

THE GENUS *BUTHUS* LEACH, 1815 (SCORPIONES: BUTHIDAE) IN THE IBERIAN PENINSULA. PART 2: TWO MORE REDESCRIPTIONS

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Abstract: The present paper is a continuation of our taxonomic revision of the genus *Buthus* Leach, 1815 in the Iberian Peninsula. In this second contribution we revalidate two old and virtually neglected species: *Buthus ajax* (C. L. Koch, 1839) and *Buthus halius* (C. L. Koch, 1839). We redescribe both taxa in detail (with the designation of neotypes to stabilise the nomenclature) and clarify their geographical distribution. The West European diversity of *Buthus* now reaches 12 species, all of them local endemics.

Key words: Scorpiones, Buthidae, *Buthus*, taxonomy, redescrpciones, Iberian Peninsula.

El género *Buthus* Leach, 1815 (Scorpiones: Buthidae) en la Península Ibérica. Parte 2: otras dos redescrpciones

Resumen: El presente artículo es continuación de nuestra revisión taxonómica del género *Buthus* Leach, 1815 en la Península Ibérica. En esta segunda contribución revalidamos dos especies antiguas y prácticamente olvidadas: *Buthus ajax* (C. L. Koch, 1839) y *Buthus halius* (C. L. Koch, 1839). Redescrivimos ambos taxones en detalle (con designación de neotipos para estabilizar su nomenclatura) y esclarecemos su distribución geográfica. La diversidad de *Buthus* en el poniente europeo alcanza ahora 12 especies, todas endémicas locales.

Palabras clave: Scorpiones, Buthidae, *Buthus*, taxonomía, redescrpciones Península Ibérica.

Taxonomía/Taxonomy: *Buthus ajax* (C. L. Koch, 1839) **stat. rev.**, *Buthus halius* (C. L. Koch, 1839) **stat. rev.**

Introduction

Six months ago, the present authors (Teruel & Turiel, 2020) published the first part of a thorough taxonomic revision of the genus *Buthus* Leach, 1815 in the Iberian Peninsula (actually Western Europe), which contributed the following main results:

- The four species previously recognized were proved valid: *Buthus elongatus* Rossi, 2012, *Buthus ibericus* Lourenço & Vachon, 2004, *Buthus montanus* Lourenço & Vachon, 2004 and *Buthus occitanus* (Amoreux, 1789). All were redefined and thoroughly redescribed, including neotype designations for *B. occitanus* and its confirmed junior synonym *B. europaeus tridentatus* Franganillo, 1918.

- Six new species were described, all from southern Spain: *Buthus alacanti* (from coastal Alicante, in southern Valencia), *Buthus baeticus* (from adjacent Sevilla and Málaga, in central Andalucía), *Buthus delafuentei* (from extreme western Huelva, in southwestern Andalucía), *Buthus garcialorcai* (from central Granada, in south-central Andalucía), *Buthus manchego* (from extreme western Ciudad Real, in southern Castilla-La Mancha) and *Buthus serrano* (from northwestern Granada, in western Andalucía).

In the above-mentioned paper, Teruel & Turiel (2020: 4) announced a soon-coming second part of the revision, which was originally intended to be the completion of the work at least for an immediate future. Nevertheless, the highly problematic situation caused by Covid-19 in all countries involved (not only the targeted Portugal, Spain and France, but Cuba and Germany as well, where the present authors do reside and work), prevented us from completing a great part of the required tasks due to the severe and repeated restriction measurements implemented. Especially detrimental is the

closure of national frontiers that interrupted or limited travels and post-mail services, together with the reiterated and prolonged lockdowns and curfews that included closing research institutions and museums. All of this caused our initial plans to fall through, mainly because most of the huge photographic work could not be finished on time.

As the present situation does not seem to improve, either now or within an immediate future, we must adapt ourselves to the new situation in order to continue working. Thus, we decided to present this Part 2 containing two relevant results: the resurrection of *Androctonus ajax* C. L. Koch, 1839 and *Androctonus halius* C. L. Koch, 1839. These two old, virtually neglected species were long regarded as junior synonyms of *B. occitanus*, but are in fact clearly valid and recognizable from their original descriptions and figures. Both are herein redescribed in detail and illustrated, including the designation of neotypes to stabilize their nomenclature.

Methods & Material

See complete information in Teruel & Turiel (2020: 4–5), with the exceptions detailed below.

- **Erratum.** Teruel & Turiel (2020: 13–17) based the redescription of *B. occitanus* upon the adult male neotype designated therein, but incorrectly listed it as a topotype in page 14 due to an unfortunate typo.

- We received for study several additional samples from Portugal (five specimens from three localities) and Spain (five specimens from two localities), as shown herein in figure 1a. The material examined during this continued

revision increased accordingly to 301 specimens, arranged in 54 samples from 51 localities scattered across Spain (44), Portugal (4) and France (3). More samples have already been obtained and will arrive once the postal services and commercial flights return to normal.

• Measurements of the holotypes of *Androctonus ajax* and *Androctonus halius* given by C. L. Koch (1839a–b), were carefully resized here by converting the original German imperial measurement units (lines) to the metric system. During the XIX century, the line did not have a fixed standard and varied loosely from 2.03–3.04 mm, because it represented 1/12 inch, an inch represented 1/12 Bavarian foot and the latter varied from 292–304 mm. It is impossible to define the exact equivalence of the lines used by C. L. Koch (1839a–b), so we decided to use the average value of 2.53 mm as the conversion factor, by being the most accurate.

Systematics

Buthus ajax (C. L. Koch, 1839) status revalidated

Tables I, III–IV. Figures 1b, 2–5, 10a–b, 11

And[roctonus]. ajax: C. L. Koch, 1839a: 127–128 [*nomen nudum*: no description included].

Androctonus ajax C. L. Koch, 1839b: 53; pl. 193, fig. 467. Fet & Lowe, 2000: 93–94, 662. Sousa *et al.*, 2017: 53.

Buthus ajax: Vachon, 1952: 73 [as a junior synonym of *B. occitanus*].

Buthus occitanus: Simon, 1879: 96, 98 [misidentification: synonymy]. Lourenço & Rossi, 2013: 13; fig. 10 [misidentification: map area covering south-central Spain].

Buthus ibericus: Sousa *et al.*, 2010: 207–209; tab. 1; figs 1–2 [misidentification: sample coded Sc161].

TYPE DATA. SPAIN: CASTILLA-LA MANCHA: Toledo Province: Porzuna Municipality: Montes de Toledo: 1 km south-east of Porzuna, along road CM-403 (39°08'11"N / 04°07'36"W / 706 m a.s.l.); 13/June/2018; C. Turiel; 1♂ neotype (herein designated - IES). **Note.** See a detailed discussion below, in Remarks section.

DIAGNOSIS. Adult size large to very large for the genus (70–79 mm in males, 75–91 mm in females), males smaller than same size-class females. Coloration with base olivaceous to reddish brown; carapace and tergites with a blurred, dark trivittate pattern all along; carapace, tergites and metasoma with all carinae deeply infuscate; chelicerae with a faint dark grey reticulate pattern dorsodistally on manus; pedipalps and legs with carinae deeply infuscate. Sexual secondary dimorphism moderate in habitus (males smaller and slightly slenderer), inconspicuous in pedipalps (globose and much wider than patella in both sexes, slightly more in males) and moderate in metasoma (slenderer in males). Pedipalp chela with only a few dark macrosetae scattered on ventral surface; manus with all carinae vestigial to weak, smooth; fingers long (movable finger/manus length ratio: 1.54–1.60 in males, 1.38–1.65 in females), fixed finger with 12–14 principal rows of denticles, movable with 13–14 (mode 13 in both fingers), basal lobe/notch combination moderately strong. Pectines with 30–34 teeth in males, 26–28 in females. Metasoma of male with size and shape standard for the genus (see ratios in tab. IV); dorsal lateral and lateral supramedian carinae moderately serratocrenulate to crenulate on segments II–IV, ventral submedians on II–III markedly raised distally (much stronger and coarser in females); intercarinal tegument coriaceous, minutely punctate and with fine granules scattered, but

irregularly and minutely granulose on IV (dorsally and dorso-laterally only) and V (all surfaces); setation sparse, with 2–4 pairs of dark macrosetae on almost all carinae (4–5 pairs on lateral supramedians and ventral laterals of V). Telson vesicle moderately large and subglobose in adult males, large and globose in adult females.

REDESCRIPTION (adult male neotype; tabs. I, III–IV; figs. 2, 4a, 5a).

Coloration. Base reddish brown, conspicuously paler on chelicerae, pedipalp fingers, legs and telson. Chelicerae largely immaculate, but with a faint, narrow, transverse area of infuscation and fine dark grey reticulations on dorsodistal portion of manus. Pedipalp femur yellowish brown, with tip and all carinae deeply infuscate; patella reddish brown with all carinae deeply infuscate and large, irregular dark brown spots all over except ventrally; chela manus vivid reddish, with slight traces of dark variegations along external surface of manus, fingers vivid yellow, immaculate. Carapace with all carinae and coarse granulation deeply infuscate and with diffuse, symmetric blackish reticulations and spots all over; eyes and ocular tubercles black. Tergites with all carinae and coarse granulation deeply infuscate and with diffuse, symmetric blackish spots all over, defining altogether a blurred trivittate pattern (i.e., a narrow, median solid line plus two broad, variegated lateral stripes, all three interconnected by an almost solid, broad, dark transverse stripe anteriorly and dark reticulations medially). Pectines pale yellowish, with basal portion and basal plate progressively darker due to heavier sclerotization. Sternopectinal region and sternites immaculate. Legs yellowish brown, with most carinae moderately to deeply infuscate, as well as irregularly on distal half of femur and basal half of patella (except on leg I). Metasoma concolor (i.e., no segments conspicuously darker), with very faint, diffuse, irregular, infuscation all over (much darker and better defined on V, especially ventrally) and all carinae moderately to deeply infuscate (progressively darker posteriorly and ventrally). Telson yellowish brown, immaculate, distal half of aculeus blackish.

