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MORPHOLOGICAL, TAXONOMICAL AND ECOLOGICAL CONTRIBUTIONS TO THE CHILOPOD FAUNA OF ANDALUSIA (SIERRA DE GRAZALEMA AND LOS ALCORNOCALES), SPAIN

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ABSTRACT

K. Voigtländer & H. Reip. 2013. Morphological, taxonomical and ecological contributions to the chilopod fauna of Andalusia (Sierra de Grazalema and Los Alcornocales), Spain. *Graellsia*, 69(2): 217-241.

To increase our knowledge of the chilopod fauna of some poorly investigated regions of southern Spain, we arranged a collecting trip to Andalusia with a specific concentration on the Sierra de Grazalema and Los Alcornocales. As a result of hand collections and sieving at 21 localities we found altogether 20 species, 4 of them being new for Andalusia: *Cryptops trisulcatus* Brölemann, 1902; *Algerophilus hispanicus* (Meinert, 1870); *Stigmatogaster superba* (Meinert, 1870) and *Henia vesuviana* (Newport, 1845). For each of the species, records notes on general distribution, morphology and ecology are given. Taxonomic problems are discussed in relation to literature records.

Key words: Scolopendromorpha; Geophilomorpha; Lithobiomorpha; morphology; taxonomy; ecology; Andalusia; Spain.

RESUMEN

K. Voigtländer & H. Reip. 2013. Contribución a la morfología, taxonomía y ecología de la fauna de Quilópodos de Andalucía (Sierra de Grazalema y Los Alcornocales), España. *Greallsia*, 69(2): 217-241 (en inglés).

Con el fin de aumentar el conocimiento de la fauna de quilópodos de algunas regiones poco investigadas de España meridional, organizamos un viaje de recolección a Andalucía, dirigido a la Sierra de Grazalema y Los Alcornales. El resultado de colectas manuales y cribado en 21 localidades fue un total de 20 especies, 4 de las cuales son nuevas citas para Andalucía: *Cryptops trisulcatus* Brölemann, 1902; *Algerophilus hispanicus* (Meinert, 1870); *Stigmatogaster superba* (Meinert, 1870) y *Henia vesuviana* (Newport, 1845). Para cada especie se dan comentarios sobre su distribución general, morfología y ecología. Se discuten los problemas taxonómicos en relación con las citas encontradas en la literatura.

Key words: Scolopendromorpha; Geophilomorpha; Lithobiomorpha; morfología; taxonomía; ecología; Andalucía; España.

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Introduction

In contrast to Northern Spain (e.g. Navarra), in the middle and southern regions our knowledge of the chilopod and diplopod fauna is still incomplete. In particular the ecology of most species is poorly known. Moreover the taxonomic identity of some taxa (species, subspecies) is still uncertain. For these reasons we concentrated our attention and collecting activity on the region of Andalusia, especially in the Sierra de Grazalema and Los Alcornocales. This paper deals with the results for the centipede fauna, a later one will concentrate on the millipedes.

Sites and methods

The area of the Sierra de Grazalema and Los Alcornocales is situated in the far south of Spain, north of Algeciras, east of Cádiz and around 30 km west of Ronda (Fig. 1a). We collected around the small towns of Ubrique, Cortes de la Frontera, Benaoján and Grazalema on 21 sites (Fig. 1b).

Sites are listed and described according to the following standard: serial number (bold): sampling date; region; locality, possible details; GPS (WGS84) position; altitude; habitat; microhabitat. Sampling methods are also given for each site.

1: 03.II.2008; Sierra de Grazalema; Cortes de la Frontera, south side of the village near the hotel "Sol y Sierra"; N36.617°, W5.344°; 620 m; fallow and grassland, partly wasteland; under stones. Hand sampling.

2: 04.II.2008; Sierra de Grazalema; Sierra de Blanquilla (east of Sierra del Palo), road from Cortes de la Frontera to Benaoján, south of Barriada de la Estación; brook valley of Chapí west of the road; N36.651°, W5.300°; 580 m; small, deeply incised brook valley, humid with a dense shrub layer; within leaf litter. Hand sampling and sieving.

3: 04.II.2008; Sierra de Grazalema; Sierra de Blanquilla, road from Cortes de la Frontera to Benaoján near Casas de la Cueva de la Pileta, at the bottom of a limestone rock; N36.687°, W5.271°; 610 m; open grassland with small shrubs; under stones. Hand sampling.

4: 04.II.2008; Sierra de Grazalema; Sierra de Blanquilla, road from Cortes de la Frontera to Benaoján, steps to Cueva de la Pileta at the south-east slope of the limestone rocks; N36.691°, W5.269°; 680 m; open area with limestone debris and sparse vegetation; under stones. Hand sampling.

5: 04.II.2008; eastern border of the Sierra de Grazalema; Benaoján, road to Ronda, eastern side at the Río Guadiaro; N36.716°, W5.241°; 430 m; wet meadow with small *Salix*; in the leaf litter. Sieving.

6: 04.II.2008; ibidem; N36.720°, W5.239°; 440 m; at a dryer slope with grass cover at the border of pastures; under stones. Hand sampling.

7: 04.II.2008; eastern border of the Sierra de Grazalema; east side at Río Guadiaro, hiking trail south of Benaoján/ La Estación; N36.707°, W5.249°; 430 m; slopes with *Quercus*; under stones. Hand sampling.

8: 05.II.2008; west side of the Sierra de Grazalema; banks of the river Río del Bosque, hiking trail between El Bosque and Benamahoma; between N36.763°, W5.503° and N36.768°, W5.498°; 280 m; half open area with *Salix*, *Populus*, *Rubus*; at humid places under wood and stones. Hand sampling.

9: 05.II.2008; ibidem; around N36. 772°, W5.481°; 370 m; narrow and deeply incised valley, gallery forest; at humid sites in leaf litter. Sieving.

10: 05.II.2008; ibidem; N36.766°, W5.470°; 400 m; under bark of *Eucalyptus* trees. Hand sampling.

11: 05.II.2008; northern border of Los Alcornocales; road from Cortes de la Frontera to Alcalá de los Gazules, east of the turn-off to Ubrique, south of the mountain Peñón del Berrueco, Casa de lo Llanos, wayside; N36.614°, W5.422°; 740 m; *Quercus suber* forest, loose soil, a little humid; under dead wood and stones. Hand sampling.

12: 06.II.2008, northern side of Sierra de Grazalema, between Zahara de la Sierra and Grazalema, near the mountain area Los Cambroneros/ Los Pilones, above Garganta Verde; between N36.811°, W5.395° and N36.815°, W5.398°; 680 m; shrubland with *Quercus pubescens*, *Genista*, *Sorbus*, *Juniperus*, *Salix*, in part with sparse grass cover; under stones. Hand sampling.

13: 06.II.2008; ibidem; N36.814°, W5.403°; 560 m; *Nerium*, *Ceratonia siliqua*, *Quercus*, cool and humid; in leaf litter. Sieving.

14: 06.II.2008; Sierra de Grazalema; Cortes de la Frontera, south side of the village, near the hotel "Sol y Sierra"; N36.613°, W5.341°; 630 m; in the leaf bases of a palm tree. Hand sampling.

15: 07.II.2008; eastern border of the Sierra de Grazalema; Montejaque between the mountain Mures and Cerro de Tavizna basin to Sima del Hundidero; N36.754°, W5.238°; 700 m; upper edge of the basin, open vegetation with grass cover; under stones. Hand sampling.

16: 07.II.2008; ibidem; N36.7527°, W5.237°; 700 m; basin bottom, cool, diverse shrub vegetation; under stones. Hand sampling.

17: 07.II.2008; ibidem; N36.756°, W5.237°; 720 m; edge of the basin, *Eucalyptus* trees; under bark. Hand sampling.

18: 08.II.2008; Sierra de Grazalema; west of Benaocaz; N36.697°, W5.425°; 710 m; humid place in a cow pasture; under stones. Hand sampling.

19: 08.II.2008; Sierra de Grazalema; hiking trail between Ubrique and Benaocaz (Calzada Romana); N36.689°, W5.439°; 470 m; meadow with diverse shrubs; under stones. Hand sampling.

20: 08.II.2008; northern part of Los Alcornocales; south of the road from Cortes de la Frontera to Alcalá de los Gazules, forest way south of the mountain Peñón del Berrueco; between N36.606°, W5.419° and N36.605°, W5.423°; 780 m; open oak wood (cork and other oaks); under bark. Hand sampling.

21: 08.II.2008; ibidem; N36.593°, W5.423°; 680 m; the same as site 20; in leaf litter and dead wood. Hand sampling.

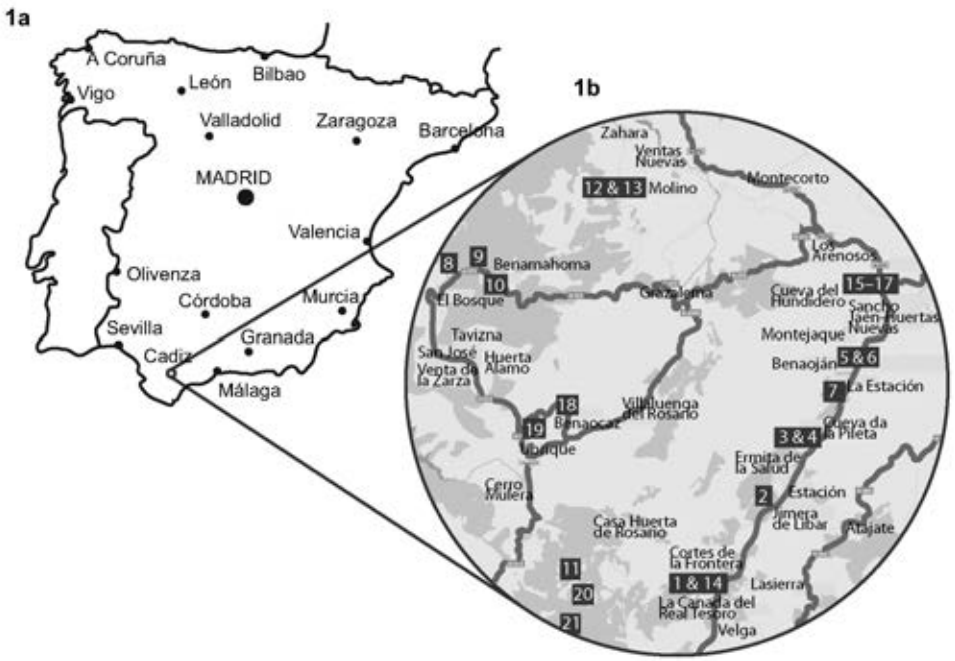


Fig. 1.– Spanish mainland (a) and localities of sampling sites (b).

Fig. 1.– Península Ibérica (a) y localidades de muestreo (b).

