JOURNAL OF NATURAL HISTORY, 2016
VOL. 50, NOS. 25–26, 1633–1648
http://dx.doi.org/10.1080/00222933.2016.1145274

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Thermonectus tremouillesi sp. nov. (Coleoptera: Dytiscidae: Aciliini): description of the adults and larvae and comparisons with other species of the genus

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ABSTRACT

A new species of Aciliini diving beetles, *Thermonectus tremouillesi* sp. nov., is described on the basis of adult and larval specimens collected in shaded forest ponds in Argentina. The adults are compared with morphologically close species and diagnosed by the following combination of characters: the colour pattern on pronotum and elytra; the sexual sculpture of the female well marked, covering basal fourth to basal half of elytra; the male protibia narrow with dorsal margin slightly prominent; the tergite IX of male with four posterior projections; the median lobe of aedeagus bifid apically; and the parameres bearing a terminal spur. The larvae, for their part, are compared with those of other species of the genus and diagnosed by the colour pattern of the cephalic capsule, the shape of the nasale, the spinulae on the prementum, and several chaetotaxic features. Both adults and larvae are illustrated in detail combining scanning electron microscope images, digital photos and line drawings of selected structures. The habitat of the new species and its associated fauna are briefly described.

ARTICLE HISTORY
Received 22 May 2015
Accepted 18 January 2016
Online 29 February 2016

KEYWORDS
Dytiscinae; *Thermonectus*; new species; adults; larvae; chaetotaxy; Argentina

Introduction

On collecting trips to El Palmar and Iguazú National Parks (NP) in Argentina performed more than 10 years ago, we captured adults and larvae of an unusual and particularly interesting diving beetle in shaded forest ponds. After examination under a microscope, these beetles were proven to belong to the American genus *Thermonectus* Dejean, 1833, which includes 19 species of medium-sized Dytiscidae (Nilsson 2015). When attempting to identify the adults to species level using the key of Trémouilles (1989) for South American *Thermonectus*, we found that they did not fit any of the species. Then, we started a more detailed investigation consulting original descriptions and keys to the species from other areas (e.g. McWilliams 1968), and found no similarity of our material to any described species except, probably, *Thermonectus laporti* (Aubé 1838), which is known only from a very succinct description of a single specimen from Brazil, lacking more precise geographic information (Aubé 1838). There is, however, no complete

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agreement between the description of *T. laporti* and our specimens. We tried to locate the holotype of *T. laporti*, originally described in the genus *Acilius* Leach, 1817 and transferred to *Thermonectus* by van den Branden (1885). For more than 10 years, we consulted several museums including the Natural History Museum, London, United Kingdom, and the Muséum national d'Histoire naturelle, Paris, France, where we suspected it might be held. We could corroborate that in the latter institution, a specific place in a drawer was reserved for the specimen, although it was not there, and there is no information on where it could be. This finding, in addition to the fact that not even Sharp (1882) in his comprehensive study on the Dytiscidae had the opportunity to see the specimen, reinforces the hypothesis that the holotype of *T. laporti* is unfortunately lost (see also Evenhuis 2012). In Nilsson's (2015) catalogue, the holotype for this species is marked with a question sign ('Holotype ?'). The impossibility of performing a more in-depth comparison of our specimens with *T. laporti* raised the question of how to proceed. After discussing the subject with specialist colleagues, and considering that the conspecificity with *T. laporti* is not warranted, we here describe our material as a new species.

As mentioned above, larvae were collected in association with the adults, which gives also the opportunity to provide a description of this stage. The goals of this paper, therefore, are: (1) to describe a new species of *Thermonectus* and illustrate selected adult structures using scanning electron microscopy (SEM), digital imaging and line drawings; (2) to describe and illustrate in detail the three larval instars of this taxon including detailed morphometric and chaetotaxic analyses; and (3) to compare both stages with other species of the genus.

Materials and methods

Material examined

The descriptions provided in this paper are based on 40 adults and 10 larvae (two instar I, one instar II and seven instar III) collected at the following localities: (1) Argentina, Misiones Province, Iguazú NP, 12/19 August 2000 (one adult); (2) Argentina, Misiones Province, Iguazú NP, San Martín Island, 15 February 2002, 25° 41′14.75"S, 54°26′31.71"W (one adult, nine larvae); (3) Argentina, Entre Ríos Province, El Palmar NP, La Glorieta, 26 February 2002, 31°53′12.95"S, 58°16′28.15"W (32 adults, one larva); (4) Argentina, Entre Ríos Province, El Palmar NP, La Glorieta, 26 February 2004, 31°53′12.95"S, 58°16′28.15"W (six adults). One of the larvae collected in Iguazú NP was reared to the adult stage.

Specimen depositories

The type material of the new species described herein is deposited in the Museo Argentino de Ciencias Naturales Bernardino Rivadavia (Buenos Aires, Argentina; MACN), the Natural History Museum (London, United Kingdom; NHML), and the Muséum national d'Histoire naturelle (Paris, France; MNHN). Additional adult specimens and larval specimens are held in the collection of the senior author (Laboratory of Entomology, Buenos Aires University, Argentina; MCMC).

Methods for the study of adults

Dried specimens were relaxed in hot water for some minutes, then the genitalia and other body parts were removed, washed with distilled water and either transferred into polyvinyl-lacto-glycerol for microscopic examination, or prepared for SEM or digital imaging.

Measurements were taken using a micrometer eyepiece mounted on an Olympus SZ61 stereoscopic microscope. Total length (TL) was measured in dorsal view from the anterior margin of the clypeus to the elytral apex. Maximum width (MW) was measured in dorsal view at the widest part of the body.

Photographs were taken using a Nikon D90 digital camera equipped with a Nikon AF-S VR Micro-NIKKOR 105 mm f/2.8G IF-ED lens; the final images were generated using Helicon Focus 5.3 Pro software and digitally edited. SEM images were taken with a Philips XL30 TMP New Look SEM.

Methods for the study of larvae

The larvae were cleared in lactic acid, dissected and mounted on glass slides in polyvinyl-lacto-glycerol. Microscopic examination at magnifications up to 1000□ and drawings were made using an Olympus CX31 compound microscope equipped with a camera lucida. Drawings were scanned and digitally inked using a Genius PenSketch tablet.

The methods and terms used herein follow those employed in previous papers dealing with the larval morphology and chaetotaxy of *Thermonectus* species. The reader is referred to Michat and Torres (2005), Alarie et al. (2011) and Michat (2013) for a complete list and additional explanations of the terms used in the present study (see also Tables 1 and 2). Homologies were recognised using the criterion of similarity of position (Wiley 1981).