Chelicerae. With dentition typical for the genus, teeth standard-sized and sharp. Tegument glossy and minutely punctate, dorsodistal portion of manus with fine, glossy granulation scattered and coarse, glossy granules irregularly arranged around dorsodistal depression. Setation very dense ventrally, but essentially lacking dorsally except for a patch of macrosetae at fixed finger base and few setae around dorsodistal depression of manus.

Pedipalps. Size standard for the genus (3.68 times longer than carapace). Femur essentially straight (very slightly bent inwards distally) and with many dark macrosetae, largely concentrated along ventrodorsal edge; all carinae strong and formed by coarse, isolated, glossy granules; intercarinal tegument coriaceous, minutely punctate on glossier areas and with minute to fine granulation scattered dorsally. Patella straight and with only a few dark macrosetae scattered all over; all carinae moderate to strong and granulose to costate, formed by very coarse, isolated to partially anastomosed, glossy granules; intercarinal tegument coriaceous and minutely punctate on glossier areas, internal surface with many small to medium-sized denticles. Chela with manus large and almost round, globose (length/width ratio = 1.27, length/depth ratio = 1.25, median part widest), much wider than patella (ratio 1.38) and with only a few dark macrosetae scattered on ventral surface, all carinae vestigial to weak but

coarse, smooth, intercarinal tegument vestigially but coarsely reticulate, glossy and minutely punctate; fingers long (movable 1.54 times longer than underhand), thick and evenly curved, fixed finger with 13/13 principal rows of denticles plus 13/13 inner and 12/13 outer accessory denticles (much coarser than principal denticles), movable finger with 13/13 principal rows of denticles plus 12/11 inner and 12/12 outer accessory denticles (much coarser than principal denticles) and the standard apical subrow with 2/3 denticles (large terminal denticle not included), basal lobe/notch combination moderately strong.

Carapace. Slightly wider than long (length/width ratio = 0.94). Anterior margin very shallowly V-shaped, with 4–5 pairs of dark macrosetae. Carinae with lyre-shaped configuration perfectly defined: anterior medians and superciliaries strong, fused into a spoon-shaped figure and formed by coarse, isolated, glossy to rough granules; central laterals and posterior medians strong, fused into an S-shaped figure and formed by coarse, isolated, glossy granules; lateral oculars and central medians strong, not fused and formed by medium-sized to coarse, isolated, glossy granules; posterior laterals moderate and formed by medium-sized, isolated, glossy granules. Furrows: posterior laterals deep and wide, other furrows obscured by remarkably depressed areas between adjacent carinae. Tegument coriaceous, minutely punctate and irregularly covered by moderately dense, fine, glossy, tuberculate granules largely concentrated along lateral and frontal areas. Median eyes large, separated by more than twice the ocular diameter; lateral eyes much smaller and mostly concealed below a granulose carina.

Sternum. Type 1, very small, triangular and bulky, with one pair of dark macrosetae, plus some minor setae. Tegument minutely and very densely granulose, with some coarser granules scattered.

Genital operculum. With six pairs of dark macrosetae and some inconspicuous minor setae. Valves roundly subtriangular, shallowly convex and widely separated all along; tegument coriaceous, minutely punctate and densely covered by moderately dense, fine to medium-sized, glossy granules along margins except medially. Genital papillae large, thick and slightly protruding.

Pectines. Long (but not reaching midpoint of leg IV trochanter) and narrowly subtriangular, setation moderately dense and dark. Tooth count 30/31, teeth moderately swollen. Fulcra large and swollen, paraboloid to round. Basal middle lamella trapezoidal. Pre-pectinal plate heavily sclerotized, very short, wide and folded transversely, crescent-shaped; tegument coriaceous. Basal plate heavily sclerotized, wider than long, with 1–2 pairs of dark macrosetae; anterior margin shallowly bilobed, posterior margin markedly convex; tegument very finely and densely granulose, with some slightly coarser granules scattered and three conspicuous, deep depressions: one anteromedian (transverse, narrow and progressively much deeper medially to become a pit) and two laterals (large and roundly subtriangular).

Legs. Long and slender, with all carinae weak to moderate and smooth to subgranulose except on femur and patella, where moderate to strong and serrate to dentate. Intercarinal tegument coriaceous and minutely punctate on glossier areas, external surface of femur with many fine, glossy granules scattered. Bristlecombs well developed on I–III. Tibial and pedal spurs very large and thin. Claws medium-sized to long and well curved.

Mesosoma. Size and shape standard for the genus. Tergites coriaceous, minutely punctate and irregularly covered by moderately dense, fine to medium-sized, glossy to rough, tuberculate granules more concentrated along lateral areas, lateral margins finely denticulate, posterior margin minutely subgranulose; carinae: median longitudinal straight, progressively longer and stronger backwards and formed by medium-sized, isolated, glossy to rough granules, submedians anteriorly divergent, shallowly arcuate (I–VI) to shallowly S-shaped (VII), progressively longer and stronger backwards and formed by medium-sized, isolated, glossy to rough granules, laterals absent on I–VI, very strong, arcuate and formed by medium-sized to coarse, isolated, glossy granules on VII. Sternites with some dark macrosetae scattered all over (denser on III); lateral margins of all sternites finely serrate to granulose, posterior margin minutely denticulate to granulose; carinae: submedians moderately strong, almost complete on posterior two-thirds of III–IV (smooth, subcostate and anteriorly convergent as an inverted V-shaped boss), complete on V–VI (smooth, subcostate and parallel, but very slightly divergent medially) and complete on VII (subcrenulate and parallel, but very slightly convergent anteriorly), laterals moderate but progressively stronger backwards, absent on III, present on posterior two-thirds of IV–VI (smooth, costate and sinuose) and present posterior two-thirds of VII (subcrenulate and anteriorly divergent); tegument coriaceous with some symmetric, glossy areas, minutely punctate and densely covered by minute granules on lateral and submedian areas (some minute granules scattered also medially); spiracles very long and slit-like; sternite V with median smooth patch very short and wide, slightly bulky and translucent yellowish.

Metasoma. Size and shape standard for the genus (4.71 times longer than carapace), progressively narrower and lower distally, with segment V both narrowest and lowest. Segment I with ten complete carinae, II–IV with eight, V with five: dorsal laterals strong and coarsely serratocrenulate on I, moderate and coarsely serratocrenulate to subcrenulate on II–III, weak and coarsely subcrenulate on IV, absent on V; lateral supramedians strong and coarsely serratocrenulate to crenulate on I–II, moderate and coarsely serratocrenulate to crenulate on III–V; lateral inframedians strong and coarsely crenulate, complete on I, present on distal two-thirds of II and distal half of III, absent on IV–V; ventral laterals strong and coarsely subcrenulate to crenulate on I–IV, strong and coarsely but irregularly serrate to lobate on V (with about 4–5 lobes much larger than the others); ventral submedians strong and coarsely subcostate on I, strong, progressively stronger backwards and coarsely subserrate to serratocrenulate on II–III (moderately raised distally), strong and coarsely serratocrenulate on IV, absent on V (but indicated by an incomplete but raised row of coarse granules on more than basal half two-thirds); ventral median absent on I–IV, moderate and coarsely but irregularly serrate on V (bifurcate on distal third). Intercarinal tegument coriaceous, minutely punctate on glossier areas and with some fine granules scattered all over, but irregularly, minutely granulose on IV (dorsally and dorsolaterally only) and V (all surfaces); dorsal furrow complete, wide and shallow on all segments; setation sparse, with 2–3 pairs of dark macrosetae on most carinae (4–5 pairs on lateral supramedians and ventral laterals of V).

Telson. Vesicle moderately large, subglobose (length/width ratio = 1.24, width/depth ratio = 1.06), with six pairs of dark

macrosetae and several inconspicuous minor setae scattered all over; tegument glossy and minutely punctate, with coarse but obsolete to weak, glossy granules scattered ventrally and laterally; ventral median carina obsolete, as are two accessory pairs of carinae (ventral laterals and lateral supramedians?), subaculear tubercle absent, but indicated by an obsolete, coarse granule. Aculeus shorter than vesicle (ratio = 0.86), sharp and moderately curved.

FEMALES (tabs. I, III–IV; figs. 3, 4d–f, 5c, 10a–b). Sexual secondary dimorphism moderate, differing from described male by: **1**) size larger (75.1–90.8 mm); **2**) pedipalp manus slightly less swollen (length/width ratio = 1.31–1.50, length/depth ratio = 1.22–1.34); **3**) mesosoma wider, with lateral sides more convex; **4**) pre-pectinal plate reduced to a tiny oval sclerite, invaginated into the membrane to look like a transverse pit; **5**) genital papillae absent; **6**) pectines smaller, narrower and with lower tooth counts (26–28); **7**) metasoma heavier and with all carinae stronger (especially the ventral submedians of segments II–III and ventral laterals of V, which are very strongly, coarsely and irregularly lobate); **8**) telson with vesicle wider (length/width ratio = 1.16–1.23, width/depth ratio = 1.08–1.12) and aculeus slightly shorter (ratio = 0.75–0.81).

VARIATION. Specimens from the five localities studied herein are remarkably homogeneous in morphology (figs. 4–5). Most samples are too small for an appropriate comparison and study of additional material is advisable, but no clear differences seem obvious amongst different populations. In other words, individual variation of all minor samples is totally or largely included within the range of the largest sample (Puerto Lápice) and variation of the complete pooled sample matches that already documented by Teruel & Turiel (2020) for other well-studied Western European species, such as *B. elongatus*, *B. ibericus* and *B. occitanus*.

Adult size varied from 69.9–78.9 mm in males and 75.1–90.8 mm in females for the pooled sample (tab. I); two size-classes are evident in both sexes (maybe three). Although *B. ajax* is a large-sized species for the genus, some adults are truly gigantic.

The coloration (figs. 2–5, 10a–b) varies only subtly within each population, with some individuals being slightly paler or darker than the rest; age seems to be the main cause, because the darkest specimens are invariably the oldest (evidenced by cheliceral teeth, pedipalp finger denticles and leg claws, spurs and telotarsal spiniform setae, all either severely worn-out or broken). There is also some degree of variation between different populations: the base color is lighter and more olivaceous in specimens from Los Yébenes and Miramontes, but darker and more reddish in those from Porzuna and intermediate (medium brown) in the ones from Puerto Lápice and Carrión de Calatrava. Eval variation is evident too: early to mid-instar juveniles have the base color paler and the dark patterns better defined and more contrasting, but these differences decrease gradually through development and late-instars and subadults are very similar to or same-colored as adults.