The keys in Attems (1927), Machado (1952), Demange (1958a), Matic *et al*. (1967), Iorio (2010) and especially Serra (1980) were used for first identification. In some cases it was necessary to consult special literature and descriptions for each species in detail. The taxonomic nomenclature is based on Chilobase. The terminology for external anatomy follows Lewis *et al*. (2005) and Bonato *et al*. (2010).

The specimens are deposited in the collection of the Senckenberg Museum of Natural History Görlitz.

Results

Species spectrum and distribution on the sites

Altogether 20 species with 102 specimens were found (12 specimens of Scolopendromopha, 17 of Geophilomorpha and 73 of Lithobiomorpha). Table 1 gives an overview on the distribution of the species on the sites. Because the sampling was not standardized, only presence is noted here. The highest number of species (7) was found at site 12. Notably the Scolopendromorpha with 5 species were very frequent in this dry and relatively open site with shrub vegetation. Of the Lithobiomorpha only *Lithobius hispanus* and *L. variegatus* were found here. Also at the more or less open sites 13 and 19 the scolopendromorph and geophilomorph species dominate the spectrum, whereas in leaf litter and under bark of more wet sites (7, 11, 14 and 21) the lithobiomorph species are the sole or most frequent species.

Catalogue of the species

In this section the species collected are listed and discussed. For each species the number of individuals caught (in brackets), geographic distribution, ecological notes and species morphology compared with data from other authors are given. If necessary, taxonomic notes are added.

Table 1.– Species distribution in the Andalusian sites investigated; x: presence.

Tabla 1.– Distribución de las especies en las locallidades andaluzas muestreadas; x: presencia.

	Site numbers																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Scolopendromorpha																					
C. hispanus												x									
C. similis			x																		
C. trisulcatus												x									
S. cingulata												x									
S. oraniensis	x											x						x			
T. erythrocephala	x												x						x		
Geophilomorpha																					
D. microcephalus								x					x								
H. vesuviana												x	x	x							
S. superba								x					x								
A. hispanica																		x	x		
G. carpophagus s. l.		x						x	x	x										x	
G. gavoyi																x					
Lithobiomorpha																					
L. castaneus									x		x				x	x					
L. hispanus			x				x					x		x				x			
L. inermis	x						x				x			x							
L. lusitanus							x														
L. obscurus	x						x							x			x			x	
L. cf. *osellai*																		x			
L. variegatus		x				x	x	x	x		x	x						x		x	x
Lam. emarginatus					x																x
Number of species	**4**	**2**	**2**	**0**	**1**	**1**	**5**	**4**	**3**	**1**	**3**	**7**	**4**	**4**	**1**	**2**	**1**	**5**	**2**	**3**	**2**

Scolopendromorpha

Cryptopidae

Cryptops* (*Cryptops*) *hispanus Brolemann, 1920

MATERIAL EXAMINED: Site 12 (1 specimen, teste M. Zapparoli 2010).

GEOGRAPHIC DISTRIBUTION: Spanish mainland (widespread in Andalusia, summarised in Serra 1985) and Balearic Islands (Sammler *et al*., 2006).

ECOLOGICAL NOTES: *C. hispanus* was found mostly under stones in open habitats like macchia and at roadsides (Sammler *et al*., 2006). Matic (1960, 1968a) recorded this species also from Spanish caves.

MORPHOLOGY: Ochre-yellow. Body length 14 mm. Breadth of cephalic shield 0.9 mm, length 1.2 mm. T1 with a curved anterior transverse suture as depicted in Serra (1985: fig. 3) but without other sutures and no posterior paramedian sutures at the cephalic shield. In coincidence with Brolemann (1920) with 12 prelabral setae and divided tarsi of legs 1-19. Last legs of the specimen examined were broken off. Brolemann (1920) recorded 8 tibial saw teeth and 4 tarsal teeth in accordance with specimens from Ibiza (collection SMNG). Machado (1953), Serra 1985) numbered 12 and 6 teeth resp. Lewis (2011) described specimens (cf. *hispanus*) with 7 tibial and 3 tarsal teeth.

Cryptops* (*Trigonocryptops*) *similis Machado, 1953

= ? *Cryptops* (*Trigonocryptops*) *numidicus* H. Lucas, 1846
= ? *C. numidicus aelleni* Manfredi, 1956

MATERIAL EXAMINED: Site 3 (1 specimen, det. M. Zapparoli 2010).

GEOGRAPHIC DISTRIBUTION: Spanish mainland; Algeria, Morocco (*C. numidicus*); Morocco (*C. numidicus aelleni*); East Africa (*C. numidicus tropicus* Attems, 1909).

This species has been described by Machado (1953) after some specimens from Southern Spain (Tarifa, Cádiz; Alcojona, Ronda) and then quoted

by Serra (1985) (Puerto del Cabrito, Algeciras, Cádiz) and Carballo & Daza (1991) (Alcalá de los Gazules, Cádiz) and also by M. Zapparoli (com. pers., 2011) for the same area. This is the fourth published record of this taxon from Spain.

ECOLOGICAL NOTES: Hitherto there has been no information about the habitats of the species. We found it under a stone in open grassland with some shrubs.

MORPHOLOGY: Pale yellow. Body length about 20 mm. Cephalic plate as long as broad (1.0 mm), sparsely punctuated (Fig. 2) overlapping the first tergite, with 2 longitudinal sutures (a) which run more or less parallel from the posterior edge and diverge towards the anterior edge of the head. Anterior border of coxosternite slightly protuberant, with 7 setae on each side. All antennal articles with a whorl of setae at the base, very inconspicuous at the end. The first two antennal articles with very numerous long setae over the whole surface, in the following articles the number of setae is successive reduced (Fig. 2), with minute setae only.

First tergite (Fig. 2) with an anterior transverse suture (b), 2 parallel, paramedial longitudinal sutures (c), running from the base to the posterior edge of the tergite and 2 lateral longitudinal sutures (d). There is also a faint, incomplete, posterior transverse suture. Paramedial longitudinal sutures and transverse anterior sutures are present up to tergite 20. Sternites with a medio-transversal, arcuated ridge and a medio-longitudinal suture, which is very distinct in the anterior part of the body.

The two-part articulation of the tarsi is very indistinctly visible. Last legs: coxa with a few short and stout setae and very small setae among the pores of the cribriform area, which does not extend up to the posterior border of the coxa; prefemur and femur with many short and robust setae laterally and ventrally and a few small scattered setae dorsally; tibia, tarsus 1 and 2 are covered with fine setae; prefemur without a ventral groove or bare area, with 1 curved dorsal spine; femur and tibia each with 2 curved dorsal spines; with 11 tibial and 3 tarsal saw teeth.

TAXONOMIC NOTES: Possibly *C. similis* is a junior synonym of *C. numidicus aelleni*. The taxonomic identity of these and further taxa of the *numidicus*-group deserve further investigation.

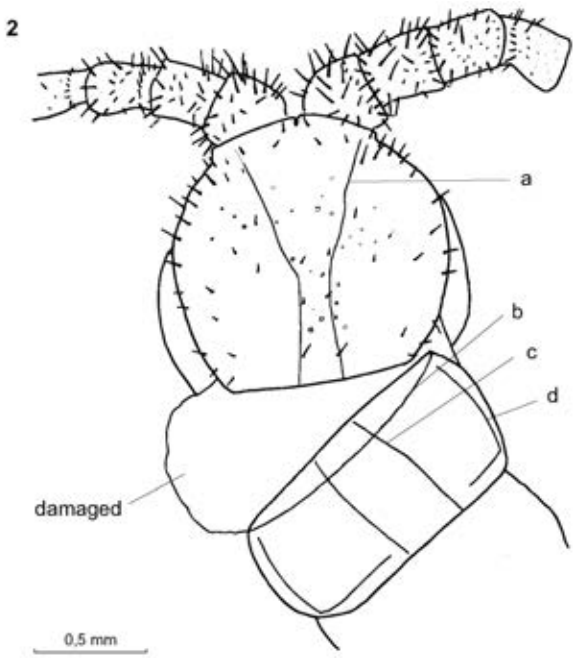


Fig. 2. – *Cryptops similis*. Head and first trunk tergite: longitudinal suture (a), anterior transverse suture (b), paramedial longitudinal suture (c), lateral longitudinal suture (d).

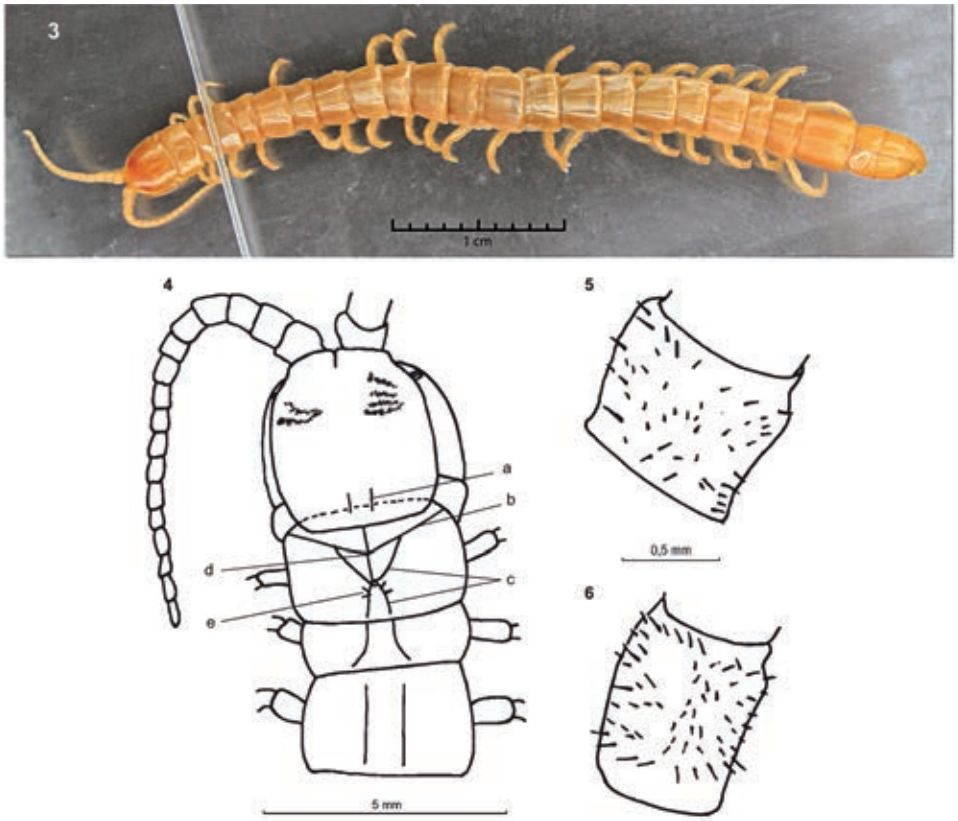
Fig. 2. – *Cryptops similis*. Cabeza y primer terguito troncal: sutura longitudinal suture (a), sutura anterior transversa (b), sutura paramedial longitudinal (c) y sutura lateral longitudinal (d).