Detailed descriptions, including chaetotaxic analyses, of all larval instars of the other two species of *Thermonectus* [*T. succinctus* (Aubé 1838) and *T. alfredi* Griffini, 1898] were published by Michat and Torres (2005) and Michat (2013), respectively. For this reason, the morphological and chaetotaxic characters common to the three species are not included in the present description, and only diagnostic features are mentioned.

Results

Thermonectus tremouillesi sp. nov.
(Figures 1–4)

Type locality
Argentina, Entre Ríos Province, El Palmar NP.

Type material (labels)
Holotype male (MACN): 'Argentina, Entre Ríos Prov., El Palmar NP, 26–II–2002, Michat & Torres col.' [white, rectangular, printed label], 'HOLOTYPE *Thermonectus tremouillesi*

Table 1. Measurements and ratios for the larvae of *Thermonectus tremouillesi*.

Measure	Instar I (n = 2)	Instar II (n = 1)	Instar III (n = 5)
TL (mm)	8.00–8.30	13.10	15.20–23.60
MW (mm)	0.80–1.20	1.60	2.10–2.90
HL (mm)	1.40	1.88	2.70–2.83
HW (mm)	1.15	1.56	2.16–2.21
FRL (mm)	0.64–0.65	0.84	1.16–1.22
OCW (mm)	0.43	0.56	0.92–0.99
HL/HW	1.22	1.20	1.23–1.28
HW/OCW	2.71	2.78	2.22–2.38
COL/HL	0.54	0.55	0.56–0.57
FRL/HL	0.46	0.45	0.43–0.44
A/HW	0.50	0.44	0.37–0.42
A1/A3	0.79	0.79	0.71–0.86
A2/A3	0.79–0.82	0.88	0.81–0.93
A4/A3	0.33–0.37	0.25	0.16–0.20
MNL/MNW	2.74–2.89	3.04	3.13–3.30
MNL/HL	0.46	0.47	0.44–0.46
PPF/MP1	0.36–0.40	0.22	0.20–0.25
A/MP	1.77–1.81	1.79	1.58–1.76
MP1/MP2	0.56–0.58	0.75	0.76–0.91
MP3/MP2	1.84–1.89	1.50	1.29–1.45
GA/MP1	2.91–3.20	2.61	2.06–2.48
MP/LP	0.88–0.89	0.88	0.82–0.87
LP2/LP1	0.94–0.95	0.82	0.64–0.72
L3 (mm)	2.86–2.98	4.03	5.81–6.25
L3/L1	1.00–1.03	1.07	1.11–1.12
L3/L2	0.95–0.97	0.99	1.01–1.02
L3/HW	2.59	2.58	2.68–2.82
L3 (CO/FE)	0.74–0.81	0.76	0.81–0.86
L3 (TI/FE)	0.76–0.77	0.72	0.65–0.70
L3 (TA/FE)	0.58–0.59	0.52	0.45–0.48
L3 (CL/TA)	0.36–0.37	0.25	0.23–0.24
LAS (mm)	1.55–1.63	1.93	2.68–3.00
LAS/HW	1.41	1.23	1.22–1.33
U (mm)	0.60	0.75	1.05–1.34
U/LAS	0.37–0.39	0.39	0.39–0.45
U/HW	0.52	0.48	0.49–0.59

A: antenna; A1–A4: antennomeres 1–4; CL: longest claw; CO: coxa; COL: coronal line length; FE: femur; FRL: frontoclypeus length; GA: galea; HL: head length; HW: head width; LAS: length of last abdominal segment; LP: labial palpus; LP1–LP2: labial palpomeres 1–2; L1–L3: legs 1–3; MNL: mandible length; MNW: mandible width; MP: maxillary palpus; MP1–MP3: maxillary palpomeres 1–3; MW: maximum body width; OCW: occipital foramen width; PPF: palpifer; TA: tarsus; TI: tibia; TL: total body length (excluding urogomphi); U: urogomphus length.

Michat & Torres' [red, rectangular, printed label]. Paratypes (28 exs.): same data as holotype [white, rectangular, printed label], 'PARATYPE *Thermonectus tremouillesi* Michat & Torres' [red, rectangular, printed label] (13 males, five females, MACN; one male, one female NHML; one male, one female MNHN); same data as holotype, except '26–II–2004' [white, rectangular, printed label], 'PARATYPE *Thermonectus tremouillesi* Michat & Torres' [red, rectangular, printed label] (five males, one female, MACN).

Additional material examined

These are damaged or parts of specimens that we prefer not to include in the type series: Argentina, Entre Ríos Province, same data as holotype (six males, three females,

Table 2. Number and position of secondary setae on the legs of larvae of *Thermonectus tremouillesi*.

Segment	Position	Instar II (n = 1)	Instar III (n = 3)
Coxa	P	2/4–5/1–2	9–16/5–17/3–21
	V	5–7/4–5/4	11–17/7–20/11–22
	Total	7–9/8–10/5–6	23–33/12–33/21–39
Trochanter	Di	0/0/0–1	0–1/0–1/0–2
	Pr	2/2/2	4–9/4–7/4–9
	Total	2/2/2–3	5–9/5–7/5–9
Femur	A	1–4/8/20	9–13/16–31/16–40
	ADi	1–2/2–3/4	1–2/4–5/2–6
	D	6–8/6–7/10–12	10–15/18–24/16–28
	PDi	1/1/1	1/1/1
	PV	16–17/18–20/22–24	22–24/24–30/22–28
	Total	27–30/37/57–61	45–54/63–91/62–99
Tibia	A	1–2/8–10/24	6–9/13–35/14–39
	ADi	2/1/2	2/1–4/2–3
	D	11–12/11–12/14	11–13/16–25/15–21
	PDi	1/1/1	2/1/1
	PV	0/0/0	6–9/7–10/6–12
	Total	16/21–24/41	27–35/40–73/43–76
Tarsus	D	7–8/7–8/5	6–8/7–9/8
	V	8–9/6–10/11	10–12/9–13/10–12
	Total	16/14–17/16	17–19/16–22/18–20

Numbers between slashes refer to pro-, meso- and metathoracic leg, respectively. A: anterior, D: dorsal, Di: distal, P: posterior, Pr: proximal, V: ventral, Total: total number of secondary setae on the segment (excluding primary and natatory setae).