Number of principal rows of denticles varied from 13–14 on fixed and movable fingers (exceptionally 12 in the former), with a clearly defined mode of 13 in both. Specimens with asymmetrical counts between fixed/movable fingers and/or left/right pedipalps were slightly predominant, with nine specimens (47%) having the same count in all four

fingers: eight with 13 rows (the juvenile female from Los Yébenes, an adult and a juvenile females from Puerto Lápice, both males from the type locality, the juvenile male from Carrión de Calatrava, an adult female and a juvenile male from Miramontes) and one with 14 rows (an adult female from Miramontes). Three juveniles (two females from Puerto Lápice and one male from Miramontes) had their left fixed finger with dentition aberrant because of regeneration, thus, it was excluded from counts.

Pectinal tooth counts (tab. IV) varied from 30–34 in males and 26–28 in females, without a clearly defined mode in either sex. Single-tooth asymmetry was a frequent occurrence (53% of the 19 specimens), but with opposite trends in each sex: it occurred in six (86%) of the seven males, but only in four (33%) of the 12 females. Apart from this, only two specimens (10%) had a two-tooth asymmetry: a juvenile male from Miramontes and an adult female from Los Yébenes, with 30/32 and 26/28, respectively.

COMPARISON. Amongst the other 11 described Iberian congeners, this species resembles only *B. baeticus*, *B. delafulentei*, *B. halius* and *B. ibericus* by having pedipalp fingers with lobe/notch combination developed. The adults of these four species can be safely distinguished from *B. ajax* as follows:

- ***B. baeticus*:** **1**) size smaller (males 64–69 mm, females 59–70 mm); **2**) sexual secondary dimorphism in habitus much less evident (pedipalps and metasoma very similar in both sexes); **3**) coloration with base much paler (light yellowish brown) and dark pattern more reduced, but very sharply contrasting (pedipalps and legs essentially immaculate, tergites with the dark trivittate pattern perfectly defined); **4**) pedipalps with carinae weaker and finer (especially on femur and patella); **5**) pedipalp chela much slenderer (length/width ratio = 3.84–4.07 in males, 4.14–4.53 in females); **6**) pedipalp fingers thinner, with basal lobe/notch combination weaker and with accessory denticles only slightly coarser than principal denticles; **7**) metasoma slenderer (especially in males) and with carinae weaker and finer (especially the ventral submedians on II–III only feebly raised distally and the ventrolaterals on V with the flared lobes fewer and smaller); **8**) telson with vesicle proportionally smaller and less globose (length/width ratio = 1.29–1.36 in males, 1.23–1.28 in females).

- ***B. delafulentei*:** **1**) sexual secondary dimorphism in size opposite, with males larger than same size-class females (males 65–72 mm, females 58–66 mm); **2**) sexual secondary dimorphism in habitus much more evident (males with pedipalps much more robust, but also with mesosoma and metasoma much longer and slenderer); **3**) coloration with base much paler (vivid yellow to pale yellowish brown) and the dark patterns more reduced, but very sharply contrasting (pedipalps and legs essentially immaculate, tergites with the dark trivittate pattern perfectly defined); **4**) pedipalps with carinae weaker and finer (especially on femur and patella); **5**) pedipalp chela slenderer (length/width ratio = 3.51–3.52 in males, 4.69–4.80 in females, in the latter sex also narrower than patella); **6**) pedipalp fingers thinner and with accessory denticles only slightly coarser than principal denticles; **7**) metasoma much slenderer (especially in males) and with carinae finer (especially the ventral submedians on II–III only feebly raised distally and the ventrolaterals on V with the flared lobes smaller and sharper); **8**) telson with vesicle proportionally smaller in females and with aculeus less curved (especially in males).

• ***B. halius***: 1) coloration with the dark patterns more sharply contrasting (chelicerae more densely infuscate, tergites with the dark trivittate pattern well defined); 2) pedipalps with carinae weaker and finer; 3) pedipalp chela proportionally smaller and more ovate (especially in males); 4) pedipalp fingers thinner and with accessory denticles only slightly coarser than principal denticles; 5) pectines with tooth counts slightly but consistently lower (28–31 in males, 24–28 in females); 6) sternites III–VI with tegument noticeably matter, coriaceous; 7) metasoma slightly longer and slenderer.

• ***B. ibericus***: 1) size smaller (males 52–64 mm, females 65–76 mm); 2) habitus very different, much shorter and fatter ("squat", "dumpy"); 3) coloration with base much paler (vivid yellow to light yellowish brown) and the dark patterns much more reduced, but very sharply contrasting (pedipalps and legs essentially immaculate, tergites with the dark trivittate pattern better defined); 4) pedipalps with carinae much weaker; 5) pedipalp chela slenderer (length/width ratio = 3.37–3.72 in males, 3.84–4.20 in females); 6) pedipalp fingers thinner and with accessory denticles only slightly coarser than principal denticles; 7) pectines with tooth counts consistently lower (26–31 in males, 21–26 in females); 8) whole body and appendages with tegument noticeably glossier; 9) metasomal segments remarkably more robust, swollen and with carinae much weaker (especially the ventral submedians on II–III only feebly raised distally and the ventrolaterals on V with the flared lobes fewer and smaller).

All the differences mentioned above are very easy to appreciate even to unaided eye: compare figures 2–5 to 6–9 herein and to figures 4–6 and 16–20 in Teruel & Turiel (2020: 41–42, 48–50). See also tables I–IV herein and III–IV, IX–X and XIII–XIV in Teruel & Turiel (2020: 34–39).

It is worth to mention here that *B. manchego* lives in the same geographical area, with its nearest record (Peñarroya, the type locality) only 55 km straight-line to the southeast of Puerto Lápice; see figure 1b herein. Juveniles and adult females of both species superficially look alike (although the pedipalp fingers with vs. without basal lobe/notch and coarse vs. fine accessory denticles are diagnostic), but the adult males are very different, even to unaided eye (see description, tables and figures of *B. manchego* in Teruel & Turiel, 2020).

This case brings further support to the rule of thumb set by Teruel & Turiel (2020: 4–5): the precise identity of any Western European population of *Buthus* may be defined with absolute certainty only when adults of both sexes are available and adult males alone are the second best choice, but females and/or juveniles alone easily lead to misidentifications. Very recently, Cain *et al.* (2021: 19) documented the same situation amongst the Levantine species of the closely related Old-World genus *Buthacus* Birula, 1908.

DISTRIBUTION (fig. 1b). According to our personal data and high-resolution photographs of collaborators, *B. ajax* is widespread across the central part of the Submeseta Sur of Spain (Castilla-La Mancha and Andalucía), between the main mountain ranges of Montes de Toledo and Sierra Morena. Additional samples from this region (including Extremadura) and western Portugal (Évora) are currently under study, to define the precise geographical range of this scorpion (R. Teruel & C. Turiel, in preparation).

ECOLOGICAL NOTES. This is a lapidicolous scorpion, which digs short burrows and scrapes in clay and clay-sandy soil under rocks, both limestone and volcanic (figs. 10–11). It occurs in a wide range of Mediterranean-type vegetal formations (fig. 11), both primary and secondary but open and seasonally dry, e.g., chaparral, maquis, sparse pine and oak forests and "dehesa" (anthropogenic, secondarily grown in places where the original Mediterranean chaparral and oak forests have been heavily altered by human activities such as overgrazing and burning).

REMARKS. C. L. Koch (1839b: 53) explicitly stated he described *Androctonus ajax* from a single, dry specimen collected in Spain without precise locality and housed in the private collection of the well-known illustrator, botanist and entomologist Jakob Sturm, in Nuremberg. According to the original description and color image of C. L. Koch (1839b: 53; pl. 193, fig. 467), it was a subadult and possibly a female, judging from its size about 66 mm and habitus, especially the slender pedipalp chelae (see figure 5 herein). This specimen, correctly listed as holotype by Fet & Lowe (2000: 93), is long considered lost (Fet & Lowe, 2000: 93; Sousa *et al.*, 2017: 53).

This species was synonymized under *B. occitanus* by Simon (1879: 96, 98), who explicitly declared to have based such synonymy not upon the study of C. L. Koch's type, but instead on "a great number of specimens [...] from Spain" [originally in French, translated into English here]. Such synonymy was never revised and this taxon was neglected for 142 years, being cited in the literature only twice (Fet & Lowe, 2000: 93–94, 662; Sousa *et al.*, 2017: 53).

The first author to enter the nomenclatural combination *Buthus ajax* was implicitly Vachon (1952: 73), who listed it hierarchically under *Buthus* within the synonymy of *B. occitanus*. Such nomenclatural act was overlooked by Fet & Lowe (2000) and Sousa *et al.* (2017).

Another nomenclatural issue involving this taxon has gone unnoticed so far. Carl Ludwig Koch's series titled "*Die Arachniden. Getreu nach der Natur abgebildet und beschrieben (Fortsetzung des Hahn'schen Werkes)*" was published in 12 separate volumes from 1834 through 1848, of which the one containing the original description of *Androctonus ajax* came out numbered as the sixth (C. L. Koch, 1839b). However, two mentions of this taxon as "*And. ajax*" were published earlier in the fifth part (C. L. Koch, 1839a: 127–128), inside the original description of *Androctonus eupeus* (currently the type species of the genus *Mesobuthus* Vachon, 1950). This constitutes a *nomen nudum*, but the posterior description of the same taxon by C. L. Koch (1839b) made the binomen *Androctonus ajax* available under this publication date, as ruled by Article 21.5 of the Code (CINZ, 1999: 23) for a work issued in parts.

In order to stabilize nomenclature through the clarification of the precise taxonomic identity of *Androctonus ajax*, there is an inevitable need to fix it by permanently linking it to an existing, representative and accessible name-bearing type. This becomes especially relevant today, when the diversity of the genus in Spain has proven to be far more diverse than previously assumed (see e.g., Teruel & Turiel, 2020) and some of these taxa are close relatives of *B. ajax*. Thus, we selected a perfectly preserved, freshly collected adult male with complete locality data as the neotype and deposited it at IES (a public, well-recognized research institution), fulfilling **all** conditions and recommendations set by Article

75 of the Code for this nomenclatural act (CINZ, 1999: 86–89).

