

Four new species of *Typhlocharis* (*baetica* group) (Coleoptera: Carabidae: Anillini) from southwestern Iberian Peninsula with notes on their biogeographical and morphological implications

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Abstract. Four new species of *Typhlocharis* (Carabidae: Anillini) are described from the southwest of the Iberian Peninsula, assigned to the *baetica* species group. *T. prima* sp.n., *T. secunda* sp.n. and *T. tertia* sp.n. (from La Palma del Condado, Huelva, Spain) are syntopic, and *T. quarta* sp.n. (from Barrancos, Beja, Portugal) is the first species of the group with umbilicate series 4 + 4. They represent, respectively, the southernmost and westernmost distribution data for the group. The *baetica* group remains well defined and includes ten species. The diagnosis is simplified, with the confirmation that many morphological features characteristic of this group are widespread within the genus. The defining character is the presence of denticles in apical margin of elytra, not associated to the seventh stria or to the elytral suture. The new species provide morphological data that suggest the *baetica* and *silvanoides* groups are closely related. Distribution of both groups in the south of the Iberian Peninsula and the presence of morphological characters that are considered plesiomorphic are coherent with the hypothesis of betic-riffain origin of the genus. They also support the hypothesis of easy alteration of the umbilicate pattern between closely related species and the independent origin of apical denticles in the group compared with those present in other species of the genus. The presence of three well-differentiated size ranges in syntopic populations suggest ecological diversification to avoid interspecific competition.

Introduction

Typhlocharis is a genus of small endogean carabid beetles (Anillini: Typhlocharina), including 52 species distributed throughout the Iberian Peninsula and North Africa (Pérez-González & Zaballos, 2012). Nowadays it is the most diversified Anillini group of the Mediterranean region (Ortuño & Gilgado, 2011).

The current definition of species groups is based on morphological characters (Zaballos & Ruíz-Tapiador, 1997; Zaballos & Wrase, 1998). The actual phylogenetic relationships within the genus are still unknown. However, it is probable that some of the considered species groups represent true clades.

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One of the groups with higher biogeographical and morphological coherence is the *baetica* group, with six species (*T. baetica* Ehlers, 1883; *T. pacensis* Zaballos & Jeanne, 1987; *T. aguirrei* Zaballos & Banda, 2001; *T. millenaria* Zaballos & Banda, 2001; *T. furnayulensis* Zaballos & Banda, 2001; and *T. matiasi* Zaballos & Banda, 2001). It is recognized by the presence of many (more than two) pairs of denticles in the apical margin of elytra, but they are not associated to the seventh stria or to the median suture, as found in all the other species of *Typhlocharis* with some kind of apical teeth.

The knowledge on this group is summarized in three works: description of *T. baetica* (Ehlers, 1883), description of *T. pacensis* (Zaballos & Jeanne, 1987) and the revision by Zaballos & Banda (2001). The information given by Zaballos & Banda (2001) can be summarized in four points: (i) all the species in the group are essentially similar in their morphology

but show great heterogeneity in the pattern of umbilicate series of elytral setae (four setae in the anterior group and three, two or one in the posterior group); (ii) the origin of denticles in the apical margin of the elytra may be different from those present in other species of *Typhlocharis*; (iii) the six species come from a restricted geographical core on the southern slopes of the Sierra Morena (southern Iberian Peninsula); and (iv) some of the species coexist in the same locality.

The results of several samplings carried out in the south-western region of the Iberian Peninsula have resulted in the collection of specimens of *Typhlocharis* with three to six pairs of apical denticles in the elytra, assignable to the *baetica* group. The study led to the conclusion that this material consists of four new species, being the first records of the *baetica* group from the provinces of Huelva (Spain, three species) and Beja (Portugal, one species), the latter being the westernmost and farthest from the core of the species in Sierra Morena (approximately 170 km) as well as the only one in the group having an umbilicate series with eight setae.

The study of the new material and the revision of the series studied by Zaballos & Banda (2001) have allowed the knowledge of this species group, now comprising ten species, to be checked and updated.

Material and methods

The specimens were obtained with Berlese apparatus from soil samples collected under deeply buried boulders and on stream slopes, conserved in Scheerpeltz liquid. The number of specimens and data from the sites are given in the Results section. Those specimens designated for morphological studies under light microscopy were rinsed in lactic acid. The extracted genitalia and the rinsed specimens were mounted with dimethyl hydantoin formaldehyde resin (Bameul, 1990) on cards with a glass window. Untreated specimens were mounted on regular entomological cards. Measurements were taken with a Wild Heerbrugg M8 stereomicroscope (Switzerland). Drawings were done from photographs taken using a Zeiss 474620-9900 microscope, digitized and outlined in Adobe PHOTOSHOP CS2 9.0.

The nomenclature of cephalic chaetotaxy follows Zaballos (2005). The nomenclature and descriptions of rows of setae (indicated in the text by bold formulae in parentheses) follow the criteria in Pérez-González & Zaballos (2012). The width of the intermetacoxal space is described by comparison to the ranges observed in Pérez-González & Zaballos (2012).

The studied specimens of other species of the group, mainly the type material, come from Coll. Zaballos, Universidad Complutense de Madrid (UCM), and include: *T. baetica* (7 ♂♂, 6 ♀♀); *T. aguirrei* (1 ♂ HT, 1 ♂, 4 ♀♀ PT); *T. millenaria* (1 ♂ HT, 4 ♂♂, 4 ♀♀ PT); *T. pacensis* (1 ♂ HT, 6 ♂♂, 4 ♀♀ PT); *T. furnayulensis* (1 ♂ HT, 72 ♂♂, 69 ♀♀ PT); and *T. matiasi* (1 ♂ HT, 113 ♂♂, 82 ♀♀ PT). Parts of the type series of the new species are deposited in the Museo Nacional de Ciencias Naturales of Madrid (MNCN).

Results

Typhlocharis prima Pérez-González & Zaballos sp.n. (Figs 1, 2)

Type series. Holotype, ♂, SPAIN: Huelva, La Palma del Condado (7 km N), 10-02-2011, 125 m (N 37°26', W 06°37'), J.P. Zaballos & S. Pérez leg. (Coll. J.P. Zaballos, UCM). Paratypes, same data as holotype: 167 ♂♂, 174 ♀♀ (Coll. J.P. Zaballos and Coll. S. Pérez-González, UCM). 2 ♂♂, 2 ♀♀ (MNCN, Madrid, Catalogue number 2255).

Diagnosis. Small endogean beetle, anophthalmous, with narrow and subrectangular body covered by microreticulate integument and scattered pubescence. Vertex with *pars stridens*. Elytra faintly serrated in lateral margins and apical margin with four to six pairs of small denticles. Umbilicate series with five setae (4 + 1). Aedeagus as in Fig. 2, 'stick-shaped' endophallic sclerite. Female genitalia as in Fig. 2.

Description. Length 1.03–1.11 mm (males), 1.01–1.17 mm (females) (Fig. 1).

Head: wider (0.21–0.26 mm) than long (0.20–0.22 mm), covered by subhexagonal microreticulation. Stridulatory organ (*pars stridens*) on vertex, present in both sexes. Semilunar notch in posterolateral region of cephalic capsule. Subrectangular labrum, with rounded edges and triangular area with middle button of thicker cuticle. Clypeus with straight anterior margin. Moniliform antennae with 11 antennomeres progressively more quadrate, except last one, pyriform. Pedicel of third antennomere not elongate. Right mandible with blunt tooth on inner margin. Left mandible without teeth, but inner margin with sharp edge. Labium without special characters. Ligula with very prominent middle lobe and long paraglossae. Gula approximately twice as long as wide. Cephalic chaetotaxy: five pairs of labral setae (**s-l-m-s-m / m-s-m-l-s**), two pairs of clypeal setae (**l-s / s-l**), one pair of frontal setae, two pairs of supraocular setae (anterior and posterior), one pair of supra-antennal setae, three pairs of occipital setae and two pairs of genal setae, as well as scattered pubescence. Labium with a pair of setae near base of the middle tooth, a pair of long setae near base of epilobes, a pair of very short setae near apex of epilobes and a pair of very short setae near posterior suture. Prebasilar with a pair of setae near anterior margin, a pair of very short lateral setae in mid-region and two pairs of setae (lateral pair much longer) in posterior region, with some degree of individual variation over this basic pattern.

Pronotum: subquadrate, slightly longer (0.26–0.32 mm) than wide (0.24–0.30 mm), narrowed in posterior region. Anterior and posterior margins smoothly sinuate. Anterior margin slightly crenulate, with medial hiatus (approximately as wide as two adjacent intersetae spaces). Lateral margins with three denticles near posterior angles, blunt and irregular. Surface covered by subhexagonal microreticulation. Disc flattened, with medial line and pair of faint lateral sulci.