MCMC); Misiones Province, Iguazú NP, 12/19 August 2000 (one male, MCMC); Misiones Province, Iguazú NP, San Martín Island, 15 February 2002 (1 female, MCMC).

Diagnosis

Medium-sized species; colour pattern on head, pronotum and elytra as in Figure 1B, D, E; sexual sculpture of female elytra well visible, covering basal fourth to basal half (Figure 1D); male protibia narrow, dorsal margin slightly prominent (Figure 2D); tergite IX of male with four posterior projections (Figure 2F); median lobe of aedeagus bifid apically (Figure 2E); parameres with a terminal spur (Figure 2E).

Description

Habitus (Figure 1B, C). Oval, greatest width at posterior third, moderately narrowed anteriorly, regularly curved on margins, dorsal surface markedly convex; females somewhat larger than males; male: TL = 11.8–12.6 mm (mean = 12.1 mm); MW = 6.7–7.4 mm (mean = 7.2 mm) (N = 18) (holotype: TL = 12.4 mm; MW = 7.3 mm); female: TL = 12.2–13.2 mm (mean = 12.5 mm); MW = 7.0–7.7 mm (mean = 7.3 mm) (N = 6).

Colour. Dorsal surface (Figure 1B, D, E): yellowish to orangish background with black markings as follows: head with postocular band all along posterior margin, projected forward on internal ocular margin to approximately half of eye length, and isolated V-shaped macula in middle of interocular space (Figure 1E), sometimes coalescent with ocular markings (Figure 1B) [holotype: V-shaped macula isolated]; pronotum with transverse band on anterior margin, its width slightly greater than head width,

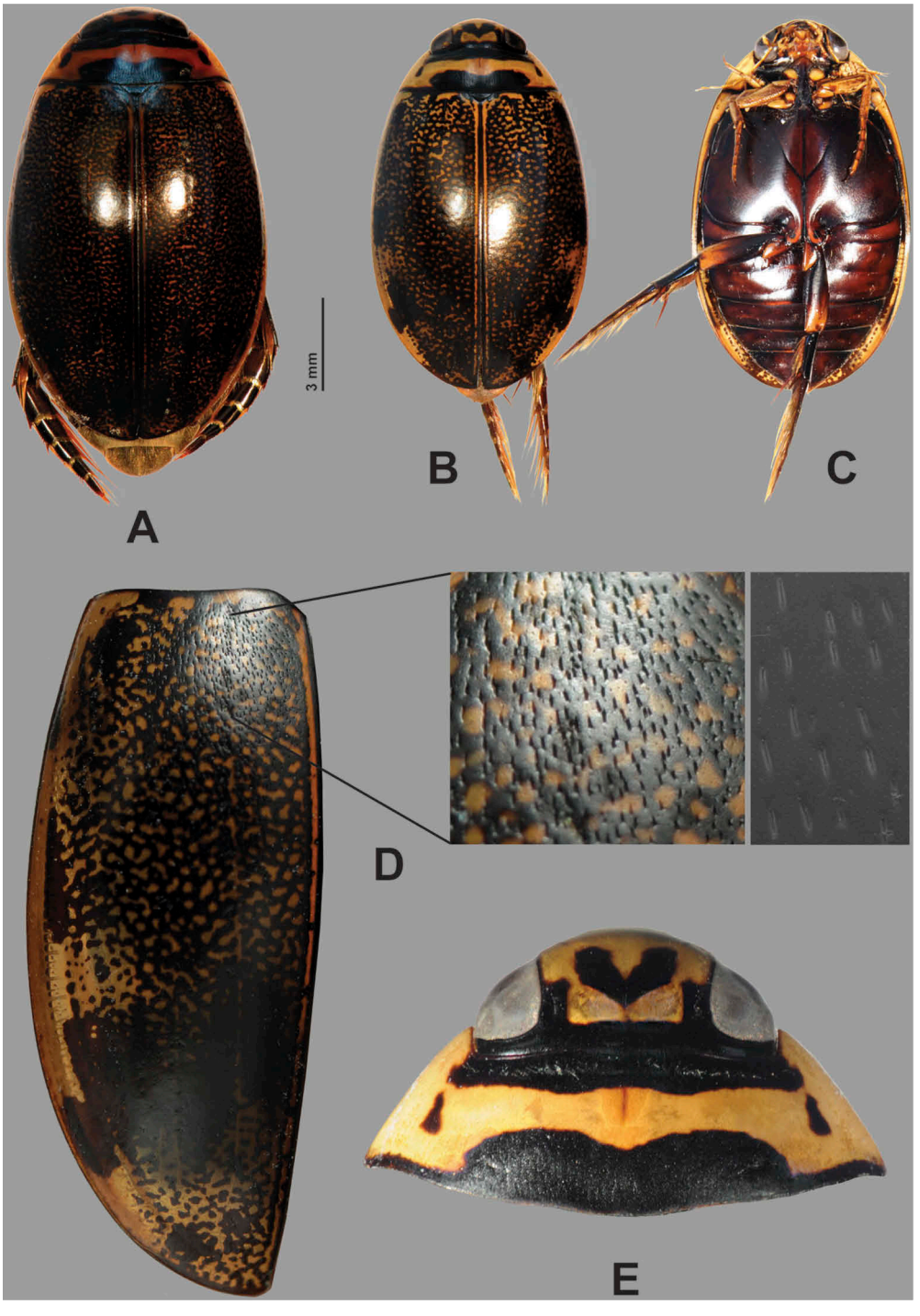

Figure 1. Photographs of adults of *Thermonectus*. (A) *T. alfredi*, male, habitus, dorsal aspect; (B–E) *T. tremouillesi*: (B) male, habitus, dorsal aspect; (C) male, habitus, ventral aspect; (D) female, left elytron, dorsal aspect, including details of punctation and sexual sculpture (right detail from SEM); (E) female, head and pronotum, dorsal aspect.

