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On hypogean *Roncocreagris* (Arachnida: Pseudoscorpiones: Neobisiidae) from Portugal, with descriptions of three new species

ANA SOFIA P.S. REBOLEIRA[1,2], JUAN A. ZARAGOZA[3,4], FERNANDO GONÇALVES[1] & PEDRO OROMÍ[2]

[1]*Departamento de Biologia & Centro de Estudos do Ambiente e do Mar, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro. Portugal. E-mail: sreboleira@ua.pt*
[2]*Departamento de Biología Animal, Facultad de Biología, Universidad de La Laguna. 38206 La Laguna. Tenerife. Canary Islands, Spain. E-mail: poromi@ull.es*
[3]*Departamento de Ecología, Facultad de Ciencias, Universidad de Alicante, E-03080 Alicante, Spain. E-mail: ja.zaragoza@ua.es*
[4]*Corresponding author. E-mail: ja.zaragoza@ua.es*

Abstract

Three new hypogean species of the Iberian genus *Roncocreagris* Mahnert, 1974 are described from mainland Portugal: *R. borgesi* **sp. nov.** and *R. gepesi* **sp. nov.** from caves in the Sicó massif, and *R. occidentalis* **sp. nov.** from caves in the Montejunto and Cesaredas karst plateau. This brings to nine the number of known hypogean species of the mostly Iberian genus *Roncocreagris*: five from Portugal and four from Spain. Ecological comments and new localities for some of the previously known species are also included.

Key words: Pseudoscorpions, troglobiont, karst, Iberian Peninsula

Resumo

Três novas espécies do género Ibérico *Roncocreagris* Mahnert, 1974 são descritas de Portugal continental. Todas as espécies foram descobertas em grutas, *R. borgesi* **sp. nov.** e *R. gepesi* **sp. nov.**, no maciço de Sicó, e *R. occidentalis* **sp. nov.**, no maciço de Montejunto e no planalto das Cesaredas. Esta descoberta aumenta para nove as espécies hipógeas conhecidas do género *Roncocreagris*: cinco de Portugal e quatro de Espanha. São também incluídos comentários e novas localidades para as espécies conhecidas.

Introduction

Portugal is located in the westernmost part of continental Europe, forming part of the Mediterranean biodiversity hotspot region. Extensive biological collecting carried out in Portuguese caves in recent years have led to the discovery of new and interesting arthropod species (Reboleira *et al.* 2011a, 2013).

All Portuguese karst areas with caves are located on the mainland, which is currently divided into two main biospeleological districts (Bellés 1987). These regions have different patterns of subterranean biodiversity: the Lusitanian district in the centre, which includes the main karst regions, and the Baetic district, located in the south and extending through Spanish Andalusia, composed of the richest Algarve massif, which harbours the relict pseudoscorpion species *Titanobochica magna* Zaragoza & Reboleira, 2010 and *Lusoblothrus aenigmaticus* Zaragoza & Reboleira, 2012 (Reboleira *et al.* 2010a, 2012).

The genus *Roncocreagris* was established by Mahnert (1974) after the definition of the genus *Microcreagris* Balzan, 1892. *Roncocreagris* comprises 19 species (Zaragoza 2007, 2008) and is mostly distributed in the Iberian Peninsula (Portugal and Spain), with the exception of *Roncocreagris cambridgei* (L. Koch, 1873), which has also been recorded from Algeria, France, Ireland, Italy and the United Kingdom (Harvey 2011). Most of the species are epigean, small in size and frequently inhabit forest leaf-litter. Up to now, a small number of species showing distinct adaptations to hypogean life have been found in caves.

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The first known *Roncocreagris* species with troglomorphic tendencies was *R. cavernicola*, described by Vachon (1946) from the region of Leiria (Portugal). A few years later Beier (1962) described *R. blothroides* from the Coimbra region, also in Portugal. Four additional hypogean species have been described from mainland Spain (Zaragoza 2000, 2002, 2003): *R. aurouxi* Zaragoza, 2000, *R. lucensis* Zaragoza, 2002, *R. salgadoi* Zaragoza, 2002 and *R. iglesiasae* Zaragoza, 2003. The present study reviews the hypogean species of *Roncocreagris* from caves in Portugal and describes three species new to science.

Material and methods

Fieldwork was conducted in caves of mainland Portugal from 2007 to 2013. The sampling strategy included active searching and the use of baited pitfall traps in deep parts of the caves.

The specimens were dissected and examined as temporary glycerine mounts in cavity slides, after which they were preserved in 70% ethanol inside glass vials, with the dissected appendages in a glass microvial. Some *Roncocreagris blothroides* specimens were preserved in 100% ethanol for later molecular studies.

The specimens were studied under a trinocular Zeiss Axiolab light microscope and measurements were taken with an ocular micrometer, using the reference points proposed by Chamberlin (1931). Measurements are expressed in millimeters, followed by standard ratios in parentheses. The ratios given are length/width for carapace, chelicera and pedipalps, and length/depth for legs; when two articles are compared the ratio is length/length index.

The general terminology follows Chamberlin (1931), including trichobothriotaxy, with modifications or additions proposed by Harvey (1992) and Judson (2007a). The chaetotaxic formula of the carapace follows Gabbutt & Vachon (1968) and the terminology of the chelal microsetae pattern is based on Zaragoza (2008). Inclusion of the pedicel in measurements of the chela is indicated by a plus sign (e.g. hand^{+}) and its exclusion by a minus sign (e.g. hand^{-}) (Judson 2007b).

Abbreviations. *Em*: antiaxial microseta. *Im*: paraxial microseta. *Mm*: medial microseta. TS: tactile seta. DEUA: Departamento de Ecología, Universidad de Alicante, Spain; DZUL: Departamento de Biología Animal, Universidad de La Laguna, Tenerife, Canary Islands, Spain. MNCN: Museo Nacional de Ciencias Naturales, Madrid. MNHN: Muséum national d'Histoire naturelle, Paris. MCNB: Museu de Ciències Naturals de Barcelona. SR: Sofia Reboleira collection, Portugal.

Systematics

Superfamily Neobisioidea Chamberlin, 1930

Family Neobisiidae Chamberlin, 1930

Subfamily Microcreagrinae Balzan, 1892

Genus *Roncocreagris* Mahnert, 1974

Roncocreagris cavernicola (Vachon, 1946)

Microcreagris cavernicola Vachon 1946: 333–334, figs 1–6.
Roncocreagris cavernicola (Vachon): Mahnert 1976: 212.

Material. We have not examined the type specimens described by Vachon (1946) from Portugal, district of Leiria, Abiúl, Algar sul das Corujeiras (male) and Santiago da Guarda, Algar da Lapa (female), but Dr Mark Judson (MNHN), at our request, has kindly checked the most important diagnostic characters of the species, mentioned below. Recent searches for *R. cavernicola* at the type localities have been unsuccessful. In the case of the Algar da Lapa locality, the cave can no longer be found and the cave entrance was probably destroyed by building construction in the area (Grupo Protecção Sicó, pers. com.).

Diagnosis. No eyes or eye-spots. Strong troglomorphic adaptations. Carapace with 18 setae, of which 4 on posterior margin. Tergite I 4 setae. Galea short in both sexes, simple in male and with tiny apical rami in female. Pedipalp: femur ratio 5.9 in male and 6.9 in female, femur distinctly shorter than the chelal movable finger; chela$^+$ ratio about 6.0 in male and 7.0 in female; ratio movable finger/hand$^+$ 1.7 in both sexes; ratio trichobothria *ib–ist*/*ist–it* 1.1–1.3, ratio *isb–ist*/*ib–isb* 0.5–0.7.

Remarks. The following data are based on Vachon's original description (1946) with additions or modifications from examination of the syntypes (♂ MNHN Ps620-291, on 3 slides, ♀ MNHN Ps620-292 on 2 slides).

Male, female in square brackets. Carapace with 4 posterior setae in both sexes. Chaetotaxy of tergites I–IV: 4:7:7:7 [4:6:6:7]. Manducatory process with 3 setae on each side in both sexes. Trichobothrial ratio *ib–ist*/*ist–it* 1.1 [1.3]; ratio *isb–ist*/*ib–isb* 0.5 [0.7]. Pedipalp measurements: femur 1.42/0.24 (5.9) [1.59/0.24 (6.9)]; patella 1.40/0.29 (4.9) [1.62/0.27 (6.0)], pedicel 0.36 [0.41], club 1.04/0.29 (3.6) [1.21/0.27 (4.5)], ratio club/pedicel 2.9 [3.0]; chela$^+$ 2.45/0.42 (5.8) [2.76/0.40 (6.9)]; hand$^+$ 0.94 (2.2) [1.05/0.4 (2.6)]; movable finger 1.59 [1.77]; ratio movable finger/hand$^+$ 1.7 [1.7]; finger/femur 1.1 [1.1]; femur/patella 1.0 [1.0]; patella/hand$^+$ 1.5 [1.5].