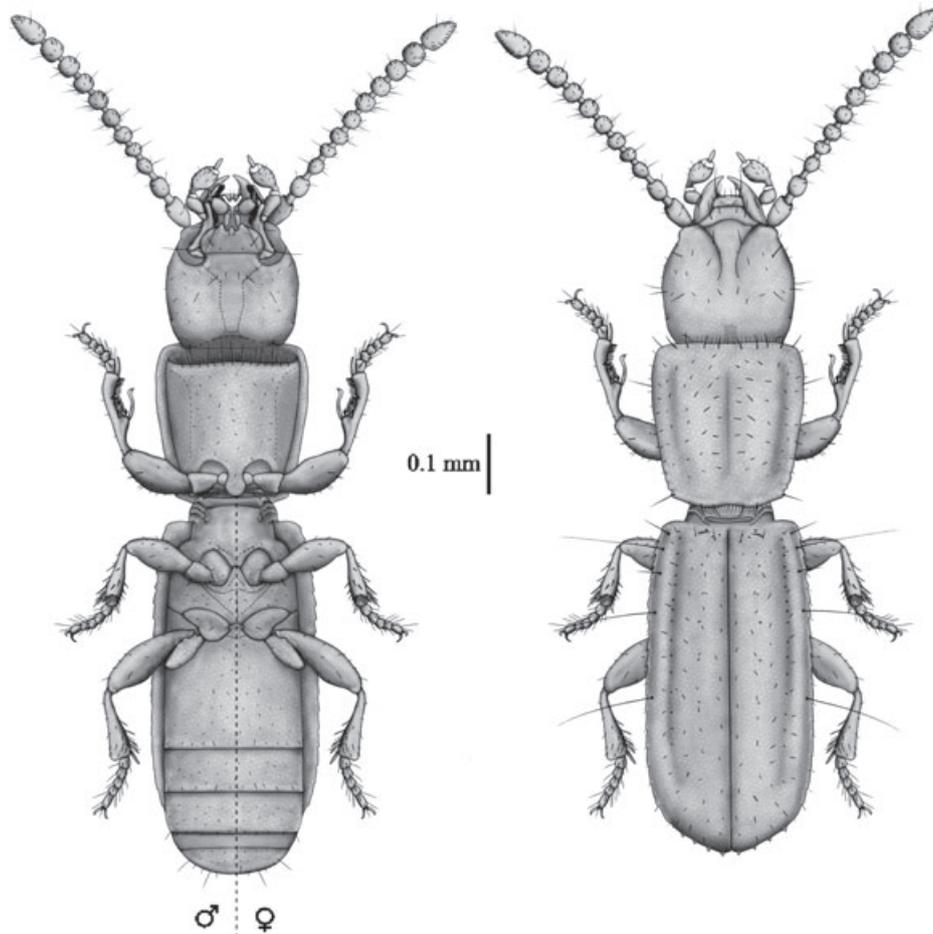


Fig. 1. *Typhlocharis prima* sp.n.—habitus: ventral (left half: male, right half: female) and dorsal (male) views.

Chaetotaxy: one pair of long setae in first third of lateral margins, one pair of long setae near posterior angles, a row of five to six pairs of setae [1-(l)-l-l-l-l / l-l-l-l-(l)-l] parallel to anterior margin, two to three pairs of setae, parallel to posterior margin [(s)-l-l / l-l-(s)], row of small, thin setae regularly placed in anterior and posterior margins, row of short setae in lateral margins, and approximately five pairs of longitudinal rows of short pubescence in disc. Proepisternal suture marked. Prosternal apophysis rounded. Anterior margin of prosternum with a row of long, thin setae and six to seven pairs of short setae parallel to it [s-(s)-s-s-s-s-s / s-s-s-s-s-(s)-s]. Prosternum covered in scattered pubescence, absent in proepisternum.

Elytra: approximately 2.2 times longer (0.55–0.65 mm) than wide (0.25–0.30 mm), subparallel. Lateral margins with 18–21 subtriangular denticles, faintly marked and progressively smoother, practically nonexistent in last third. Apical margin smoothly rounded, with four to six pairs of small denticles (showing some degree of individual variation, seven pairs in some specimens). Disc flattened, with longitudinal lateral carinae associated to seventh stria. Surface covered by irregular subhexagonal microreticulation. Elytral pores present all along

seventh stria to approximately last third of elytra; scattered pores also in scutellar region and disc. Transverse scutellar organ and pair of ‘buttonholes’ present near base of elytra. Chaetotaxy: umbilicate series formed by anterior group with four setae and posterior group with one seta (Fig. 1). One pair of scutellar setae and one pair of setae longer than surrounding pubescence between scutellar pair and humeral region. No apparent discal setae. Discal pubescence arranged in five or six pairs of longitudinal rows. Apical pair of pubescent setae present. Lateral margins with a short seta for every denticle, forming a row, last one being noticeably longer than rest.

Legs: similar in both sexes. Intermetacoxal space not widened. Inner side of femora without protuberances. Rounded metatrochanters, slightly angular metafemora and metatibiae with dilated distal region.

Abdomen: covered by irregular microreticulation, except for last segment, with ‘belt’ of scaly microsculpture, every scale with finely serrated edge in both sexes. Ventral foveae absent. Last ventrite without lateral teeth, pattern of five to six pairs of setae in posterior margin, sexually dimorphic: l-s-s-l-s / m-s-l-s-s-l (Fig. 1).

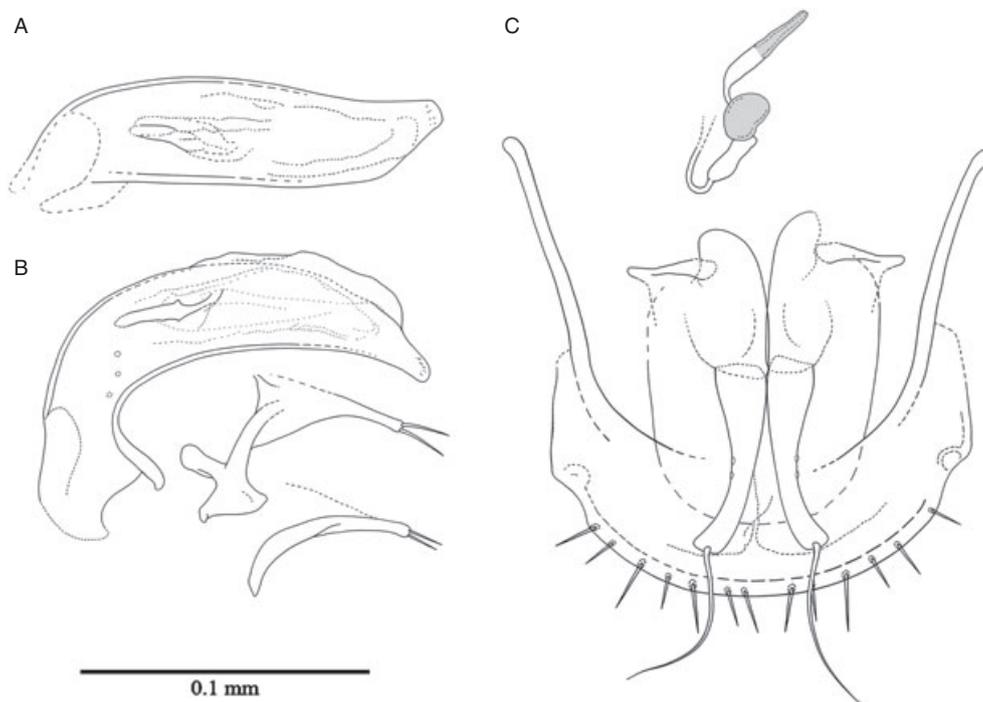


Fig. 2. *Typhlocharis prima* sp.n. (A, B) Aedeagus: (A) median lobe (dorsal view); (B) median lobe and parameres (lateral view). (C) Female genitalia (ventral view).

Aedeagus: sickle-shaped median lobe (length: 0.14 mm) and subtriangular, smoothly rounded apex, slightly bent to right (anatomically oriented) in dorsal view (Fig. 2A). Endophallus with robust, 'stick-shaped' sclerites smoothly curved upwards distally. Left paramere subtriangular, with two medium-sized apical setae. Right paramere shorter and curved downwards, also with two medium-sized apical setae (Fig. 2B).

Female genitalia: as described by Vigna-Taglianti (1972). Long tubular gonocoxites, robust, with double apical setae (visible under light microscopy in some specimens). Lateral setae absent, lateral pores present in the gonocoxites. Gonoduct differentiated in thinner proximal region (diameter 0.002 mm) and thicker distal region (diameter 0.008 mm). Reniform spermatheca (length: 0.018 mm). Conical spermathecal gland (length: 0.022 mm), sclerotized in distal region (Fig. 2C).

Etymology. The name of the species refers to the number of setae in the posterior group of the umbilicate series and to the fact of being the first and most abundant of the new species identified from the locality of La Palma del Condado.

Habitat. *Typhlocharis prima* sp.n. coexists in the same locality with *T. secunda* sp.n. and *T. tertia* sp.n., an open holm-oak (*Quercus ilex* L.) forest with abundant asphodel (*Asphodelus* sp.), thistles and scattered fan palms (*Chamaerops humilis* L.), crossed by a stream. There were clayey soils with

embedded boulders (Visean shales, Early Carboniferous) of different sizes and high humidity. The samples were collected under boulders and in a small 1-m-high creek bank under a holm oak.

Variability. The study of a large series (346 specimens) has shown some degree of variability within the population sample. The most common variations are to the marking of the denticles in posterior angles of the pronotum and the chaetotaxy of the last ventrite, with many specimens adding/lacking one or two short setae over the described pattern (this is especially common in females). Other variable characters are the tooth of the right mandible (ranging between faintly marked to very prominent), the basilar chaetotaxy, the number of setae in the anterior margin of the pronotum (up to seven pairs in some specimens) and the width of the hiatus (narrower in a few specimens).

The variation and asymmetry in the number of apical denticles of the elytra within individuals is also frequent, commonly with six denticles in one elytron and seven in the other (other combinations, less frequent, are elytra with three and four denticles or four and six denticles). One of the specimens shows double denticles.

Several cases of teratologies and morphological irregularities were observed: fusion of antennomere 3 and 4 (one specimen), deformed metatibia (one specimen), apex of elytra greatly asymmetric (one specimen) and damaged or notched elytra (two specimens).

Affinities. The presence of four to six pairs of apical denticles in the elytra allows this species to be included in the *baetica* group. Within the group, an umbilicate series pattern of 4 + 1 is only shared with *T. millenaria*, a species very close morphologically, which differs in the shape of the sclerotized piece of endophallus, much thicker and more robust in *T. prima* **sp.n.**, and in the shape of the spermatheca, reniform in the new species and subspherical to irregular in *T. millenaria*. The latter also presents sexual dimorphism in the belt of the microsculpture in the last ventrite (serrated scales in males, smooth in females), whereas in *T. prima* **sp.n.** both sexes present serrated scales. Chaetotaxy of the last ventrite also differs between both species (Table 1). The denticles of lateral margins of the elytra are less marked in *T. prima* **sp.n.**

***Typhlocharis secunda* Pérez-González & Zaballos sp.n.**
(Figs 3, 4)

Type series. Holotype, ♂, SPAIN: Huelva, La Palma del Condado (7 km N), 10-02-2011, 125 m (N 37°26', W 06°

37'), J.P. Zaballos & S. Pérez leg. (Coll. J.P. Zaballos, UCM). Paratypes, same data as holotype: 14 ♂♂, 16 ♀♀ (Coll. J.P. Zaballos and Coll. S. Pérez-González, UCM). 1 ♂, 1 ♀ (MNCN, Madrid, Catalogue number 2256).