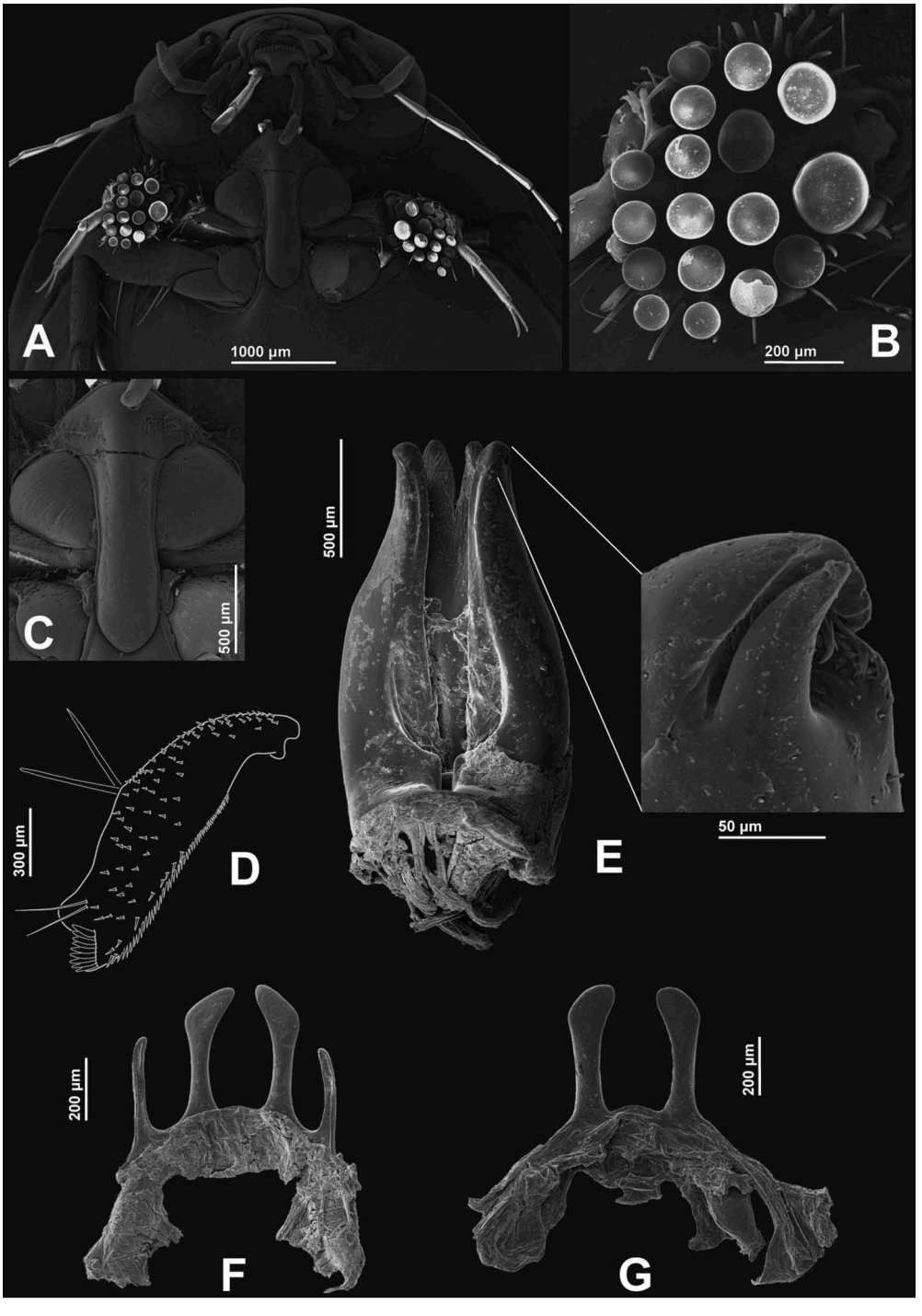

Figure 2. SEM images of male adults of *Thermonectus*. (A–F) *T. tremouillesi*: (A) anterior portion, ventral aspect; (B) right protarsal palette, ventral aspect; (C) prosternal process, ventral aspect; (D) right tibia, anterior aspect (line drawing); (E) aedeagus, ventral aspect, including detail of apex of right paramere; (F) tergite IX, ventral aspect; (G) *T. alfredi*, tergite IX, ventral aspect.

continued posterolaterally in short projections (Figure 1B) that sometimes appear as isolated maculae (Figure 1E) [holotype: anterior band and posterolateral projections connected], and transverse band on posterior margin, a bit narrower and about twice thicker than anterior band, with anterior border indented medially and laterals irregularly rounded and continued to pronotal edge as a fine marginal band; elytra irrorate, irroration absent or reduced on humeral angles, external and internal margins, and two submarginal areas, one just posterior to mid-length, the other subapical; irroration interrupted by an irregular transverse black fascia on distal fourth in some specimens (Figure 1D), in other specimens only an irregular submarginal macula is evident on each elytron (Figure 1B) [holotype: transverse fascia well developed]; internal margin of elytra with a fine black band from scutellum to apex. Ventral surface (Figure 1C): ferrugineous to piceus black except antennae, maxillary and labial palpi, pro- and mesolegs, ventral surface of pronotum, and epipleura yellowish, and base of prosternal process, metatrochantera and distal portion of metafemora orangish.

Sculpture and punctation. Smooth, shiny; microreticulation minute, of regular meshes; head, pronotum and to somewhat lesser degree elytra with very fine, closely distributed punctures combined with larger, sparsely distributed punctures (Figure 1D, SEM detail); each elytron with four longitudinal rows of widely spaced setiferous punctures, one contiguous to elytral commissure, the other three on disc; ventral side with fine, irregularly distributed punctation.

Structure. Head deeply set into pronotum, ratio head length/maximum head width about 0.4; pronotum deeply notched to hold head, ratio length of pronotum at midpoint/greatest width of pronotum about 1/3, ratio width on anterior margin of pronotum/width on posterior margin of pronotum about 0.6; prosternal process moderately widened on distal third, rounded apically (Figure 2C); posterior apex of scutellum rounded; elytra widely rounded on distal third (Figure 1B, D).

Male. Protibia narrow, dorsal margin slightly prominent (Figure 2D); tarsal palette bearing 18 (occasionally 19) sucker-like setae, three of the basal ones a bit larger (among these, one about 20% larger than the other two) and two of the distal ones a bit smaller than the others (Figure 2B); tergite IX with four posterior projections (Figure 2F); median lobe of aedeagus bifid apically (Figure 2E); parameres symmetrical, with a minute, partly concealed apical spur (Figure 2E, detail).

Female. Protibia not distinctly modified, dorsal margin not prominent; elytra bearing well-visible, closely spaced longitudinal sculpture on basal fourth to basal half (Figure 1D).

