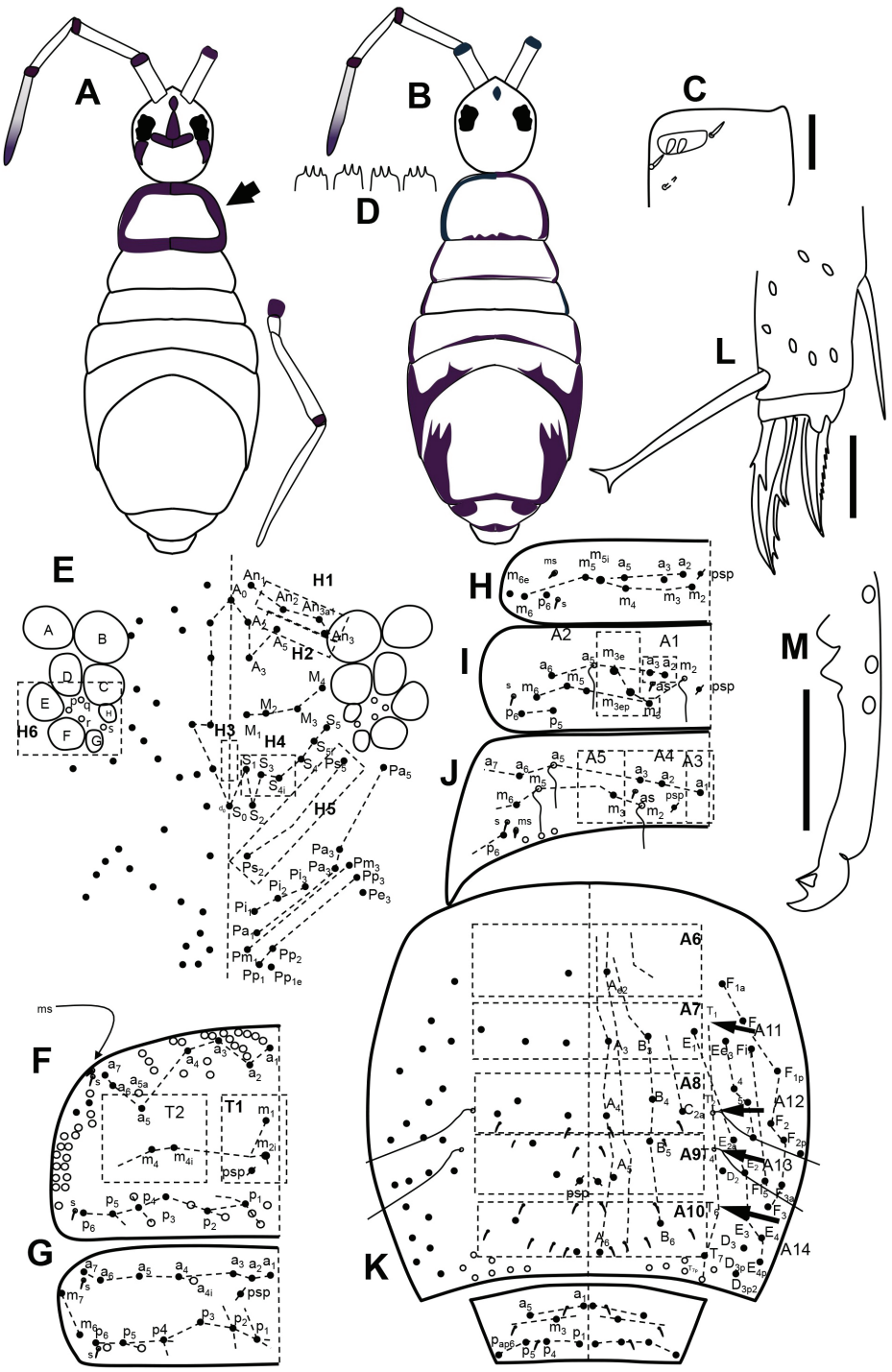

Figure 4. *Entomobrya benaventi* sp. nov. A, habitus male; B, habitus female; C, Ant III sensory organ; D, labral papillae; E, head chaetotaxy; F, Th II chaetotaxy; G, Th III chaetotaxy; H, Abd I, chaetotaxy I; I, Abd II chaetotaxy; J, Abd III chaetotaxy; K, Abd IV and V chaetotaxy; L, claw; M, dens end and mucro (bar: 0.020 mm). Entomobrya benaventi *sp. nov. A, habitus del macho; B, habitus de la hembra; C, ant III órgano sensorial; D, papilas del labro; E, quetotaxia de la cabeza; F, quetotaxia Th II; G, quetotaxia Th III; H, quetotaxia Abd I; I, quetotaxia Abd II; J, quetotaxia Abd III; K, quetotaxia Abd IV and V; L, uña; M, parte apical del dens con el mucrón (escala: 0.020 mm).*