Diagnosis. Small endogean beetle, anophtalmous, body sub-rectangular and narrow, covered by microreticulate integument and scattered pubescence. Vertex with *pars stridens*. Elytra with well-marked denticles of lateral margins and apical margin with six to seven pairs of small denticles. Umbilicate series with six setae (4 + 2), posterior group appears in a forward position. Aedeagus as in Fig. 4, 'Y-shaped' endophallic sclerites. Female genitalia as in Fig. 4.

Description. Length 1.30–1.53 mm (males), 1.32–1.51 mm (females) (Fig. 3).

Head: wider (0.28–0.32 mm) than long (0.25–0.30 mm). Right mandible with two teeth on inner margin. Labium with smoothly truncated epilobes, a variable character within individuals. Ligula with very prominent median lobe and long

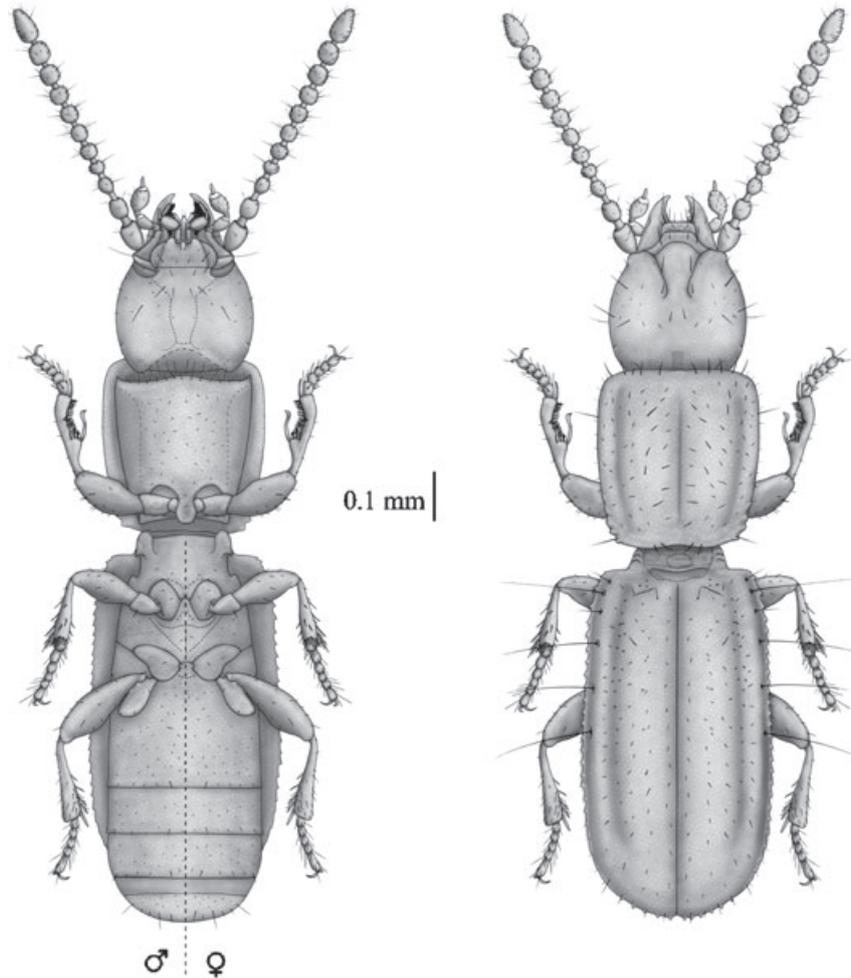


Fig. 3. *Typhlocharis secunda* **sp.n.** – habitus: ventral (left half, male; right half, female) and dorsal (male) views.

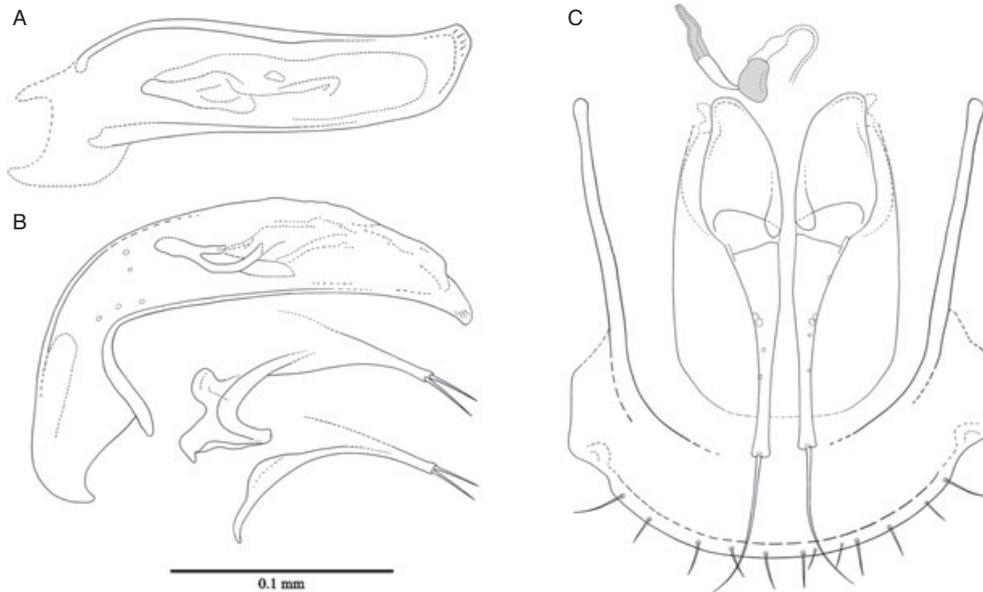


Fig. 4. *Typhlocharis secunda* sp.n. (A, B) Aedeagus: (A) median lobe (dorsal view); (B) median lobe and parameres (lateral view). (C) Female genitalia (ventral view).

paraglossae. Rest of characters as described for *T. prima* sp.n. Cephalic chaetotaxy: as described for *T. prima* sp.n., except prebasilar with two pairs of setae near anterior margin (lateral pair longer).

Pronotum: subquadrate, slightly longer (0.35–0.43 mm) than wide (0.32–0.38 mm). General shape as described for *T. prima* sp.n. Medial hiatus approximately as wide as three adjacent intersetae spaces. Lateral margins with three to four blunt denticles near posterior angles. Chaetotaxy: as for *T. prima* sp.n. except row of anterior margin with four to six pairs of setae [l-l-(l)-(m)-l-l / l-l-(m)-(l)-l-l] and two pairs of setae parallel to posterior margin (l-l / l-l). Prosternum as described for *T. prima* sp.n.

Elytra: approximately twice as long (0.70–0.81 mm) as wide (0.35–0.40 mm), subparallel. Lateral margins with 23–25 denticles, strongly marked in first third, progressively smoother towards posterior. Apical margin smoothly rounded, with six to seven pairs of small denticles. Disc, microsculpture, scutellar organ and ‘buttonholes’ as described for *T. prima* sp.n. Elytral pores present in scutellar region, disc and along seventh stria to approximately last third of total length. Chaetotaxy: umbilicate series with anterior group of four setae and posterior group of two setae, located in a forward position (whole umbilicate series restricted to first half of elytral length) (Fig. 3). One pair of scutellar setae and one pair of small discal setae located in first third of disc. Discal pubescence distributed in five to six pairs of longitudinal rows. Row of four to five pairs of medium-sized setae in apical margin (m-(m)-m-m-m / m-m-m-(m)-m). Short seta in every denticle of lateral margin.

Legs: as described for *T. prima* sp.n.

Abdomen: ventrites with very faint lateral foveae, sometimes absent. Last ventrite without lateral teeth, pattern of six to

seven pairs of setae in posterior margin, sexually dimorphic: l-(s)-s-s-l-s / m-s-l-s-s-(s)-l (Fig. 3). Abdominal microsculpture as for *T. prima* sp.n.

Aedeagus: sickle-shaped median lobe (length: 0.21 mm). Apex blunt and rounded, slightly bent to right in dorsal view (Fig. 4A). Endophallus with Y-shaped, forked sclerites and a lateral projection strongly bent upwards. Parameres as in *T. prima* sp.n. (Fig. 4B). Apodemal ring with elongate and thin anterior projection.

Female genitalia: long tubular, slender gonocoxites, with double apical setae. Lateral setae absent, lateral pores present. Gonoduct with two regions: thinner proximally (diameter: 0.002 mm) and thicker distally (diameter: 0.007 mm). Irregularly reniform spermatheca (length: 0.019 mm). Spermathecal gland conical (length: 0.026 mm), distally sclerotized (Fig. 4C).

Etymology. The name of the species refers to the number of setae in the posterior group of the umbilicate series and the fact that it is the second species to be identified from the locality of La Palma del Condado. Further, it is the second species in abundance from the studied sample.

Habitat. *Typhlocharis secunda* sp.n. coexists in the same locality with *T. prima* sp.n. and *T. tertia* sp.n.

Variability. The range of intraspecific variation (33 specimens) is similar to the one described for *T. prima* sp.n., including chaetotaxy of the last ventrite, anterior and posterior margins of the pronotum and basilar (adding/lacking one or two setae over the general trend), prominence and number of posterior denticles of lateral margins of pronotum (between three

and five) and number of elytral apical denticles (one specimen shows eight denticles in one elytron and six in the other).