Variation

The V-shaped macula of head may be more or less developed; in extreme cases it reaches the ocular markings (Figure 1B, E). The pronotal central maculae show different degree of development, from small and isolated (Figure 1E) to somewhat larger and widely connected with the anterior transverse band of the pronotum. The transverse black fascia on distal fourth of the elytra varies greatly in extent; in most

specimens it is well developed (Figure 1D), but in some specimens it is reduced and appears as an irregular submarginal macula on each elytron (Figure 1B). The female sexual sculpture varies in extent, covering basal fourth (Figure 1D) to basal half of elytra.

Larvae

Diagnosis. Instar I (Figures 3A–I, 4A–E): head length: 1.40 mm; nasale rounded, markedly projected forward, bearing about 80–100 lamellae clypeales on anterior margin (Figure 3A); ratio length of maxillary palpus/length of labial palpus: 0.88–0.89; stipes with a row of 15–19 additional spine-like setae on dorsal surface (Figure 3E); prementum with three additional spine-like setae on each side of anterodorsal surface (Figure 3H); ratio length of metathoracic leg/head width: 2.59; pro-, meso- and metafemur with one, 1–2 and 2–3 additional anterodistal setae respectively (Figure 4A); additional measurements and ratios that characterise the body shape are shown in Table 1.

Instar II: head length: 1.88 mm; nasale rounded, markedly projected forward, bearing about 110–130 lamellae clypeales on anterior margin; parietal with 11 temporal and 8–9 ventral spine-like setae on each side; antennomere 1 with 5–7 secondary hair-like setae; mandible with a row of 30–32 secondary hair-like setae on basoexternal margin; ratio length of maxillary palpus/length of labial palpus: 0.88; stipes with a row of 28 dorsal secondary spine-like setae and 16–18 external and 35–40 dorsoexternal secondary hair-like setae; prementum with 9–10 secondary spine-like setae on each side of anterodorsal surface, bearing dorsal spinulae on basal half and on margins; ratio length of metathoracic leg/head width: 2.58; posterior surface of coxa with one secondary pore; additional measurements and ratios that characterise the body shape are shown in Table 1; detailed secondary leg setation is given in Table 2.

Instar III (Figure 4F–G): head length: 2.70–2.83 mm; nasale rounded, markedly projected forward, bearing about 190–210 lamellae clypeales on anterior margin (Figure 4F); anterolateral lobes of frontoclypeus not projecting beyond nasale (Figure 4F); parietal with 11–13 temporal and 9–15 ventral spine-like setae on each side; antennomere 1 with 8–11 secondary hair-like setae; mandible with a row of 28–38 secondary hair-like setae on basoexternal margin, and several minute secondary setae on external margin; ratio length of maxillary palpus/length of labial palpus: 0.82–0.87; stipes with a row of 25–35 dorsal secondary spine-like setae, 17–20 external and 32–50 dorsoexternal secondary hair-like setae, and few secondary, minute, ventroexternal setae; prementum with 10–14 secondary spine-like setae on each side of anterodorsal surface, bearing dorsal spinulae on basal half and on margins (Figure 4G); ratio length of metathoracic leg/head width: 2.68–2.82; posterior surface of coxa with 1–3 secondary pores; additional measurements and ratios that characterise the body shape are shown in Table 1; detailed secondary leg setation is given in Table 2.

Colour. Based on ethanol preserved specimens; therefore, colour pattern might be altered. Instar I: Background colour of cephalic capsule testaceous, stemmatal areas with more or less extended light brown macula; head appendages testaceous, distal half of mandible light brown; thoracic tergites light brown with diffuse testaceous maculae on laterals; legs testaceous to light brown; abdominal sclerites light brown; membranous parts creamy white; urogomphus brown with a narrow ring-like testaceous band at mid length.