Cryptops* (*Cryptops*) *trisulcatus Brölemann, 1902

MATERIAL EXAMINED: Site 12 (1 specimen, det. M. Zapparoli 2010).

GEOGRAPHIC DISTRIBUTION: Algeria, Canary Islands, South of France (incl. Corsica), Insular Greece (Ionian, S. Sporades and Crete), Italy (incl. Sicily, Sardinia), Maltese Archipelago, Portugal (mainland), Romania, Spain (incl. Balearic Islands), Tunisia, SE Turkey. References see Zapparoli, 2009.

ECOLOGICAL NOTES: This widespread Mediterranean species lives in macchia, garrigue and phrygana of insular Greece and Insular Spain (Zapparoli, 1996, 2002; Sammler *et al*., 2006). In Italy and Tunisia (Zapparoli, 2006, 2009; Zapparoli & Peroni, 2007; Akkari *et al*., 2008) the species is mostly related to *Quercus* woods *(Q. faginea*, *Q. ilex*, *Q. pubescens*, *Q. suber*, *Q. cerris*). There, it is also found in heterogenous



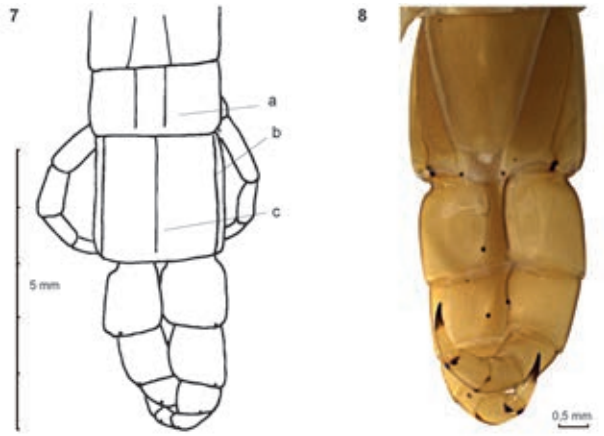
Figs 3–6.– *Theatops erythrocephala.* 3: Entire animal (dorsal). 4: Head and first three tergites, paramedian sulcus (a), anterior transversal suture (b), cruciform suture (c), median suture (d), additional furrows (e). 5: Second antennal article. 6: Fourth antennal article.

Figs 3–6.– *Theatops erythrocephala.* 3: Animal completo (dorsal). 4: Cabeza y primeros tres terguitos, sulcus paramediano (a), sutura anterior transversa (b), sutura cruciforme (c), sutura media (d), surcos adicionales (e). 5: Segundo artejo de la antena. 6: Cuarto artejo de la antena.

Eucalyptus forests, *Ostrya carpinifolia* woods, *Fagus sylvatica* woods, and in mixed woods of *Quercus* and *Pinus halepensis.* One record comes from an Italian *Castanea sativa* wood (Zapparoli, 2006) and another from a riparian habitat in Sardinia (Zapparoli 2009). *C. trisulcatus* also occurs in caves and rarely in rural areas, urban wasteland and botanical gardens (e.g. Matic & Negrea, 1966; García Ruiz & Serra, 2003; Zapparoli, 1990, 2002, 2006, 2009, 2011).

MORPHOLOGY: Pale yellow, head a little darker. Length of the specimen found only about 15 mm (known up to about 35 mm length), head longer than broad (0.85 x 0.7 mm). Cephalic shield overlaps the first tergite, with two abridged posterior and two inclined anterior sutures (Attems, 1930: fig. 289), first tergite with obvious sutures: an anterior transverse suture from which two diverging sutures run to the posterior border of the tergite (Attems, 1930: fig. 291; Akkari *et al*., 2008: fig. 26). Last legs of the specimen examined are broken off.

MORPHOLOGICAL NOTES: The most frequent numbers of saw teeth are 8 to 13 on tibia, and 4 to 6 on first tarsus of 21th legs (Iorio & Geoffroy, 2008); the numbers of 6 or 7 on tibia and 3 on first tarsus are very probably only present in young specimens. The most frequent body size in adults is between 16 and 28 mm; the old adults may reach 35 mm (Iorio & Geoffroy, 2008).



Figs. 7–8.– *Theatops erythrocephala.* 7: Tergites 20 and 21 and last legs (dorsal), paramedian longitudinal suture (a), lateral margin of tergite 21 (b), median suture (c). 8: Sternite 21 and last legs (ventral).

Figs. 7–8.– *Theatops erythrocephala.* 7: Terguitos 20 y 21 y últimas patas (dorsal), sutura longitudinal paramediana (a), margen lateral del terguito 21 (b), sutura mediana (c). 8: Esternito 21 últimas patas (ventral).

Theatops erythrocephala (C. L. Koch, 1847)

MATERIAL EXAMINED: Sites: 1 (1 ad.), 13 (1 juv.).

GEOGRAPHIC DISTRIBUTION: *T. erythrocephala* is known from all Mediterranean regions in Southern Europe (with the exception of France). The species is widespread in Spain (distribution map in Serra, 1983a).

ECOLOGICAL NOTES: Mostly recorded from caves (e.g. Attems, 1959; Matic, 1960). Other known habitats are holly oak forests (Orno-Quercetum ilicis) or Carpinetum orientalis croaticum (Matic, 1966), both slightly humid habitats. A preference for cool and humid habitats seems to be possible.

MORPHOLOGY (Fig. 3; specimen from site 1): Dirty yellow, the anterior region of the head only is rust-coloured. Body length 40.2 mm. Cephalic plate a little longer than broad (3.0 x 2.7 mm), with two short and indistinct paramedian sulci (Fig. 4a) at its posterior edge. Anterior border of coxosternite protuberant; the 3 teeth more indistinct than shown by Matic (1960: fig. 8). Trochanteroprefemur with an apical-medial process and a short furrow at its base (see ibidem).

The first antennal article is nearly glabrous; in the articles 2 to 6 the pilosity becomes increasingly dense (Figs. 5 and 6); from article 7 on it is very dense.

Tergite 1 (Fig. 4): The anterior transversal sulcus (b) is running –in contrast to Attems (1930: fig. 334, nominate form) and by Matic (1960: fig. 7) for *T. e. breuili*– not parallel, but expanding triangularly towards the midline. The cruciform (c) and median (d) sutures agree with the description given in Matic (1960). The number of very small additional furrows (e) at each side of the cruciform sutures varies between 0 (specimen from site 13), 1 in Matic (1960) and two (specimen from site 1).

The following descriptions are in agreement with Matic (1960):

Tergite 2 to 20 (Fig. 7) with 2 paramedian longitudinal sutures (a), tergite 21 laterally marginated (b) with one median suture (c). Last tergite 2.9 long and 3.0 mm broad.

Tarsi 1 to 19 uniarticulated, ventrally having a single spine; tibia 1 to 18 have two spines (VmT and DaT); tibia 19 with only a single ventral spine, tibia 20 without spines.

Last legs very stout (Figs. 7 and 8); internal surface of coxa with many pores and 1 ventral spine (VaC); prefemur as long as broad, prefemur and femur ventrally with 1 median spine, tibia and the two tarsal articles without spurs, claw nearly as long as both tarsi together.

TAXONOMIC NOTES: Our material as well as the material studied by Serra (1983a, 1985) is very similar to the *T. e. breuili* originally described by Matic (1960) as a subspecies. It differs from the nominate form in the presence of two short furrows at the posterior head edge, also the cruciform structure of the furrows on the first tergite and a furrow at the trochanteroprefemur (Matic, 1960: figs. 7 and 8). After investigation of more material, which showed a high degree of variability in the *breuili*-characters, Matic (1968a) did relegate it to the status of a variety.

Scolopendridae

Scolopendra cingulata Latreille, 1789

MATERIAL EXAMINED: Site 12 (1 juv., det. M. Zapparoli 2010, teste E. Iorio 2013).

COMMENT: The specimen seems to be an immature of the common Mediterranean *S. cingulata*. Although the determination is uncertain we have

Fig. 9.– *Scolopendra cingulata.* Entire animal (dorsal).

Fig. 9.– *Scolopendra cingulata.* Animal completo (dorsal).

admitted it in our list because the occurrence of this species in Spain is absolutely typical.

GEOGRAPHIC DISTRIBUTION: Albania, Bosnia Herzegovina, Bulgaria, Croatia, Cyprus, France, mainland and insular Greece, Hungary, Italy (incl. Sicily), Montenegro, Near and Middle East, North Africa, Macedonia, Portugal, Romania, Serbia, Slovenia, Spain, Tadjikistan, Ukraine (incl. Crimea). References see Zapparoli, 2009.

ECOLOGICAL NOTES: Thermophilous species, mostly in open Mediterranean habitats (grassland, meadows, pastures, garrigues, maquis), in calanques and in more or less open oak woods, mixed *Quercus* and *Ulmus* woods, *Pinus* afforestations, olive groves and urban habitats (Zapparoli, 2006).

MORPHOLOGY (Fig. 9): Yellowish, anterior region of the head and a transverse band on the posterior border of tergites 2 to 20 dark olive green. Body length about 27 mm. Head width 2.1 mm. Antennae with 18 articles, the first 6 nearly glabrous. Cephalic shield and tergite 21 without sutures. Tergite 1 without a curved anterior transverse sulcus; tergites 18 to 21 marginated. Sternite paramedian suture complete. Last legs: coxopleural processes protruding beyond the posterior border of the coxopleura, with 3 spines; prefemur with 2 spines ventrally, all spines on a swollen base, the dorsal prefemoral process with 3 spines; prefemora of the examined juvenile specimen relatively longer than is usual in adults (3 times as long as wide in contrast to the usual 1.5. to 2.25 times). Tarsus without spurs.

Scolopendra oraniensis Lucas, 1846

MATERIAL EXAMINED: Sites: 1 (1♂), 12 (2♂, 1♀), 18 (1♂), 19 (1♂).

GEOGRAPHIC DISTRIBUTION: France (Corsica), Iran, Italy, Malta, Portugal, Spanish mainland and Balearic Islands, North Africa (Algeria, Morocco, but not in Tunisia –Akkari *et al*., 2008). The species is widespread in Spain (see distribution map in Serra, 1983a).

ECOLOGICAL NOTES: As mentioned in the literature *S. oraniensis* is commonly found under stones in streambeds that dry out in spring and summer, garrigue and open habitats, mostly in coastal areas, also in *Quercus ilex* high shrubs, more rarely in forest associations (e.g. Zapparoli *et al*., 2004; Zapparoli, 2006, 2009; Minelli & Zapparoli, 2011). Exceptionally in caves (Zapparoli, 2011). In our investigation the species avoided moist places.