Species showed sexual dimorphism in their colour distribution. Characteristic colour pattern are as follows: males have a blue-coloured dark band surrounding their Th terguite II and a ground whitish body; females have a similar pattern on their Th II but have a narrower surrounding band, lateral longitudinal stripes along their body segments; Th III and Abd II–V have a posterior dark blue band. This sp. nov. is characterised by labral papillae spinulate and chaetotaxy with the following simplified formula: 3-1-0-3-2/2-3/2-3/1-2-1/1-3-3-2-2. (An_2, An_{3e1}, An_3, A_5, M_1–M_4, S_1, S_3, S_{4i}, S_4, S_{5i}, S_5, Ps_2 and P_{s5} as Mc on the head; Th II with Mc m_1, m_{2i}, a_5, m_4 and m_{4i}; Th III with Mc a_1–a_7, p_1–p_6, m_6–m_7; Abd II with Mc a_2, a_3, m_3, m_{3ep} and m_{3e}; Abd. III with Mc $a_{1\text{-}3}$, and m_3; Abd. IV A_3–A_6, A_{a2}, B_3–B_6, C_{2a} and E_1).

Description

Body colour pattern. The sp. nov. has whitish ground colour. There are sexual dimorphism in colour; males present dark blue colour distribution on an anterior and lateral band on their Th II and a posterior band as depicted in Figure 4A; females have lateral bands on all segments and the posterior part of each segment except Abd I and VI, as shown in Figure 4B. Ant has a dark spot at the distal part of Ant I, II and III, and Ant IV entirely pigmented. There is a dark spot on coxae and at the end of femora. Body length is 1.66 mm (n = 17).

Head. Apical bulb of Ant IV bilobed. The sensory organ of Ant III with two central oval sensorial papillae and two lateral and one posterior sensillae (Fig. 4C). Ant II has similar sensory papilla located distally. The labral papillae have projections spine-like (Fig. 4D). Prelabral and labral chaetae with 4/554 formula. Prelabral chaetae are clearly ciliated, and the labral chaetae are smooth. The labium has –MR*ELL ciliated Mc. R* half as long as M. The remaining labial Mc are smooth. The maxillary palp has three sublobal chaetae. The papilla E has a process reaching the end of the papilla. In the dorsal head chaetotaxy (Fig. 4E), the H1 area has 3 Mc (An_2, An_{3e1} and An_3), and the H2 area with A_5 Mc present. Mc series M with M_1–M_4. The H3 area without Mc S'_0, the H4 area with S_1, S_3 and S_4 Mc and the H5 area with Ps_2 and Ps_5 Mc. Eyes G and H are small and subequal. There are four chaetae on the ocular well: p, q, r and s (Fig. 4E). The Ant/head ratio is 2.8 (n = 6). Ratio Ant I:II:I-II:IV = 1:2.1:1.9:2.29.

Thorax. The Th chaetotaxy (Figs 4F–G) has two Mc (m_1 and m_{2i}) on the T1 area on Th II; the T2 area has three Mc (a_5, m_4 and m_{4i}). Th III has complete basal chaetotaxy (a_1–a_7, p_1–p_6, m_6–m_7). The bothriotricha on Abd IV are at T2 and T4 locations. Sensillar chaetotaxy is as follows: (S, sensilla; ms, microsensilla) S = 2, 2/1, 2, 2, 10, 3. ms = 1, 0/1, 0, 1.

Abdomen. The abdominal chaetotaxy is depicted in Figures 4H–K. The Abd II has a2 and a3 Mc on area A1 and three Mc on area A2 (m3, m3ep and m3e). Abd. III has 1, 2 and 1 Mc on areas A3–A5 (a1–3 and m3). Abd. IV with 22 central posterior Mc: A3–A6, Aa2, B3–B6, C2a and E1 (Fig. 4K). The mucro has 12 µm (n = 6) (Fig. 4M). The Abd IV/III ratio is 3.2 (n = 6). The chaetotaxy formula from Jordana and Baquero (2005) is as follows: 3-1-0-3-2/2-3/2-3/1-2-1/1-3-3-2-2.

Legs. The trochanteral organ has 16–20 smooth and spiniform chaetae. The claw (Fig. 4L) has four inner teeth; these paired teeth were located at approximately 50 % of the inner claw length. There are two clear unpaired teeth on the internal edge of the claw, the first one located at 75 % of the claw basis. There are also two lateral teeth; the dorsal tooth is located intermediately between the internal teeth and the basal part of the claw. The empodium in leg 3 is longer than that in leg 1; both empodia are acuminated and have a serrated external edge. The tenent hair is expanded on its end and is longer than the claw.