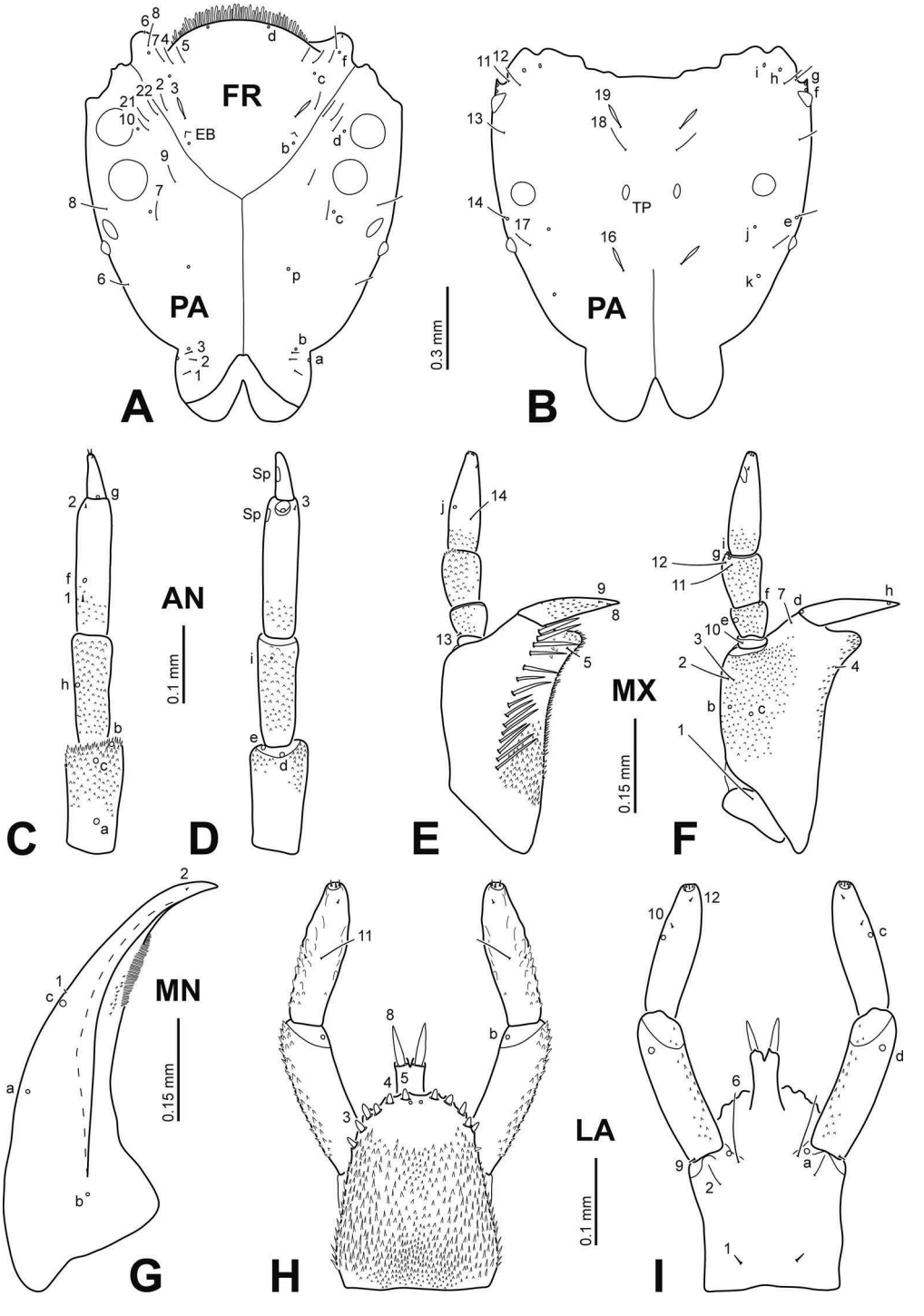

Figure 3. Line drawings of instar I larvae of *Thermonectus tremouillesi*. (A) Cephalic capsule, dorsal aspect; (B) cephalic capsule, ventral aspect; (C) left antenna, dorsal aspect; (D) right antenna, ventral aspect; (E) left maxilla, dorsal aspect; (F) right maxilla, ventral aspect; (G) left mandible, dorsal aspect; (H) labium, dorsal aspect; (I) labium, ventral aspect. Numbers and lowercase letters indicate ancestral setae and pores, respectively; additional sensilla not labelled. AN: antenna; EB: egg burster; FR: frontoclypeus; LA: labium; MN: mandible; MX: maxilla; PA: parietal; Sp: spinula; TP: tentorial pit.

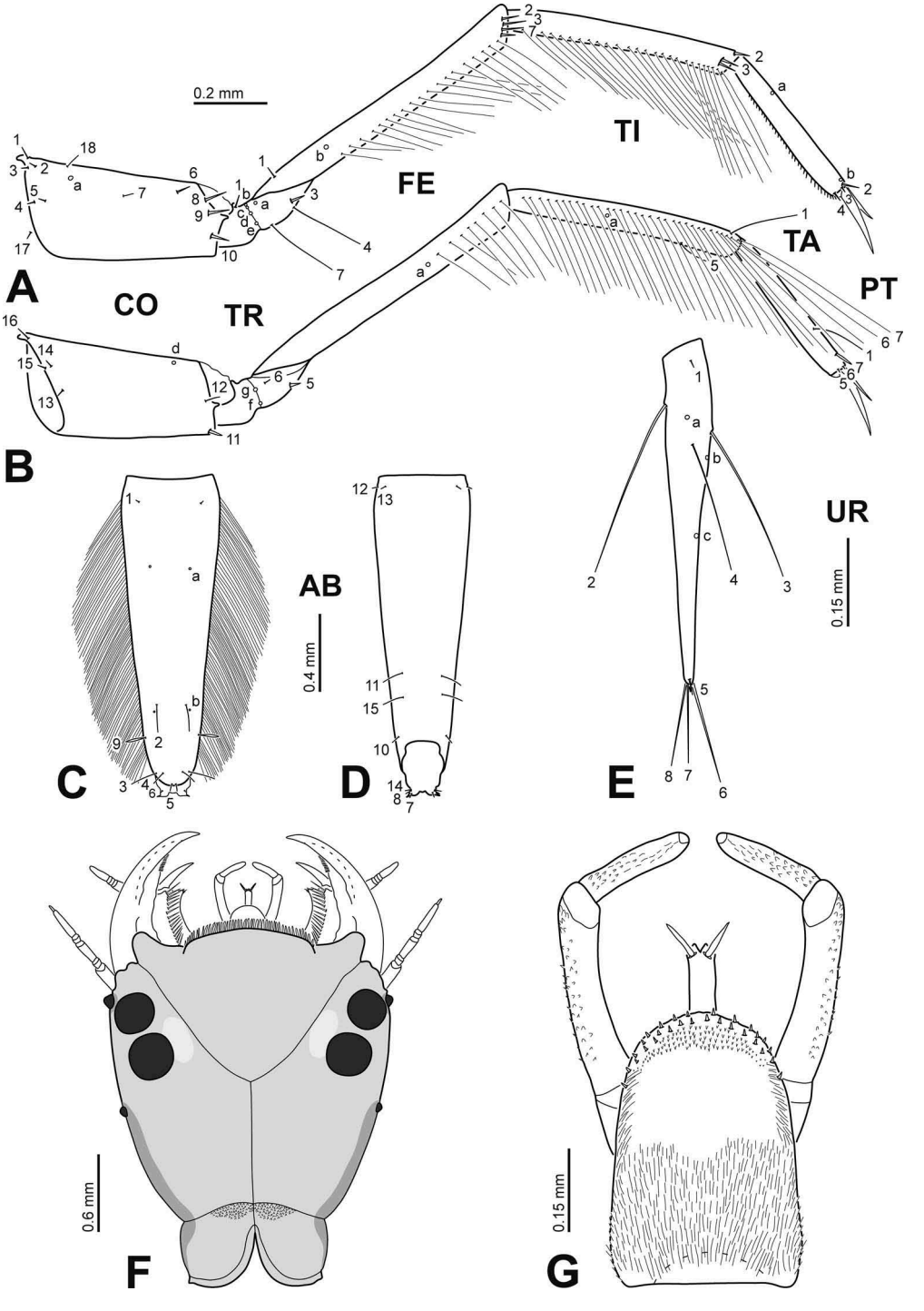

Figure 4. Line drawings of larvae of *Thermonectus tremouillesi*. (A) Left prothoracic leg of instar I, anterior aspect; (B) right prothoracic leg of instar I, posterior aspect; (C) abdominal segment VIII of instar I, dorsal aspect; (D) abdominal segment VIII of instar I, ventral aspect; (E) right urogomphus of instar I, dorsal aspect; (F) head of instar III, dorsal aspect, showing colour pattern on cephalic capsule (chaetotaxy omitted); (G) labium of instar III, dorsal aspect. Numbers and lowercase letters indicate ancestral setae and pores, respectively; additional sensilla not labelled. AB: abdominal segment VIII; CO: coxa; FE: femur; PT: pretarsus; TA: tarsus; TI: tibia; TR: trochanter; UR: urogomphus.

Instar II. As for instar I except: light brown stemmatal macula restricted to area surrounding anterolateral stemma; lateral margin of parietal with diffuse light brown area from posterior (smallest) stemma to occipital suture; urogomphus light brown, lacking ring-like testaceous band.