Vachon's (1946) description stated that in *R. cavernicola* the manducatory process bears only 2 setae, which would be quite exceptional in the family Neobisidae (Harvey & Volschenk 2007). Zaragoza (2000, 2002) also used this character for taxonomic comparisons. However, Vachon's observation is incorrect because 3 setae are present on the manducatory process of both of the type specimens (M. Judson, in litt.).

FIGURE 1. Distribution of subterranean species of *Roncocreagris* Mahnert, 1974 in Portuguese caves. Cave numbers: 1, Arrifana (*R. blothroides*); 2, Santa Maria da Estrela (*R. blothroides*); 3, Confraria I (*R. blothroides*); 4, Algarinho (*R. gespei*); 5, Lapa (*R. cavernicola*); 6, Cerâmica (*R. blothroides*, *R. borgesi*); 7, Corujeiras (*R. cavernicola*); 8, Bolhos (*R. occidentalis*); 9, Javali (*R. occidentalis*).

***Roncocreagris blothroides* (Beier, 1962)**
(Figs 2–11)

Microcreagris blothroides Beier 1962: 25–26, fig. 1.
Roncocreagris blothroides (Beier): Mahnert 1976: 212.

Material. Portugal, Sicó massif, district of Leiria, three caves: Santiago da Guarda, Gruta da Cerâmica (39º55′36.57″N, 8º31′03.63″W; 355 m.a.s.l.), 29.VIII.2009, 1 ♂ (DZUL), 28.XI.2009, 6 ♀ (2 DEUA, 1 DZUL, 1 MNHN, 1 MNCN, 1 SR), 1 ♂ (DEUA), 21.III.2010, 3 ♀ (1 DZUL, 1 MCNB, 1 SR), 27.XII.2010, 2 ♀ (1 DEUA, 1 SR), 1 ♂ (SR), 10.VI.2011, 2 ♀ (1 DEUA, 1 DZUL), 1 ♂ (DEUA); Redinha, Gruta de Santa Maria da Estrela (39º55′41.15″N, 8º32′59.4″W; 380 m.a.s.l.), 8.III.2009, 2 ♀ (1 DEUA, 1 DZUL), 1 ♂ (DEUA); 11.VI.2009, 2 ♀ (1 DEUA, 1 SR); 28.XII.2009, 1 ♂ (DEUA); Abiúl, Algar da Confraria I (39°55′51.01"N, 8°31′35.64"W; 420 m.a.s.l.), 22.VII.2007, 1 ♀ (DEUA). All specimens lgt. A.S.P.S. Reboleira.

Diagnosis. No eyes or eye-spots. Extreme troglomorphic adaptations. Carapace usually with 18 setae, of which 4 on posterior margin. Tergite I with 4 setae. Galeal chelicera short in both sexes, with 3–5 tiny apical rami. Pedipalp: femur ratio about 8.0, femur roughly same length as the patella and almost as long as the movable chelal finger; chela^{+} ratio about 8.0 in males, 7.0–7.8 in females; chelal hand maximum width distal of middle, ratio movable finger/hand^{+} about 1.7; trichobothrium *ist* about halfway between *ib* and *it*, ratio *ib–ist*/*ist–it* 0.9–1.2; ratio *isb–ist*/*ib–isb* 0.8–1.0.

Description. *Males, followed by females in square brackets*. Large species (Fig. 2). Opisthosoma and legs yellowish. Carapace, chelicerae and pedipalps pale brown.

Carapace markedly longer than broad (Fig. 3). Without eyes or eye-spots. Anterior margin moderately prominent medially, with blunt, low epistome with some tiny denticles (Fig. 4). Chaetotaxy: 18–19 setae, formula 4:4:6:4–5. Four microlyrifissures in ocular zone, two between median and posterior zones.

Coxal area. Manducatory process with 3 setae. Anterior process of coxa I long and apically pointed; medial process straight, with some low tubercles (Fig. 5). Pedipalpal coxa with 7 setae, pedal coxa I 5–7, II: 5–6, III: 3–4, IV: 6.

Tergal chaetotaxy I–X: 3–5:6:6–7:7–8:7:7:7:7:7:7 [4–6:6–7:6–7:7–8:7–8:7–10:7–8:7–8:6–8:7]. Male genital area with 10–11 setae on sternite II; sternite III with 11–16 setae, 6 of them along posterior margin of genital opening. Female genital area with 5–6 microsetae on sternite II, sternite III with 8–10 setae. Sternal chaetotaxy IV–X: 7–8:11:11–12:11–12:10–11:9–10:9 [6–7:10–11:10–11:11–13:10–11:10:9], each sternite VI and VII with 2 discal setae (included in sternal formula). Segment XI: 9–10 setae, including 6 TS. Chaetotaxy of stigmata of sternites III and IV 1–3 and 1–3 respectively. Anal cone with two dorsal and two ventral setae.

Chelicerae (Figs 6–7). Palm with 6 setae, subgaleal seta 0.63–0.68 from base of movable finger. Galea short (length 0.04 mm), apically with 3–5 short rami, about same length and shape in both sexes. Fixed finger with 10–15 medium or small teeth, two medial teeth of them larger than the others; movable finger with 8–13 teeth, one large and blunt medial tooth, the others medium or small, dental row ending proximad to subgaleal seta. Rallum with 7–8 blades, all unilaterally pinnate on anterior face, basal blade about half length of others. Serrula exterior with 33–36 blades, serrula interior 27–31 blades.

Pedipalps (Figs 8–10). Trochanter, femur, distal third portion of the patella and chelal hand with low granulation, more pronounced on paraxial faces. Lyrifissures as in Figs 8–10. Femur with one tiny tubercle distad of middle on antiaxial face, 2–3 distal glandular pores present. Patella dorsally with one micropore at base of pedicel and 1–2 distal glandular pores. Chelal hand dorsally more or less parallel-sided, maximum width distad of middle; pedicel dorsal bears 2–3 dorsal micropores; antiaxial face with an irregular row of 3–5 glandular pores close to base of finger. Fixed finger with 139–148 teeth, most of them apically cusped, dental row reaching to level of trichobothrium *esb*; *nodus ramosus* short, reaching level of 3–5th distal teeth; trichobothrium *it* proximad to *et*, about half way between *est* and *et*; trichobothrium *ist* closer to the base of finger than to apex; distance between trichobothria *ib* and *ist* 0.9–1.2 times that between *ist* and *it*; distance between trichobothria *isb* and *ist* 0.8–1.0 times that between *isb* and *ib*. Chelal microsetae pattern (as defined by Zaragoza 2008): all groups present, *Em*: 4–6 curved setae (same length as normal setae), *Mm:* 2–3, *Im*: 1. Movable finger with 132–141 teeth, most of them apically cusped, dental row shorter than on fixed finger, ending just distad of trichobothrium *b*; distance between trichobothria *sb* and *st* 1.3–1.8 times that between *sb* and *b*. One sensillum near tip of both fingers; one diploid sensillum *pc* close to dental margin and not raised, close to or slightly distad of trichobothrium *sb*.

Legs. Claws of legs I and IV with a tiny dorsal tooth proximad of middle (Fig. 11), subterminal setae with 3–4 rami (Fig. 12). Leg IV tibia with four long setae, TS ratio 0.33–0.49 for longest, basitarsus TS: 0.12–0.14, telotarsus TS: 0.21–0.38.