Affinities. The presence of four to six pairs of apical denticles in the elytra permits inclusion of this species in the *baetica* group. The umbilicate series pattern of 4 + 2 also appears in *T. pacensis* and *T. furnayulensis*, the latter being the most similar to the new species. It is well differentiated from both by its considerably larger size (1.4 mm on average in the new species, 1.1 mm in the other two) and by the presence of a pair of discal setae (Table 1).

***Typhlocharis tertia* Pérez-González & Zaballos sp.n.**
(Figs 5, 6)

Type series. Holotype, ♂, SPAIN: Huelva, La Palma del Condado (7 km N), 10-02-2011, 125 m (N 37° 26', W 06° 37'), J.P. Zaballos & S. Pérez leg. (Coll. J.P. Zaballos, UCM). Paratypes, same data as holotype: 5 ♂♂, 9 ♀♀ (Coll. J.P. Zaballos and Coll. S. Pérez-González, UCM). 1 ♀ (MNCN, Madrid, Catalogue number 2257).

Diagnosis. Small, anophtalmous, endogean beetle with narrow and subrectangular body, covered in microreticulate integument with scattered pubescence. Vertex with *pars stridens*. Elytra with denticles of lateral margins strongly developed, hooked in first third of elytral length. Apical margin of elytra with three pairs of large denticles. Umbilicate series with seven setae (4 + 3). Femora with scaly protuberances on inner margin. Aedeagus as in Fig. 6, irregularly branched, 'Y-shaped' endophallic sclerites. Parameres with broad distal region. Female genitalia as in Fig. 6.

Description. Length 1.55–1.75 mm (males), 1.58–1.77 mm (females) (Fig. 5).

Head: slightly wider (0.33–0.36 mm) than long (0.32–0.35 mm). Pedicel of third antennomere elongate (approximately 0.7–1 times the length of the rest of the antennomere). Right mandible with double tooth on inner margin. Ligula with low, slightly convex median lobe and long paraglossae. Cephalic chaetotaxy: prebasilar with two pairs of setae near anterior margin (lateral pair much longer). Rest of cephalic characters as previously described for *T. prima* sp.n.

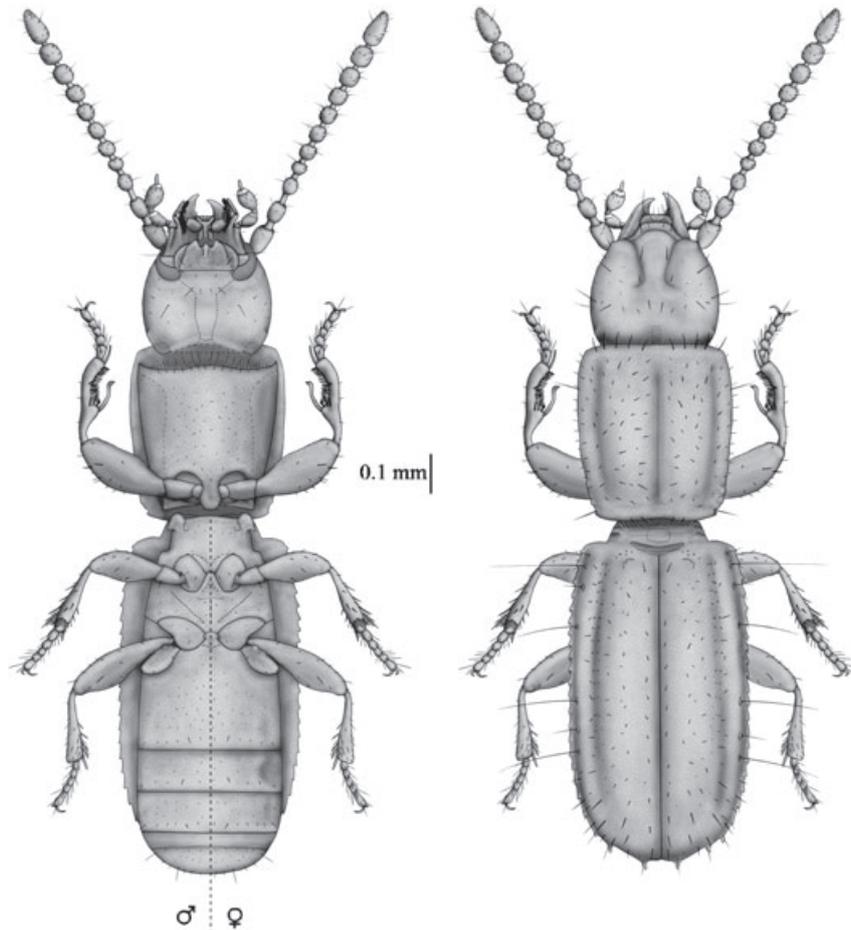


Fig. 5. *Typhlocharis tertia* sp.n. – habitus: ventral (left half, male; right half, female) and dorsal (male) views.

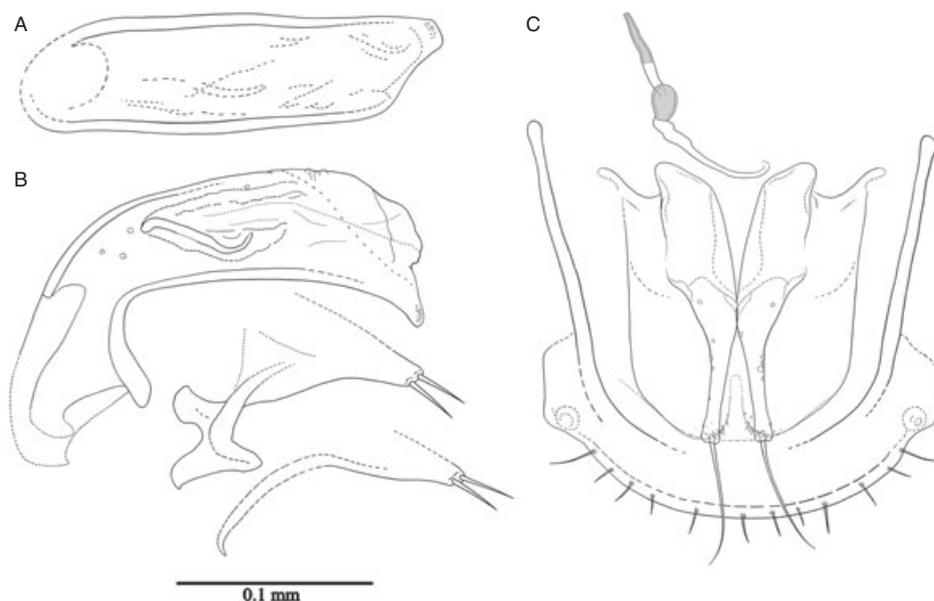


Fig. 6. *Typhlocharis tertia* sp.n. (A, B) Aedeagus: (A) median lobe (dorsal view); (B) median lobe and parameres (lateral view). (C) Female genitalia (ventral view).

Pronotum: subquadrate, longer (0.43–0.50 mm) than wide (0.40–0.42 mm), shape and microsculpture as previously described. Narrow medial hiatus (approximately as wide as, or less wide than, two adjacent intersetae spaces). Lateral margins with three to four denticles in posterior region, blunt and faintly marked. Chaetotaxy: same as in *T. prima* sp.n. but only two pairs of setae parallel to posterior margin (**I-I / I-I**). Proepisternum as previously described.

Elytra: approximately 1.8 times longer (0.80–0.92 mm) than wide (0.43–0.49 mm), subparallel. Lateral margin with 19–21 denticles strongly developed, hooked, especially in first third of elytral length, slightly less pronounced towards posterior, but well marked even in apical region, where last ones are progressively larger, ending in two to three pairs of large apical denticles. Disc, microsculpture, scutellar organ and ‘buttonholes’ as described for *T. prima* sp.n. Elytral pores in scutellar region, disc and along seventh stria, in a double row extended approximately to last third of elytra. Chaetotaxy: umbilicate series with anterior group of four setae and posterior group of three setae (Fig. 5). One pair of scutellar setae. No apparent discal setae, some pubescent setae slightly longer than rest. Discal pubescence in five to six pairs of longitudinal rows. Apical region with longer pubescence and marginal row of three to four pairs of setae (**m-(m)-m-m / m-m-(m)-m**). Lateral margins with a short seta associated to every denticle.

Legs: as previously described, but inner side of femora with scaly protuberances. Abdomen: ventrites with lateral foveae, very faint or absent in males; well developed pair of foveae (sternum III) in females. Last ventrite without lateral teeth, pattern of six to eight pairs of setae in posterior margin, sexually dimorphic: **I-(s)-s-s-I-s-s-(s) / s-s-I-s-s-(s)-I** (Fig. 5). Abdominal microsculpture as previously described.

Aedeagus: sickle-shaped, robust median lobe (length: 0.22 mm). Blunt apex, slightly bent to right in dorsal view (Fig. 6A). Endophallus with stick-shaped, forked sclerites, with lateral projection strongly curved upwards. Left paramere short and subtriangular with unusually broad distal region ending in two medium-sized setae. Right paramere shorter, curved downwards, also with broad distal end and two medium-sized apical setae (Fig. 6B).

Female genitalia: long tubular gonocoxites, with double apical setae. Lateral setae absent, lateral pores present. Gonoduct gradually thicker towards distal, with two regions not as clearly differentiated as in the other species. Irregularly ovoid spermatheca (length: 0.018 mm). Spermathecal gland conical (length: 0.028 mm), distally sclerotized (Fig. 6C).

Etymology. This species is named after the number of setae in the posterior group of the umbilicate series, in progression with the other species from La Palma del Condado. It also follows the progression in being the third identified species and the largest one from that locality.

Habitat. *Typhlocharis tertia* sp.n. coexists in the same locality with *T. prima* sp.n. and *T. secunda* sp.n.

Variability. The range of intraspecific variation (16 specimens) is similar to that described for *T. prima* sp.n. and *T. secunda* sp.n. Apical denticles of elytra vary between two and four pairs, being sometimes difficult to tell apart from the last denticles of the lateral margins. One of the studied males shows more developed ventral foveae than the other specimens, but these are not as pronounced as in females.