Remarks: The *Entomobrya benaventi* sp. nov. (Figs. 5A, 5F) showed sexual dimorphism in its colour distribution. Males are similar to European *Entomobrya atrocincta* (sensu Jordana 2012) (Fig. 5G) and differed from the males of *E. atrocincta* Schött, 1896 (Figs. 5B–D) and *E. nigrocincta* Denis, 1924 (Figs. 5H–I). Females are similar in colour to *Entomobrya multifasciata* (Tullberg, 1871) or *E. nigrocincta*. Therefore, there are differences in the new species: it does

not have a hind band in Abd I, and the colour pattern is different in both described female species (Figs. 5E–H). European *E. atrocincta* has differential characters in colour and chaetotaxy (Fig. 5, Table 2) and smooth labral papillae. In *E. atrocincta* sensu Katz *et al.* (2015) noted that there is broad variation on the chaetotaxy in the head and Abd II–IV, while the new species has a

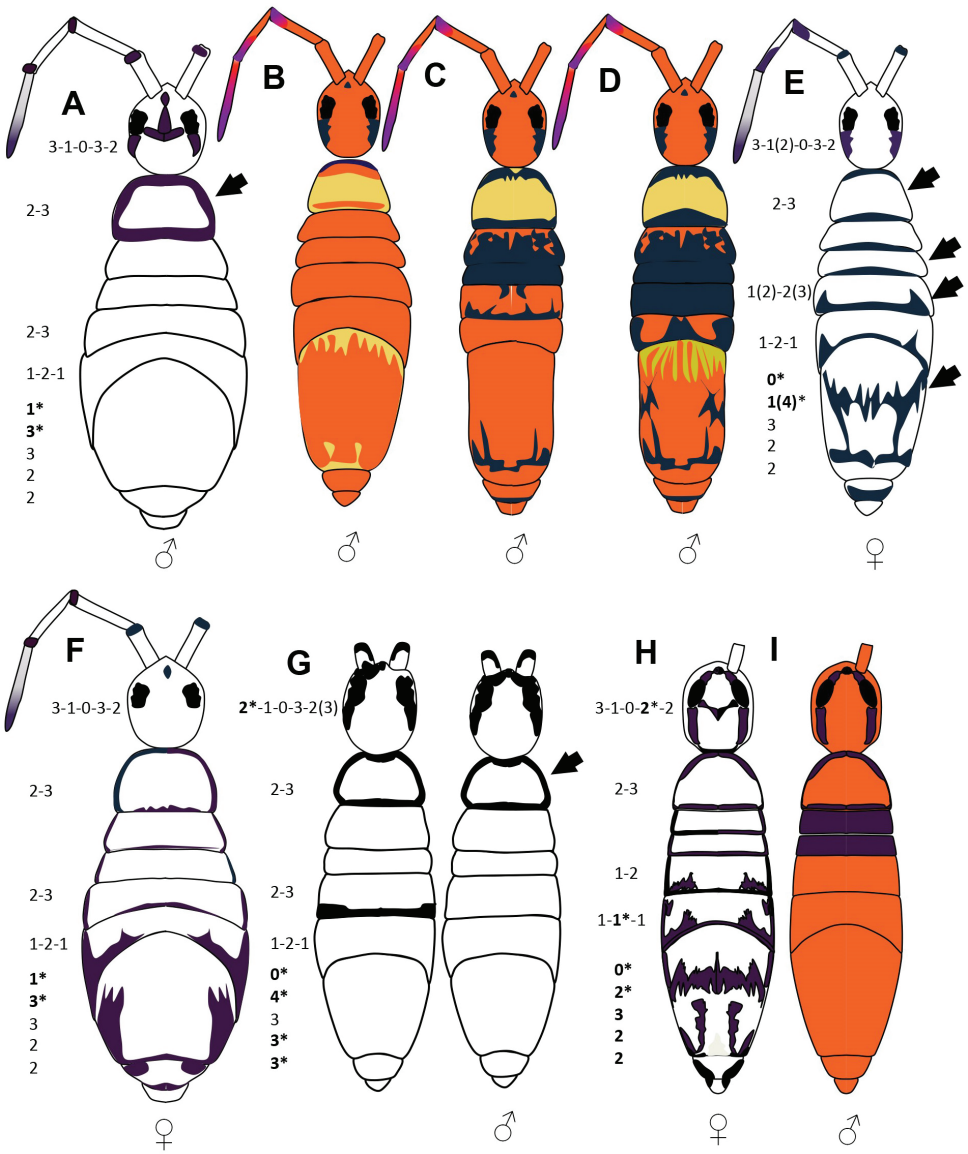

Figure 5. Comparison among similar species with sexual dimorphism. A, male of *E. benaventi* sp. nov.; B–D, male colour forms of *E. atrocincta* USA (from Katz *et al.*, 2015); E, female of *E. atrocincta*; F, female of *E. benaventi* sp. nov.; G, *E. atrocincta* Europe (from Jordana, 2012); H, *E. nigrocincta* female; I, *E. nigrocincta* male (From Jordana, 2012). The numbers next to the head and body segments indicate the chaetotaxy; the differences with the sp. nov. are in bold and have an asterisk. *Comparación entre especies similares con dimorfismo sexual. A, macho de* E. benaventi *sp. nov.; B-D, colores del macho en* E. atrocincta *USA (sensu Katz* et al.*, 2015); E, hembra de* E. atrocincta*; F, hembra de* E. benaventi *n. sp.; G,* E. atrocincta *europea (de Jordana, 2012); H, hembra de* E. nigrocincta*; I, macho de* E. nigrocincta *(de Jordana, 2012). Los numeros junto a cabeza y segmentos del cuerpo indican la quetotaxia; en negrita y con asterisco las diferencias con la sp. nov.*