Instar III (Figure 4F). As for instar II except: somewhat darker in general; background colour of cephalic capsule light brown; light brown area on lateral margin of parietal more or less developed (sometimes absent); one small lighter macula contiguous to largest stemma; legs light brown.

Distribution

Argentina, Entre Ríos and Misiones Provinces.

Habitat

Thermonectus tremouillesi apparently exploits a particular habitat. It was found only in lentic water bodies in the forest, shaded with large- and medium-sized trees, with muddy bottom and dark cold water with abundant organic matter. In Iguazú NP (15 February 2002), nine larvae (one of them reared to the adult stage) were collected from a relatively small pond under a bridge, almost completely devoid of aquatic vegetation, in association with adults of *Tropisternus* Solier, 1834, *Copelatus* Erichson, 1832 and *Helochares* Mulsant, 1844, and larvae of *Tropisternus* and *Hydaticus palliatus* Aubé, 1838. In El Palmar NP (26 February 2002), several adults and one larva were taken from a small pond 3 m long, 2 m wide and 20 cm in depth, completely devoid of aquatic vegetation, in association with adults of *Tropisternus, Enochrus* Thomson, 1859, *Copelatus* and *Rhantus calidus* (Fabricius, 1792). In El Palmar NP (26 February 2004), several adults were taken from a large pond with similar characteristics to the previous sites except for the presence of floating vegetation (Figure 5), placed contiguously to the small pond sampled in 2002, which by that time was dry.

Etymology

Dedicated to Prof. Edgardo R. Trémouilles, in recognition of his valuable contributions to the knowledge of the dytiscid fauna of South America. The specific epithet is a noun in the genitive case.

Discussion

The identity of many insect species described a long time ago is based on succinct, undetailed and unillustrated original descriptions. Although, by the time they appeared, these descriptions served their purpose, the substantial increase in known diversity during the last few centuries has undoubtedly rendered many old descriptions insufficiently documented from a comparative point of view. This is particularly problematic in the cases in which the holotypes are lost, where species identity might be severely compromised. In the case documented in this paper, after gathering convincing information that the holotype of *T. laporti* is lost, we considered two possibilities of how to proceed: to consider that our specimens belong to *T. laporti* and possibly to designate a neotype, or to describe them as a new species. After several discussions with colleagues, the first option appeared more problematic because if we described our material as *T. laporti* and the lost

Figure 5. Habitat of *Thermonectus tremouillesi*: shaded, lentic water body at El Palmar NP, Entre Ríos Province, Argentina.

holotype eventually appeared, there could be some confusion. Also, some presumed differences in dorsal colour pattern (see below) might argue against the recognition of our specimens as *T. laporti*. On the other hand, if we described our material as a new species, and if the holotype of *T. laporti* appeared, two scenarios are possible: (1) both holotypes are identical implying a new synonymy, which is no major problem; and (2) both holotypes are different species which means there is no conflict. A careful consideration of these arguments underpinned our decision to describe our material as a new species.

Body size, dorsal colour pattern, and sexual and genital characters have proven to be the most useful in separating species within *Thermonectus* (McWilliams 1968; Trémouilles 1989). The distinct dorsal colour pattern of *T. tremouillesi* differentiates it from most species of the genus. Only four species (*T. alfredi, T. simulator* Sharp, 1882, *T. depictus* Sharp, 1882 and *T. laporti*) exhibit rather similar colouration, mostly on the head and pronotum. *Thermonectus alfredi* and *T. simulator* are two closely related species (Trémouilles 1989), undoubtedly close to *T. tremouillesi* in aedeagal structure, although visibly larger and bearing completely (or sometimes almost completely in *T. alfredi*) irrorate elytra (Figure 1A). The elytra in *T. tremouillesi* are mostly irrorate but exhibit premarginal yellowish to orangish areas and a more or less extended transverse black fascia (Figure 1B, D) which is never present in the other species. The shape of the male tergite IX of *T. tremouillesi*, bearing four posterior projections (Figure 2F), clearly differs from that of *T. alfredi* (Figure 2G) but is rather similar to that of *T. simulator*. The female

sexual sculpture, however, is well marked and closely spaced in *T. tremouillesi* (Figure 1D), whereas it is very subtle and more sparsely distributed in *T. simulator*. Also, the male protibia is narrow, with the dorsal margin slightly prominent in *T. tremouillesi* (Figure 2D), whereas in *T. simulator* and *T. alfredi* it is broader and the dorsal margin is more prominent, giving the tibia a rather triangular appearance (Trémouilles 1989). On the other hand, in *T. depictus*, the anterior pronotal transverse band has pointed ends, and the posterolateral projections (or isolated central maculae) are absent, whereas the tergite IX of the male bears only two posterior projections (Trémouilles 1989). As already mentioned, the separation of *T. tremouillesi* and *T. laporti* is more difficult based on available information. Both species have similar size and general colouration, although the following differences can be marked after comparison of our specimens with the original description of *T. laporti* (Aubé 1838): (1) the projection forward (following the internal ocular margins to approximately half of the eye length) of the postocular black band, which is present in *T. tremouillesi*, is not mentioned for *T. laporti*; this is a rather conspicuous feature, and its omission from the description of the latter species may indicate an absence; (2) the posterior transverse black band of the pronotum is 2.5 times broader than long in *T. laporti*, whereas it is more than four times broader than long in *T. tremouillesi*; also, the laterals of this band are continued to the pronotal edge as a fine marginal band in *T. tremouillesi*, which is not mentioned for *T. laporti*; (3) the elytra of *T. laporti* are described as being black and covered with yellowish rounded maculae; in *T. tremouillesi* the background colour of the elytra is yellowish to orangish and covered with black irroration. This last character, however, should be taken with care as it is just a point of view which colour (black or yellow) to choose as the background. *Thermonectus tremouillesi* keys to couplet 6 in Tremouilles' (1989) key on South American *Thermonectus*. This couplet is formed by *T. simulator* and *T. alfredi*, both species differing from *T. tremouillesi* in the characters mentioned above.