Affinities. *T. tertia* **sp.n.** is included in the *baetica* group based on the presence of three pairs of denticles in the apical margin of the elytra. Their size and pattern, as well as a larger body size (1.6 mm on average) and the distinct shape of the parameres, allow easy differentiation of the new species from any other in the group. The umbilicate series pattern of seven setae (4 + 3) is the most common combination within the group and also appears in *T. baetica*, *T. aguirrei* and *T. matiasi*. The new species shares with *T. matiasi* the presence of well developed ventral foveae. The species most similar to *T. tertia* **sp.n.** are *T. baetica* and *T. quarta* **sp.n.**, sharing the presence of microsculpture arranged in scaly tubercles on the inner side of the femora, the pattern of apical row of pubescence (thin and long setae), the presence and distribution of elytral pores (scutellar, discal and associated to the seventh stria) and the strongly marked, 'hooked' denticles of the lateral margins of the elytra.

***Typhlocharis quarta* Pérez-González & Zaballos sp.n.**
(Figs 7, 8)

Type series. Holotype, ♂, PORTUGAL: Beja, Barrancos, 13-02-2011, 276 m (N 38° 05', W 07° 06'), J.P. Zaballos & S. Pérez leg. (Coll. J.P. Zaballos, UCM).

Paratypes, same data as holotype: 7 ♂♂, 4 ♀♀, 1 elytra (Coll. J.P. Zaballos and Coll. S. Pérez-González, UCM). 1 ♂ (MNCN, Madrid, Catalogue number 2258). PORTUGAL: Beja, Barrancos, 10-11-2010 (N 38° 10', W 07° 01'), A.R.M. Serrano & C. Aguiar leg.: 14 ♂♂, 16 ♀♀ (2 ♂♂, 2 ♀♀ gold coated), 11-11-2010: 3 ♂♂, 3 ♀♀, 1-12-2011: 35 ♂♂, 26 ♀♀, 18-12-2011: 1 ♂, 1 ♀; Beja, Vila Verde do Ficalho, 12-11-2010 (N 37° 55', W 07° 17'), A.R.M. Serrano & C. Aguiar leg. : 1 ♀ (Coll. A.R.M. Serrano, Universidade de Lisboa).

Diagnosis. Small, anophtalmous, endogean beetle with narrow and subrectangular body, covered in microreticulate integument and scattered pubescence. Vertex with *pars stridens*. Elytra with denticles of lateral margins strongly developed, hooked in the first third of the elytral length, apical margin with six pairs of small denticles. Umbilicate series with eight setae (4 + 4). Femora with scaly protuberances in the inner side. Aedeagus as in Fig. 8, 'C-shaped', forked endophallic sclerites. Female genitalia as in Fig. 8.

Description. Length 1.45–1.70 mm (males), 1.39–1.63 mm (females) (Fig. 7).

Head: almost as wide (0.29–0.35 mm) as long (0.28–0.35 mm). Anterior margin of clypeus smoothly curved. Right mandible with one tooth on inner margin. Ligula with median lobe slightly convex, long paraglossae. Cephalic chaetotaxy: labium with two pairs of very short setae near posterior suture. Prebasilar with two pairs of setae near anterior margin (lateral pair much longer). Rest of cephalic characters as described for *T. prima* **sp.n.**

Pronotum: subquadrate, longer (0.36–0.48 mm) than wide (0.35–0.43 mm), shape and microsculpture as described for *T. prima* **sp.n.** Medial hiatus absent. Lateral margins with four

or five denticles in posterior region, blunt but well defined. Chaetotaxy: row of five pairs of setae [1-1-1-1 / 1-1-1-1] parallel to anterior margin, two pairs of setae parallel to the posterior margin (**m-1 / 1-m**). Other setae as described for *T. prima* **sp.n.** Propisternum as previously described.

Elytra: about twice as long (0.75–0.89 mm) as wide (0.40–0.46 mm). Subparallel lateral margins with 19–23 denticles, hooked, strongly developed, especially in first third. Apical margin smoothly rounded, with six pairs of small denticles. Disc, microsculpture, scutellar organ and 'buttonholes' as described for *T. prima* **sp.n.** Elytral pores present in scutellar region, disc and along seventh stria to approximately last third of total length of elytra. Chaetotaxy: umbilicate series with anterior group of four setae and posterior group of four setae (Fig. 7). One pair of scutellar setae, no apparent discal setae. Discal pubescence arranged in five or six pairs of longitudinal rows. Row of four or five pairs of long, thin setae (**1-(1)-1-1-1 / 1-1-1-(1)-1**) in apical margin. Short seta associated to every denticle of lateral margins.

Legs: as described for the other species, but inner side of femora with scaly protuberances.

Abdomen: ventrites with very faint or absent lateral foveae. Last ventrite without lateral teeth, pattern of six to seven pairs of setae in posterior margin, without sexual dimorphism: **1-(s)-s-s-1-s-s / s-s-1-s-s-(s)-1** (Fig. 7). Abdominal microsculpture as previously described.

Aedeagus: sickle-shaped median lobe (length: 0.21 mm). Blunt apex, slightly bent to the right in dorsal view (Fig. 8A). Endophallus with forked sclerites, more or less 'J' or 'C-shaped', with short dorsal projection and longer ventral piece with a thin lateral branch curved upwards. Parameres as in *T. prima* **sp.n.** (Fig. 8B).

Female genitalia: long tubular gonocoxites, with double apical setae (fused, giving the impression of a single seta). Lateral setae absent, lateral pores present. Gonoduct thicker towards distal, with thin (diameter: 0.003 mm) and thick (diameter: 0.008 mm) regions. Subspheric spermatheca (diameter: 0.016 mm). Conical spermathecal gland (length: 0.024 mm), distally sclerotized (Fig. 8C).

Etymology. The name refers to the singular presence of a pattern of four setae in the posterior group of the umbilicate series and to the fact that it is the fourth species of the *baetica* group found during the spring field campaign of 2011.

Habitat. This species was collected from a stony slope, with greyish clayey soil, recently ploughed, in a open dehesa with holm oaks (*Quercus ilex* L.) and pastures with laudanum shrub (*Cistus ladanifer* L.). The lithology of the region corresponds to the Ossa Formation (Cambrian), with boulders of grey shale.

Variability. The shape, number and pattern of apical denticles can be slightly variable from one individual to another (13 specimens) or even within elytra of the same individual. Some specimens show a small hint of hiatus, but it is always narrow and never reaches the width of species with well developed

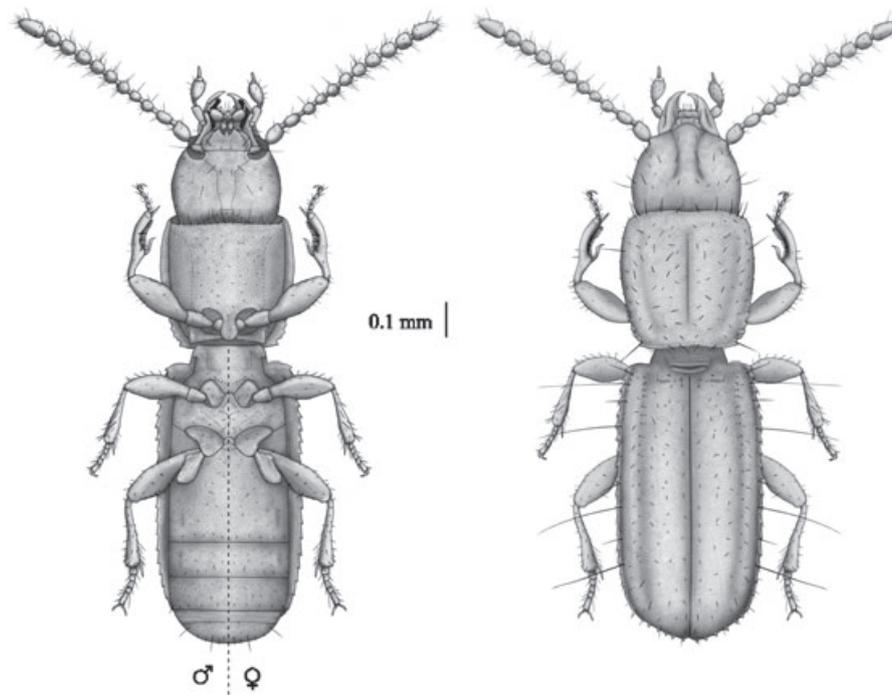


Fig. 7. *Typhlocharis quarta* sp.n. – habitus: ventral (left half, male; right half, female) and dorsal (male) views.

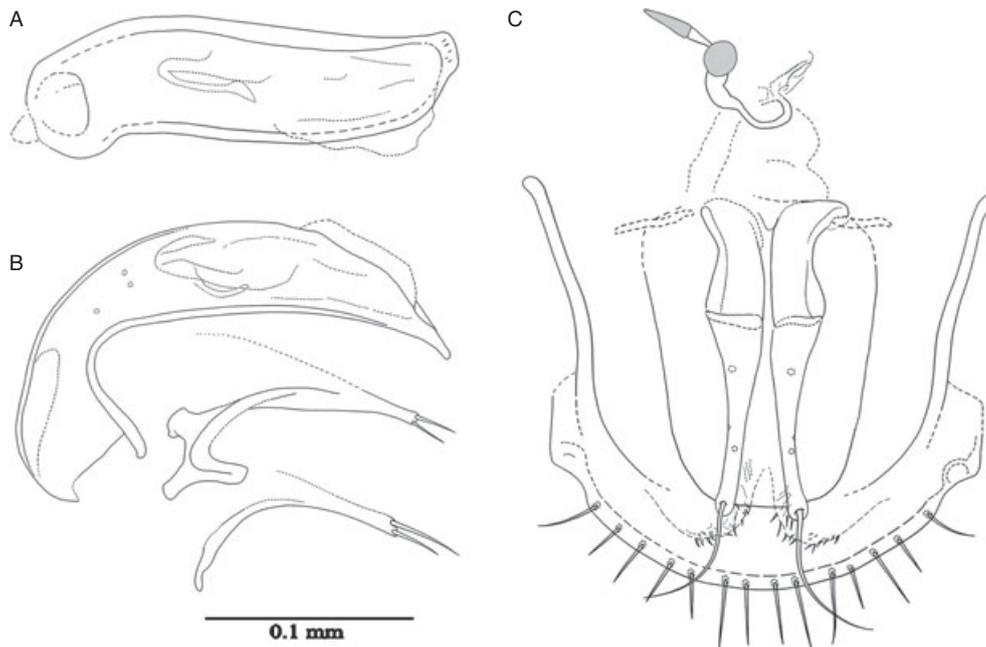


Fig. 8. *Typhlocharis quarta* sp.n. (A, B) Aedeagus: (A) median lobe (dorsal view); (B) median lobe and parameres (lateral view). (C) Female genitalia (ventral view).