Table 2. Comparative table of chaetotaxy of *Entomobrya benaventi* sp. nov., *E. atrocincta* (USA), *E. atrocincta* Europe (EU) and *E. nigrocincta*. + = Mc present, - = Mc absent, * = difference in relation to the sp. nov. *Tabla comparativa de la quetotaxia de* Entomobrya benaventi *sp. nov.,* E. atrocincta *(USA),* E. atrocincta *Europa (EU) and* E. nigrocincta. + = *Mc presente,* - = *Mc ausente,* * = *diferencia en relación a la sp. nov.*

		Head H1			**Head H2**		**Head H3**				**Head H5**			**Th T1**		**Th T2**				
Especies/Character		An2	An3a1	An3	A5	A6	S'0	S1	S3	S4i	Ps2	Ps3	Ps5	m1	m2i	a5	m4	m4i	a2	a3
E. benaventi sp. nov.	Chaetotaxy	+	+	+	+	-	-	+	+	+	+	-	+	+	+	+	+	+	+	+
E. benaventi sp. nov.	Formula		**3**			**1**	**0**		**3**			**2**			**2**		**3**			**2**
E. atrocincta USA	Chaetotaxy	+	+	+	+	-(+)*	-	+	+	+	+	-	+	+	+	+	+	+	+	+(-)
E. atrocincta USA	Formula		**3**			**1(2)***	**0**		**3**			**2**			**2**		**3**			**1(2)***
E. atrocincta EU	Chaetotaxy	+	-*	+	+		-	+	+	+	+	-(+)*		+	+	+	+	+	+	+
E. atrocincta EU	Formula		**2***			**1**	**0**		**3**			**2(3)***		**2**			**3**			**2**
E. nigrocincta	Chaetotaxy	+	+	+	+		-	-*	+	+	+	-	+	+	+	+	+	+	+	-
E. nigrocincta	Formula		**3**			**1**	**0**		**2***			**2**			**2**		**3**			**1***

	Abd II			Abd III				Abd IV													
	A2			A3	A4		A5	A6					A8			A9			A10		
	m3	m3ep	m3e	a1	a2	a3	m3	Ae2	A3	B3	C1	E1	A4	B4	C2a	A5	A5epp	B5	A6	Ai2	B6
Chaetotaxy	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	-	+
Formula		**3**		**1**	**2**		**1**	**1**			**3**			**3**			**2**			**2**	
Chaetotaxy	+	-(+)*	+	+	+	+	+	-	+	-(+)*	-(+)*	-(+)*	+	+	+	+	-	+	+	-	+
Formula		**2(3)***		**1**	**2**		**1**	**0**			**1(4)***			**3**			**2**			**2**	
Chaetotaxy	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
Formula		**3**		**1**	**2**		**1**				**4***			**3**			**3***			**3***	
Chaetotaxy	+	-	+	+	+	-	+	-	+			+	+	+	+	+	-	+	+	-	+
Formula		**2***		**1**	**1***		**1**	**0**			**2***			**3**			**2**			**2**	

constant chaetotaxy (Table 2); European *E. atrocincta* differs in its abdominal chaetotaxy (Table 2), and *E. nigrocincta* differs in the chaetotaxy of Abd II–IV (Table 2). *E. nigrocincta* and *E. atrocincta* are different in their chaetotaxy and similar in colour. All these considerations support the assertion that the *Entomobrya* found in the Devesa, Albufera of Valencia is a new species.
Etymology. The specific name refers to the first director of the Albufera Natural Park, Joan Miquel Benavent.

12. *Entomobrya nicoleti* (Lubbock, 1868)

Malladas (La01), 7-IV-2004, 1 sp. on slide.

13. *Entomobrya quinquelineata* Börner, 1901

Malladas (Ho02), 7-IV-2004, 1 sp. on slide; Malladas (Ho03), 28-IV-2004, 4 sp. on slide.

14. *Entomobrya schoetti* Stach, 1922

Malladas (Ma01), 13-IV-2004, 1 sp. on slide; Sa04, 13-I-2005, 1 sp. (juvenile) on slide; Sa04, 13-I-2005, 4 sp. on slide; Sa04, 13-I-2005, 1 sp. (juvenile) on slide.

Order Symphypleona Börner, 1901
Family Arrhopalitidae Stach, 1956

15. *Arrhopalites* sp.

Devesa, Ho07, 29-IX-2005, 1 sp. (juvenile-1st stage) on slide.

Family Dicyrtomidae Börner, 1906

16. *Dicyrtoma fusca* (Lubbock, 1873)
Devesa (Ma01), 30-X-2007, 1 sp. on slide.

17. *Jordanathrix articulata articulata* (Ellis, 1974)

Figures 6–9

Syn. *Calvatomina articulata* Ellis, 1974
First citation of this specie in the Iberian Peninsula; the species was previously cited as *Jordanathrix articulata navarrae* by Bretfeld and Arbea in 1999 (Bretfeld, 1999).