As stated above, the type locality of *B. ajax* was originally fixed by C. L. Koch (1839b: 53) vaguely as Spain only, without any further precision; we could not find any supplementary sources where to gather this crucial information. Following Recommendation 76A of the Code (CINZ, 1999: 89) to narrow it down, we first clarified that the specimens that match best the original description and figure of C. L. Koch (1839b) are those from Porzuna (see figure 5 herein) and by designating one of them as the neotype, its collecting site becomes the type locality as defined by Article 76.3 of the Code (CINZ, 1999: 89).

This species has been widely misidentified in the literature, as either *B. ibericus* or *B. occitanus*. The first case seems to involve the specimen coded Sc161 by Sousa *et al.* (2010) within his "*Buthus ibericus* (mtDNA Lineage 1)": the locality name was not disclosed therein, but the coordinates given in the table 1 of Sousa *et al.* (2010: 207;) place it 43 km straight-line to the northwest of Porzuna, along the occurrence area of *B. ajax*. On the other hand, the figure 10 of Lourenço & Rossi (2013: 13) depicts an occurrence area for *B. occitanus* that entirely overlaps *B. ajax* (compare to our figure 1b herein); most important, none of the many samples studied by us from the same geographical area (south-central Spain), even morphologically matches *B. occitanus*.

MATERIAL EXAMINED (19 specimens: 2♂♂, 7♀♀, 5 juvenile ♂♂, 5 juvenile ♀♀): **SPAIN: CASTILLA-LA MANCHA:** Toledo Province: Los Yébenes Municipality: Sierra del Castañar: Los Yébenes windmills (39°35'38"N / 03°51'57"W / 967 m a.s.l.); 14/June/2018; C. Turiel; 1♀, 1 juvenile ♀ (RTO). Ciudad Real Province: Puerto Lápice Municipality: Sierra de Reventón y Luenga: Puerto Lápice windmills (39°19'42"N / 03°29'28"W / 789 m a.s.l.); 10/June/2018; C. Turiel; 1♂, 3♀♀, 1 juvenile ♂, 4 juvenile ♀♀ (RTO). Porzuna Municipality: Montes de Toledo: 1 km southeast of Porzuna, along road CM-403 (39°08'11"N / 04°07'36"W / 706 m a.s.l.); 13/June/2018; C. Turiel; 1♂ neotype (IES), 1♀, 1 juvenile ♂ topotypes (RTO). Carrión de Calatrava Municipality: Sierra Morena: between Los Pozuelos and Alcolea de Calatrava, along road CR-4125 (38°57'48"N / 04°09'50"W / 651 m a.s.l.); 24/June/2016; C. Turiel; 1 juvenile ♂ (RTO). **ANDALUCÍA:** Córdoba Province: Santa Eufemia Municipality: Sierra Morena: Sierra Madrona: Miramontes Castle (38°36'01"N / 04°54'53"W / 644 m a.s.l.); 13/June/2018; C. Turiel; 2♀♀, 2 juvenile ♂♂ (RTO).

***Buthus halius* (C. L. Koch, 1839) status revalidated**

Tables II–IV. Figures 1b, 6–9, 10c–d, 12

Androctonus halius C. L. Koch, 1839a: 69–70, 155; pl. 163, fig. 383. Gervais, 1844: 43. C. L. Koch, 1850: 90. Fet & Lowe, 2000: 93, 673.

Buthus halius: Vachon, 1952: 73 [as a junior synonym of *B. occitanus*]. Sousa *et al.*, 2017: 15, 44–45; fig. 13 (except 13a, c) [as a junior synonym of *B. ibericus* by deemed *nomen oblitum*].

Buthus occitanus [as *B. europaeus* from *Scorpio europaeus*, the Rejected and Invalid Specific Name in Zoology # 381]: Simon, 1879: 96, 98 [misidentification: synonymy].

Buthus ibericus: Rossi, 2012: 273–274, 276–279; figs. 6a, 7. Sousa *et al.*, 2017: 15, 44–45; fig. 13 (except 13a, c) [misidentification: synonymy].

TYPE DATA. PORTUGAL: TRÁS-OS-MONTES E ALTO DOURO: Vila Real District: Alijó Municipality: Amieiro

Parish: Tua riverbank facing Santa Luzia train station (41°16'58"N / 07°23'34"W / 164 m a.s.l.); 23/July/2006; P. R. de Sousa; 1♂ neotype (herein designated - IES, ex CIBIO-Sc094). **Note.** See a detailed discussion below, in Remarks section.

DIAGNOSIS. Adult size large for the genus (67 mm in male, 76–79 mm in females), males smaller than same size-class females. Coloration with base light yellow to pale orange-brown; carapace and tergites with a well-defined, dark trivittate pattern all along; carapace, tergites and metasoma with all carinae deeply infusate; chelicerae with a contrasting blackish reticulate patch dorsodistally on manus; pedipalps and legs with carinae deeply infusate. Sexual secondary dimorphism conspicuous in habitus (males smaller and slenderer), moderate in pedipalps (manus swollen and wider than patella in both sexes, bulkier in males) and inconspicuous in metasoma (very similar in both sexes). Pedipalp chela with only a few dark macrosetae scattered on ventral surface; manus with all carinae moderate to strong, smooth; fingers long (movable finger/manus length ratio: 1.76 in male, 1.46–1.52 in females), both fingers with 12–13 principal rows of denticles (modes 13 and 12 in fixed and movable, respectively), basal lobe/notch combination strong. Pectines with 28–31 teeth in males, 24–28 in females. Metasoma of male with size and shape standard for the genus (see ratios in tab. IV); dorsal lateral and lateral supramedian carinae weakly serrate to serratocrenulate on segments II–IV, ventral submedians on II–III markedly raised distally (stronger and coarser in females); intercarinal tegument coriaceous and minutely punctate, but very sparsely, minutely granulose dorsally on V (denser and also laterally in females); setation sparse, with 2–4 pairs of dark macrosetae on almost all carinae (5–6 pairs on ventral laterals of V). Telson vesicle large and globose in adults of both sexes.

REDESCRIPTION (adult male neotype; tabs. II–IV; figs. 6a, 7, 9a).

Coloration. Base pale orange-brown, paler on chelicerae, legs, venter and telson. Chelicerae largely immaculate, but with a large, sharply contrasting patch of deep infuscation and dense blackish reticulation on dorsodistal portion of manus. Pedipalps with carinae of femur and patella deeply and broadly infusate; chela manus with carinae faintly infusate, fingers yellow, immaculate. Carapace with all carinae and coarse granulation deeply infusate and with a pair of arrowhead-shaped, symmetric dark brown spots flanking median eyes; eyes and ocular tubercles black. Tergites with all carinae and coarse granulation deeply infusate and with diffuse, symmetric dark brown to blackish spots on anterior and lateral areas, defining altogether a clearly defined trivittate pattern (i.e., a narrow, median solid stripe plus two broad, diffusely variegated lateral stripes, all three well separated). Pectines pale yellowish, with basal portion and basal plate progressively darker due to heavier sclerotization. Sternopectinal region and sternites immaculate. Legs with most carinae deeply infusate, as well as distal half of femur and basal half of patella (except on leg I). Metasoma concolor (i.e., no segments conspicuously darker), essentially immaculate and with all carinae feebly to moderately infusate (progressively darker ventrally). Telson immaculate, distal half of aculeus blackish.

Chelicerae. With dentition typical for the genus, teeth standard-sized and sharp. Tegument glossy and minutely punctate,

dorsodistal portion of manus with some minute granulation scattered and some medium-sized, glossy granules irregularly arranged around dorsodistal depression. Setation very dense ventrally, but essentially lacking dorsally except for a patch of macrosetae at fixed finger base and some setae around dorsodistal depression of manus.

Pedipalps. Size standard for the genus (3.93 times longer than carapace). Femur essentially straight (very slightly bent inwards distally) and with some dark macrosetae, largely concentrated along ventrodistal edge; all carinae strong and formed by coarse, isolated, glossy granules; intercarinal tegument coriaceous, minutely punctate on glossier areas and with sparse, minute granulation scattered dorsally. Patella straight and with only a few dark macrosetae scattered all over; all carinae strong and subcostate to subgranulose except for the dorsal median and dorsal internal, which are formed by coarse, isolated, glossy granules; intercarinal tegument coriaceous and minutely punctate on glossier areas, internal surface with several small denticles. Chela with manus short-oval and swollen (length/width ratio = 1.31, length/depth ratio = 1.24, median part widest), much wider than patella (ratio 1.30) and with only a few dark macrosetae scattered on ventral surface, all carinae moderate to strong (especially the dorsal secondary, which runs as a well-defined raised edge all along its length), smooth, intercarinal tegument smooth, glossy and minutely punctate; fingers long (movable 1.60 times longer than underhand), thick and evenly curved, fixed finger with 13/12 principal rows of denticles plus 13/12 inner and 11/12 outer accessory denticles (coarser than principal denticles), movable finger with 13/13 principal rows of denticles plus 12/12 inner and 12/12 outer accessory denticles (coarser than principal denticles) and the standard apical subrow with 3/3 denticles (large terminal denticle not included), basal lobe/notch combination strong.

Carapace. Very slightly longer than wide (length/width ratio = 1.01). Anterior margin vestigially convex, with 3–4 pairs of dark macrosetae. Carinae with lyre-shaped configuration perfectly defined: anterior medians and superciliaries strong, fused into a spatula-shaped figure and formed by medium-sized, isolated, glossy granules; central laterals and posterior medians strong, fused into an S-shaped figure and formed by medium-sized, isolated, glossy granules; lateral oculars and central medians strong, not fused and formed by medium-sized, isolated, glossy granules; posterior laterals moderately strong and formed by medium-sized, isolated, glossy granules. Furrows: posterior laterals deep and wide, other furrows inconspicuous, obscured by remarkably depressed areas between adjacent carinae. Tegument coriaceous, minutely punctate and irregularly covered by moderately dense, fine, rough granules largely concentrated along lateral and frontal areas. Median eyes large, separated by about twice the ocular diameter; lateral eyes much smaller and mostly concealed below a granulose carina.