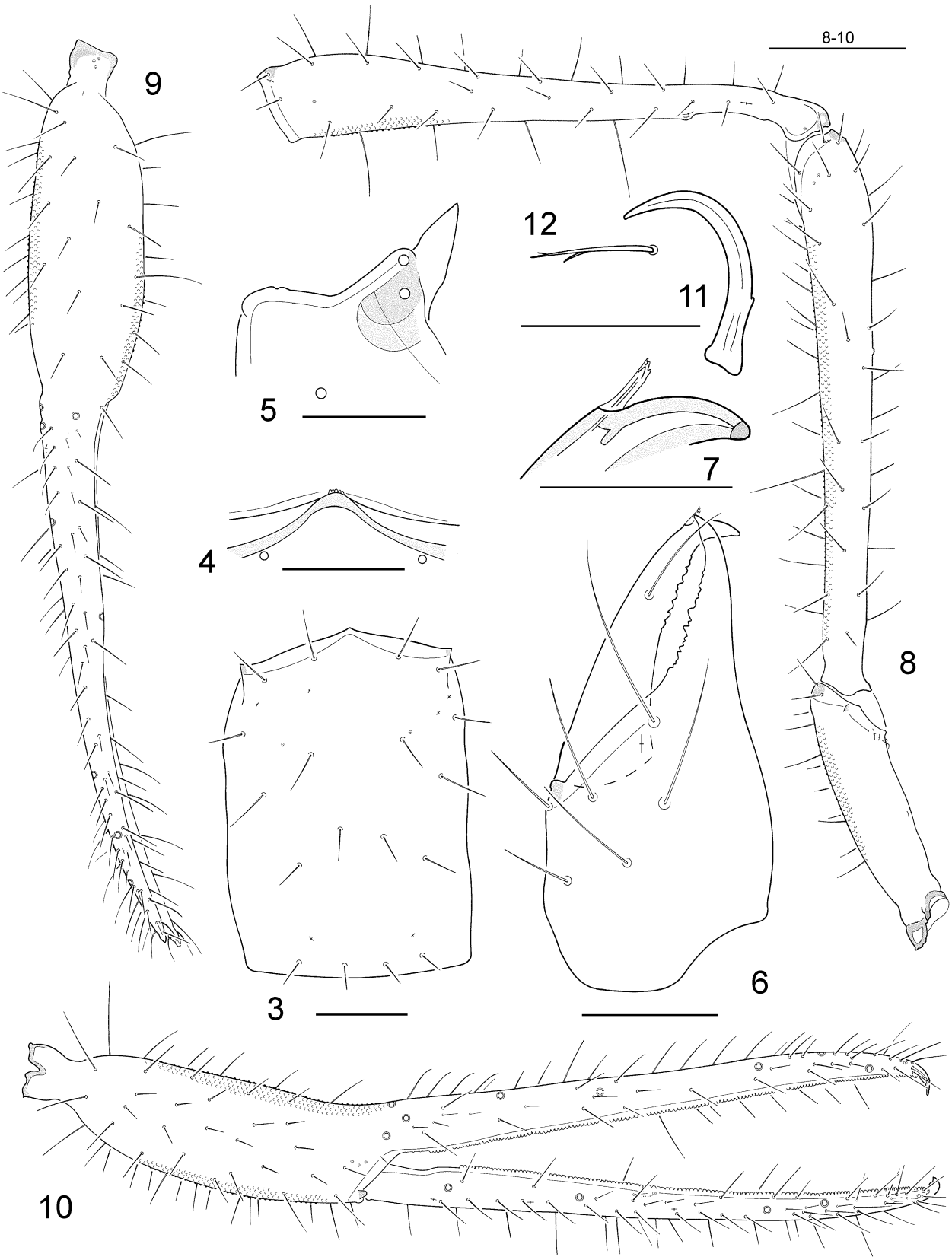
FIGURE 2. *Roncocreagris blothroides* (Beier, 1962), Gruta da Cerâmica, Sicó massif, habitus of living specimen, dorsal view.

Measurements and ratios. *Males, followed by females in square brackets*. Body 3.08–3.1. Carapace 1.0–1.2/0.7–0.79 (1.4–1.5) [1.16–1.22/0.79–0.87 (1.4–1.5)]. Chelicera: palm 0.65–0.72/0.3–0.4 (2.1) [0.7–0.73/0.35–0.37 (2.0)], movable finger 0.41–0.45 [0.46–0.49]. Pedipalp: trochanter 0.93–1.02/0.23–0.24 (4.0–4.3) [1.02–1.04/0.24–0.26 (4.0–4.3)]; femur 1.84–2.12/0.23–0.26 (8.0–8.2) [2.0–2.09/0.29–0.3 (7.6–8.1)]; patella 1.75–2.1/0.26–0.3 (6.8–7.1) [2.02–2.09/0.29–0.3 (6.8–7.2)], pedicel 0.44–0.5 [0.49–0.51], club 1.31–1.6/0.26–0.3 (5.1–5.4) [1.53–1.59/0.29–0.3 (5.1–5.5)], ratio club/pedicel: 3.0–3.2 [3.1–3.2]; chela^{+} 2.98–3.38/0.38–0.42 (7.9–8.1) [3.35–3.44/0.44–0.48 (7.1–7.8)], chela^{-} 2.82–3.16/0.38–0.42 (7.5–7.6) [3.15–3.23/0.44–0.48 (6.6–7.3)]; hand^{+} 1.15–1.26 (3.0–3.1) [1.28–1.31 (2.7–2.9)], hand^{-} 0.99–1.04 (2.5–2.6) [1.07–1.1 (2.3–2.4)]; movable finger 1.85–2.15 [2.11–2.19]; ratio finger/hand^{+} 1.6–1.7 [1.6–1.7)]; ratio chela^{+}/carapace 2.8–3.0 [2.8–3.0]; femur/carapace 1.8 [1.6–1.8]; finger/femur 1.0 [1.0–1.1]; femur/patella 1.01–1.05 [1.0]; patella/hand^{+} 1.5–1.7 [1.5–1.6]. Leg I: femur 0.9–1.05/0.14–0.15 (6.4–6.9) [1.0–1.07/0.15–0.16 (6.6–6.7)]; patella 0.70–0.84/0.12–0.13 (6.0–6.5) [0.74–0.84/0.13–0.14 (5.7–6.2)]; tibia 0.86–1.02/.09–0.1 (9.4–10.7) [0.98–1.02/0.1 (10.2–10.4)]; basitarsus 0.47–0.56/0.08–0.09 (6.0–6.6) [0.52–0.53/0.08 (6.5/6.7)]; telotarsus 0.60–0.71/0.07 (9.0–9.9) [0.66–0.7/0.07 (9.1–9.4)]; ratio femur/patella 1.3 [1.3–1.4]; telotarsus/basitarsus 1.3 [1.3]. Leg IV: femur+patella 1.58–1.78/0.21–0.22 (7.6–8.1) [1.7–1.8/0.21–0.23 (7.5–8.8)]; tibia 1.55–1.79/0.13–0.14 (11.9–13.0) [1.68–1.74/0.14–0.15 (11.8–12.1)]; basitarsus 0.59–0.69/0.1–0.11 (6.1–6.5) [0.65–0.7/0.11 (6.0–6.4)]; telotarsus 0.71–0.84/0.08–0.09 (8.4–9.3) [0.82–0.87/0.09 (9.0–9.3)]; ratio femur+patella/tibia 1.0 [1.0]; telotarsus/basitarsus 1.2 [1.2–1.3].

Remarks. Beier (1962) described the tarsal claws of *R. blothroides* as lacking a dorsal tooth and used this as a characteristic to separate this species from *R. cavernicola*; as did Mahnert (1976), based on Beier's description. Zaragoza (2002) suggested that, due to the tiny size of the teeth in some *Roncocreagris* species, it was not difficult to imagine that Beier might have overlooked them in *R. blothroides*. Given the agreement in all other studied characters, we have no doubt that the specimens described above belong to *R. blothroides*, hence the absence/presence of teeth on the tarsal claws is not a valid diagnostic character for this species.

Beier's original diagnosis (1962) of *R. blothroides* stated that it bears 4 setae on the posterior margin of the carapace and 4 setae on tergite I. Of the 24 specimens checked, 16 coincide with this (4+4), two bear 4+3, two 4+5, one 4+6, one 5+4, and two 5+5. No specimens bear 6 or more setae on posterior margin of carapace, and this number of setae is very rare on tergite I. This pattern is important for separating taxonomic groups within the genus *Roncocreagris*.

The discal setae of the sternites are glandular with a visible duct, as first described and illustrated by Judson (1992) and also mentioned and illustrated by Zaragoza 2002.



FIGURES 3–12. *Roncocreagris blothroides* (Beier, 1962), Gruta da Cerâmica, male. **3.** carapace; **4.** anterior margin of carapace; **5.** anterior and medial processes of left coxa I; **6.** left chelicera; **7.** apex of movable finger of left chelicera, showing galea; **8.** right pedipalp minus chela, dorsal view; **9.** right chela, dorsal view; **10.** right chela, lateral view; **11.** claw of right leg IV; **12.** subterminal tarsal seta of right leg IV. Scale bars (in mm): 0.10 (Figs 5, 7, 11, 12), 0.20 (Figs 4, 6), 0.30 (Fig. 3), 0.50 (Figs 8–10).

The sensillum of the movable finger, near dental margin and close to the trichobothrium *st*, is diploid as mentioned and illustrated for other species by Judson (1992) and Zaragoza (2003), but it is not raised in this species.

Roncocreagris blothroides and *R. cavernicola* share the feature of being the only species to usually have 4 setae on the posterior margin of the carapace and on tergite I. They differ as follows: the chelal measurements and ratios are distinctly larger in *R. blothroides* than in *R. cavernicola*; trichobothrium *ist* is medial with respect to *ib*/*it*, and *it* is medial with respect to *est*/*et* in *R. blothroides*, whereas in *R. cavernicola ist* is placed more basally and *it* is closer to *est* than to *et*; the male galea bears some rami apically in *R. blothroides*, but it is simple in *R. cavernicola*.

Distribution and habitat. All specimens of *Roncocreagris blothroides* were collected in the deepest parts of three caves, the two farthest separated by over 25 km. In addition to the type localities of Santa Maria da Estrela and Moura (= Arrifana) Caves, this species is newly recorded from Cerâmica and Confraria Caves, all of which are located in the Sicó karst massif (Fig. 1).