MORPHOLOGY (Figs. 10 and 11): Coloration very variable: the whole body ochre yellow or ochre yellow with a greenish anterior border of the head, sometimes also the anterior segments greenish; or posterior and lateral borders of tergites with greenish coloration; the longitudinal band along the tergites greenish, sometimes pale yellow; antennae pale yellowish, sometimes greenish. Body about 41 to 45 mm long. Head wide 2.5 to 2.8 mm. Antennae with 17 up to mostly 19 articles; the first 5 articles hairless, the following densely and shortly bristled; in one case the distal end of article 5 sparsely haired and in a second article 3 to 5 with sparse pilosity.

First tergite without transversal sulcus; tergites 2 to 20 with 2 medial longitudinal sulci; tergite 21 with 1 medial longitudinal sulcus; the lateral longi-

Figs. 10–11.– *Scolopendra oraniensis*. 10: Entire animal (dorsal). 11: Prefemural process of the left leg (dorso-ventral).

Figs. 10–11.– *Scolopendra oraniensis*. 10: Animal completo (dorsal). 11: Proceso prefemoral de la pata izquierda (dorso-ventral).

tudinal sulci starts between tergite from 17 to 19, in one case at tergite 13; tergite 2 up to (mostly) tergite 15 with an abridged lateral slanting sulcus. Second tarsus of first legs ventrally with 2 spines.

Ultimate legs: Prefemur: with 20, 26 and mostly 27 spines of which 10 to 14 are located more or less ventrally; the dorsal prefemoral process always with 2 spines (Fig. 11); prefemur and also femur dorsally a little flattened. Processes of the coxopleurites long and slender, with 8 to 11 spines (sometimes 5) on the tip. The two tarsi have dense and short bristles all round in the three males examined, the tarsi of the fourth male only sparsely so, but with bristles all round as also in the two females studied.

MORPHOLOGICAL NOTES: The body size of *S. oraniensis* can reach 60 mm or even very rarely 68 mm (Iorio & Geoffroy, 2006, 2008). Generally the prefemur has 20 to 30 spines of which 9 are located ventrally. The coxopleural process has generally 6 to 13 spines (Attems, 1930; Iorio & Geoffroy, 2006, 2008).

TAXONOMIC NOTES: Since Attems (1930), *S. oraniensis* was treated as a subspecies of *S. canidens* by many authors (e.g. Brolemann, 1930, 1932; Machado, 1952; Matic *et al*., 1967). The differential characters between these taxa are given in Würmli (1980). In the same paper Würmli raised *oraniensis* to species level again.

According to Attems (1930), the pilosity of the tarsi of the males is always dense, the tarsi of females are glabrous. Würmli (1980) had noted the incorrectness of this description, substantiated by the present investigations.

Geophilomorpha

Geophilidae

Geophilus carpophagus Leach, 1815 sensu lato

MATERIAL EXAMINED: Sites: 2 (1 ♀), 8 (1♂), 9 (1 juv. ♂), 10 (2♂, 3 ♀, 3 juv. ♂, 2 juv. ♀), 20 (1 ♀).

GEOGRAPHIC DISTRIBUTION: Widespread in Europe, Macaronesia and North Africa.

ECOLOGICAL NOTES: *G. carpophagus* is known as euryoecious, mostly a woodland species (Minelli & Iovane, 1987; Sammler *et al*., 2006; Zapparoli, 2009; Minelli & Zapparoli, 2011). This account corresponds to what was found in our investigation: here the species prefers humid locations, living in leaf litter, under stones and in dead wood but also occurring in dryer habitats such as cork oak or *Eucalyptus* forests (under bark).

MORPHOLOGY: The males have 47 or 49, the females 49 to 53 pairs of legs. Body length varies between 29 and 38 mm in males and between 32 and 44 mm in females; head width between 0.78 and 0.91 mm in males and 0.82 to 0.95 mm in females. The number of coxal pores varies between 4 to 8, sometimes right and left sides have different numbers.

The four juvenile males have 2 coxal pores (see Gregory & Barber, 2010: figs. 18 and 19), 49 pairs

of legs, a body length of about 15 mm; the head width varies between 0.48 and 0.5 mm. The two juvenile females have 51 pairs of legs, body length of about 15 and 21 mm and a head width from 0.53 and 0.57 mm. The larger specimen shows 2 coxal pores on the left and 4 coxal pores on the right side; the smaller one has 2 coxal pores on each side.

TAXONOMIC NOTES: British specimens of *G. carpophagus* and the closely connected *G. easoni* Arthur, Foddai, Kettle, Lewis, Luczynski, Minelli, 2001 were briefly investigated and the specimens can be distinguished very well (Arthur *et al*., 2001, 2002; Haswell *et al*., 2006). For material from outside Britain a clear differentiation of these two species is not given hitherto (Gregory & Barber, 2010). Characters suitable to distinguish the British species clearly (e.g. segment numbers, numbers of fimbriae on the side pieces of the labrum) have been shown to vary widely and to overlap between the two species there. Further investigations for new characters are necessary.

For example, in our Andalusian specimens the numbers of leg pairs as well as the shape of the mid-piece of the labrum would lead to *G. easoni*, whereas other characters (number of fimbriae of the side piece of labrum, number of coxal pore/in relation to body length, relation of width of the tip of the apical claws to width of the base of claw) are more similar to the description of *G. carpophagus*. A decision about the unambiguous identification of these specimens will be possible only based on an intensive investigation of this species over its whole distribution area.

Geophilus gavoyi Chalande, 1910

MATERIAL EXAMINED: Site 16 (1♂).

GEOGRAPHIC DISTRIBUTION: France (incl. Corsica), Italy, Spain. Selected references: Geoffroy & Iorio, 2009; Minelli & Zapparoli, 2011; García Ruiz & Serra, 2000).

Dumitrescu & Orghidan (1969) have recorded the species from caves in Romania. These records are highly doubtful, even Matic (1972) does not quote them (probably confused with *Geophilus alpinus* Meinert, 1870 = *G. insculptus* Attems, 1895).

ECOLOGICAL NOTES: *G. gavoyi* was found by Verhoeff (1928, as *G. aetnensis*) at the slope of Etna (Randazzo, Sicily), under *Quercus* and *Castanea* ("Buschwald"). Jeekel (1964) has collected the species under stones near melting snow patches (Gran Sasso, Central Italy). It also occurs in Rome (Silvestri, 1895 as *G. vinciguerrae*) and in a garden on Corsica (Verhoeff, 1943a as *G. evisensis*). Newer records from Spain (García Ruiz & Serra, 2000) give no information about habitat.

MORPHOLOGY: Pale yellowish, head a little darker. The only male we found is 22.1 mm long and has 53 pairs of legs. Head as long as broad (0.56 mm), without cephalic transverse suture.

Mouth-parts as shown in Chalande (1910: figs. 1 to 3). Labrum: intermediate part with 8 denticles; lateral parts with 7 bristles (9 denticles and 4 and 5 bristles in the original description of Chalande). First maxillae without lappets. Pretarsi of second maxillae cone-shaped with two small rods.

Carpophagus pit and also the ventral pore-field up to the 17th sternite. Ultimate legs a little thickened in males, with a distinct apical claw; coxopleura each with 5 pores.

Algerophilus hispanicus (Meinert, 1870)

MATERIAL EXAMINED: Sites: 18 (1♀, det. L. Bonato 2010) (61 leg pairs), 19 (1♂) (59 leg pairs).

GEOGRAPHIC DISTRIBUTION: Spanish mainland and Balearic Islands.

ECOLOGICAL NOTES: *A. hispanicus* was found under stones and bark in forests of *Pinus halepensis* and in macchia alta on the Balearic Island of Ibiza (Sammler *et al*., 2006). We found the species in more humid areas in pastures and meadows with shrubs; there also under stones.

MORPHOLOGY AND TAXONOMICAL NOTES: A complete redescription and illustrations as well as a discussion of its taxonomic position are given in (Bonato *et al*., 2012).

Himantariidae

Stigmatogaster superba (Meinert, 1870)

MATERIAL EXAMINED: Site 6 (1♀).

GEOGRAPHIC DISTRIBUTION: Italy (Sardinia, Sicily), Spain, North Africa (Attems, 1929, chilobase).

ECOLOGICAL NOTES: Virtually nothing is known about the ecological preferences of this not frequent species. Minelli & Zapparoli (2011) found it

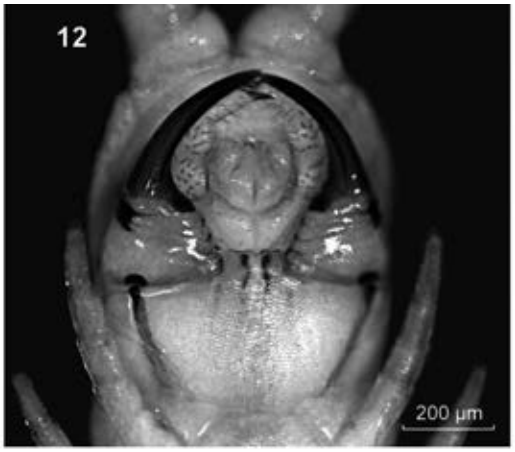
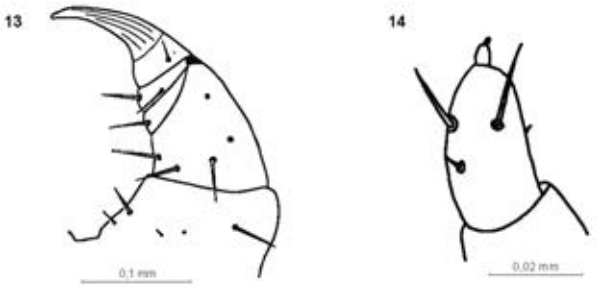


Fig. 12.– *Stigmatogaster superba*. Head with forcipules (ventral).

Fig. 12.– *Stigmatogaster superba*. Cabeza con forcípulas (ventral).



Figs. 13–14. – *Dignathodon microcephalus*. 13: Right forcipule (ventral). 14: End of second maxilla.

Figs. 13–14. – *Dignathodon microcephalus*. 13: Forcípula derecha (ventral). 14: Extremo de la segunda maxila.

at an abandoned farm land dominated by *Ferula communis*.

MORPHOLOGY: The characters of this species are described in detail and figured in Chalande & Ribaut (1909).

Whitish, head slightly pale yellowish, forcipules brownish. Body length 45 mm. 143 pairs of legs. Head a little broader than long (0.7 x 0.6 mm). Forcipular segment (Fig. 12): poison claw without a basal denticle; coxosternite with well developed chitin-lines. The second to the penultimate sternite with a transverse oval pore group. Metasternite trapeziform, with a longitudinal median gutter in females (undivided in males). Last legs slightly swollen in males; coxal pores regularly distributed over the whole surface. Without an apical claw.

Dignathodontidae

Dignathodon microcephalus (Lucas, 1846)

MATERIAL EXAMINED: Sites: 8 (1♂), 13 (1♂ det. L. Bonato 2010).

GEOGRAPHIC DISTRIBUTION: This southern European species is mostly distributed in the Mediterranean region, but there are also records from Austria, Bulgaria, Czech and Slovak Republics, Hungary (Loksa 1961), Romania, Serbia, Ukraine (Crimea). North Africa, Near and Middle East. In Luxembourg probably introduced. References see Zapparoli, 2006.