Sternum. Type 1, very small and triangular. Tegument very finely and densely granulose.

Genital operculum. Valves roundly subtriangular and separated along distal two-thirds; tegument coriaceous and very shallowly convex. Genital papillae very large, thick and slightly protruding.

Pectines. Long (but not reaching trochanter-femur joint of leg IV) and narrowly rectangular, setation moderately dense and dark. Tooth count 28/29, teeth not swollen. Fulcra large and swollen, paraboloid to round. Basal middle lamella trap-

ezoidal. Pre-pectinal plate heavily sclerotized, very short, wide and folded transversely. Basal plate heavily sclerotized, wider than long, with two pairs of dark macrosetae; anterior margin essentially straight, posterior margin shallowly concave; tegument coriaceous, with three conspicuous depressions: one anteromedian (transverse, narrow and progressively much deeper medially to become a pit) and two laterals (long, narrow and shallow).

Legs. Slender, with all carinae weak to moderate and smooth to subgranulose except on femur and patella, where moderate to strong and serrate to dentate. Intercarinal tegument coriaceous and minutely punctate on glossier areas, external surface of femur with sparse vestiges of minute granules scattered. Bristlecombs well developed on I–III. Tibial and pedal spurs large and thin. Claws long and moderately curved.

Mesosoma. Slenderer than standard for the genus. Tergites coriaceous, minutely punctate and irregularly covered by moderately dense, fine, rough granules more concentrated along lateral areas, lateral margins finely granulose to denticulate, posterior margin minutely granulose; carinae: median longitudinal straight, progressively longer and stronger backwards and formed by medium-sized, isolated, glossy granules, submedians anteriorly divergent, shallowly arcuate (I–V) to straight (VI) to inverted L-shaped (VII), progressively longer and stronger backwards and formed by medium-sized, isolated, glossy granules, laterals absent on I–VI, moderately strong, shallowly arcuate and formed by medium-sized, isolated, glossy granules on VII. Sternites with few dark macrosetae scattered all over (denser on III); lateral margins of all sternites finely crenulate, posterior margin minutely granulose; carinae: submedians weak but progressively stronger backwards, indistinct on III, present only on posterior half of IV–VI (smooth, subcostate and parallel, but anteriorly convergent) and almost complete on VII (subcrenulate and parallel, but very slightly divergent medially), laterals moderate but progressively stronger backwards, present on posterior half of IV–VI (smooth, costate and parallel to slightly divergent anteriorly) and present only on median portion on VII (crenulate and moderately divergent anteriorly); tegument coriaceous and minutely punctate, matter on lateral areas; spiracles very long and slit-like; sternite V with median smooth patch indistinct or absent.

Metasoma. Size and shape standard for the genus (4.90 times longer than carapace), progressively narrower and lower distally, with segment V both narrowest and lowest. Segment I with ten complete carinae, II–IV with eight, V with five: dorsal laterals moderate but progressively weaker backwards, finely serratocrenulate on I, finely serratocrenulate to subcrenulate on II, finely crenulate to subcrenulate on III–IV, absent on V; lateral supramedi-ans moderate but progressively weaker backwards, finely crenulate on I–II, finely crenulate to subcrenulate on III–IV, finely subcrenulate to granulose on V; lateral inframedi-ans moderate and crenulate, complete on I, present on distal half of II–III, absent on IV–V; ventral laterals moderate and crenulate on I–IV, strong and irregularly serrate to lobate on V (with about 2–3 lobes much larger than the others); ventral submedi-ans moderate and subcrenulate on I, strong, progressively stronger backwards and crenulate to serratocrenulate on II–III (moderately raised distally), moderate and serrate on IV, absent on V (but indicated by an incomplete but raised row of serrate granules on basal two-thirds); ventral median absent on I–IV, moderate and irregularly serrate on V (bifurcate on distal third). Intercarinal

tegument coriaceous and minutely punctate, but irregularly, minutely granulose on V (dorsally only); dorsal furrow complete, wide and shallow on all segments; setation sparse, with 2–4 pairs of dark macrosetae on most carinae (5–6 pairs on lateral supramedians and ventral laterals of V).

Telson. Vesicle large, globose (length/width ratio = 1.29, width/depth ratio = 1.08), with six pairs of dark macrosetae and several inconspicuous minor setae scattered all over; tegument glossy, with coarse but weak, glossy granules scattered ventrally and laterally; ventral median carina obsolete, as are two accessory pairs of carinae (ventral laterals and lateral supramedians?), subaculear tubercle absent. Aculeus shorter than vesicle (ratio = 0.80), sharp and shallowly curved.

FEMALES (tabs. II–IV; figs. 6c, 8, 9b–c). Sexual secondary dimorphism moderate, differing from described male by: **1**) size larger (75.6–78.6 mm); **2**) pedipalp manus slenderer (length/width ratio = 1.46–1.51, length/depth ratio = 1.25–1.30); **3**) mesosoma much wider, with lateral sides more convex; **4**) pre-pectinal plate reduced to a tiny oval sclerite, invaginated into the membrane to look like a transverse pit; **5**) genital papillae absent; **6**) pectines slightly smaller, narrower and with lower tooth counts (24–28); **7**) metasoma heavier and with all carinae stronger (especially the ventral submedians of segments II–III and ventral laterals of V, which are very strongly, coarsely and irregularly lobate); **8**) telson with vesicle wider (length/width ratio = 1.14–1.20, width/depth ratio = 1.12–1.15) and aculeus slightly longer (ratio = 0.82–0.86).

VARIATION. Although the pooled sample is small, specimens from the three localities studied herein are remarkably homogeneous in morphology (figs. 6–9), except as noted below. Number of principal rows of denticles varied from 12–13 on fixed and movable fingers. There is a clear trend to have 13 rows in the former and 12 in the latter.

Pectinal tooth counts (tab. IV) varied as follows: neotype male with 28/29, juvenile male with 31/30, topotype female with 27/28, female with 25/24 and juvenile female with 26/25.

COMPARISON. Amongst the other 11 described Iberian congeners, this species resembles only *B. ajax*, *B. baeticus*, *B. delafuentei* and *B. ibericus* by having pedipalp fingers with lobe/notch combination developed. The adults of these four species can be safely distinguished from *B. halius* as follows:

• ***B. ajax*:** **1**) coloration with the dark patterns more diffuse (chelicerae less densely infuscate, tergites with the dark trivittate pattern blurred); **2**) pedipalps with carinae stronger and coarser; **3**) pedipalp chela proportionally larger and more round (especially in males); **4**) pedipalp fingers thicker and with accessory denticles much coarser than principal denticles; **5**) pectines with tooth counts slightly but consistently higher (30–34 in males, 26–28 in females); **6**) sternites III–VI with tegument noticeably glossier, shiny; **7**) metasoma slightly shorter and heavier.

• ***B. baeticus*:** **1**) size somewhat smaller (males 64–69 mm, females 59–70 mm); **2**) sexual secondary dimorphism in habitus much less evident (pedipalps and metasoma very similar in both sexes); **3**) chelicerae essentially immaculate, lacking any contrasting blackish patterns (at most with slight traces of irregular variegations dorsodistally on manus); **4**) pedipalp chela remarkably slenderer, especially in males (length/width ratio = 3.84–4.07 in males, 4.14–4.53 in fe-

males) and with all carinae much weaker (absent to obsolete); **5**) pedipalp fingers with basal lobe/notch combination weaker; **6**) whole body and appendages with tegument noticeably glossier (especially on carapace, tergites and sternites); **7**) pectines with tooth counts higher (31–33 in males, 27–30 in females); **8**) telson with vesicle proportionally smaller and less globose (length/width ratio = 1.29–1.36 in males, 1.23–1.28 in females).

• ***B. delafuentei*:** **1**) sexual secondary dimorphism in size opposite, with males larger than same size-class females (males 65–72 mm, females 58–66 mm); **2**) sexual secondary dimorphism in habitus much more evident (males with pedipalps much more robust, but also with mesosoma and metasoma much longer and slenderer); **3**) chelicerae essentially immaculate, lacking any contrasting blackish patterns (at most with a tiny dorsodistal gray spot on manus); **4**) pedipalp chela heavier in males (length/width ratio = 3.51–3.52), but narrower than patella and much slenderer in females (length/width ratio = 4.69–4.80); **5**) pectines with tooth counts higher (31–34 in males, 26–28 in females); **6**) whole body and appendages with tegument noticeably glossier (especially on carapace, tergites and sternites); **7**) telson with aculeus remarkably less curved (especially in males) and vesicle proportionally smaller and less globose in females (length/width ratio = 1.19–1.23).

• ***B. ibericus*:** **1**) size smaller (males 52–64 mm, females 65–76 mm); **2**) habitus very different, much shorter and fatter (i.e., "squat, dumpy"); **3**) chelicerae essentially immaculate, lacking any contrasting blackish patterns (at most with fine dark brown reticulations on distal part of manus); **4**) pedipalps with carinae much weaker, in males also remarkably shorter and more robust; **5**) females with pedipalp chela remarkably slenderer (length/width ratio = 3.84–4.20); **6**) pectines with tooth counts slightly but consistently lower (26–31 in males, 21–26 in females); **7**) whole body and appendages with tegument noticeably glossier (especially on carapace, tergites and sternites); **8**) metasomal segments and telson remarkably more robust, swollen and with carinae much weaker; **9**) metasomal segments II–III with ventral submedian carinae much weaker (especially in females).

All the differences mentioned above are very easy to appreciate even to unaided eye: compare figures 6–9 to 2–5 herein and to figures 4–6 and 16–20 in Teruel & Turiel (2020: 41–42, 48–50). See also tables I–IV herein and III–IV, IX–X and XIII–XIV in Teruel & Turiel (2020: 34–39).