Roncocreagris blothroides is an abundant pseudoscorpion in the studied caves, with up to ten individuals being found during a single cave visit. It was found inhabiting a temperature range of 13.6–16.6ºC at soil level. This species shares its habitat with some frequent troglophile springtails, such as *Neelus murinus* Folsom, 1896, *Willemia buddenbrocki* Hüther, 1959, *Onychiurus insubraruis* Gisin, 1952, *Onychiurus subgranulosus* Gama, 1964, *Folsomia candida* (Willem, 1902), *Proisotoma gisini* Gama, 1964 and *Tullbergia krausbaueri* (Börner, 1901) (Gama 1962, 1965).

Roncocreagris borgesi Zaragoza & Reboleira sp. nov.

(Figs 13–22)

Type material. Holotype: ♂, Portugal, Sicó Massif , Santiago da Guarda, District of Leiria, Gruta da Cerâmica (39º55′36.57″N, 8º31′03.63″W; 355 m.a.s.l), 28.XI.2009, lgt. A.S.P.S. Reboleira (DEUA coll.).

Etymology. The species is dedicated to the Portuguese biologist Professor Paulo Borges, who has greatly contributed to our knowledge of the hypogean fauna of the Azores.

Diagnosis. No eyes or eye-spots. Moderately troglomorphic. Carapace with 20 setae, 6 on the posterior margin. Tergite I with 6 setae. Male cheliceral galea short and simple. Pedipalp: femur ratio about 6.0, femur as long as the movable finger; chela^{+} length/breadth ratio about 5.0; chelal hand widest proximad of middle, ratio movable finger/hand^{+} 1.4; trichobothium *ist* close to the middle of the finger, ratio *ib–ist*/*ist–it* 1.5, ratio *isb–ist*/*ib–isb* 1.5.

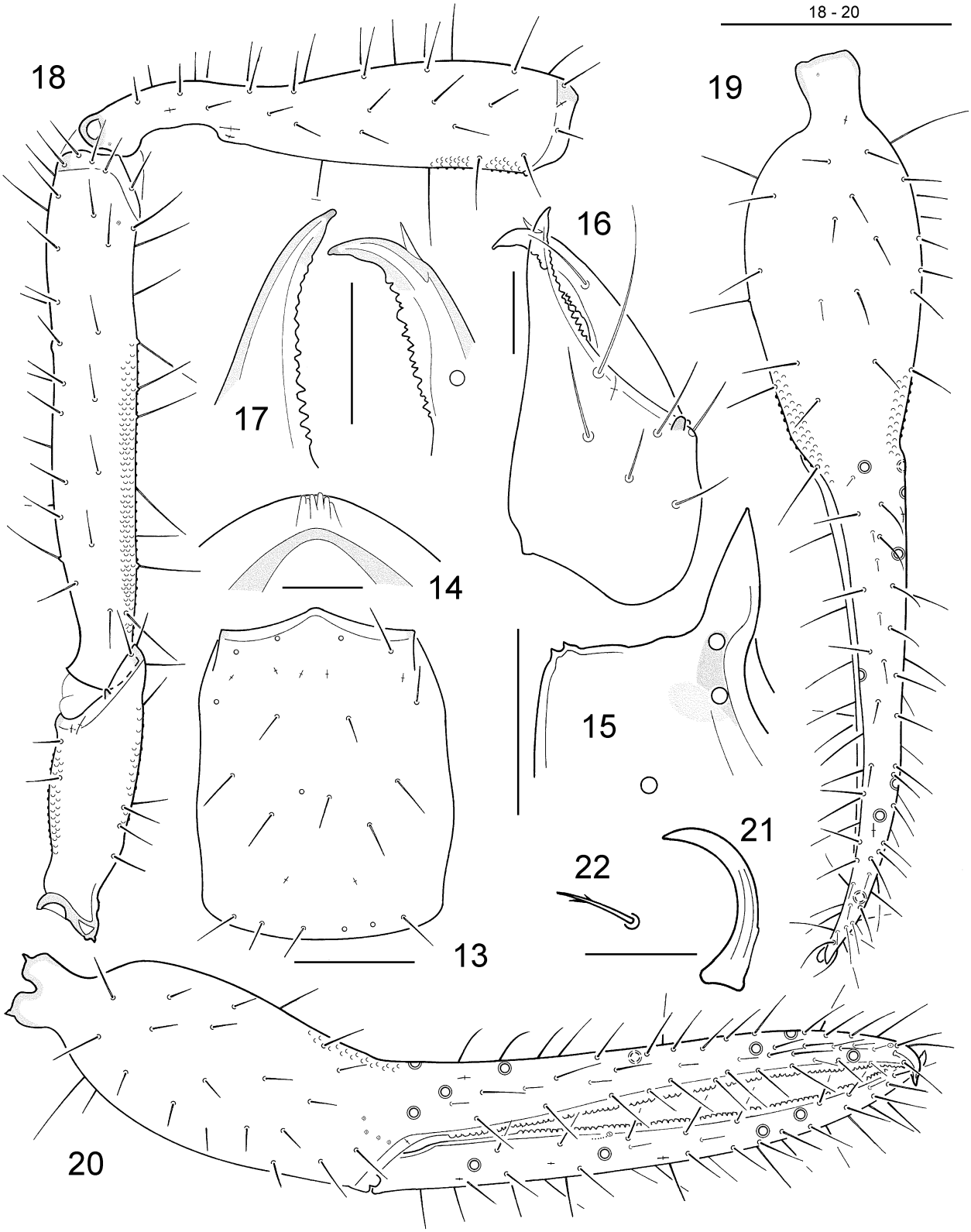
Description. Medium-sized pseudoscorpion. Opisthosoma elongate, moderate troglomorphic adaptations. Opisthosoma and legs yellowish. Carapace, chelicerae and pedipalps reddish brown.

Carapace longer than broad (Fig. 13). Without eyes or eye-spots. Anterior margin moderately prominent medially, epistome blunt and almost indistinguishable, with some tiny denticles not exceeding the anterior margin (Fig. 14). Chaetotaxy: 20 setae, formula 4:4:6:6. Five microlyrifissures on ocular zone, two between median and posterior zones.

Coxal area. Manducatory process with 3 setae. Anterior process of coxa I with simple tooth shape, long and apically pointed; medial process straight with a few denticles (Fig. 15). Pedipalpal coxa with 7 setae, pedal coxa I with 6, II: 3–4, III: 3–4, IV: 6.

Tergal chaetotaxy I–X: 6:7:9:9:9:11:11:10:10:9, most hairs lacking. Male genital area with 10 long setae on sternite II; sternite III with 10 setae, 4 of them along posterior margin of genital opening. Sternal chaetotaxy IV–X: 8:11:11:13:11:11:11; sternites VI and VII with 1 and 2 discal setae respectively (included in sternal formula); discal setae glandular, with visible duct. Segment XI 9 setae. Chaetotaxy of stigmata of sternites III and IV could not be checked due to partial contraction of opisthosoma. Anal cone with two dorsal and two ventral setae.

Chelicerae (Figs 16–17). Palm with 6 setae; subgaleal seta 0.65 from base of movable finger. Galea short (length 0.03 mm), pointed and simple. Fixed finger with 6 small, blunt, distal denticles, resembling protuberances, and 10 normal teeth, 4 basal ones larger than the others; movable finger with 17 teeth, one large and blunt subdistal tooth, the others medium or small, dental row ending just proximad of subgaleal seta. Rallum with 8 blades, all unilaterally pinnate on anterior face, the basal one about half length of others. Serrula exterior with 31 blades, serrula interior 25 blades.



FIGURES 13–22. *Roncocreagris borgesi* **sp. nov.**, male holotype. **13.** carapace; **14.** anterior margin of carapace; **15.** anterior and medial processes of left coxa I; **16.** right chelicera; **17.** partial view of fingers of right chelicera, showing galea; **18.** left pedipalp minus chela, dorsal view; **19.** left chela, dorsal view; **20.** right chela, lateral view; **21.** claw of right leg IV; **22.** subterminal seta of right leg IV. Scale bars (in mm): 0.05 (Figs 14, 21, 22), 0.10 (Figs 15–17), 0.30 (Fig. 13), 0.50 (Figs 18–20).

Pedipalps (Figs 18–20). Trochanter, femur, distal third of the patella and the hand at base of the fingers with low granulation, more pronounced on paraxial faces. Lyrifissures as in Figs 18–20. Femur with one tiny tubercle distad of middle of antiaxial face, one distal glandular pore present. Patella with one micropore at base of pedicel. Chelal hand oval shaped in dorsal view, maximum width proximad of middle; pedicel bears one dorsal micropore; antiaxial face, close to finger base, bears an irregular row of 4 glandular pores. Fixed finger with 93 teeth, most of them apically cusped, dental row reaching up to level of trichobothrium *esb*; *nodus ramosus* short, at level of 4th distal tooth; trichobothrium *it* proximad of *et*, distinctly closer to *est* than to *et*; trichobothrium *ist* closer to base of finger than to apex; distance between trichobothria *ib* and *ist* 1.5 times longer than that between *ist* and *it*; distance between trichobothria *isb* and *ist* 1.5 times longer than that between *isb* and *ib*. Chelal microsetae pattern with all groups present, extending distad of trichobothrium *isb*, *Em* 3–4, *Mm* 3, *Im* 1. Movable finger with 85 teeth, most of them apically cusped, dental row shorter than on fixed finger, ending distad of trichobothrium *b*; distance between trichobothria *sb* and *st* 1.2 times longer than that between *sb* and *b*. One sensillum near tip of both fingers; diploid sensillum *pc* not raised, close to dental margin, level with trichobothrium *sb*.