ECOLOGICAL NOTES: The species occurs in some very different habitats with different moisture content and vegetation cover, mostly in oak woods. It is quite common in artificial or disturbed habitats (e.g. Zapparoli, 2006).

MORPHOLOGY (Figs. 13 and 14): Male from site 8: Whitish to pale yellow. Body 21 mm long and very setose forward region strongly narrowed. With 61 pairs of legs. Head very small, as broad as long (0.3 mm). Antennae slightly claviform, last article without fovea.

Forcipules: In contrast to the *D. microcephalus* typical poison claw with two long and slender teeth, the males from the Sierra de Grazalema do not have such teeth (Fig. 13), they are without a basal denticle; coxosternite with complete chitin-lines.

First maxillae without lappets. Apical claws of the second maxillary telopodites with a small peg (Fig. 14).

Last legs: Strongly thickened; coxal pores in grooves in front of the coxa and near the edge of the sternite. With distinct apical claws.

Henia vesuviana (Newport, 1845)

MATERIAL EXAMINED: Sites: 12 (1♀, teste L. Bonato 2010), 13 (1♂), 14 (1♂, 2♀).

GEOGRAPHIC DISTRIBUTION: Croatia, France, southern England, Hungary, Italy, Romania, Slovenia, Spain, Switzerland, Tunisia; in Central

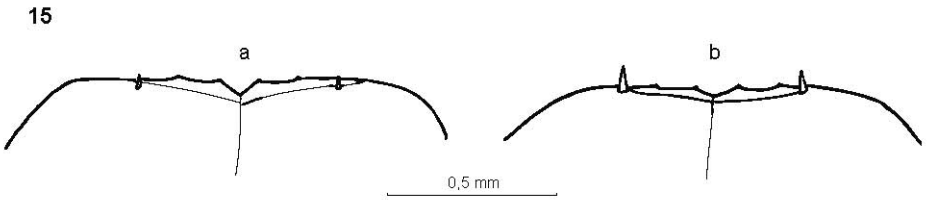


Fig. 15. – *Lithobius castaneus*. Variations (a, b) of coxosternum (anterior border).

Fig. 15. – *Lithobius castaneus*. Variaciones (a, b) del coxosternum (borde anterior).

Europe mostly in towns (e.g. Voigtländer, 1988; Schulte *et al*., 1989; Lindner, 2007). References see Zapparoli, 2006.

ECOLOGICAL NOTES: *H. vesuviana* is an euryoecious species (Minelli & Iovane, 1987), known from open and dry habitats, forests of *Pinus halepensis,* woods of *Quercus cerris, Q. ilex, Fagus sylvatica* and many other trees (e.g. Zapparoli, 2006). Zapparoli (2011) classified the species as a woodland species, where it occurs mostly in the leaf litter and humus layer (Zapparoli, 2009, 2011), but also in rotten wood (Sammler *et al*., 2006). In open and thermophilous sites the species is found mostly under stones.

MORPHOLOGY: The present material agrees very well with the description given by Eason (1964). Males with 66, two females with 75 and one female with 73 pairs of legs. The body length varies between 21 and 24 mm in males, and between 27 and 36 mm in females; the head width varies between 0.53 and 0.56 in males and 0.53 and 0.83 mm in females.

Lithobiomorpha

Henicopidae

Lamyctes emarginatus (Newport, 1844)

MATERIAL EXAMINED: Sites: 5 (1 ♀), 21 (1 juv. ♀).

GEOGRAPHIC DISTRIBUTION: Originally occurring only in the southern hemisphere, the species has now been distributed over the whole world by human influence (Stoev *et al*., 2010; Zapparoli, 2010).

ECOLOGICAL NOTES: Open (arid and wet) and disturbed land with sparse vegetation are very much dominant among the localities in which *L. emarginatus* is present in Europe (e.g. Zerm, 1997; Voigtländer, 2005; Andersson, 2006; Zapparoli, 2006; Dunger & Voigtländer, 2009).

MORPHOLOGY: Juvenile from site 21: Pl 1: Whitish-yellowish, head borders darker. Body length 3.9 mm; this is much smaller than the length given in Andersson (1984). Head as long as broad (0.5 mm). Antennae with 19 articles. Coxosternite with 3+3 teeth. Coxal pores: 1111. Accessory claws of last legs well developed. No tibial projection on last leg. Female gonopods exist as small stumps.

Lithobiidae

Lithobius* (*Lithobius*) *castaneus Newport, 1844

MATERIAL EXAMINED: Sites: 9 (1♂), 11 (1 ♀), 15 (3♂, 1 ♀), 16 (1 juv. ♂).

GEOGRAPHIC DISTRIBUTION: Austria, Bosnia-Herzegovina, Croatia, Guatemala (introduced), France (incl. Corsica), Italy (incl. Sicily and Sardinia), Malta, North Africa, Portugal, Serbia, Slovenia, Spain. References see Zapparoli, 2006.

ECOLOGICAL NOTES: The most frequent habitat records of this S-European species comes from Italy and Italian islands (e.g. Verhoeff, 1943b; Matic, 1966, Marcuzzi & Bonometto, 1973; Minelli & Iovane, 1987; Zapparoli, 1990, 2006, 2009; Zapparoli *et al*., 2004; Minelli & Zapparoli, 2011). There it is especially frequent in diverse wood types with *Quercus cerris* and *Fagus sylvaticus* (for instance Querceto-Carpinetum, Abieto-Fagetum, Erico-Pinetum, Salvio-Fraxinetum); under *Castanea*, *Ostrya* and *Quercus ilex*. Sometimes the species is found in more open shrub and grassland habitats, garrigue and macchia alta,

Table 2.– Plectrotaxy of a juvenile male of *L. castaneus* in comparison with adults. **( )**: observed in all adults, ( ): observed in most adults.

Tabla 2.– Plectrotaxia de un macho juvenil de *L. castaneus* en comparación con la de los adultos. **( )**: observada en todos los adultos, ( ): observada en la mayoría de adultos.

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	mp	am**(p)**	am	–	–	amp	ap	a(p)
2	–	–	mp	am**(p)**	am	–	–	amp	ap	ap
3	–	–	mp	am**(p)**	am	–	–	amp	ap	ap
4	–	–	mp	amp	am	–	–	amp	ap	ap
5	–	–	mp	amp	am	–	–	amp	ap	ap
6	–	–	mp	amp	am	–	–	amp	ap	ap
7	–	–	mp	amp	am	–	–	amp	ap	ap
8	–	–	mp	amp	am	–	–	amp	ap	ap
9	–	–	mp	amp	am	–	–	amp	ap	ap
10	–	–	mp	amp	am	–	–	amp	ap	ap
11	–	–	amp	amp	am	–	–	amp	ap	ap
12	–		amp	amp	am	–	–	amp	ap	ap
13	–	–	amp	amp	am	–	–	amp	ap	ap
14	–	m	amp	amp	am	a	–	amp	p	p
15	a	m	amp	am	a	a	–	amp	p	–

Table 3.– Plectrotaxy of *L. hispanicus*. ( )*: this variant occurs with the same frequency, ( ): this variant occurs a little less commonly.

Tabla 3.– Plectrotaxia de *L. hispanicus*. ( )*: variante que aparece siempre con la misma frecuencia, ( ): variante menos frecuente.

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	–	(m)	m	–	–	–	a	a
2	–	–	–	m	m	–	–	–	ap	a
3	–	–	–	am	m	–	–	–	ap	ap
4	–	–	–	am	m	–	–	–	ap	ap
5	–	–	–	am	m	–	–	–	ap	ap
6	–	–	–	am	m	–	–	–	ap	ap
7	–	–	–	am	m	–	–	–	ap	ap
8	–	–	–	am	m	–	–	–	ap	ap
9	–	–	–	am	m	–	–	–	ap	ap
10	–	–	–	am	m	–	–	–	ap	ap
11	–	–	–	am	m	–	–	–	ap	ap
12	–	–	p(–)*	am	m	–	–	(mp)	ap	ap
13	–	–	p(mp)	am	m	–	–	mp	p	p(ap)
14	–	m	mp	m	–	–	–	mp	–(p)	–
15	–	m	mp	m	–	–	–	mp	–	–

and even in bad lands and dunes; sometimes in urban or suburban habitats. In Corsica, *L. castaneus* is a typical woodland species (Iorio, 2010; Zapparoli & Iorio, 2012). In Eastern Pyrenees it was also found mostly in woods and in garrigue (Tobias, 1969). In Spain *L. castaneus* is known from *Abies* and *Picea* reafforestations, but also from more open land (Prunello-Sarothamnetum) (Serra & Ascaso, 1990). From other parts of the distribution area no habitat records exist. Occurrences in caves are not rare (e.g. Matic 1958, 1961, 1968a; Zapparoli, 2009; Iorio, 2010).

MORPHOLOGY: Adults: The specimens examined agree with the very detailed description and the figures given in Koren (1992) and Eason (1980). There are only two differences in the plectrotaxy of the legs from that given in Eason: 13 DaC may occasionally be absent in our specimens and sometimes DpT at leg 1 is present. Machado (1952) refers to VaP first on leg 12, in our material this spine could be observed first on leg 10.

Verhoeff (1934) differentiates between four races according of the presence or absence of VaC, number and shape of the coxal pores, the shape of the gonopod claw as well as the size of prosternal teeth and parodonts. In our material these characters are very variable (an example is shown in Fig. 15). In agreement with Eason (1980), a morphological differentiation according to Verhoeff (1934) is not given.

Juvenile male (site 16): Pale amber. 14 mm long. Head as long as wide (1.35 mm). Antennae with 25 articles. Coxal pores: 3555 (up to 8 in adults). Coxosternite: the teeth are well developed, the porodont is long and acuminated. The plectrotaxy differs from adults only in the absence of VpF on 1st and 2nd legs, which occurs in all adult specimens examined as well as in the absence of 1 DpT, which occurs in the most of adults examined (Table 2).

Lithobius* (*Lithobius*) *hispanicus Meinert, 1872

MATERIAL EXAMINED: Sites: 3 (1♂), 7 (1♀), 12 (1♂, 3♀), 14 (1♂, 6♀), 18 (1♂).

GEOGRAPHIC DISTRIBUTION: Gibraltar, Morocco, Portuguese mainland, Spanish mainland, Tunisia. Selected references: Attems, 1903, 1927, 1952; Brolemann 1932; Serra, 1979b; Zapparoli, 1984, collection SMNG.

ECOLOGICAL NOTES: In Portugal in "Nardos heath with heather, gorse, rosemary and grasses" (cit. Eason in Kime, 2003). We found the species in very different habitats from open dry grassland and humid places in pastures to macchia and *Quercus* slopes, mostly under stones. A very special place with the greatest abundance of this species was on a living palm tree at the base of old leaves, where conditions were more humid.