DISTRIBUTION (fig. 1b). According to our personal data and high-resolution photographs of collaborators, *B. halius* seems restricted to the lower Douro (= Duero) river drainage system of northern Portugal (Vila Real and Bragança, apparently also in Porto, Aveiro, Guarda and Viseu) and maybe in adjacent areas of northwestern Spain (Galicia and Castilla y León). Additional samples from this region are currently under study, to define the precise geographical range of this scorpion (R. Teruel & C. Turiel, in preparation).

ECOLOGICAL NOTES. This is a lapidicolous scorpion, which occurs in rocky areas covered with sparse, stunted Mediterranean vegetation such as mixed oak, pine, chestnut and gall oak forests, with variable grass understorey (fig. 12). At least in mountainous northern Portugal, *B. halius* seems restricted to the lower-altitude (below 500 m a.s.l.) river valleys and south-facing slopes, where summer is mild and winter is cold, with regular snowfalls every year.

REMARKS. C. L. Koch (1839a: 70) explicitly stated he described *Androctonus halius* from a single, dry specimen with pectines either lost or damaged, collected in Portugal without precise locality. According to the original description and color images of C. L. Koch (1839a: 69–70, 155; pl. 163, fig. 383), it was an adult and possibly a female, judging from its size about 76 mm and habitus, especially the body proportions (see figure 6 herein). This specimen, correctly listed as holotype by Fet & Lowe (2000: 93), is long considered lost (Fet & Lowe, 2000: 93; Sousa *et al.*, 2017: 44).

The validity of this species was questioned first by Gervais (1844: 43), who regarded it as "not different" from *B. occitanus*, but without entering the formal synonymy. It was done later by Simon (1879: 96, 98), who explicitly declared to have based the synonymy under *B. occitanus* not upon the study of C. L. Koch's type, but instead on "a great number of specimens [...] from Spain" [originally in French, translated into English here]. By the way, Simon (1879: 98) missed C. L. Koch's original record of *B. halius* from Portugal. Such synonymy was never revised and this taxon was neglected for 138 years, being cited in the literature only twice (Vachon, 1952: 73; Fet & Lowe, 2000: 93, 673).

Recently, Sousa *et al.* (2017) correctly resurrected *B. halius* as a valid species, but wrongly deemed it a senior subjective synonym of *B. ibericus* and subsequently proposed to discard the former as a *nomen oblitum* and to retain the latter as a *nomen protectum*. Although thoroughly explained therein, Sousa *et al.* (2017: 44) explicitly based the conspecificity of *B. halius* and *B. ibericus* upon a single morphological character: the possession of a developed basal lobe/notch combination in pedipalp fingers. This was a logical reasoning then, but now we know this conspicuous character is present in at least five Iberian species (Teruel & Turiel, 2020; this paper) and most important, *B. halius* and *B. ibericus* are not only distinct species, but not even the closest relatives within this taxonomic complex (see Comparison section above). Therefore, *nomen oblitum* status is not applicable to the former nor *nomen protectum* to the latter, and the proposal of Sousa *et al.* (2017) must be discarded.

By the way, when Sousa *et al.* (2017) used the binomen *Buthus halius*, they incorrectly deemed it a new combination. Vachon (1952: 73) entered it first, implicitly, when he listed *halius* hierarchically under *Buthus* instead of *Androctonus*, within the synonymy of *B. occitanus*. We guess Sousa *et al.* (2017) merely followed Fet & Lowe (2000: 93, 673), who also missed the valid nomenclatural act of Vachon (1952).

In order to stabilize nomenclature through the clarification of the precise taxonomic identity of *Androctonus halius*, there is an inevitable need to fix it by permanently linking it to an existing, representative and accessible name-bearing type. This becomes especially relevant today, when the diversity of the genus in Spain has proven to be far more diverse than previously assumed (see e.g., Teruel & Turiel, 2020) and some of these taxa are close relatives of *B. halius*. Thus, we selected a perfectly preserved, freshly collected adult male with complete locality data as the neotype and deposited it at IES (a public, well-recognized research institution), fulfilling **all** conditions and recommendations set by Article 75 of the Code for this nomenclatural act (CINZ, 1999: 86–89).

As stated above, the type locality of *B. halius* was originally fixed by C. L. Koch (1839a: 70) vaguely as Portugal only, without any further precision; we could not find any

supplementary sources where to gather this crucial information. Following Recommendation 76A of the Code (CINZ, 1999: 89) to narrow it down, we first clarified that the specimens that match best the original description and figures of C. L. Koch (1839a) are those from Amieiro (see figure 6 herein) and by designating one of them as the neotype, its collecting site becomes the type locality as defined by Article 76.3 of the Code (CINZ, 1999: 89).

Sousa *et al.* (2010) found their samples from extreme north-eastern Portugal (Miranda do Douro area, in Bragança District) to be genetically distinct from all others analyzed by them, to the point they informally separated this clade as a "sublineage" or "subregion" within a "*Buthus ibericus* (mtDNA Lineage 1)". Sousa *et al.* (2010: 209) stated that this distinct clade was restricted to northern Portugal, which generally matches the origin of our specimens and likely represents *B. halius*.

Moreover, the records of *B. ibericus* from northern Portugal by Rossi (2012) all clearly represent misidentifications. First, *B. ibericus* is now known to be endemic to southernmost Andalucía (Teruel & Turiel, 2020). Second, Rossi's specimens were from Santo Tirso and Lousada (Oporto District), also in the low-altitude tributaries of the Douro river drainage system and less than 95 km straight-line to the west of our *B. halius* localities. Moreover, the adult female shown in a color photograph by Rossi (2012: 278; fig. 6a), matches our specimens of *B. halius* very well, except for its smaller size.

The five specimens of *B. halius* examined herein have some legs or their parts cut-off: **a)** both the neotype male and topotype female lack left legs II–IV; **b)** the other adult female lacks left legs III–IV and right leg III; **c)** the juvenile male lacks all left legs; **d)** the juvenile female lacks right legs II–IV. All these missing parts are separately stored in CIBIO collection as DNA voucher samples, unequivocally identified and coded (Arie van der Meijden, personal communication).

MATERIAL EXAMINED (5 specimens: 1♂, 2♀♀, 1 juvenile ♂, 1 juvenile ♀): **PORTUGAL: TRÁS-OS-MONTES E ALTO DOURO:** Bragança District: Vila Flor Municipality: Freixiel Parish: Abreiro train station in Tua riverbank, west of Quinta do Carvalhinho (41°20'44"N / 07°16'50"W / 180 m a.s.l.); 26/July/2006; P. R. de Sousa; 1 juvenile ♂ (CIBIO-Sc092). Vila Real District: Alijó Municipality: Amieiro Parish: Tua riverbank facing Santa Luzia train station (41°16'58"N / 07°23'34"W / 164 m a.s.l.); 23/July/2006; P. R. de Sousa; 1♂ neotype (herein designated - IES, *ex* CIBIO-Sc094), 1♀ topotype (RTO, *ex* CIBIO-Sc087). São Mamede de Ribatua Parish: Tua riverbank along Quinta da Ribeira (41°13'40"N / 07°25'09"W / 141 m a.s.l.); 26/July/2006; P. R. de Sousa; 1♀ (RTO, *ex* CIBIO-Sc093), 1 juvenile ♀ (CIBIO-Sc091).

Acknowledgments

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Table I. Measurements of six adults of *Buthus ajax* from Spain. Abbreviations: length (L), width (W), posterior width (Wp), depth (D). A: Andalucía; CLM: Castilla-La Mancha.

Dimensions (mm)		CLM: Puerto Lápice ♂	CLM: Porzuna ♂ neotype	CLM: Puerto Lápice ♀	CLM: Porzuna ♀ topotype	CLM: Los Yébenes ♀	A: Miramontes Castle ♀
Carapace	L / Wp	7.65 / 8.15	8.25 / 8.75	8.50 / 9.55	9.10 / 10.70	9.40 / 10.95	10.05 / 11.25
Mesosoma	L	18.60	22.00	21.25	25.30	25.10	26.55
Metasoma	L	35.30	38.85	36.10	40.60	41.30	43.10
Segment I	L / W / D	5.50 / 5.05 / 4.50	6.15 / 5.60 / 4.85	5.55 / 5.60 / 4.90	6.70 / 6.05 / 5.30	6.25 / 6.60 / 5.70	6.50 / 6.45 / 5.80
Segment II	L / W / D	6.50 / 5.00 / 4.40	6.95 / 5.50 / 4.80	6.45 / 5.25 / 4.70	7.15 / 5.65 / 5.10	7.25 / 6.75 / 5.50	7.50 / 6.10 / 5.50
Segment III	L / W / D	6.60 / 4.75 / 4.20	7.25 / 5.24 / 4.65	6.70 / 5.15 / 4.40	7.15 / 5.50 / 5.05	7.60 / 6.10 / 5.60	8.00 / 6.00 / 5.50
Segment IV	L / W / D	7.70 / 4.50 / 3.90	8.85 / 5.10 / 4.30	7.75 / 4.80 / 4.20	8.50 / 5.40 / 4.65	9.05 / 5.65 / 4.95	9.20 / 5.75 / 4.95
Segment V	L / W / D	9.00 / 4.10 / 3.45	9.65 / 4.65 / 4.00	9.65 / 4.50 / 3.80	11.10 / 5.00 / 4.05	11.15 / 5.40 / 4.50	11.90 / 5.70 / 4.40
Telson	L	8.35	9.15	9.30	10.30	10.60	11.15
Vesicle	L / W / D	4.75 / 3.65 / 3.25	5.25 / 4.25 / 4.00	5.30 / 4.35 / 3.95	5.80 / 4.70 / 4.35	5.85 / 5.00 / 4.50	6.15 / 5.30 / 4.75
Aculeus	L	3.60	3.90	4.00	4.50	4.75	5.00
Pedipalp	L	28.50	30.40	30.85	32.35	35.00	36.95
Femur	L / W	6.65 / 2.00	7.40 / 2.20	7.25 / 2.15	7.60 / 2.40	8.10 / 2.60	8.50 / 2.80
Patella	L / W	7.65 / 2.95	8.25 / 3.30	8.35 / 3.40	8.75 / 3.70	9.40 / 4.00	9.90 / 4.20
Chela	L	14.20	14.75	15.25	16.00	17.50	18.55
Manus	L / W / D	5.45 / 4.00 / 4.25	5.80 / 4.55 / 4.65	5.75 / 4.10 / 4.70	6.10 / 4.65 / 5.00	6.85 / 5.15 / 5.50	7.80 / 5.20 / 5.80
Movable finger	L	8.75	8.95	9.50	9.90	10.65	10.75
Total	L	69.90	78.85	75.15	85.30	86.40	90.85

Table II. Measurements of three adults of *Buthus halius* from Portugal. Abbreviations: length (L), width (W), posterior width (Wp), depth (D).