Legs. Claws of legs I and IV with a tiny dorsal tooth proximad of middle (Fig. 21), subterminal setae with three rami (Fig. 22). Leg IV tibia TS 0.44, basitarsus TS 0.22, telotarsus TS 0.24.

Measurements and ratios. Body 2.1. Carapace 0.85/0.64 (1.3). Chelicera: palm 0.49/0.24 (2.0), movable finger 0.33. Pedipalp: trochanter 0.66/0.19 (3.5); femur 1.15/0.19 (6.1); patella 1.06/0.23 (4.6), pedicel 0.29, club 0.77/0.23 (3.4), ratio club/pedicel: 2.7; chela$^+$ 1.98/0.39 (5.0), chela$^-$ 1.84/0.39 (4.7); hand$^+$ 0.85 (2.2), hand$^-$ 0.71 (1.8); movable finger 1.16; ratio finger/hand$^+$ 1.4; ratio chela$^+$/carapace 2.3; femur/carapace 1.4; finger/femur 1.0; femur/patella 1.1; patella/ hand$^+$ 1.2. Leg I: femur 0.57/0.11 (5.2); patella 0.41/0.12 (3.3); tibia 0.53/.009 (5.6); basitarsus 0.26/0.08 (3.5); telotarsus 0.40/0.06 (6.9); ratio femur/patella 1.4; telotarsus/basitarsus 1.5. Leg IV: both femoris contracted and not measurable, patella 0.51/0.22 (2.4); tibia 0.88/0.11 (8.2); basitarsus 0.33/0.09 (3.4); telotarsus 0.49/0.07 (5.1); ratio telotarsus/basitarsus 1.5.

Remarks. Among the species with 6 setae or more on posterior margin of carapace and tergite I, the new species shares with *R. aurouxi* Zaragoza, 2000 (from Cantabria, Spain) the simple shape of the cheliceral galea, although it should be noted that the types of the two species belong to different sexes (only the female is known for *R. aurouxi*). Also, both species have relatively low ratios for pedipalpal femur and chela for hypogean species of the genus. However, they differ in the chelal movable finger/hand ratio, which is 1.4 in *R. borgesi* vs 1.7 in *R. auroxi*; moreover the chelal finger length is almost equal than the femur in the new species, but distinctly longer in *R. aurouxi*.

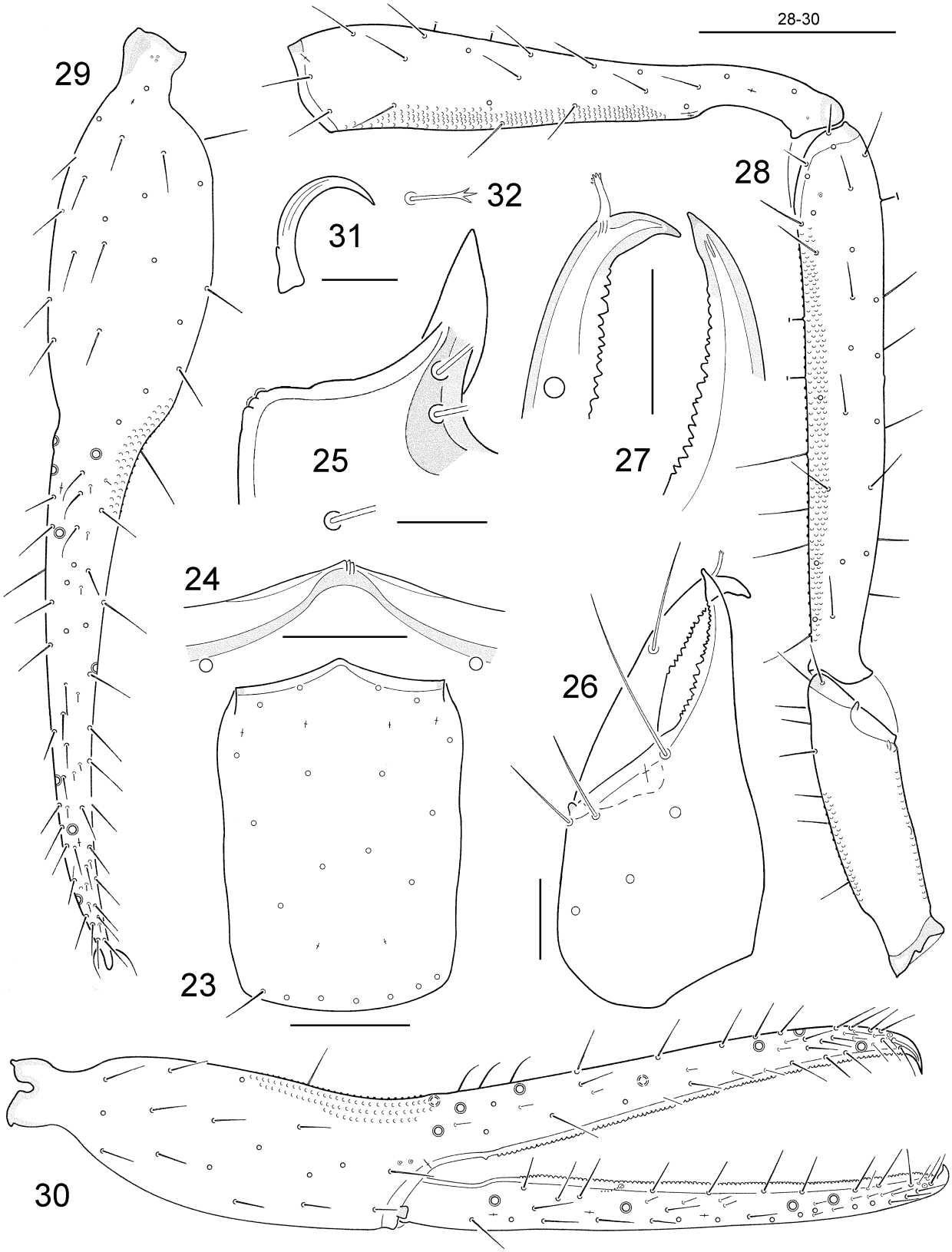
Distribution and habitat. Only known from the type locality in Sicó massif, *Roncocreagris borgesi* **sp. nov.** was collected in the deepest galleries of Cerâmica Cave, where relative humidity is around 100% throughout the year and mean temperature at soil level is 15.3ºC. The presence of two hypogean pseudoscorpion species, *R. blothroides* and *R. borgesi*, in the same cave is infrequent but not unknown (e.g. Zaragoza 2007). Due to the moderate troglomorphism and scarce occurrence of *R. borgesi* in the cave, compared to *R. blothroides*, we suggest that this species might predominantly occur in the mesovoid shallow substratum, rather than in the cave itself.

Cerâmica Cave is the richest one of central Portugal in terms of known troglobiont fauna, harboring 10 cave-adapted species: 3 pseudoscorpions, 1 spider, 1 millipede, 3 oniscidean woodlice, 1 dipluran and 1 beetle (Reboleira, 2012). Among the cave-adapted species, the pseudoscorpions *R. blothroides*, *R. borgesi* **sp. nov.** and *Chthonius* sp., the spider *Lepthyphantes* sp. and the rove-beetle *Domene lusitanica* Reboleira & Oromí, 2011 are macro- and micropredators, while a new species of chordeumatid millipede, the woodlice *Porcellio cavernicolus* Vandel, 1964 and two trichoniscids, together with the dipluran *Podocampa* cf. *fragiloides* Silvestri, 1932, play a detritivorous role in this subterranean ecosystem (Reboleira *et al.* 2011a, 2011b). Other interesting troglophile species have stable populations in this biocoenosis, such as the gastropod *Oxychilus draparnaldi* (Beck, 1837), the centipede *Lithobius pilicornis* Newport, 1844 and the ground beetle *Trechus fulvus* Dejean, 1831.

***Roncocreagris gepesi* Zaragoza & Reboleira sp. nov.**

(Figs 23–32)

Type material. Holotype ♀, Portugal, Sicó Massif , district of Coimbra, Penela, Gruta do Algarinho/Dueça Cave system (39°59′4.89"N, 8°23′5.86"W; 208 m.a.s.l.), 25.IV.2009, lgt. A.S.P.S. Reboleira (DEUA).



FIGURES 23–32. *Roncocreagris gepesi* **sp. nov.**, female holotype. **23.** carapace; **24.** anterior margin of carapace; **25.** anterior and medial processes of left coxa I; **26.** left chelicera; **27.** partial view of fingers of left chelicera, showing galea; **28.** right pedipalp minus chela, dorsal view; **29.** right chela, dorsal view; **30.** right chela, lateral view; **31.** claw of left leg IV; **32.** subterminal seta of left leg IV. Scale bars (in mm): 0.05 (Figs 25, 31, 32), 0.10 (Figs 24, 26, 27), 0.30 (Fig. 23), 0.50 (Figs 28–30).