Table 1. Comparison of relevant morphological characters in the species of the *baetica*.

Species	Total length (mm)	Median lobe of ligula	Hiatus	Posterolateral denticles of pronotum	No. of setae in anterior margin of pronotum (pairs)	No. of setae in posterior margin of pronotum (pairs)	Umbilicate series	Elytral pores	Discal and apical setae	Apical denticles of elytra
<i>T. baetica</i>	1.5	Low	Yes	4–6, well marked (serrated)	5–6	2–3	4 + 3	Yes, scutellar, discal and in seventh stria	No, long apical row	6–7 pairs
<i>T. pacensis</i>	0.9–1	Curved	Yes	±3, blunt	5	2	4 + 2	Yes, very faint, only in seventh stria	No, very short apical row	4-‘5’ pairs
<i>T. aguirrei</i>	1.1	Curved	Yes	±3, blunt	5–6	2	4 + 3	No	No, short apical row	5-‘6’ pairs
<i>T. millenaria</i>	1.1	Curved	Yes (narrow)	±4, blunt and faint	6	4	4 + 1	Yes, very faint, only in seventh stria	No, short apical row	5 pairs
<i>T. furnayulensis</i>	1.1	Curved	Yes	±3, blunt and faint	4–5	2–3	4 + 2	Yes, very faint, only in seventh stria	No, short apical row	‘5’–6–‘7’ pairs
<i>T. matiasi</i>	1.3	Curved	Yes	3–4, low and very faint	6	2	4 + 3	Yes, very faint, only in seventh stria	No, short apical row	4-‘5’ pairs
<i>T. prima sp.n.</i>	1.1	Very prominent	Yes	±3, low and very faint	5	2–3	4 + 1	Yes, very faint, only in seventh stria	No, short apical row	4–7 pairs
<i>T. secunda sp.n.</i>	1.5	Very prominent	Yes	± 4, blunt	4–5	2–3	4 + 2	Yes, scutellar, discal and in seventh stria	Yes, 1 pair (anterior third), short apical row	6-‘7’ pairs
<i>T. tertia sp.n.</i>	1.8	Curved	Yes (narrow)	3–4, blunt and faint	5–6	2	4 + 3	Yes, scutellar, discal and in seventh stria	‘Yes’, long apical row	3 pairs (large)
<i>T. quarta sp.n.</i>	1.4–1.7	Curved	No	±5, well marked (serrated)	5	2	4 + 4	Yes, scutellar, discal and in seventh stria	No, long apical row	6 pairs

Table 1. continued

Species	Lateral denticles of elytra, extension	Intermetacoxal space	Ventral foveae	'Belt' microsculpture	Chaetotaxy of last ventrite	Femoral protuberances	Dilated distal metatibia	Shape of aedeagus (lateral view)	Aedeagus (dorsal view)	Sclerites of endophallus
<i>T. baetica</i>	Strongly developed, 'hooked', the whole margin	Medium	Very faint	Smooth	l-s-s-l-s-s / s-l-s-s-(s)-l	Yes	Yes	Normal	Slightly bent	'Y-shaped' with curved lateral projection
<i>T. pacensis</i>	Normal, the whole margin	Medium - 'narrow'	No	Smooth	l-s-s-l-s-s / m- s-l-s-s-l	No	Yes	Robust	Slightly bent	Diffuse
<i>T. aguirrei</i>	Normal, the whole margin	Medium	♂ No, ♀ Very faint	♂ Smooth, ♀ serrated	l-s-s-l-s-s / m- s-l-s-s-(s)-l	No	Yes	Robust	?	'Y-shaped' with curved lateral projection
<i>T. millenaria</i>	Normal, the whole margin	Medium	No	♂ Ser-rated, ♀ smooth	l-s-s-l-s-s / m- s-l-s-s-l	No	Yes	Robust	Sub-straight	'Y-shaped' (slender) with curved lateral projection
<i>T. furnayulensis</i>	Normal, the whole margin	Medium	No	Serrated	l-s-s-l-s-s / m- s-l-s-s-(s)-l	No	Yes	Normal	Slightly bent	'Y-shaped' with curved lateral projection
<i>T. matiasi</i>	Faint, only in the first third	Medium	Yes, in both sexes	Serrated	l-s-s-l-s-s / m-l-s-s-l	No	Yes	Robust	Sub-straight	'Y-shaped' with curved lateral projection
<i>T. prima sp.n.</i>	Very faint, only in the first third	Medium	No	Serrated	l-s-s-l-s / m-s-l-s-s-l	No	Yes	Normal	Slightly bent	Robust stick
<i>T. secunda sp.n.</i>	Normal, the whole margin	Medium - 'narrow'	No	Serrated	l-(s)-s-s-l-s / m-s-l-s-s-(s)-l	No	Yes	Normal	Slightly bent	'Y-shaped' with curved lateral projection
<i>T. tertia sp.n.</i>	Strongly developed, 'hooked', the whole margin	Medium	♂ No, ♀ Yes	Serrated	l-(s)-s-s-l-s-s-(s) / s-s-l-s-s-(s)-l	Yes	Yes	Robust	Slightly bent	'Y-shaped' with curved lateral projection
<i>T. quarta sp.n.</i>	Strongly developed, 'hooked', the whole margin	Medium	Very faint	Serrated	l-(s)-s-s-l-s-s / s-s-l-s-s-(s)-l	Yes	Yes	Normal	Slightly bent	'C-shaped' with curved lateral projection

Table 1. continued

Species	Paramere 1	Paramere 2	Gonocoxites	Lateral setae of gonocoxite	Distal setae of gonocoxite	Gonoduct	Spermatheca	Spermathecal gland
<i>T. baetica</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, robust	Yes	Double	Long, uniform	Spheroidal	Conical
<i>T. pacensis</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long	No	'Double'	Long, gradually thicker	Barrel-shaped	Conical
<i>T. aguirrei</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long	No	'Double'	?	Subspheric, irregular	Conical
<i>T. millenaria</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long, curved	No	'Double'	Short, gradually thicker	Subspheric, irregular	Conical (elongated and thin)
<i>T. furnayulensis</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long	No	'Double'	Long, gradually thicker	Subspheric, irregular	Conical, elongated
<i>T. matiasi</i>	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, robust	No	Double	Long, 2 regions	Subspheric, irregular	Conical
<i>T. prima</i> sp.n.	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, robust	No	Double	Medium, 2 regions	Reniform	Conical
<i>T. secunda</i> sp.n.	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long	No	Double	Medium, 2 regions	Reniform, irregular	Conical
<i>T. tertia</i> sp.n.	Short and broad, 'spatulated', medium-sized setae	Short and broad, 'spatulated', medium-sized setae	Tubular, long	No	Double	Long, 2 regions	Ovoid, barrel-shaped	Conical
<i>T. quarta</i> sp.n.	Normal, medium-sized setae	Normal, medium-sized setae	Tubular, long	No	Double	Medium, 2 regions	Subspheric	Conical

?, not observable.

hiatus. There is also a certain degree of intraspecific variation in the location and size of some cephalic setae, especially in the labium and basilar.

Affinities. The new species belongs to the *baetica* group because of the presence of six pairs of denticles in the apical margin of the elytra. The umbilicate series pattern of eight setae (4 + 4) easily allows one to tell the new species apart from any other of the *baetica* group, as well as the reduction or absence of the hiatus in the anterior margin of the pronotum and the shape of the endophallic sclerites. The species with a closer morphology to *T. quarta* **sp.n.** are *T. tertia* **sp.n.** and *T. baetica*. Besides the similarities between these species already commented on (see affinities of *T. tertia* **sp.n.**), it shares with *T. baetica* the markedly ‘serrated’ look of the denticles of the pronotal posterior angles, the number and size of apical denticles of the elytra, the shape of the middle lobe of the aedeagus and subspheric spermatheca. In all the other species of the group, the denticles of posterior angles of the pronotum are more irregular, blunt and less defined, the elytral pores are fainter, limited to the seventh stria, the apical setae are short and pubescent and the inner sides of the femora are smooth, without scaly protuberances.