MORPHOLOGY: The species is very variable and differs in plectrotaxy, the formation of secondary sexual structures on the last legs of males, accessory apical claw and claw of the female gonopods as well as other characters (Serra, 1979b).

Yellowish-greyish (sometimes a little olive), ventral side and head (dorsal) pale yellowish as well as antennae and legs (prefemur and femur of last legs mostly a little darker). 7.6 to 16.2 mm long, mostly 9 to 12 mm. Head as long as wide (0.9 to 1.4 mm, mostly 1.03 to 1.07 mm) and as wide as tergite 3. With 6 to 9 (mostly 7) ocelli, posterior ocellus larger than the others. Coxosternite with 2+2 relatively small teeth, occupying approximately half of the proximal border (Machado, 1952: fig. XXIV 1; Salinas, 1990: fig. 9a). Antennae with 23 and 25 articles. All tergites without posterior projections. Plectrotaxy of the legs see Table 3.

Leg pairs 14 and 15 thickened in both sexes (in males more so). In the males the femur of the last leg has a dorso-proximal fossa and a proximal swelling on the dorsal surface (Matic *et al*., 1968: fig. 4; Salinas, 1990: figs. 8 b and c); tibia with a distinct dorsal depression. With the exception of one female, all specimens have an accessory apical claw on the last leg. Sometimes these claws are very small and inconspicuous (Machado, 1952: figs. 4 and 5). This agrees with the observation by Meinert (1872): "The accessory apical claw is only small or can be absent.". Coxal pores of leg 12 to 15 round in the following arrangements: all examined males: 1121; females: 1221, 1222 (mostly), 2222 or 2332. The claw of female gonopods is simple with the exception of two females which shows a small external denticle. Spurs of gonopods 2+2.

TAXONOMIC NOTES: Serra (1979b) distinguishes between two subspecies: *L. h. hispanicus* Meinert, 1872 with a distribution in Southern Spain and North Africa, and *L. h. alicatai* Matic, 1967 occurring in the centre of Spain and in Northern Portugal.

After Serra (1979) the differential characters are:

L. h. hispaniscus	*L. h. alicatai*
female gonopods with 2+2 spurs	gonopods with 2+2 spurs (seldom 2+3 or 3+3)
claw of female gonopods tridentate	claw of female gonopods simple with or without an external denticle near the base
DaP is absent (very seldom at P14 and P15)	DaP at P6 to P15
in males femur of the ulimate leg without fossa	femur of the ultimate leg with a small dorso-proximal fossa, which can be admittedly absent.

Our investigated material does not allow a clear differentiation. The plectrotaxy of most specimens is similar to *h*. *hispanicus*, also in males which show a distinct fossa at the femur or in females which have a simple gonopod claw (*h. alicatai*-characters). Only one female shows a clear tridentate "*hispanicus*" gonopod claw and a "*hispanicus*" plectrotaxy. On the contrary, another female has clear *alicatai*-characters: a simple gonopod claw/plectrotaxy. Possible combinations of characters can be seen in the following:

	L. h. hispaniscus	*L. h. alicatai*
4♂	plectrotaxy	males femur
11♀	plectrotaxy	simple claw of female gonopods
1♀	plectrotaxy	claw of the gonopods with a small external denticle
1♀	claw of gonopds tridentated/ plectrotaxy	––
1♀	––	claw of the gonopods with a small external denticle/plectrotaxy

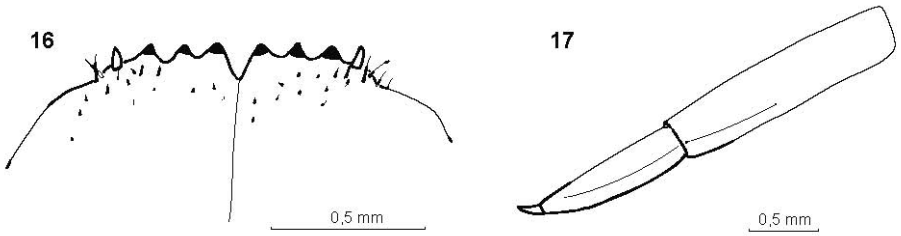
Additionally, the plectrotaxy of the paralectotype of *hispanicus* given in Eason (1974) is very similar to the plectrotaxy of *alicatai* after Matic *et al*. (1967) and Salinas (1990). More material is necessary for statistical analyses of the characters to decide whether the subspecies can really be distinguished clearly.

Lithobius* (*Lithobius*) *inermis L. Koch, 1856

MATERIAL EXAMINED: Sites: 1 (1♀, 1 juv.♂, 1 juv.♀), 7 (3♂, 1 juv.♂), 11 (2♂), 14 (1♂, 1 juv.).

GEOGRAPHIC DISTRIBUTION: *L. inermis* is a very common species in the Western Mediterranean (Iberian Peninsula). The citation of this species for France by Ern (1960) refers in fact to *L. pyrenaicus* Meinert, 1872, considered as a subsp. of *L. inermis* after Brolemann (1930). It is today eleva-ted to species-level (E. Iorio, pers. com., 2013).

ECOLOGICAL NOTES: At Ibiza *L. inermis* occurs mostly in open and dry habitats (Sammler *et al*., 2006), whereas we found it in dry localities, but



Figs. 16–17. – *Lithobius inermis*. 16: Coxosternum (anterior border). 17: Tarsi 1 and 2 of last leg (lateral interior).

Figs. 16–17. – *Lithobius inermis*. 16: Coxosternum (borde anterior). 17: Tarsos 1 y 2 de la última pata (lado interno).

also in more humid places under stones as well in dead wood. A special habitat was at the base of old leaves of a palm tree, where conditions are a little more moist.

MORPHOLOGY: Adults: Yellowish to brown. Body length 19 to 26 mm. Head as long as broad or a little broader. 10 to 13 ocelli in 3 to 4 rows, posterior ocellus largest. Antennae with 42 to 49 articles, a little longer than half of the body length (2.2 to 2.6). Coxosternite with 3+3 teeth and a porodont, which is nearly as large as a tooth (Fig. 16). The marginal furrow at the posterior edge of T1, 3 and 5 interrupted. For plectrotaxy of legs see Table 4. Last legs: without an accessory claw; tarsi 1 and 2 in both sexes laterally depressed and with a distinct lateral-internal longitudinal sulcus (Fig. 17); in males tibiae of the 14th and 15th legs with a longitudinal depression, more distinct in tibia 15, at the borders of this depressions there are numerous short bristles. Gonopods of females with simple claws (without denticles) and 2+2 long spurs.

TAXONOMIC NOTES: The group of Spanish species characterised by a lateral-interior groove on the tarsi of the 15th or 14th and 15th leg –*L. inermis* Meinert, 1872, *L. pyrenaicus* Meinert, 1872, *L. schubarti* Demange, 1959, *L. guadarramus* Matic, 1968, *L. pedisulcus* Serra, 1977 and *L. longiscissus* Serra, 1987– is described in Serra (1987).

Table 4.– Plectrotaxy of *L. inermis*. ( ): In one case there exists a very small spur DaF; **bold**, not indicated in Brolemann (1930).

Table 4.– Plectrotaxia de *L. inermis*. ( ): En un caso había una diminuta espuela DaF; **negrita**, no se indica en Brolemann (1930).

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	mp	amp	am**p**	–	–	amp	a-p	a-p
2	–	–	amp	amp	am**p**	–	–	amp	a-p	a-p
3	–	–	amp	amp	am**p**	–	–	amp	a-p	a-p
4	–	–	amp	amp	am**p**	–	–	amp	a-p	a-p
5	–	–	amp	amp	am**p**	–	–	amp	a-p	a-p
6	–	–	amp	amp	amp	–	–	amp	a-p	a-p
7	–	–	amp	amp	amp	–	–	amp	a-p	a-p
8	–	–	amp	amp	amp	–	–	amp	a-p	a-p
9	–	–	amp	amp	amp	–	–	amp	a-p	a-p
10	–	–	amp	amp	amp	–	–	amp	a-p	a-p
11	–	–	amp	amp	amp	–	–	amp	a-p	a-p
12	–	–	amp	amp	amp	–	–	amp	a-p	a-p
13	–	m	amp	amp	amp	a	–	amp	**a**-p	a-p
14	–	m	amp	amp	am**p**	a	–	amp	**(a)**-p	p
15	–	m	amp	amp	a	a	–	amp	p	–

Lithobius* (*Lithobius*) *lusitanus Verhoeff, 1925

MATERIAL EXAMINED: Site 7 (1♂).

GEOGRAPHIC DISTRIBUTION: West Mediterranean. Azores, Canary Islands, Madeira, North Africa, Portugal, Spain. Records from North Eastern Europe (e.g. Berg & Evenhuis 2001; Tajowsky, 2001) need verification (Zalesskaja & Golovatch 1996; Iorio 2005). They concern with high probability *L. valesiacus* Verhoeff, 1935.

ECOLOGICAL NOTES: *L. lusitanus* shows a high adaptability to different conditions of the environment. The species occurs at riversides with high degree of humidity, in poplar groves and brush woods as well as in rural landscapes and rubbish heaps (García Ruiz & Santibáñez, 1996; García Ruiz & Serra 2003). It is also known from caves (Demange, 1958a).

Table 5.– Plectrotaxy of *L. lusitanus*.

Tabla 5.– Plectrotaxia de *L. lusitanus*.

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	p	mp	m	–	–	mp	a	a
2	–	–	p	amp	m	–	–	mp	a	a
3	–	–	p	amp	m	–	–	mp	ap	ap
4	–	–	mp	amp	m	–	–	mp	ap	ap
5	–	–	mp	amp	m	–	–	amp	ap	ap
6	–	–	mp	amp	m	–	–	amp	ap	ap
7	–	–	mp	amp	am	–	–	amp	ap	ap
8	–	–	mp	amp	am	–	–	amp	ap	ap
9	–	–	mp	amp	am	–	–	amp	ap	ap
10	–	–	amp	amp	am	–	–	amp	ap	ap
11	–	–	amp	amp	am	–	–	amp	ap	ap
12	–	–	amp	amp	am	a	–	amp	p	ap
13	–	m	amp	amp	am	a	–	amp	p	p
14	–	m	amp	amp	m	a	–	amp	p	p
15	–	m	amp	m	–	a	–	amp	p	–

Table 6.– Plectrotaxy of *L. obscurus*. ( ): in the half of the material examined.

Tabla 6.– Plectrotaxia de *L. obscurus*. ( ): en la mitad del material examinado.