Material: Devesa: Malladas (Sa05), 06-IV-2004, 2 sp. (female) on slide; Sa09, 28-IV-2004, 1 sp. on slide; Si01, 07-IV-2004, 5 sp. on slide. Malladas (Si01), 28-IV-2004, 4 sp. on slide, 1 male, 1 female and 2 sp. deteriorated; Malladas (Si01), 28-IV-2004, 1 sp. (female) on slide; J. Rueda (Leg.) Deposited at MZNA.

Description

The organism is proportionally very small; its abdomen length has 0.8 to 1 mm and its head measured nearly 0.5 mm. The total length of the antenna is nearly 0.8 mm. The relative lengths of antennal segments are 60 : 320 : 380 : 100. Its diffuse pigment faded in alcohol. It has eight eyes in a black spot, and the legs and furca lacked pigment. The Ant has slightly blue in colour.

Head (Fig. 6). The vertex chaetae are short, not spiny like chaetae; there are 4, 4, 8 and 4 chaetae on rows A, B, C and D respectively, without unpaired chaetae. The α and β rows have four and two special sensilla of 0.015 mm in length. The clypeal chaetotaxy has six rows of chaetae a–f with 8, 9, 7, 7, 7 and 7 chaetae; there are six unpaired chaetae. Eighteen of the chaetae are sensilla with special alveoli. Labral chaetotaxy: six prelabral chaetae and 4, 5 and 5 chaetae on the a, m and p rows, respectively (Fig. 6B). Antenna (Fig. 6D) is similar to other Dicyrtomidae. Ant I with six short chaetae, Ant II with four sensilla, Ant III with ten sensilla, four in an apical whorl and two in the Ant Organ III, and Ant IV is typical of Dicyrtomidae. Maxillary palp bifurcated with one sublobal chaeta (Fig. 6C).

Body (Fig 7). Great abdominal Th II and III with a chaeta-like sensillum on row "a" and two short chaetae on row "m". Only bothriotricha A, B and C are present, forming an angle open to the hind body. There are two chaetae on row "a" (one of them is a sensillum), two on row "m" and three on "p" row at the front of the A, B and C bothriotricha. The dorsal and posterior part of the Abd have three longitudinal lines of spine-like chaetae (six to seven on each). The retinaculum tridentate and central