Key to species of *baetica* group

1. Elytra with umbilicate series 4 + 4 *T. quarta* **sp.n.**
– Elytra with umbilicate series different to 4 + 4 2
2. Elytra with umbilicate series 4 + 3 3
– Elytra with umbilicate series 4 + 2 or 4 + 1 6
3. Inner side of femora with protuberances, warty surface.
Length > 1.4 mm 4
– Inner side of femora without protuberances, smooth surface.
Length < 1.4 mm 5
4. Apical margin of elytra with six to seven pairs of small denticles. Length 1.5 mm *T. baetica* Ehlers, 1883
– Apical margin of elytra with three pairs of large denticles.
Length 1.7 mm *T. tertia* **sp.n.**
5. Elytra with lateral denticles marked in all their length. Very faint or absent ventral foveae. Length 1.1 mm
. *T. aguirrei* Zaballos & Banda, 2001
– Elytra with lateral denticles marked only in the first third of their length. Ventral foveae well developed in both sexes.
Length 1.3 mm *T. matiasi* Zaballos & Banda, 2001
6. Elytra with umbilicate series 4 + 2 7
– Elytra with umbilicate series 4 + 1 9
7. Elytra with one pair of discal setae in the anterior third.
Length 1.4 mm *T. secunda* **sp.n.**
– Elytra without discal setae. Length < 1.1 mm 8
8. Apical margin of elytra with four to five pairs of small denticles. Diffuse endophallic sclerites. Length 0.9–1 mm
. *T. pacensis* Zaballos & Jeanne, 1987
– Apical margin of elytra with five to seven pairs of small apical denticles. ‘Y-shaped’ endophallic sclerites. Length 1.1 mm *T. furnayulensis* Zaballos & Banda, 2001

9. Elytra with lateral denticles marked in all their length. Thin, ‘Y-shaped’ endophallic sclerites. Subspheric-irregular spermatheca. Length 1.1 mm *T. millenaria* Zaballos & Banda, 2001

– Elytra with lateral denticles marked only in the first third of their length. Thick, stick-shaped endophallic sclerites. Reniform spermatheca. Length 1.1 mm *T. prima* **sp.n.**

Discussion

Diagnosis of the baetica group

In the description of the group diagnosis proposed by Zaballos & Banda (2001) there are five key characters that, on the whole, identify all their species: the presence of more than two pairs of apical denticles in the apical margin of the elytra, the presence of elytral ‘buttonholes’, the lateral carinae of the seventh stria extended to the last quarter of the elytral length (but never reaching the apex), an anterior group of umbilicate series with four setae and the presence of a stridulatory organ. However, only the first of these characters is unique to the *baetica* group. The other characters are indeed present, but are not exclusive of these species: the presence of elytral ‘buttonholes’ has been verified in virtually all species in the genus (S. Pérez-González and J.P. Zaballos, personal observation). The anterior group of four umbilicate setae is typical of the entire genus, except for two species (Zaballos & Ruíz-Tapiador, 1997). The lateral carinae not extending to the apical margin of the elytra also occur in the totality of the *silvanoides* group and several species of the *diecki* group. Finally, the presence of a stridulatory organ has been proven to be common in the genus (Zaballos & Pérez-González, 2011a). Therefore, these characters provide very little information as a group diagnosis. Even taking them as a whole, four of the five characters ‘characteristic to *baetica* group’ (Zaballos & Banda, 2001) are observed and ‘characterize’ with equal effectiveness the species of the *silvanoides* group. Thus, only the presence of apical denticles associated neither to the suture nor to the seventh stria remains as a diagnostic feature for this group.

Morphological considerations

In order to establish the affinities of the new species, the type material of the *baetica* group species has been consulted, allowing the morphological knowledge on the group to be updated (Table 1) and revising some considerations made by Zaballos & Banda (2001):

1. The sclerites in the endophallus share a basic general pattern, irregularly branched, ‘Y-shaped’ with a lateral projection strongly curved upwards. This characteristic curved projection was only described in *T. matiasi* (Zaballos & Banda, 2001) but it has been observed to appear in the entire group, except for *T. pacensis*, lacking defined sclerites, and *T. prima* **sp.n.**, without an evident curved projection.

2. The reference to sexual dimorphism in *T. matiasi* is inaccurate. It has been checked that well-developed lateral foveae in the second ventrite are present in both sexes. However, the type of dimorphism originally described for *T. matiasi* (presence of ventral foveae in females, but not in males) is found in *T. tertia* **sp.n.**

3. None of the females with the genitalia extracted for study show the lateral setae of gonocoxites mentioned in Zaballos & Banda (2001) (Figs 1h–6f). This feature has been revised in the original material and it has been found to appear exclusively in *T. baetica*. The remaining species show pores in the same region of the gonocoxite. It is probable that Zaballos & Banda (2001) interpreted these structures as setigerous pores of setae lost during manipulation of the specimens. The direct observation of this feature, by transparency, in rinsed specimens with untreated genitalia (hence without risk of damage by manipulation), the preparation and mounting of new genitalia and the existence of other species lacking the lateral setae, but showing the same kind of pores (i.e. *T. silvanoides*, *T. armata*, *T. deferreri*), confirm the absence of this seta in the entire *baetica* group, except for *T. baetica*.

4. The variation in number and shape of apical denticles of the elytra is remarkable. Individuals with an asymmetric number of denticles in each elytron or with higher or lower numbers than the general trend of the species are common. In the description of *T. aguirrei*, there is an explicit mention to 'six pairs of conspicuous denticles', which is true for the golden-coated specimen shown in the electron microscopy photographs (Zaballos & Banda, 2001), but it has been verified that the holotype (♂) and at least one of the paratypes (♀) have five pairs of denticles. The idea of high plasticity for number and shape of apical denticles is reinforced by the data provided by the new species.

5. *T. baetica* was a member of the group with several unique characters, such as a bigger size or the presence of femoral protuberances. The discovery of *T. tertia* **sp.n.** and *T. quarta* **sp.n.** increased the number of species with these characters and provided evidence of two morphological trends within the *baetica* group: a trend towards 'robust' forms, with bigger average body size (1.4–1.7 mm), femoral protuberances, a serrated aspect of pronotal posterolateral denticles, strongly developed, 'hooked' lateral denticles of elytra and a large number of umbilicate setae (4 + 4 and 4 + 3), represented by *T. baetica*, *T. tertia* **sp.n.** and *T. quarta* **sp.n.**; and a trend towards 'slender' forms, with smaller size (1.1–1.5 mm), a smooth femoral inner side, faint denticles of the pronotum and lateral margins of the elytra and a reduced number of umbilicate setae (4 + 1, 4 + 2 and 4 + 3), represented by *T. pacensis*, *T. aguirrei*, *T. millenaria*, *T. furnayulensis*, *T. matiasi*, *T. prima* **sp.n.** and *T. secunda* **sp.n.**

The umbilicate series

It has been demonstrated (Serrano & Aguiar, 2002; Zaballos & Pérez-González, 2011a, b) that the number of setae in the umbilicate series is unstable in some species (*T. singularis* Serrano & Aguiar 2000, *T. silvanoides* Dieck, 1869) and,

as seen in the *baetica* group, morphologically close species otherwise very similar to each other, such as *T. baetica*, *T. aguirrei*, *T. tertia* **sp.n.**, *T. matiasi*, *T. secunda* **sp.n.**, *T. pacensis*, *T. furnayulensis*, *T. millenaria* or *T. prima* **sp.n.**, have different umbilicate formulae (4 + 3, 4 + 2 and 4 + 1).

The new species cover the whole spectrum of different combinations present in the group, and *T. quarta* **sp.n.**, with eight (4 + 4) setae, increases the disparity and raises an interesting question: The presence of eight setae in the umbilicate series is commonly interpreted as a basal feature (Jeanne, 1973; Serrano & Aguiar, 2006a,b; Zaballos & Pérez-González, 2011a,b) and has only been known in the *silvanoides* group of species until now. Both species groups (*silvanoides* and *baetica*) share many morphological characters such as the general shape of the pronotum and elytra, the presence of a stridulatory organ, the shape of the metatrochanter, the dilated distal end of the metatibiae or the shape of last ventrite (lacking lateral teeth). The umbilicate series 4 + 4 and the range of body size of *T. quarta* **sp.n.** are added to these similarities between both groups, suggesting they are closely related.

The apical denticles

Apart from being the diagnostic feature of the *baetica* group, a peculiarity of the apical denticles is their structure, suggesting a different origin from that of the apical denticles present in other species of *Typhlocharis* (Zaballos & Banda, 2001).

Within the genus, there are different combinations of apical denticles in the posterior margin of the elytra. Such combinations are the result of three known types of denticles: associated to the seventh stria, associated to the medial suture and independent of these two structures (Fig. 9).

The edge of the epipleura extends into a marginal thickening or 'border' in the apical region of the elytra, which is where apical teeth are commonly developed. In the first type of denticles, the border converges with the end of the carinae of the seventh stria and the end of the serrated lateral margin of the elytra, creating the base point for the development of the denticle. In the second type, the denticles emerge from the angulose shape of sutural edges in many species. Usually, these two models are associated and appear together (Fig. 9), which led Jeanne (1973) to relate their origin to a shortening of the elytral apex. This hypothesis is supported by the shape of the margin where the denticle-bearing border lies, which just outlines the existing reliefs given by the end of the carinae and the sutural angles, developing the denticles in those prominent regions.

In the third type, present in the *baetica* group (Fig. 9), denticles arise in numerous pairs of small size directly from the border, without reinforcing any previous relief of the elytral margin.

There is an exception within this type, *T. tertia* **sp.n.**, with two to three pairs of denticles larger than any other species of the group. In this case, only the pair close to the suture seems to be related to the extension of the epipleural border, whereas the outer pairs appear as hypertrophied marginal denticles invading the posterior margin of the elytra (Fig. 9).