Dimensions (mm)		Tua riverbank facing Santa Luzia train station		Quinta da Ribeira
		♂ neotype	♀ topotype	♀
Carapace	L / Wp	7.00 / 6.90	9.50 / 10.80	9.00 / 10.00
Mesosoma	L	17.50	19.00	18.00
Metasoma	L	34.30	40.10	38.80
Segment I	L / W / D	5.10 / 4.95 / 4.50	6.00 / 5.95 / 5.30	5.90 / 5.20 / 4.90
Segment II	L / W / D	6.25 / 4.80 / 4.40	7.25 / 5.70 / 5.00	6.95 / 5.10 / 4.70
Segment III	L / W / D	6.55 / 4.50 / 4.35	7.70 / 5.45 / 4.90	7.30 / 5.00 / 4.50
Segment IV	L / W / D	7.65 / 4.20 / 3.80	8.95 / 5.25 / 4.40	8.65 / 4.80 / 4.05
Segment V	L / W / D	8.75 / 3.95 / 3.40	10.20 / 4.90 / 4.00	10.00 / 4.85 / 3.70
Telson	L	7.90	10.00	9.75
Vesicle	L / W / D	4.40 / 3.40 / 3.15	5.50 / 4.60 / 4.10	5.25 / 4.60 / 4.00
Aculeus	L	3.50	4.50	4.50
Pedipalp	L	27.50	32.95	32.35
Femur	L / W	6.60 / 1.95	7.75 / 2.30	7.60 / 2.25
Patella	L / W	7.65 / 3.00	9.20 / 3.65	9.10 / 3.60
Chela	L	13.25	16.00	15.65
Manus	L / W / D	5.10 / 3.90 / 4.10	6.50 / 4.30 / 5.00	6.20 / 4.25 / 4.95
Movable finger	L	8.15	9.50	9.45
Total	L	66.70	78.60	75.55

Table III. Comparison between the two Iberian species of *Buthus* revised herein, based upon 14 selected morphometric ratios of adult specimens examined. Abbreviations: length (L), width (W), depth (D). To compare them both to the other 10 Western European species, see Teruel & Turiel (2020: 38; tab. XIII).

Ratios	<i>Buthus ajax</i>	<i>Buthus halius</i>
pedipalp L / carapace L	3.68–3.72	3.93
pedipalp L / carapace L	3.55–3.72	3.47–3.59
pedipalp chela L/W	3.24–3.55	3.40
pedipalp chela L/W	3.40–3.72	3.68–3.72
pedipalp manus L/W	1.27–1.36	1.31
pedipalp manus L/W	1.31–1.50	1.46–1.51
pedipalp chela L / movable finger L	1.62–1.65	1.63
pedipalp chela L / movable finger L	1.60–1.73	1.66–1.68
pedipalp manus W / patella W	1.36–1.38	1.30
pedipalp manus W / patella W	1.21–1.29	1.18
metasoma L / carapace L	4.61–4.71	4.90
metasoma L / carapace L	4.25–4.46	4.22–4.31
metasomal segment I L/W	1.09–1.10	1.03
metasomal segment I L/W	0.95–1.11	1.01–1.13
metasomal segment I L/D	1.22–1.27	1.13
metasomal segment I L/D	1.10–1.26	1.13–1.20
metasomal segment IV L/W	1.71–1.74	1.82
metasomal segment IV L/W	1.57–1.61	1.70–1.80
metasomal segment IV L/D	1.97–2.06	2.01
metasomal segment IV L/D	1.83–1.86	2.03–2.14
metasomal segment V L/W	2.08–2.19	2.22
metasomal segment V L/W	2.06–2.22	2.06–2.08
metasomal segment V L/D	2.41–2.61	2.57
metasomal segment V L/D	2.48–2.74	2.55–2.70
telson L/W	2.15–2.29	2.32
telson L/W	2.10–2.19	2.12–2.17
telson L/D	2.29–2.57	2.51
telson L/D	2.35–2.37	2.44

Table IV. Pectinal tooth count variation in the two Iberian species of *Buthus* revised herein, based upon data from the specimens examined. Abbreviations: number of pectines (N), average (Ave.), standard deviation (SD). To compare them both to the other 10 Western European species, see Teruel & Turiel (2020: 39; tab. XIV).

Species	Sex	N	Pectinal tooth count											Ave.	SD
			24	25	26	27	28	29	30	31	32	33	34		
<i>Buthus ajax</i>	♂♂	14	–	–	–	–	–	–	4	4	4	1	1	31.36	± 1.17
	♀♀	24	–	–	4	11	9	–	–	–	–	–	–	27.21	± 0.71
<i>Buthus halius</i>	♂♂	4	–	–	–	–	1	1	1	1	–	–	–	29.50	± 1.11
	♀♀	6	1	2	1	1	1	–	–	–	–	–	–	25.83	± 1.34

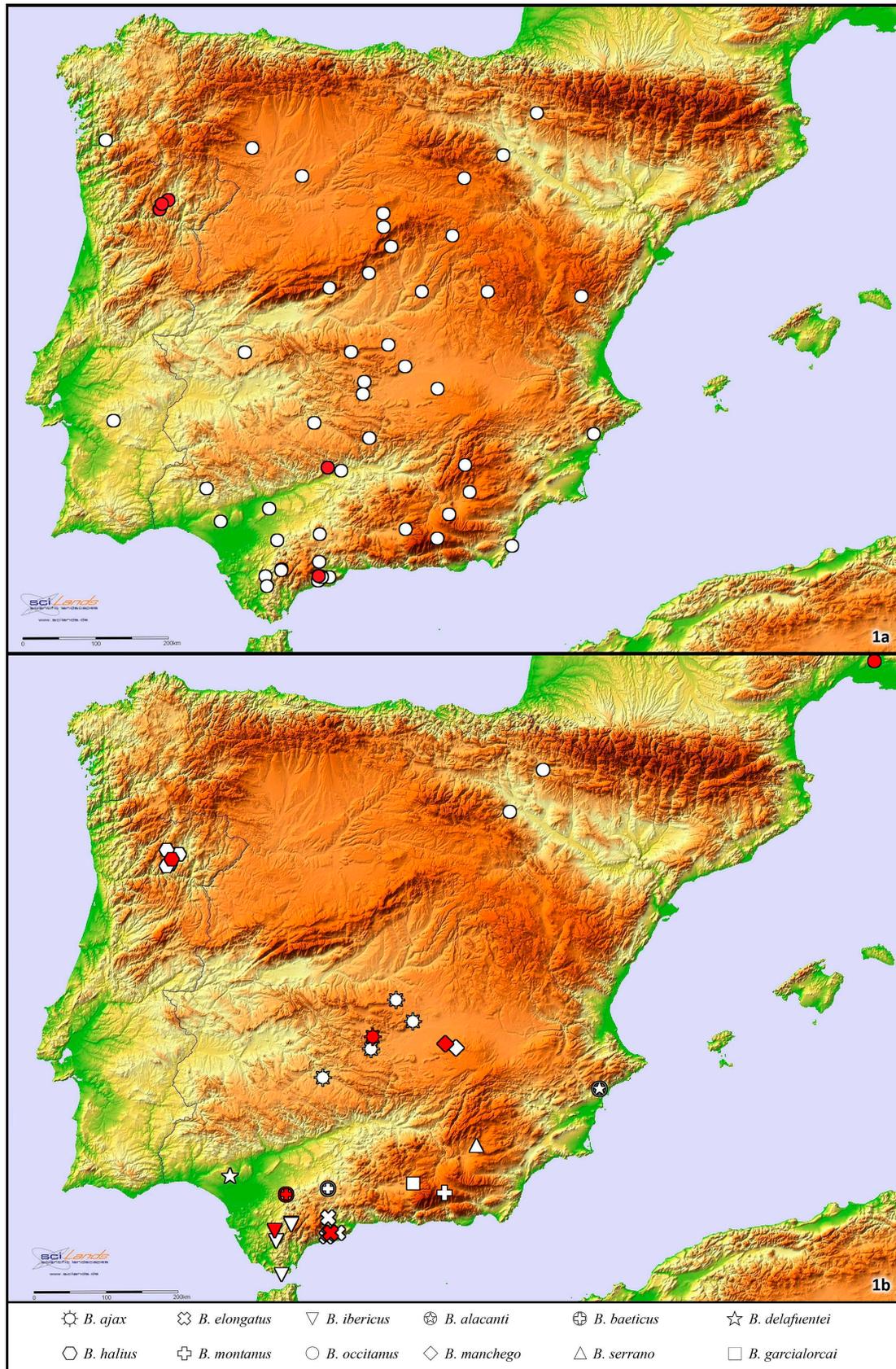
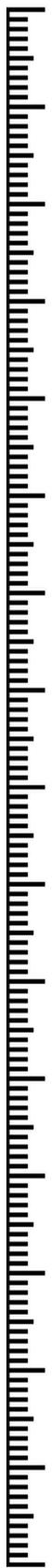


Fig. 1. Iberian Peninsula, showing: **a)** all localities sampled there during the present study (most in adjacent France not shown by being placed off-frame), with red symbols depicting new samples obtained after those published in Teruel & Turiel (2020); **b)** geographical distribution of the 12 species of *Buthus* treated herein, with red symbols depicting the type locality in each species with more than one record.



2a



3a



2b



3b

Fig. 2–3. *Buthus ajax*, adult male neotype (2) and adult female topotype (3), habitus: a) dorsal; b) ventral. Scale bar in millimeters.