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	p	amp	m	–	–	mp	a	A
2	–	–	mp	amp	am	–	–	mp	ap	A
3	–	–	mp	amp	am	–	–	mp	ap	Ap
4	–	–	mp	amp	am	–	–	mp	ap	ap
5	–	–	mp	amp	am	–	–	mp	ap	ap
6	–	–	mp	amp	am	–	–	mp	ap	ap
7	–	–	mp	amp	am	–	–	mp	ap	ap
8	–	–	mp	amp	am	–	–	mp	ap	ap
9	–	–	mp	amp	am	–	–	mp	ap	ap
10	–	–	mp	amp	am	–	–	mp	ap	ap
11	–	–	mp	amp	am	–	–	amp	ap	ap
12	–	–	mp	amp	am	–	–	amp	ap	ap
13	–	m	amp	amp	am	(a)	–	amp	ap	p
14	–	m	amp	amp	a	a	–	amp	p	p
15	–	m	amp	am	a	a	–	amp	p	–

MORPHOLOGY: Light brown, posterior borders of tergites a little darker, underside yellowish, antennae brown but becoming paler towards to the end. Body length 12 mm. Head somewhat broader (1.4 mm) than long (1.2 mm). With 12 ocelli on each side. Posterior ocellus larger than the others, which are arranged in 3 fairly regular rows. Antennae with 30 articles, approximately a third of body length. Coxosternite with 2+2 teeth and less prominent shoulders. Posterior border of T 9 right-angled, T 11 with blunt, T 13 with more prominent projections. Plectrotaxy of legs see Table 5. Last legs with an accessory claw, without any specific characters.

TAXONOMIC NOTES: see Eason (1982).

Lithobius (Lithobius) obscurus Meinert, 1872

MATERIAL EXAMINED: Sites: 1 (1♂), 7 (1♂, 1♀), 14 (3♂, 2♀, det. M. Zapparoli, 2010), 17 (1♀), 20 (1♂, 1♀).

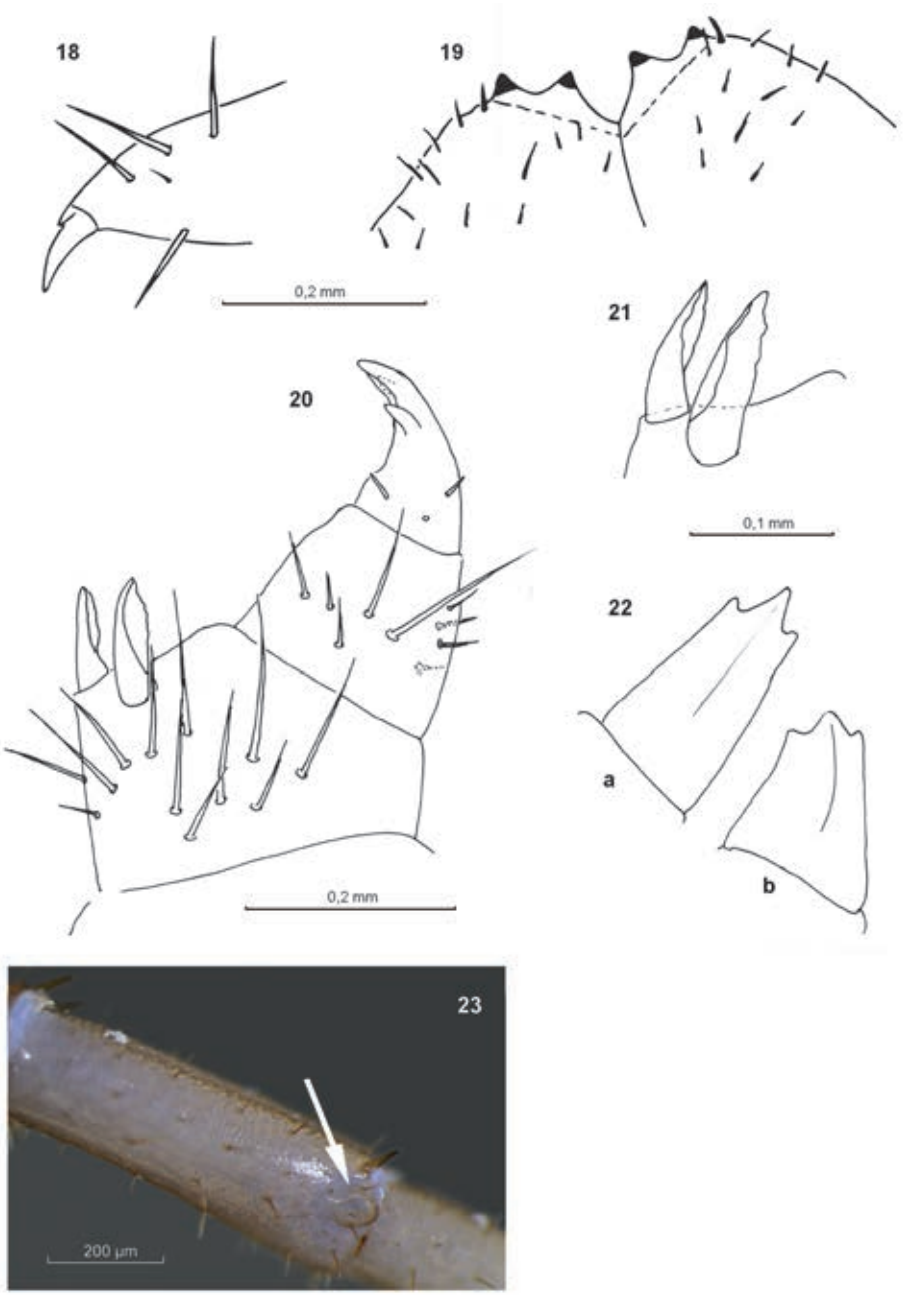
GEOGRAPHIC DISTRIBUTION: *L. obscurus* originally occurred in the western Mediterranean region (Iberian Peninsula) and North Africa, but it is now widespread around the world through human agency (Eason, 1991; Zapparoli, 2003). From Azorean caves two subspecies are known (Eason & Ashmole, 1992).

ECOLOGICAL NOTES: There is no information about the ecology of this species in the literature. We found *L. obscurus* in Andalusia in dryer habitats under stones or in specialised habitats (under bark or in the bases of palm trees).

MORPHOLOGY: ♀♀: length: 12 to 18 mm; width of tergite 3: 1.2 to 1.7 mm; ♂♂: length: 10 to 14 mm; width of tergite 3: 1.1 to 1.5 mm.

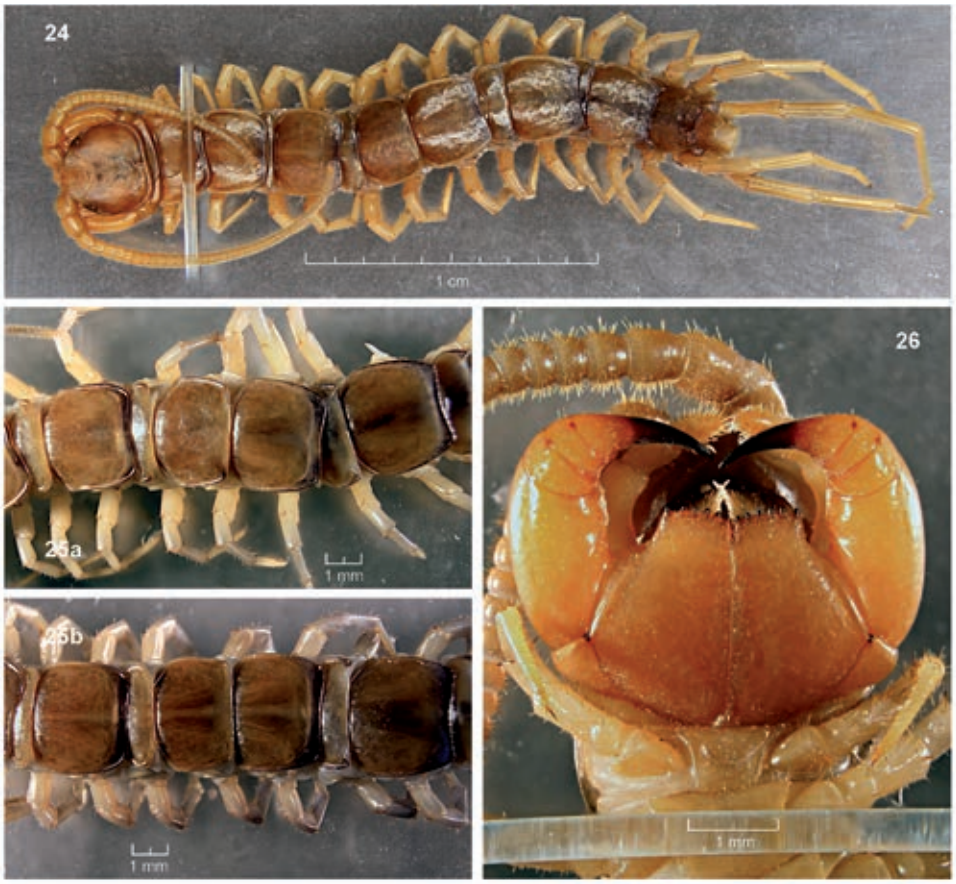
The material examined agrees with the description given by Brolemann (1924: 58, figs. 4-6; as *L. araichensis* Brolemann, 1924). Grey yellowish to brown, sometimes the posterior border of tergites a little darker, the tip of the antennae a little lighter.

The most important characters are: an additional accessory prefemoral spur; well developed prominent projections on tergites 9, 11 and 13; a very small accessory claw on the last leg (Fig. 18); mostly with 26 antennal articles; 10 to 13 (9 to 12 in Brolemann, 1924) ocelli in more or less regular rows on each side, the posterior ocellus usually the largest; coxosternite with two teeth on each side (Fig. 19). Plectrotaxy of legs see Table 6. Some differences to Brolemann (1924) can be considered: 13 DaC does not occur in his material as well as 1 DmP; VaP starts already at the 11th leg and DaP at the 9th leg in his material; 13 DaT is not



Figs. 18-23.– *Lithobius obscurus.* 18: Apical claw and distal end of metatarsus of last leg. 19: Coxosternum (anterior border). 20: Female gonopod (exterior). 21: Gonopod spurs (exterior). 22: Gonopod claw (a: dorsal, b: dorso-lateral). 23: Femur of last leg with a wart-like process (♂, dorsal).

Figs. 18-23.– *Lithobius obscurus.* 18: Garra apical y extremo distal del metatarso de la última pata. 19: Coxosternum (borde anterior). 20: Gonopodo femenino (exterior). 21: Espuelas del gonopodo (exterior). 22: Garra del gonopodo (a: dorsal, b: dorso-lateral). 23: Fémur de la última pata con proceso en forma de verruga (♂, dorsal).



Figs. 24–26 – *Lithobius variegatus*. 24: In total. 25a, b: Variations in tergites 7 and 8. 26: Head (ventral).