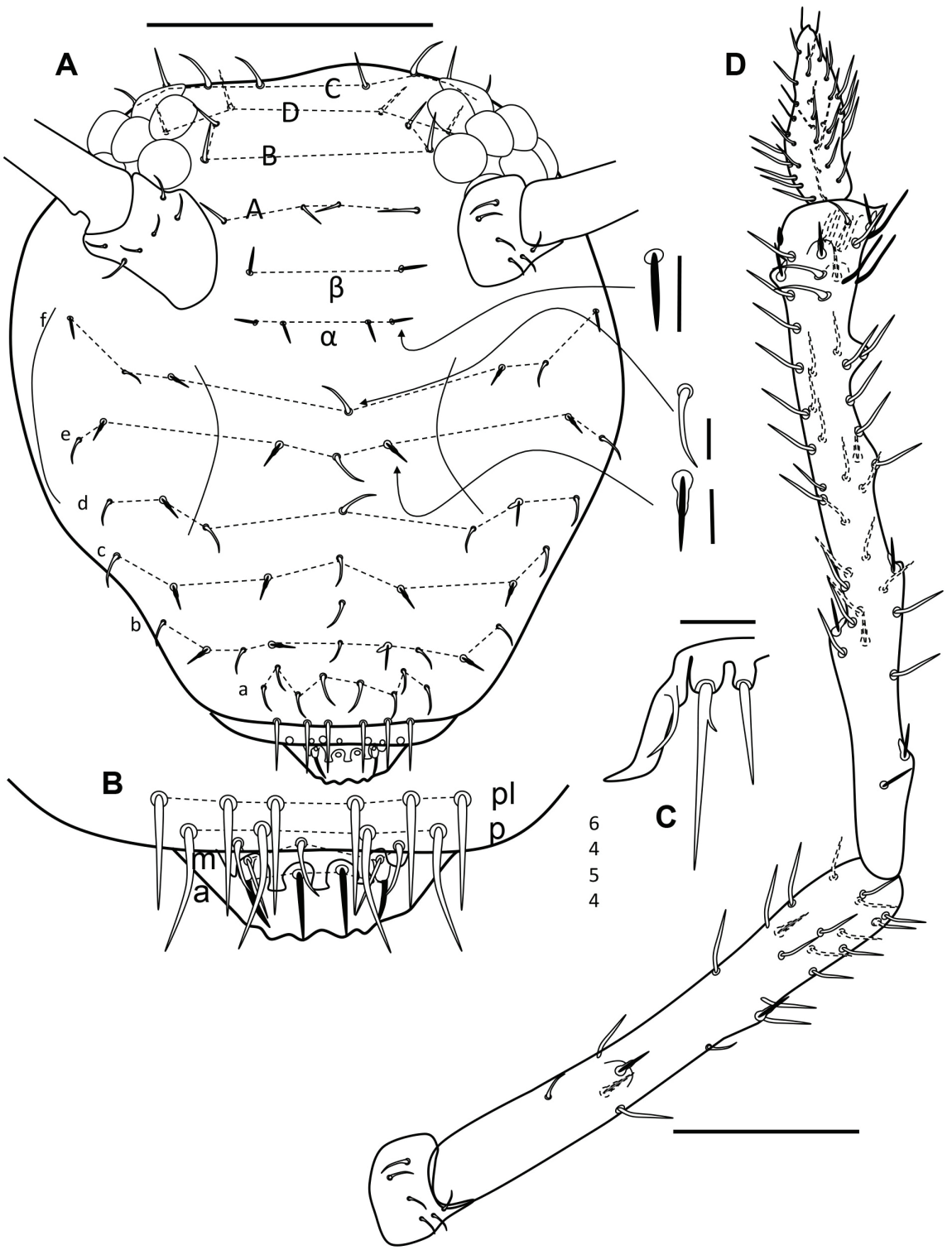

Figure 6. *Jordanathrix articulata* (Ellis, 1974). A, head chaetotaxy (bar: 0.1 mm); B, Labrum; C, maxillary palp (bar: 0.02 mm); D, antenna (bar: 0.1 mm). Chaeta and sensillae (bar: 0.015 mm). Jordanathrix articulata *(Ellis, 1974). A, quetotaxia de la cabeza (escala: 0.1 mm); B, labro; C, palpo maxilar (escala: 0.02 mm); D, antena (escala: 0.1 mm). Sedas y sensilias (escala: 0.015 mm).*

Figure 7. *Jordanathrix articulata* (Ellis, 1974). A, body chaetotaxy of a male (bar: 0.540 mm); B, retinaculum, bar: 0.030 mm. Jordanathrix articulata *(Ellis, 1974). A, quetotaxia corporal del macho (escala: 0.540 mm); B, retinaculo, escala: 0.030 mm.*