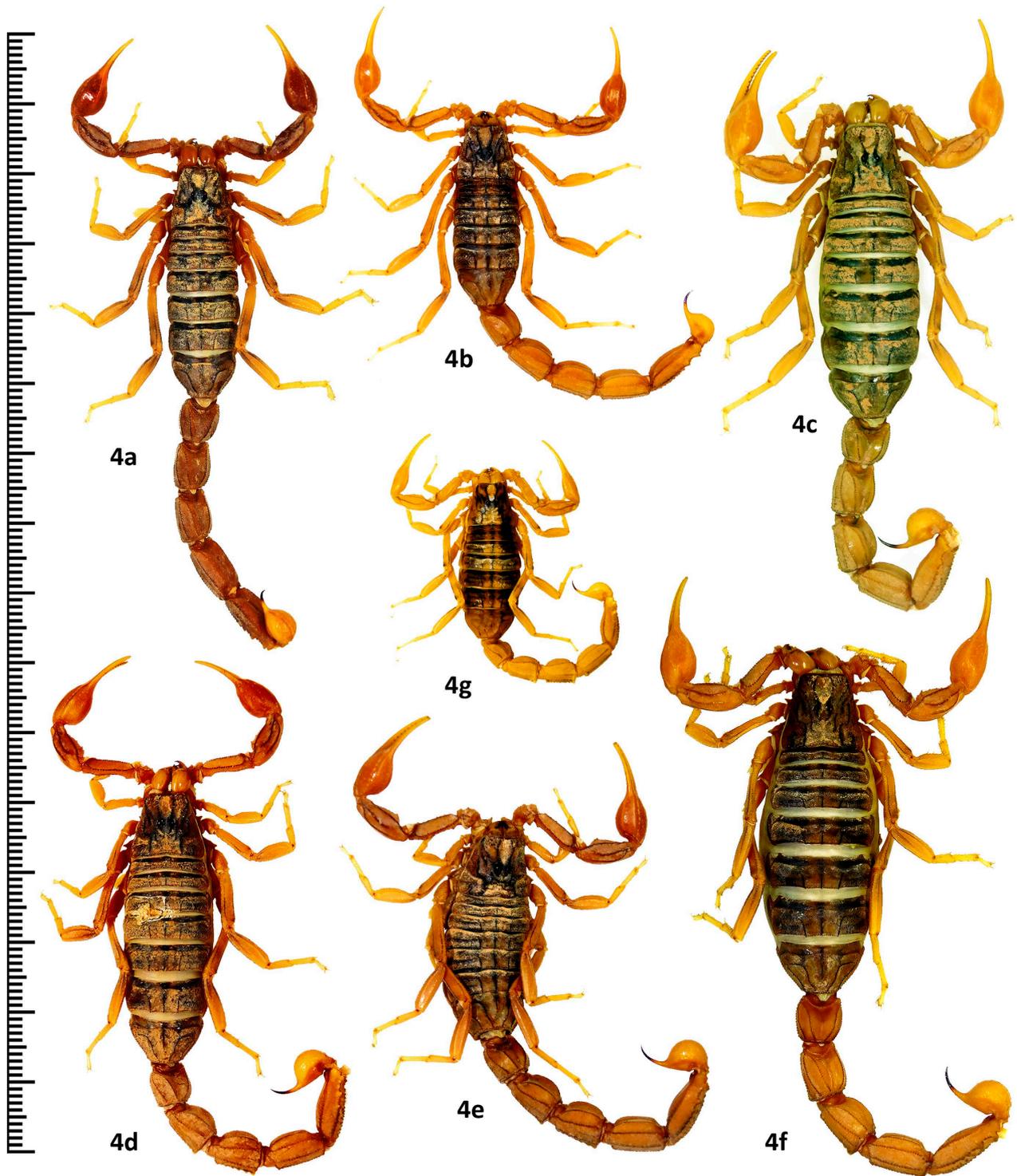


Fig. 4. *Buthus ajax*, dorsal habitus of specimens from five localities in Spain, showing morphological homogeneity with variation in size and coloration: **a)** adult male neotype; **b)** adult male from Puerto Lápice, Castilla-La Mancha; **c)** adult female from Los Yébenes, Castilla-La Mancha; **d)** adult female topotype; **e)** adult female from Puerto Lápice, Castilla-La Mancha; **f)** adult female from Miramontes, Andalucía; **g)** juvenile male from between Los Pozuelos and Alcolea de Calatrava, Castilla-La Mancha. Scale bar in millimeters.

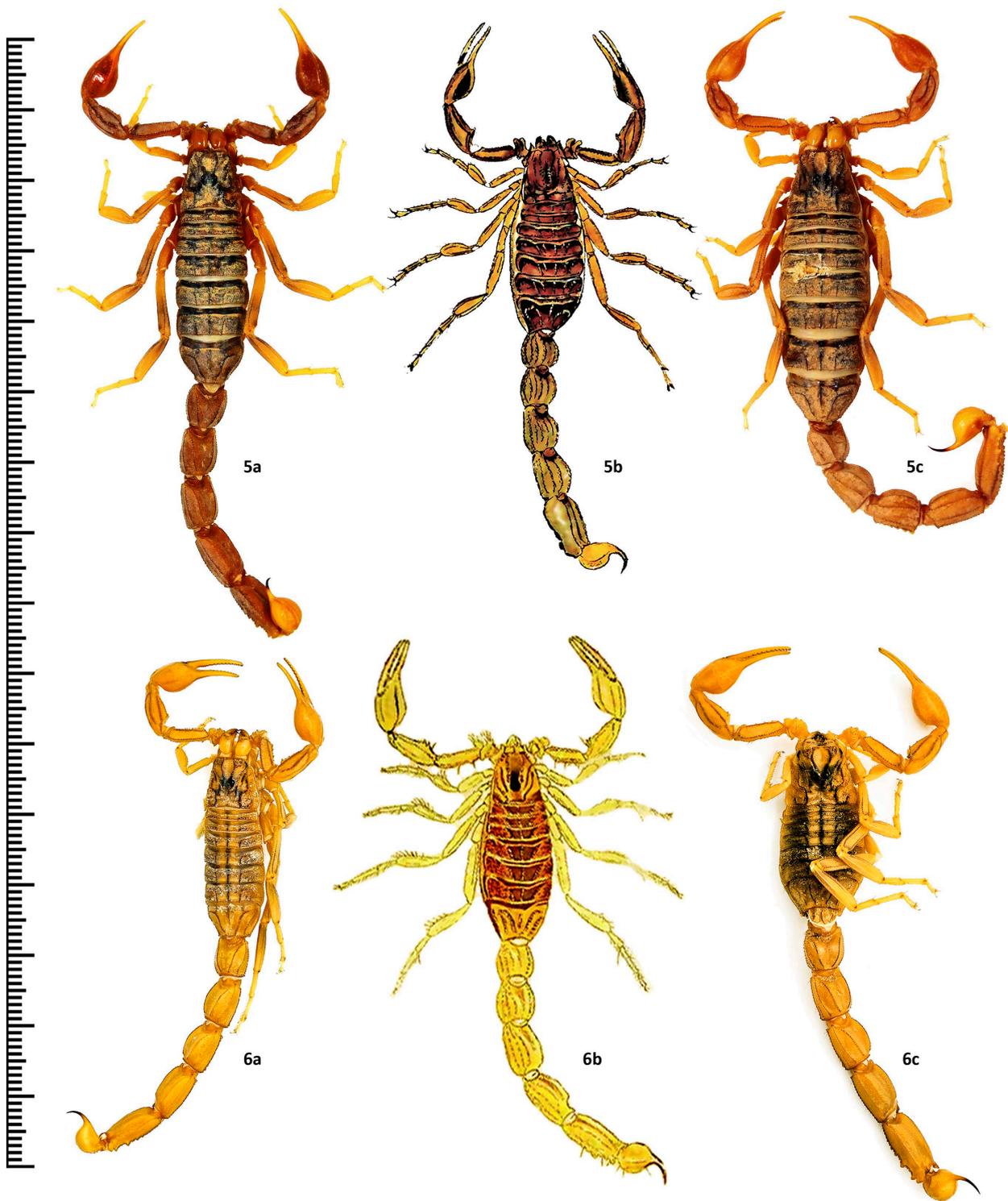


Fig. 5–6. Type specimens of *Buthus ajax* (5) and *Buthus halius* (6), in dorsal habitus, showing satisfactory match within each species: **a)** adult male neotypes; **b)** lost holotypes, from the original color plates of C. L. Koch (1839a–b); **c)** adult female topotypes. Scale bar in millimeters, Koch's images carefully resized by converting the original German imperial measurement units to the metric system (see Methods and Material section above).



▲ Fig. 7–8. *Buthus halius*, adult male neotype (7) and adult female topotype (8), habitus: a) dorsal; b) ventral. Scale bar in millimeters.

► Fig. 9. *Buthus halius*, dorsal habitus of specimens from three localities in Portugal, showing morphological homogeneity: a) adult male neotype; b) adult female topotype; c) adult female from Quinta da Ribeira; d) juvenile female from Quinta da Ribeira; e) juvenile male from Quinta do Carvalhinho. Scale bar in millimeters.

► Fig. 10. *Buthus* spp. from the Iberian Peninsula, photographed alive *in situ*: a) *B. ajax*, adult female from Puerto Lápice, Castilla-La Mancha, Spain (see shallow scrape under rock and food remains); b) *B. ajax*, adult female from Miramontes, Andalucía, Spain (see shallow scrape under rock and food remains); c) *B. halius*, adult male from Cotas, Vila Real, Portugal (©Paulo Martins, modified from iNaturalist); d) *B. halius*, juvenile from Murça, Vila Real, Portugal (©vale_da_biodiversidade, modified from iNaturalist).





Fig. 11. Habitat of *Butus ajax* in Spain: **a–b)** Los Yébenes, Toledo, Castilla-La Mancha; **c)** Puerto Lápice, Ciudad Real, Castilla-La Mancha; **d)** Porzuna, Ciudad Real, Castilla-La Mancha (type locality); **e)** Miramontes, Córdoba, Andalucía.



Fig. 12. Habitat of *Butus halius* along the Tua riverbanks, Portugal: **a–b)** Santa Luzia, Amieiro, Vila Real (type locality); **c)** Quinta do Carvalhinho, Freixiel, Bragança; **d)** Quinta da Ribeira, São Mamede de Ribatua, Vila Real.