Despite great morphological similarity in larval morphology among *Thermonectus* species, the larvae of *T. tremouillesi* look more similar to those of *T. alfredi* (Michat 2013) than to those of *T. succinctus* (Michat and Torres 2005). The nasale is rounded and somewhat more projected forward in all instars of *T. tremouillesi* and *T. alfredi* (Figures 3A, 4F). In *T. succinctus*, the nasale is more flattened and less prominent. The first instars of *T. tremouillesi* and *T. alfredi* have a larger number of additional spine-like setae on the dorsal surface of the stipes (15–19 and 17–21 respectively, Figure 3E) and bear additional anterodistal setae on the femur (Figure 4A). *Thermonectus succinctus*, on the other hand, has fewer (6–12) additional setae on the stipes and lacks additional anterodistal setae on the femur. The second and third instars of *T. tremouillesi* can be distinguished from those of *T. alfredi* and *T. succinctus* in the larger number of secondary spine-like setae on the anterodorsal surface of the prementum. Also, the number of secondary hair-like setae on the basoexternal margin of the mandible is larger in *T. tremouillesi* and *T. alfredi* than in *T. succinctus*. With respect to the third instar, in *T. tremouillesi* and *T. alfredi*, the basal one-half to two-thirds of the dorsal surface of the prementum is covered with spinulae (Figure 4G), whereas in *T. succinctus*, the spinulae are present only on the basal third. The dorsal colour pattern of the cephalic capsule in *T. tremouillesi* and *T. succinctus* lacks light maculae on each side of the frontoclypeus and on the parietals (close to the joint of frontal and coronal sutures), thus differing from *T. alfredi*. The absence of dark maculae on the frontoclypeus of the mature larva of

T. tremouillesi (Figure 4F) also distinguishes it from the mainly North American species *T. basillaris* (Harris, 1829) and *T. nigrofasciatus ornaticollis* (Aubé 1838), which bear, in different degrees, frontoclypeal dark maculae (Wilson 1923; Carroll and Barman 2004).

Acknowledgements

We are grateful to Jiří Hájek and an anonymous referee for their valuable comments on the manuscript. We thank the curators of all the museums and institutions consulted while looking for the holotype of *Thermonectus laporti*. Thanks also to María L. Libonatti (University of Buenos Aires, Argentina) for her assistance in the Muséum national d'Histoire naturelle, Paris, France. We are grateful to Anders N. Nilsson (University of Umeå, Sweden), Edgardo R. Trémouilles (Argentine Museum of Natural Sciences, Argentina) and Axel O. Bachmann and Silvia A. Mazzucconi (University of Buenos Aires, Argentina) for useful discussions and comments on the holotype of *T. laporti*.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by Consejo Nacional de Investigaciones Científicas y Técnicas [grant number PIP1087] and by Agencia Nacional de Promoción Científica y Tecnológica [grant numbers PICT0135 and PICT0853].

References

Alarie Y, Michat MC, Miller KB. 2011. Notation of primary setae and pores on larvae of Dytiscinae (Coleoptera: Dytiscidae), with phylogenetic considerations. Zootaxa. 3087:1–55.

Aubé C. 1838. Hydrocanthares et gyriniens. In: Dejean PFMA, editor. Species général des coléoptères de la collection de M. le Comte Dejean. Vol. 6. Paris: Méquignon Père et Fils.

Carroll K, Barman EH. 2004. A redescription of the mature larva of *Thermonectus basillaris* Harris (Coleoptera: Dytiscidae: Dytiscinae). Georgia J Sci. 62:171–178.

Dejean PFMA. 1833. Catalogue des coléoptères de la collection de M. le comte Dejean. Livraisons 1 & 2. Paris: Méquignon-Marvis.

Erichson WF. 1832. Genera Dyticeorum. Berolini: Nietackianis.

Evenhuis NL. 2012. François-Louis Comte de Castelnau (1802–1880) and the mysterious disappearance of his original insect collection. Zootaxa. 3168:53–63.

Griffini A. 1898. Viaggio del Dott. Alfredo Borelli nel Chaco boliviano e nella Repubblica Argentina. XIII. Descrizione d'un nuovo *Thermonectes* di Tala (Republica Argentina). Bol Musei Zool Anat Com Reale Univ Torino. 13:1–2.

Harris TW. 1829. Corrections and additions for the "Contributions to entomology". New England Farmer 8:1–2.

Leach WE. 1817. The zoological miscellany; being descriptions of new or interesting animals. Vol. 3. London: E. Nodder & Son.

McWilliams KL. 1968. A taxonomic revision of the North American species of the genus *Thermonectus* Dejean (Coleoptera: Dytiscidae) [Doctoral thesis]. Indiana University, Bloomington, Indiana; 226 p.

Michat MC. 2013. Description of the larvae of *Thermonectus alfredi* Griffini, 1898 (Coleoptera: Dytiscidae). Kol Rdsch. 83:7–15.

Michat MC, Torres PLM. 2005. Larval morphology of *Thermonectus succinctus* (Aubé 1838) (Coleoptera: Dytiscidae: Dytiscinae), with biological notes and chaetotaxic analysis. Aquat Insects. 27:281–292.

Mulsant E. 1844. Histoire naturelle des Coléoptéres de France. Palpicornies. Paris: L. Maison.

Nilsson AN. 2015. A world catalogue of the family Dytiscidae, or the diving beetles (Coleoptera, Adephaga). Version 1.I.2015. Umeå: distributed electronically as a PDF file by the author, 298 pp. Available from: http://www2.emg.umu.se/projects/biginst/andersn/World catalogue of Dytiscidae 2015.pdf

Sharp D. 1882. On aquatic carnivorous Coleoptera or Dytiscidae. Sci T Roy Dublin Soc. 2:179–1003.

Solier AJJ. 1834. Observations sur la tribu des Hydrophiliens, et principalement sur le genre *Hydrophilus* de Fabricius. An Soc Entomol Fr. 3:299–318.

Thomson CG. 1859. Skandinaviens Coleoptera. Vol. 1. Lund: Berlingska Boktryckeriet.

Trémouilles ER. 1989. Contribución para el conocimiento del género *Thermonectus* Dejean en la Argentina y areas limítrofes (Coleoptera, Dytiscidae). Rev Soc Entomol Argentina. 46:95–115.

van den Branden C. 1885. Catalogue des coléoptères carnassiers aquatiques (Haliplidae, Amphizoidae, Pelobiidae et Dytiscidae). An Soc Entomol Belgique. 29:5–116.

Wiley EO. 1981. Phylogenetics. The theory and practice of phylogenetic systematics. New York (NY): John Wiley and Sons.

Wilson CB. 1923. Water beetles in relation to pondfish culture, with life histories of those found in fishponds at Fairport, Iowa. Bull Bur Fish. 39:232–345.