Etymology. This species is dedicated to the speleological association Grupo Protecção Sicó (GPS), for its contribution to the knowledge and protection of caves and karst of Sicó region, and as recognition to its members for their effort and support during our field work.

Diagnosis. No eyes or eye-spots. Strong troglomorphic adaptations. Carapace with 21 setae, 7 on the posterior margin. Tergite I 6 setae. Female cheliceral galea long, with five short, apical rami. Pedipalp: femur ratio about 6.6, femur longer than movable finger; chela$^+$ ratio about 5.9; chelal hand widest at middle, ratio movable finger/hand$^+$ 1.4; trichobothium *ist* close to middle of finger, ratio *ib–ist*/*ist–it* 1.3, ratio *isb–ist*/*ib–isb* 1.8.

Description. Large pseudoscorpion. Opisthosoma elongate, advanced troglomorphic adaptations. Opisthosoma and legs yellowish. Carapace, chelicerae and pedipalps reddish brown.

Carapace distinctly longer than broad (Fig. 23). Without eyes or eye-spots. Anterior margin moderately prominent medially, epistome blunt and short (Fig. 24). Chaetotaxy: 21 setae, formula 4:4:6:7. Four microlyrifissures in ocular zone, two between median and posterior zones.

Coxal area. Manducatory process with 3 setae. Anterior process of coxa I with simple tooth shape, long and apically pointed; medial process straight with some small tubercles (Fig. 25). Pedipalpal coxa with 7 setae, pedal coxa I with 6, II: 5–6, III: 3, IV: 5.

Tergal chaetotaxy I–X: 6:6:7:10:9:10:10:10:9:9, most hairs lacking. Genital area with 5 thin setae on sternite II. Sternal chaetotaxy III–X: 9:7:12:12:12:9:9:8; sternites VI and VII each with 2 discal setae (included in sternal formula); discal setae glandular, with visible duct. Segment XI 9 setae. Chaetotaxy of stigmata of sternites III and IV with 3 microsetae on each side. Anal cone with two dorsal and two ventral setae.

Chelicerae (Figs 26–27). Palm with 6 setae, subgaleal seta 0.68 from base of movable finger. Galea 0.04 mm long, with five short, apical rami. Fixed finger with 5 small, blunt distal denticles and 14 other small, medium teeth; movable finger with 13 teeth, one large and blunt subdistal tooth, the others medium or small, dental row ending just proximad of subgaleal seta. Rallum with 8 blades, all unilaterally pinnate on anterior face, basal blade about half length of others. Serrula exterior with 32 blades, serrula interior 27 blades.

Pedipalps (Figs 28–30). Trochanter, femur, distal third of patella and hand at base of the fingers distinctly granulated, more pronounced on paraxial faces. Lyrifissures as in Figs 28–30. Antiaxial face of trochanter and femur with one tiny tubercle at middle or slightly more distad; femur bearing one distal glandular pore. Patella with one micropore at base of pedicel. Chelal hand elliptic in dorsal view, maximum width at middle; three dorsal micropores on pedicel; two glandular pores on antiaxial face close to finger base. Fixed finger with 98 teeth, most of them apically cusped, dental row almost reaching level of trichobothrium *esb*; *nodus ramosus* short, reaching level of 5th distal tooth; trichobothrium *it* proximad of *et*, closer to *est* than to *et*; trichobothrium *ist* slightly closer to base of finger than to apex; distance between trichobothria *ib* and *ist* 1.3 times longer than that between *ist* and *it*; distance between trichobothria *isb* and *ist* 1.7 times longer than that between *isb* and *ib*; distance between trichobothria *et* and *it* 1.2 times longer that between *it* and *est*. Chelal microsetae pattern: *Em* 3 curved setae, *Mm* 2, *Im* 1. Movable finger with 103 teeth, most of them apically cusped, dental row ending distad of trichobothrium *b*, shorter than that of fixed finger. Distance between trichobothria s*b* and *st* 1.2 times longer than that between *sb* and *b*. One sensillum near the tip of both fingers; diploid sensillum *pc* not raised, close to dental margin, slightly proximad of trichobothrium *sb*.

Legs. Claws of legs I and IV with a tiny dorsal tooth proximad to middle (Fig. 31), subterminal setae with three rami, trident shaped (Fig. 32). Leg IV tibia TS ratio 0.48, basitarsus TS 0.13, telotarsus TS 0.27.

Measurements and ratios. Body 2.19. Carapace 0.95/0.65 (1.5). Chelicera: palm 0.57/0.27 (2.1), movable finger 0.36. Pedipalp: trochanter 0.79/0.21 (3.9); femur 1.46/0.22 (6.6); patella 1.41/0.26 (5.5), pedicel 0.36, club 1.05/0.26 (4.1), ratio club/pedicel: 2.92; chela$^+$ 2.39/0.41 (5.9), chela$^-$ 2.21/0.41 (5.5); hand$^+$ 1.03 (2.5), hand$^-$ 0.85 (2.1); movable finger 1.39; ratio finger/hand$^+$ 1.4; ratio chela$^+$/carapace 2.5; femur/carapace 1.5; femur/finger 1.1; femur/patella 1.0; patella/ hand$^+$ 1.4. Leg I: femur 0.73/0.14 (5.4); patella 0.51/0.12 (4.4); tibia 0.68/.08 (8.7); basitarsus 0.33/0.07 (5.0); telotarsus 0.45/0.06 (8.2); ratio femur/patella 1.4; telotarsus/basitarsus 1.4. Leg IV: femur+patella 1.12/0.25 (4.5); tibia 1.12/0.13 (8.4); basitarsus 0.41/0.1 (4.2); telotarsus 0.58/0.08 (7.4); ratio femur+patella/tibia 1.0; ratio telotarsus/basitarsus 1.4.

Remarks. The new species is easily distinguishable from *R. borgesi* **sp. nov.** by the shape of the chelal hand, which is elliptic and widest at middle in *R. gepesi* versus oval and widest proximad of middle in *R. borgesi*; also the pedipalps are larger and more slender in *R. gepesi*. The new species can be differentiated from *R. cavernicola* by the chelal movable finger/hand$^+$ ratio (1.4, versus 1.7) and by the chaetotaxy of the posterior margin of the carapace

(7 setae, versus 4) and of tergite I (6 setae, versus 4). *Roncocreagris gepesi* is more closely related to *R. lucensis* Zaragoza, 2002 (from Galicia, Spain), despite being 400 km away, but in the latter the pedipalps are shorter and less slender than in *R. borgesi*, and the distance between trichobothria *et* and *it* is 3.3 times longer than that between *it* and *est* in the Spanish species, versus 1.2 in the Portuguese species.

Distribution and habitat. *Roncocreagris gepesi* **sp. nov.** was collected in Algarinho, one of the caves of the Dueça system, opened in 1998 with the aid of a backhoe (Neves *et al*. 2005). This species was not found in Soprador do Carvalho, a cave located only 200 m from the entrance of Algarinho Cave. The mean cave temperature is 14.9ºC at soil level. The new species shares its habitat with other hypogean species, such as the woodlouse *Porcellio cavernicolus* and the dipluran *Podocampa* cf. *fragiloides.*

Roncocreagris occidentalis Zaragoza & Reboleira sp. nov.
(Figs 33–43)

Type material. Holotype ♀, Portugal, Serra de Montejunto, District of Lisboa, Pragança, Algar do Javali (39º11.965′N, 9º01.718′W; 380 m.a.s.l.), 19.IX.2009, lgt. A.S.P.S. Reboleira (DEUA). Paratypes: 1 deutonymph, same location as holotype, 19.IX.2009, lgt. A.S.P.S. Reboleira (DEUA); 1 ♀, same location as holotype, 5.IV.2009 lgt. A.S.P.S. Reboleira (DZUL); 1 ♀, Portugal, Cesaredas Plateau, District of Lisboa, Bolhos, Gruta dos Bolhos (39°18′31.35"N, 9°16′36.69"W; 145 m.a.s.l.), 26.XII.2010, lgt. A.S.P.S. Reboleira (DEUA).

FIGURE 33. *Roncocreagris occidentalis* **sp. nov.**, Algar do Javali, Montejunto massif, habitus, dorsal view. **A.** living specimen; **B.** preserved specimen.