Figs. 24–26 – *Lithobius variegatus*. 24: Aninal completo. 25a, b: Variaciones en los terguitos 7 y 8. 26: Cabeza (ventral).

considered in our material. Numbers of coxal pores on 12th leg (the most frequent number underlined): 3, 4, 5; on 13th: 4, 5, 6; on 14th: 4, 5, 6 and on 15th: 3, 4 (according to Brolemann, 1924 the number of coxal pores on legs 12 to 15 is: 5663-4). In males the femur of last leg has a dorsal wart-like process close to DpF (Fig. 23). The female gonopods (Fig. 20) have two long and slender spurs, serrated at the edge (Fig. 21) and a claw with both lateral and medial denticles well-developed (Fig. 22).

Lithobius* (*Lithobius*) *variegatus Leach, 1814

MATERIAL EXAMINED: Sites: 2 (1♂), 6 (1 juv.), 7 (1♀, 2 juv.♂, 1 juv.), 8 (1♀), 9 (1 juv.), 11 (2 juv.♂), 12 (1♂), 18 (3 juv.), 20 (1♂, 2 juv.♂, 1 juv.), 21 (2♂).

GEOGRAPHIC DISTRIBUTION: A West European species distributed in Britain, the Channel Islands, Gibraltar, France, Ireland, Italian mainland and Sicily, North Africa and the Spanish mainland. In the Iberian Peninsula it is one of the most frequently found species of Lithobiidae (incl. *L. v. rubriceps* Newport, 1845).

ECOLOGICAL NOTES: According to Eason (1964), *L. variegatus* is a woodland species, but also common in grassland, moorland, mountainous country and coastal areas, relatively uncommon in gardens and suburban areas. We found the species in many different habitats; both in humid stream valleys and in open dry land as well as in macchia.

MORPHOLOGY (Fig. 24): Adults: The specimens examined by us agree in colour with the description given by Eason (1964). Body length from 25 to 27

mm. The legs are long and slender and reach scarcely half the length of body (Fig. 24). Tergite 7 with small but distinct posterior projections (Fig. 25a; see also Eason & Serra, 1986: fig. 1) or with only a trace of posterior projections (Fig. 25b; see also Eason & Serra, 1986: fig. 5). Glandular pores on forcipules, coxosternite and on last two pair of legs not numerous. Coxal pores were found in the following arrangements: 6665, 6554, 6555, 5555. The claw of the gonopod in both of the females examined was simple without any trace of denticles (as in Eason & Serra, 1986: fig. 8 and Salinas, 1990: fig. 14C).

TAXONOMIC NOTES: *L. variegatus* varies very widely. In Spain there exists beside the nominate form (found only in the north) a second (widespread) form *L. v. rubriceps* in the range of a subspecies (Eason & Serra, 1986). The two subspecies are not always easily distinguished. *L. v. variegatus* and *L. v. rubriceps* differ in following characters:

	L. v. variegatus	*L. v. rubriceps*
Colour	pale brown and violet marbled*	uniform dark brown
Body size	shorter (maximal about 30 mm)*	longer (maximal up to 40 mm)
last legs	about half the length of body*	about one-third the length of body
posterior projection on T7	distinct or at least with some trace*	without
female gonopod	with dentate claw	simple*
glandular pores on forcipules, coxosternite and last two pairs of legs	not numerous (Fig. 26)*	very numerous
distribution in Spain	northern regions	widespread, but more in southern regions*

Star * marks the characters which were found in our material. The specimens are mostly similar to the nominate form. Only the simple gonopod claw and the distribution area indicate *L. v. rubriceps.* Because of the substantial overlapping of all the characters in our Andalusian material an obvious classification of subspecies is not possible. The differentiation of the two subspecies is not as clear as suggested by Eason & Serra (1986).

Lithobius* (*Monotarsobius*) cf. *osellai Matic, 1968

MATERIAL EXAMINED: Site 18 (2♀)

Table 7.– Plectrotaxy of *L.* cf. *osellai*. * very small; **bold** absent in Matic (1968); ( ): present in Matic (1968).

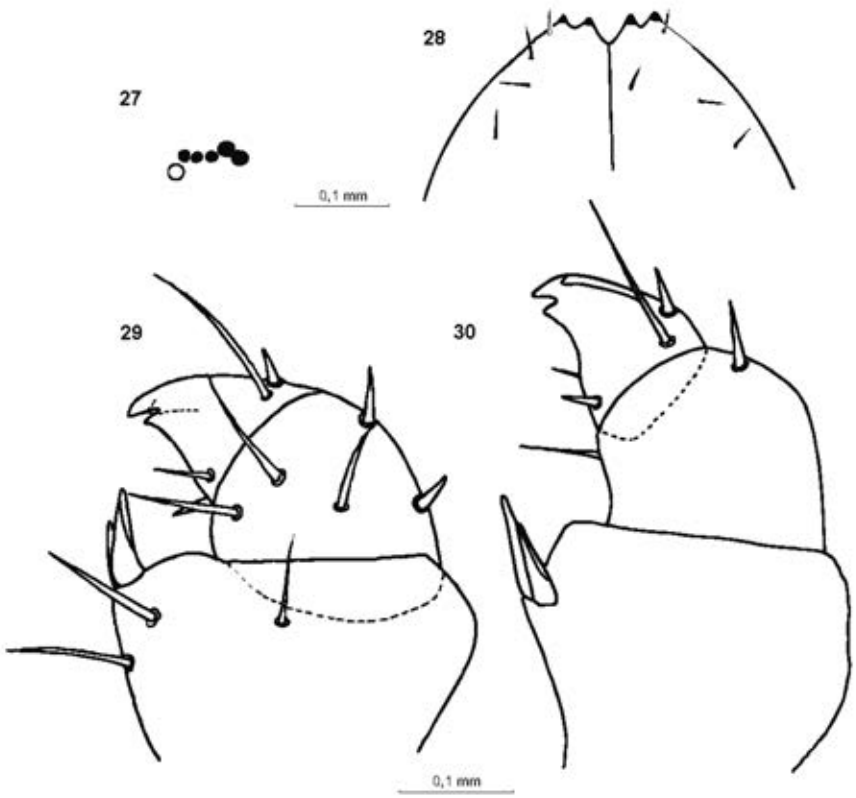
Tabla 7.– Plectrotaxia de *L.* cf. *osellai*. * muy pequeño; **negrita** no citado en Matic (1968); ( ): citado en Matic (1968).

	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	–	–	m	–	–	–	a	a
2	–	–	–	–	m	–	–	–	a	a
3	–	–	–	**m**	m	–	–	–	(a)	a(p)
4	–	–	–	m	m	–	–	–	(ap)	a(p)
5	–	–	–	m	m	–	–	–	(ap)	a(p)
6	–	–	–	m	m	–	–	–	(ap)	a(p)
7	–	–	–	m	m	–	–	–	(ap)	a(p)
8	–	–	–	m	m	–	–	–	(ap)	a(p)
9	–	–	–	(a)m	m	–	–	–	(ap)	a(p)
10	–	–	?	?	?	–	–	?	?	?
11	–	–	–	**a**m	m	–	–	–	**p**	a(p)
12	–	–	–	**a**m	m	a	–	**p**	**p**	-(ap)
13	–	–	mp*	**a**m	m	a	–	mp	**p**	-(p)
14	–	m	mp	**a**m	**m**	a	–	mp	–	–
15	–	m	**a**mp	m	–	a	–	mp	–	–

GEOGRAPHIC DISTRIBUTION: Spain.

ECOLOGICAL NOTES: The type locality was a cave (Cueva del Valle) at the Sierra de Gredos. Eason doubtfully recorded *L. osellai* from Malta "under stones in green area beside road, on Upper Corallian limestone" (Kime, 2003), but this species is not quoted in Zapparoli *et al*. (2004).

MORPHOLOGY: Pale yellow, head and body a little darker. Body lengths 5.3 and 6.8 mm. Head as long as broad (0.62 and 0.65 mm respectively). Five ocelli arranged in a more or less single row at each side (Fig. 27), posterior two ocelli a little larger than the others, as large as the organ of Tömösváry. Antennae with 20 articles, 1/4 of body length. Coxosternite with 2+2 pointed teeth, porodontal spines delicate, without shoulders (Fig. 28). All tergites without posterior projections. Legs: tarsi of legs 1 to 13 uniarticulated; legs 14 and 15 slightly thickened, with numerous cuticular pores on the internal surface; accessory apical claw of 14th leg very small; absent on 15th leg. Coxal pores 2222. Plectrotaxy see Table 7. It differs in some features from the description given in Matic



Figs. 27–30.– *Lithobius* cf. *osellai*. 27: Ocelli. 28: Coxosternum (anterior border). 29: Female gonopod (exterior). 30: Female gonopod (interior).

Figs. 27–30.– *Lithobius* cf. *osellai*. 27: Ocelos. 28: Coxosternum (borde anterior). 29: Gonopodo hembra (exterior). 30: Gonopodo hembra (interior).

(1968b): the total absence of DpT and DapF being especially notable.

A further variation in plectrotaxy is given by Serra (1979a) for a female of *L. osellai.* The distinctive difference between the plectrotaxy given by Matic (1968b) and also seen in our material is the presence of VaF on legs 2 to 9. The femura and tibiae 2 to 10 show dorsal a-p (in agreement with Matic) whereas our material has no spurs on the femura and only one (a) on the tibiae.

Female gonopods (Figs. 29 and 30): with 2+2 rather slender spurs; claw with two well developed denticles, one dorsomedial and one ventromedial seta, both stout and straight; the interior surface of the basal article is without setae; article II with one dorsomedial stout and straight seta at the proximal end and a second smaller one approximately in the middle; on the external surface some long setae.

Discussion

The chilopod fauna of the second largest Spanish Autonomous Community of Andalusia has been investigated dispersedly (e.g. Serra, 1985; Carballo *et al*., 1986, 1988; García Ruiz, 1993, 2006; García Ruiz & Serra, 2000; García Ruiz & Baena, 2009). Four of the presently listed species are new for this region: *Cryptops trisulcatus, Algerophilus hispanicus*, *Stigmatogaster superba* and *Henia vesuviana*.

All species mentioned in this paper are known from the Spainish mainland (e.g. Attems, 1927, 1952; Demange, 1958a, b; Matic & Darabantu, 1968; Barace & Herrera, 1980, 1982; Salinas, 1990; García Ruiz & Serra, 2000) and/or from the Balearic Islands (e.g. Verhoeff, 1924; Demange, 1961; Matic *et al*., 1967; Negrea & Matic, 1973;

Eason, 1975; Serra, 1983b, c; Sammler *et al*., 2006). Most of them are Mediterranean species. It is not surprising that the Andalusian fauna is relatively similar to that of the Balearic Islands, Portugal (e.g. Machado, 1952; García Ruiz & Santibáñez, 1992), the coastal areas of the Eastern Pyrenees (Brolemann, 1926), Alpes Maritimes (Iorio, 2008) and North Africa (e.g. Brolemann, 1932).

Our investigations underline the fact that the Scolopendromorpha are especially adapted to live in dry and open places, whereas the Lithobiomorpha mostly prefer more humid locations, living especially in leaf litter and under bark. Notes on the autecology of these species are rare in the literature; more attention should be given to this.

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