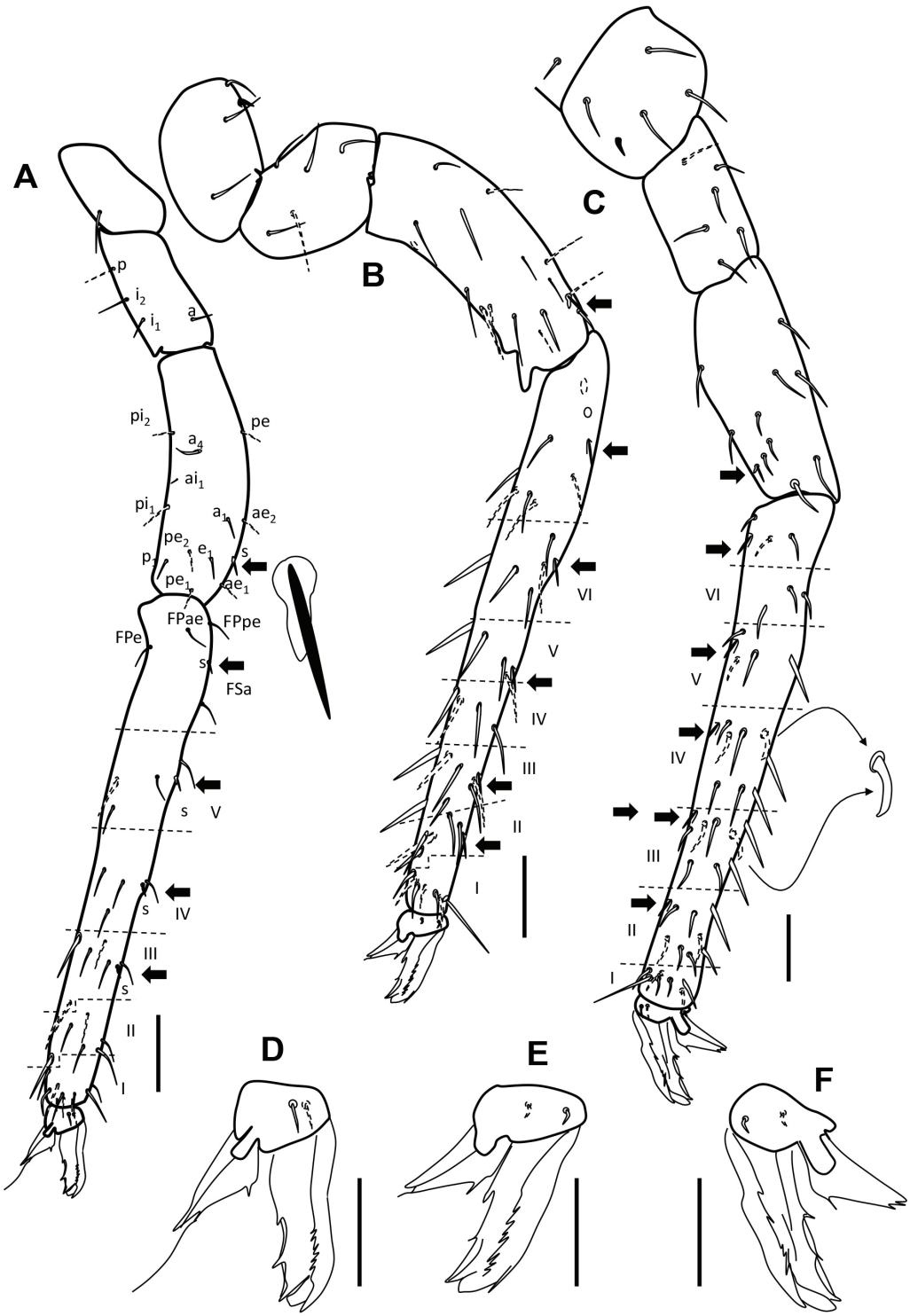

Figure 8. *Jordanathrix articulata* (Ellis, 1974). A, leg 1 (posterior view); B, leg 2 (posterior view); C, leg 3 (anterior view) (bar of legs: 0.05 mm). D, claw 1; E, claw 2; F, claw 3, bar for claws: 0.03 mm. Jordanathrix articulata *(Ellis, 1974). A, pata 1 (vista anterior); B, pata 2 (vista anterior); C, pata 3 (vista posterior) (escala de las patas: 0.05 mm). D, uña 1; E, uña 2; F, uña 3, escala de las uñas: 0.03 mm.*

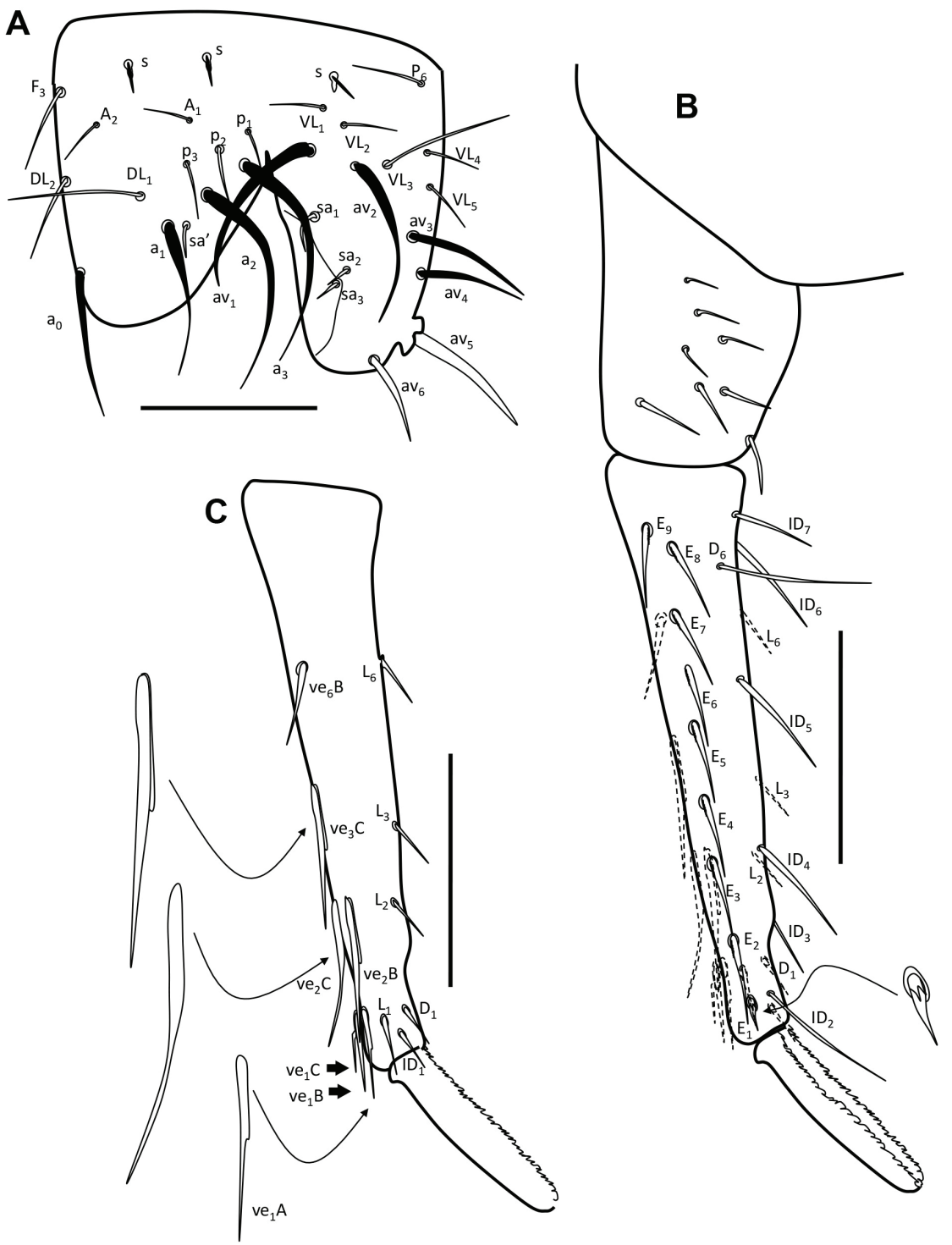

Figure 9. *Jordanathrix articulata* (Ellis, 1974). A, chaetotaxy of epiproctum and paraproctum of a female (bar: 0.080 mm); B, furca (dorso-lateral view) bar: 0.050 mm; C, dens and mucro (ventro-lateral view) bar: 0.050 mm. Jordanathrix articulata *(Ellis, 1974). A, quetotaxia del epiprocto y paraprocto de la hembra (escala: 0.080 mm); B, furca (dorso–lateral view) (escala: 0.050 mm); C, dens y mucrón (vista ventro-lateral) escala: 0.050 mm.*