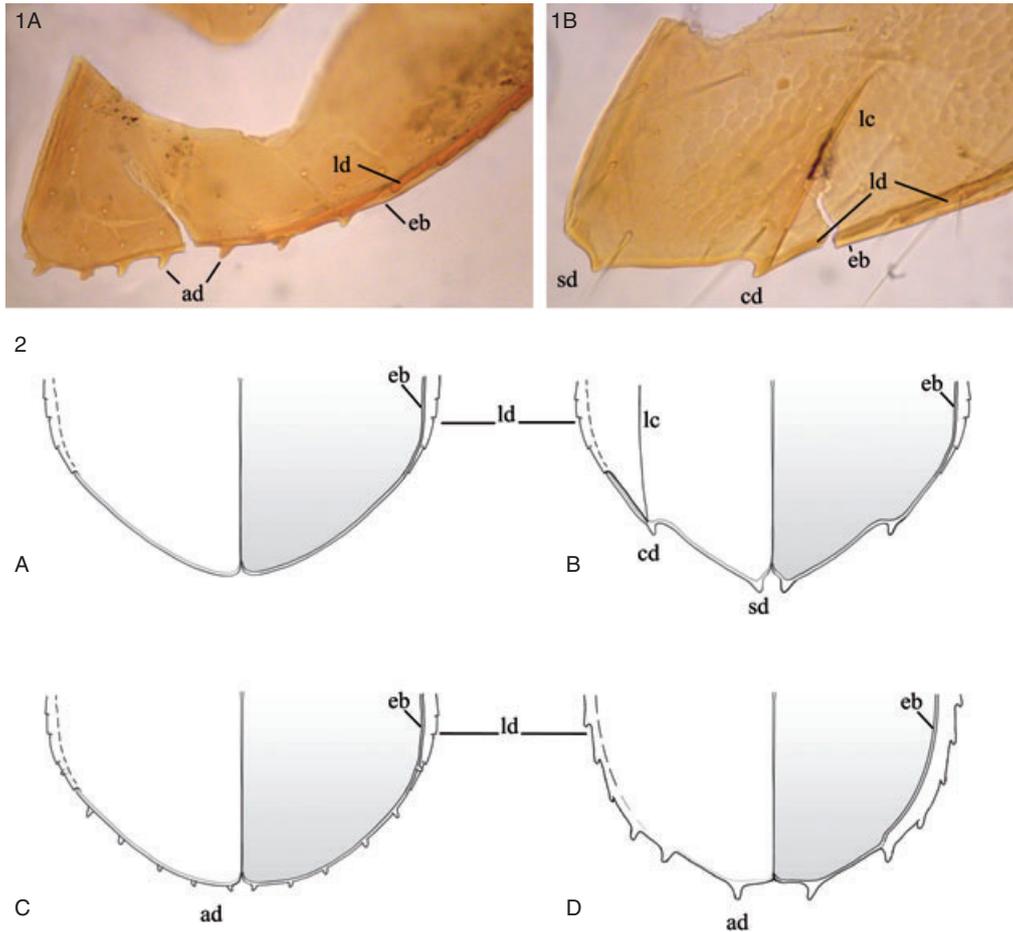


Fig. 9. (1) Apex of elytra in: (A) *Typhlocharis baetica* Zaballos & Banda, 2001; (B) *T. intermedia* Zaballos, 1986. (2) Schematic representation of the structure of the basic types of apical denticles: (A) *T. algarvensis* Coiffait, 1969, smooth, rounded apex without denticles; (B) *T. intermedia*, denticles associated to the lateral carinae of the seventh stria and to the sutural angles (note the shape of the elytral margin is altered by these structures); (C) denticles independent of the lateral carinae or the sutural angles in *T. baetica*; numerous small denticles, all starting from the apical extension of epipleural border; (D) *T. tertia* sp.n., two to three pairs of large denticles, outer pairs as extension of the serration of the lateral margins. Abbreviations: eb, epipleural border; ld, lateral margin denticles; lc, lateral carinae (seventh stria); cd, lateral carinae denticle; sd, sutural denticle; ad, apical denticle. Left elytron (lightened) in dorsal view, right elytron (shaded) in ventral view.

The asymmetry of denticle numbers and the possibility of denticle fusion/divergence observed in some specimens of this group suggest that the denticles in the *baetica* group evolved from *T. tertia*-like forms, with few large denticles posteriorly reduced and multiplied, or *T. baetica*-like forms, with many small denticles posteriorly enlarged.

These structural differences between the models support the hypothesis of independent origin of apical denticles within the *baetica* group.

Finally, some species of the *silvanoides* group (*T. carinata* Serrano & Aguiar, 2006 and *T. paulinoi* Serrano & Aguiar, 2006; S. Pérez-González & J.P. Zaballos, personal observation) have scaly irregularities in the apex of the elytra, resembling a miniaturized version of the third type of denticles. This is another feature that suggests a link between the *silvanoides* and the *baetica* groups.

Distribution and biogeography

Until now, the distribution of the *baetica* group was considered to be notably restricted (Zaballos & Banda, 2001). The majority of the species were known from a small area in the southern slopes of the Sierra Morena, covering approximately 58 km² (Fig. 10) between the localities of Hornachuelos and Posadas (Córdoba). *T. matiasi* Zaballos & Banda, 2001, from the eastern side of the city of Córdoba (approx. 40 km), and *T. pacensis* Zaballos & Jeanne, 1987, from Azuaga (approx. 60 km), were the most distant species with respect to the rest of the group.

The new species are found a long way from this region, in western localities at approximately 130 km from the other species, significantly increasing the known distribution of the group (Fig. 10). The locality of *T. quarta* sp.n. (Barrancos, Beja, Portugal) is placed inside the limits of the Guadiana river



Fig. 10. Detail of the *baetica* group distribution range in the Iberian Peninsula. Black circles represent the sites of the species known prior to this work. Black triangles represent the sites of the new species. The main watercourses are indicated.

basin; the locality of *T. prima* sp.n., *T. secunda* sp.n. and *T. tertia* sp.n. (La Palma del Condado, Huelva) is placed in the Odiel-Tinto river basin; the locality of *T. pacensis* (Azuaga, Badajoz) is very close to the watershed limits of the Guadiana and Guadalquivir basins and the remaining species come from the middle sections of the Guadalquivir river basin.

This discontinuous distribution demonstrates the necessity of sampling in the large gaps between localities and opens a debate about the dispersion mechanisms of the *baetica* group. Available data locate the group distribution in the drainage basins of the Guadiana (left bank) and Guadalquivir (right bank) rivers, including the minor basins of the Odiel and Tinto rivers. Accepting the betic-riffian origin proposed for the genus (Jeanne, 1973; Jeannel, 1963; Ortuño & Gilgado, 2011; Zaballos & Pérez-González, 2011a,b) and given the presence in the group of several characters considered plesiomorphic for the genus (Jeanne, 1973; Pérez-González & Zaballos, 2012) (many of them shared with species of the *silvanoides* group), it would be safe to assume a dispersion core located in the western regions of the Betic-Riffian massif, which subsequently expanded and colonized new areas by means of

hydrochory dispersal mechanisms (Ortuño & Gilgado, 2011) in drainage events occurring in the Guadiana, Guadalquivir, Odiel and Tinto basins.

The presence of *T. pacensis* near the watershed limits of two basins, in a region close to the headwaters of tributaries on the left banks of the Guadiana basin (Zújar and Matachel) and tributaries of the right banks of the Guadalquivir basin (Bembézar and Guadiato), can be used to test this hypothesis. If the hypothesis is correct, it is predicted that *T. pacensis* will also be present downstream in the slopes of both basins. Future sampling will help to test this hypothesis.

There is a record of six specimens of '*T. baetica*' (Las Aljabas, Bembézar river reservoir) by Cárdenas Talaverón & Bach Piella (1988). Two of them were later identified as '*T. pacensis*' in 1988 (J.P. Zaballos, personal observation) but are currently lost (A.M. Cárdenas, personal observation). The four remaining specimens (A.M. Cárdenas, personal observation) have been lent to Coll. Vives (Tarrasa, Spain). The diagnosis of these specimens was exclusively based in the umbilicate series (*T. pacensis* is the only 4 + 2 species known at the moment) and it is very probable that they really belong to

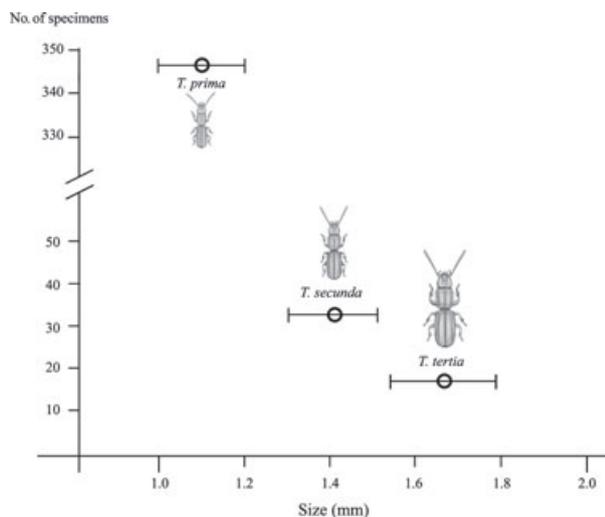


Fig. 11. Graphic comparing body size and abundance of the three syntopic species captured in the locality of La Palma del Condado (Huelva, Spain). *Typhlocharis prima* sp.n. is the smallest (average length: 1.1 mm) and, by far, the most abundant (346 specimens). *T. secunda* sp.n. appears as medium-sized (average length: 1.4 mm) with 33 specimens and. *T. tertia* sp.n. is the largest species (average length: 1.65 mm) and the rarest, with 16 specimens.

T. furnayulensis, collected in the same locality (Las Aljabaras) and described in 2001 (Zaballos & Banda, 2001).

Syntopy

Zaballos & Banda (2001) described the coexistence of two, three and even four species of the *baetica* group, which is unusual for the genus. The new samplings provide data of three species living in syntopy in the same locality (La Palma del Condado), collected simultaneously during a single sampling, showing important differences in body size and abundance (Fig. 11).

Such differences in size and abundance in closely related species are usually a result of ecological diversification, in order to minimize interspecific competence. The absolute sizes of the specimens do not overlap and the three species are separated in three size categories. Zaballos & Farinós (1995) pointed out mechanisms of prezygotic isolation for species living in syntopy, mainly based in secondary sexual characters and differentiation of the genitalia. In the populations of La Palma del Condado, the isolation between species would be given also by size differences.

The former citations and sites with coexistence of several species within the group have been checked, searching for a similar pattern of size categories. In many cases, coexistence in a locality is inferred from the capture (in the same place or nearby) of different species at different times of the year. Only in one of the localities can the capture of two species (*T. furnayulensis* and *T. millenaria*) be referred to the same sampling (Los Molinos, Hornachuelos, Córdoba, 28-1-99).

Both species are similar in size, so the pattern of size categories is, for the moment, only known for the populations of La Palma del Condado.

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