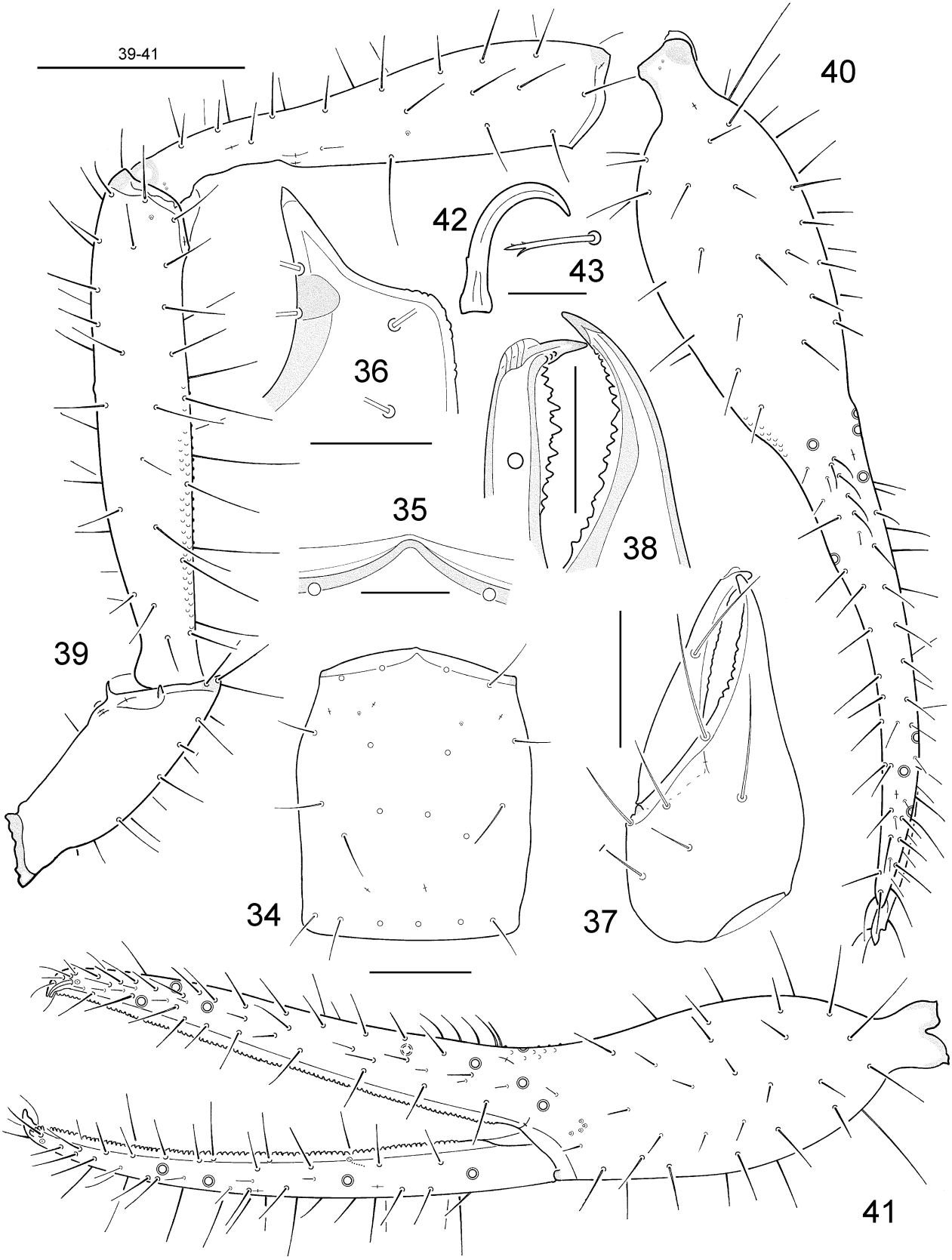
Etymology. Named in reference to the westernmost location known for a hypogean species of the genus *Roncocreagris*.

Diagnosis. No eyes or eye-spots. Strongly troglomorphic. Carapace with 20 setae, 6 on posterior margin. Tergite I 6–7 setae. Female cheliceral spinneret reduced to a hyaline dome. Pedipalp femur ratio about 5.7, femur shorter than the movable finger; chela$^+$ ratio about 5.5; chelal hand broadest proximad of middle, ratio movable finger/hand$^+$ about 1.4; trichobothium *ist* close to finger base, ratio *ib–ist*/*ist–it* about 0.5–0.6.

Description. *Female holotype, followed by female paratypes in brackets.* Large pseudoscorpion with troglomorphic adaptations (Fig. 33). Opisthosoma elongate. Opisthosoma and legs yellowish. Carapace, chelicerae and pedipalps pale brown.

Carapace (Figs 34–35) longer than broad. Without eyes or eye-spots. Anterior margin moderately prominent medially, epistome blunt and almost indistinguishable. Chaetotaxy: 20 setae, formula 4:4:6:6. Three (four) microlyrifissures in ocular zone, two between median and posterior zones.

Coxal area. Manducatory process with 3 setae. Anterior process of coxa I simple, long and apically pointed; medial process straight with some small, blunt protuberances (Fig. 36). Pedipalpal coxa with 7 (6–8) setae, pedal coxa I with 7 (7–8), II: 6–7, III: 4 (5), IV: 6–7.



FIGURES 34–43. *Roncocreagris occidentalis* **sp. nov.**, female holotype. **34.** carapace; **35.** anterior margin of carapace; **36.** anterior and medial processes of right coxa I; **37.** left chelicera; **38.** partial view of fingers of left chelicera, with spinneret; **39.** left pedipalp minus chela, dorsal view; **40.** left chela, dorsal view; **41.** left chela, lateral view; **42.** claw of left leg IV; **43.** subterminal seta of right left IV. Scale bars (in mm): 0.05 (Figs 42, 43), 0.10 (Figs 35, 36, 38), 0.20 (Fig. 37), 0.30 (Fig. 34), 0.50 (Figs 39–41).

Tergal chaetotaxy I–X: 7:7:8:9:9:10:10:11:11:10 (6–7:7–8:8:9:9–10:9–10:11:10:10–11:9), most hairs lacking. Genital area with 5 (6) thin setae on sternite II. Sternal chaetotaxy III–X: 10:8:11:13:13:11:11:11 (10:7:11:12:12:11:11:9–10); sternites VI and VII each with 2 discal setae (included in sternal formula); discal setae glandular, with visible duct. Segment XI: 9 setae. Stigmata III and IV with 3 microsetae on each side. Anal cone with two dorsal and two ventral setae.

Chelicera (Figs 37–38). Palm with 6–7 setae, subgaleal seta 0.66 (0.62–0.68) from base of movable finger. Spinneret a low hyaline dome. Fingers with teeth worn (fixed finger with 5 distal denticles and 7–12 small and medium sized teeth; movable finger with 3 distal denticles and 14 teeth, one large medial tooth, the others medium or small, dental row ending proximad of subgaleal seta. Rallum with 8 blades, all unilaterally pinnate on anterior face, basal blade about half length of others. Serrula exterior with 32 (31–33) blades, serrula interior 24 (25–26) blades.

Pedipalp (Figs 39–41). Femur weakly granulated on paraxial face, more pronounced in basal half; chelal hand weakly granulated at base of finger; trochanter and patella smooth. Lyrifissures as in Figs 39–41. Femur with one tiny tubercle just distad of middle of antiaxial face, dorsally with one distal glandular pore. Patella with two dorsal micropores at base of pedicel. Chelal hand dorsal gently ovoid, widest proximad of middle; pedicel bears two dorsal micropores; antiaxial face with 4 glandular pores close to base of finger. Fixed finger with 100 teeth, most of them apically cusped, dental row reaching base of finger; *nodus ramosus* short, level with 4th distal tooth; trichobothrium *it* proximad of *et*, halfway between *est* and *et*; trichobothrium *ist* markedly closer to base of finger than to apex; distance between trichobothria *ib* and *ist* 0.5 (0.5–0.6) times shorter than that between *ist* and *it*. Chelal microsetae pattern: all groups present, extending distad of trichobothrium *isb*, *Em* 5 (4–5), *Mm* 2, *Im* 2. Movable finger with 97 fingers, most of them cusped, dental row shorter than on fixed finger, ending just distad of trichobothrium *b*; distance between trichobothria *sb* and *st* 1.1 (0.9–1.2) times that between *sb* and *b*. One sensillum near tip of both fingers; diploid sensillum *pc* not raised, close to dental margin, level with trichobothrium *sb*.

Legs. Claws of legs I and IV with a tiny dorsal tooth proximad of middle (Fig. 42), subterminal setae with two rami and some spinules (Fig. 43). Leg IV tibia TS ratio 0.49 (0.45), basitarsus TS 0.14 (0.13), telotarsus TS 0.33 (0.44).