corpus with four sub-apical chaetae (Fig. 7B). Abdomen without macrochaetae. Near the insertion of the manubrium, a pair of neosminthuroid rough chaetae are present in the abdomen; there are four normal chaetae and two sensilla on each side.

Legs (Fig. 8). Figure 8A shows an anterior view of Leg 1. The coxa has one chaeta, and the trochanter had four normal chaetae: a, p, i_1 and i_2. The femur has a1 as a normal-type chaeta, ai1 as a small chaeta and a4 in the transversal direction. The remaining chaetae are normal plus a sensillum. Tibiotarsi without strongly differentiated chaetae; they have six whorls of chaetae and a sensillum on whorls III, IV, V and VI. Figure 8B shows an anterior view of Leg 2. The precoxa has three chaetae and a spine, and the coxa had five chaetae. Femur with fourteen chaetae and a sensillum; tibiotarsi with seven whorls of chaetae and a sensillum in whorls II–VII. The ventral chaetotaxy of the tibiotarsi has spine-like chaetae in two longitudinal rows. Leg 3 is similar to leg 2 but has two curved spines on the ventral middle side of the tibiotarsi (Fig. 8C). Claws with tunica, claw 1 with a long empodial filament, claw 2 with a short empodial filament and claw 3 without filament (Figs. 8D–F).

Male small abdomen chaetotaxy as shown in Figure 7A. Female small abdomen (Fig. 9A): there are three sensilla between F_3 and P_6 on Abd V. Among the circumanal chaetae five (a_1–a_3, av_1–av_2) are thickened at their bases; with an anal appendage similar to a thickened chaeta (av_5) but shorter.

Manubrium with 8 + 8 chaetae. Dental chaetotaxy (Figs. 9B-C) with 3,2,1…1 anterior chaetae; the external chaetae row E (2–9) are denticulate at its base. E_1 is a spine, and the remaining chaetae are smooth.

Remarks

For the first time, the main specie of *Jordanathrix* is identified in the Iberian Peninsula. It was previously cited as *J. articulata navarrae* by Bretfeld and Arbea in Bretfeld (1999) in the original description of the ssp. The species is characterised by the presence of only one neosminthuroid chaeta on the postabdomen; the specimens described in this paper have such two chaetae (Fig. 7A). It is otherwise coincident in all characteristics with the description of Ellis (1974) as *Calvatomina articulata*.

Family Sminthurididae Börner, 1916

18. *Sminthurides aquaticus* (Bourlet, 1843)

Malladas (Gr02), 26-III-2004, 3 sp. (1 male) on slide; Malladas (Li02), 6-IV-2004, 6 sp. in ethyl alcohol; Devesa (Ma01), 27-II-2008, 1 sp. on slide; Ca09 (Ca12), 13-VI-2005, 3 sp. in ethyl alcohol; Ca09, 18-IV-2005, 4 sp. in ethyl alcohol; 19-XII-2005, 11 sp. in ethyl alcohol; Ca11, 16-II-2005, 12 sp. in ethyl alcohol; 24-III-2005, 1 sp. (male) and 6 sp. in ethyl alcohol; 16-V-2005, 1 sp. on slide; 16-XI-2005, 1 sp. in ethyl alcohol; Ca11, 19-XII-2005, 1 sp. in ethyl alcohol; Ca11, 24-III-2005, 1 sp. (male) on slide; Ca12, 24-III-2005, 12 sp. in ethyl alcohol; Ra00, 11-IV-2006, 1 sp. on slide; Ra02, 12-IV-2004, 2 sp. in ethyl alcohol; Li03 P, 19-XII-2005, 1 sp. on slide, 2 in ethyl alcohol; Li03 P, 19-XII-2005, 1 sp. (male) on slide; Li03P, 16-V-2005, 1 sp. on slide; Si03, 14-I-2005, 4 sp. on slide; Si04, 14-I-2005, 10 sp. in ethyl alcohol.

This species lives near fresh water on riverbank plants. (Bretfeld, 1999).

ACKNOWLEDGEMENTS

We appreciate the financing of the projects (ref: E-3602-2005-33, E-3602-2006-57, E-03602-2007-14, E-03602-2008-21) through contracts with the Devesa Albufera Service (City Council of Valencia) and the University of Valencia with respect to the 2004 study period. A special thanks to Joan Miquel Benavent for his support in the studies carried out in this peculiar environment in which much remains to be done. We thank Ignacio Dies for always being available and his advice to minimise the impact on the Racó.

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