Deutonymph. Body and appendages yellowish. Carapace longer than broad, no eyes or eye-spots, epistome absent; chaetotaxy 20 setae, formula 4:4:6:6. Manducatory process 3 setae, pedipalp coxa 5, pedal coxa I 4, II 4, III 3, IV 4; anterior process of coxa I long and tooth-shaped , medial process straight, with one denticle. Tergal chaetotaxy I–X: 6:6:7:7:7:7:7:7:7:8. Sternal chaetotaxy III–X: 4:4:9:9:8:9:8:9; sternites VI and VII each with 2 discal setae (included in sternal formula); discal setae distinctly closer to sternal row than in adults; segment XI 9 setae; stigmata of sternites III and IV with one microseta on each side. Chelicera with five setae on palm, subgaleal seta 0.6 from base, spinneret reduced to a hyaline dome; fixed finger with 12 teeth, movable finger with 10 teeth. Pedipalps smooth, except chelal hand at base of finger; femur with a tiny antiaxial tubercle in basal half; distal opening of patella oblique; chelal hand more oval than in adults, maximum width proximad of middle, antiaxial face with one glandular pore close to base of finger, one dorsal micropore on pedicel; chelal microsetae pattern: *Em* 2, *Mm* 1, *Im* 0; fixed finger with six trichobothria and 48 teeth, movable finger with two trichobothria and 45 teeth, dental row ending at level of diploid sensillum. Leg IV: telotarsus basally swollen; claws bearing a tiny basal tooth; subterminal setae with tiny distal denticles; tibia TS 0.35, basitarsus TS 0.20, telotarsus TS 0.27.

Measurements and ratios. *Female holotype (followed by female paratype from Algar do Javali in square brackets)*. Body 3.74 [1.96, opisthosoma contracted]. Carapace 0.83/0.68 (1.2) [0.78/0.67 (1.2)]. Chelicera: palm 0.58/0.29 (2.0) [0.51/0.25 (2.0)], movable finger 0.36 [0.31]. Pedipalp: trochanter 0.68/0.22 (3.1) [0.61/0.19 (3.1)]; femur 1.28/0.22 (5.8) [1.13/0.20 (5.7)]; patella 1.21/0.26 (4.7) [1.06/0.23 (4.6)], pedicel 0.36 [0.34], club 0.85/0.26 (3.3) [0.72/0.23 (3.1)], ratio club/pedicel 2.4 [2.1]; chela^{+} 2.28/0.42 (5.5) [2.0/0.38 (5.3)], chela^{-} 2.15/0.42 (5.1) [1.85/0.38 (4.9)]; hand^{+} 0.99 (2.4) [0.83 (2.2)], hand^{-} 0.86 (2.1) [0.68 (1.8)]; movable finger 1.32 [1.18]; ratio chela^{+}/carapace 2.8 [2.6]; femur/carapace 1.5 [1.5]; finger/femur 1.03 [1.04]; femur/patella 1.06 [1.07]; patella/hand^{+} 1.22 [1.3]; finger/hand^{+} 1.3 [1.4]. Leg I: femur 0.60/0.15 (4.1) [0.55/0.15 (3.8)]; patella 0.48/0.12 (3.9) [0.41/0.13 (3.2)]; tibia 0.59/0.09 (6.9) [0.52/0.10 (5.2)]; basitarsus 0.29/0.07 (4.1) [0.26/0.07 (3.6)]; telotarsus 0.48/0.06 (8.0) [0.42/0.06 (6.7)]; ratio femur/patella 1.25 [1.3]; basitarsus/telotarsus 1.7 [1.7]. Leg IV: femur+patella 1.10/0.24 (4.7) [0.93/0.21 (4.4)]; tibia 0.99/0.13 (7.8) [0.88/0.12 (7.3)]; basitarsus 0.37/0.10 (3.7) [0.31/0.10 (3.0)]; telotarsus 0.58/0.08 (7.3) [0.53/0.09 (5.9)]; ratio femur+patella/tibia 1.1 [1.1]; telotarsus/basitarsus 1.6 [1.7].

Female paratype from Gruta dos Bolhos. Body 3.56. Carapace 0.78/0.66 (1.2). Chelicera: palm 0.52/0.26

(2.0); movable finger 0.34. Pedipalp: trochanter 0.60/0.21 (2.8); femur 1.12/0.22 (5.2); patella 1.06/0.27 (3.9), pedicel 0.32, club 0.74/0.27 (2.7), ratio club/pedicel 2.3; chela$^+$ 2.04/0.40 (5.1), chela$^-$ 1.89/0.40 (4.7); hand$^+$ 0.94 (2.3), hand$^-$ 0.79 (2.0); movable finger 1.12; ratio chela$^+$/carapace 2.6; femur/carapace 1.4; finger/femur 1.0; femur/patella 1.1; patella/hand$^+$ 1.1; finger/hand$^+$ 1.2. Leg I: femur 0.50/0.14 (3.7); patella 0.38/0.11 (3.4); tibia 0.48/0.08 (5.8); basitarsus 0.22/0.07 (3.4); telotarsus 0.40/0.06 (6.6); ratio femur/patella: 1.3; telotarsus/basitarsus 1.8. Leg IV: both legs IV absent.

Deutonymph. Body 1.52. Carapace 0.46/0.37 (1.2). Chelicera: palm 0.27/0.14 (2.0), movable finger 0.18. Pedipalp: trochanter 0.27/0.11 (2.4); femur 0.44/.012 (3.8); patella 0.37/0.14 (2.7), pedicel 0.12, club 0.25/0.14 (1.9), ratio club/pedicel 2.1; chela$^+$ 0.86/0.21 (4.2), chela$^-$ 0.81/0.21 (3.9); hand$^+$ 0.38 (1.8), hand$^-$ 0.33 (1.6); movable finger 0.48; ratio chela$^+$/carapace 1.9; femur/carapace 1.0; finger/femur 1.1; femur/patella 1.2; patella/hand$^+$ 1.0; finger/hand$^+$ 1.3. Leg IV: femur+patella 41/14 (3.0); tibia 0.32/0.7 (4.6); basitarsus 0.14/0.06 (2.4); telotarsus 0.22/0.06 (4.0); ratio femur+patella/tibia 1.3; telotarsus/basitarsus 1.6.

Remarks. The main diagnostic characters of the paratype from Gruta dos Bolhos generally coinciding with those of the holotype and paratype from Algar do Javali, but it has a less slender chela. We prefer to assign the specimen from Gruta dos Bolhos to *R. occidentalis* **sp. nov.** until new material is available for study.

Roncocreagris occidentalis represents the second hypogean *Roncocreagris* with the spinneret reduced to a hyaline dome, the other being *R. iglesiasae* Zaragoza, 2003 (Asturias, Spain). *R. occidentalis* differs from *R. iglesiasae* in the position of trichobothrium *ist*, which is distinctly nearer to the finger base than to *it* in the Portuguese species, as opposed to being closer to *it* than to the finger base in the Spanish species. Moreover, *R. occidentalis* has the pedipalps longer but less slender than in *R. iglesiasae*.

Distribution and habitat. *Roncocreagris occidentalis* **sp. nov.** was collected in two caves from two different karst units, Javali in the Montejunto massif and Bolhos in the Cesaredas plateau.

In Javali Cave, which has a year-round temperature of 15.1 $\pm$ 0.5ºC at soil level, *R. occidentalis* is found with other interesting cave-adapted species, such as the ground beetle *Trechus tatai* Reboleira & Ortuño, 2010 (Reboleira *et al.* 2010b), while in Bolhos Cave the biocoenosis is composed of a new trichoniscid woodlouse, the dipluran *Podocampa* cf. *fragiloides* and the thysanuran *Coletinia* sp. and the mean temperature is 16.3ºC. Also found in both caves was the pseudoscorpion *Chthonius (Ephippiochthonius) cardosoi* Zaragoza, 2012, previously known only from the Arrábida massif (Zaragoza 2012).

Discussion

Roncocreagris is a predominantly Iberian genus, distributed in Portugal and most of Spain, except in the eastern regions (Zaragoza 2007, 2008). The origin of the widespread distribution of *R. cambridgei* remains unknown; the records of this species for Algeria and Italy are probably due to misidentifications (Gardini 2000).

The restriction of most *Roncocreagris* to the Iberian Peninsula and the occurrence of highly adapted species to the hypogean life in this region, where epigean species are abundant (probably due to geographic isolation), suggest that the origin of the genus is the Iberian Peninsula (Zaragoza, 2008).

Although some epigean *Roncocreagris* species can be found close to or inside cave entrances (Zaragoza 2007; Zaragoza, unpublished data), true troglobionts of this genus were represented by only a few species until the year 2000 (Zaragoza 1986). Later discoveries in Portugal and Spain (Zaragoza 2000, 2002, 2003; this paper) show an important diversification of *Roncocreagris* in the hypogean environment, exhibiting particularly high endemicity levels in the karst units of central Portugal.

The ways of subterranean diversification for *Roncocreagris* seem to be different for each species. In the highly dissected karst of Sicó massif, more than one species can be found in the same cave, as in Cerâmica Cave, inhabited by *R. blothroides* and *R. borgesi* **sp. nov.** On the other hand, *R. occidentalis* was found in two caves of different karst units (Montejunto massif and Cesaredas plateau) with no limestone continuity and their entrances being almost 26 km apart. This suggests that the species may have expanded its range through a non-cave subterranean habitat, like the mesovoid shallow substratum (Juberthie *et al.* 1980).

The three new species of *Ronconcreagris* increase the number of hypogean pseudoscorpions in mainland Portugal from six (Reboleira *et al.* 2013) to nine, belonging to the families Bochicidae, Chthoniidae, Neobisiidae and Syarinidae.

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