Koleopterologische Rundschau	83	7–15	Wien, September 2013

Description of the larvae of *Thermonectus alfredi* GRIFFINI, 1898 (Coleoptera: Dytiscidae)

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Abstract

The three larval instars of *Thermonectus alfredi* GRIFFINI, 1898 (Coleoptera: Dytiscidae) are described and illustrated for the first time, emphasizing the morphometry and chaetotaxy. In this species, the median process of the prementum is slightly bifid apically, bearing two spine-like setae (LA8), which are diagnostic features of the genus *Thermonectus* DEJEAN, 1833. The first instar of *T. alfredi* differs from that of *T. succinctus* (AUBÉ, 1838) in the number of additional spine-like setae on the dorsal surface of the stipes and on the anterodorsal surface of the prementum, and in the presence of additional anterodistal setae on the metafemur. On the other hand, the third instar of *T. alfredi* differs from those of *T. basillaris* (HARRIS, 1829) and *T. succinctus* in the number of secondary setae on the femur and the metatibia, and from that of *T. nigrofasciatus ornaticollis* (AUBÉ, 1838) in the length of seta LA8, which is shorter than the median process of the prementum.

Key words: Coleoptera, Dytiscidae, Aciliini, larval morphology, chaetotaxy, Neotropical Region, Argentina.

Introduction

The diving-beetle genus *Thermonectus* DEJEAN, 1833 (Dytiscinae: Aciliini) includes 19 species (NILSSON 2010). Their larvae are characterized by a planktonic lifestyle (WILSON 1923, MICHAT & TORRES 2005). Whereas this habit is shared with other members of the tribe Aciliini, it is contrasting with other groups of diving beetles in which the larvae live mainly on the bottom or close to aquatic plants.

Larval morphology of members of *Thermonectus* is poorly known, with only five species known as larvae: *T. nigrofasciatus ornaticollis* (AUBÉ, 1838) (WILSON 1923), *T. basillaris* (HARRIS, 1829) (WILSON 1923, BARMAN & CARROLL 2002, CARROLL & BARMAN 2004, BARMAN & EPLER 2005), *T. circumscriptus* (LATREILLE, 1809) (BERTRAND 1931), *T. succinctus* (MICHAT & TORRES 2005, ALARIE et al. 2011), and *T. alfredi* (CRESPO 1987). See also SPANGLER (1966) for description of an unidentified larva. The existing descriptions have different degrees of detail, and chaetotaxy was emphasized only in few cases, which prevent in-depth comparisons among the species (see MICHAT & TORRES 2005 for a summary of the state of knowledge of the larval morphology of the genus).

Thermonectus alfredi GRIFFINI, 1898 is a large species that lives in mountainous areas in northwestern Argentina and in the Ventania system in central eastern Argentina (TRÉMOUILLES 1989). The only larval description for this species (mature larva) can be found in an unpublished thesis by CRESPO (1987), not widely available. The results of the present paper are based on the discovery of all instars of *T. alfredi* in the Ventania system, which gives the opportunity to provide a description and chaetotaxic analysis of the larvae. This paper is meant to be a step toward a better knowledge of the genus *Thermonectus*, and has the following goals: 1) to describe and illustrate the three larval instars of *T. alfredi*, 2) to perform detailed morphometric and chaetotaxic analyses of selected larval structures, and 3) to compare these larvae with those of other species of the genus.

Material and methods

Five specimens of instar I, three of instar II and four of instar III were used for the descriptions. The larvae were collected in association with adults at the following locality: Argentina, Buenos Aires Province, Sierra de la Ventana, Ernesto Tornquist Park, December 2006.

Specimens were cleared in lactic acid, dissected and mounted on glass slides with polyvinyl-lacto-glycerol. Observation (at magnifications up to 1000 ×) and drawings were made using an Olympus CX31 compound microscope equipped with a camera lucida. Drawings were scanned and edited digitally. The material is deposited in the collection of the author (Laboratory of Entomology, Buenos Aires University, Argentina).

The methods and terms used in the present paper follow those employed in previous papers dealing with the larval morphology and chaetotaxy of members of the subfamily Dytiscinae. The reader is referred to MICHAT & TORRES (2005) and ALARIE et al. (2011) for a complete list of the terms commonly used in the study of dytiscid larvae.

Table 1: Measurements and ratios for the three larval instars of *Thermonectus alfredi*.

Measure	Instar I (n = 3)	Instar II (n = 3)	Instar III (n = 3)
HL (mm)	1.46–1.53	2.20–2.26	3.14–3.23
HW (mm)	1.18–1.21	1.73–1.75	2.40–2.45
FRL (mm)	0.66–0.70	0.98–1.01	1.33–1.39
OCW (mm)	0.43–0.45	0.73–0.75	1.11–1.20
HL/HW	1.23–1.30	1.26–1.29	1.31–1.34
HW/OCW	2.64–2.85	2.33–2.38	2.00–2.16
COL/HL	0.54–0.55	0.55–0.56	0.57–0.58
FRL/HL	0.45–0.46	0.44–0.45	0.42–0.43
A/HW	0.46–0.49	0.43–0.46	0.42–0.44
A1/A3	0.81–0.85	0.76–0.82	0.77–0.89
A2/A3	0.85–0.89	0.83–0.86	0.85–0.94
A4/A3	0.31–0.32	0.19–0.24	0.11–0.13
MNL/MNW	2.65–2.70	2.74–2.79	2.95–3.44
MNL/HL	0.43–0.45	0.42–0.44	0.43–0.44
PPF/MP1	0.33–0.36	0.27–0.33	0.24–0.27
A/MP	1.68–1.73	1.68–1.73	1.59–1.67
MP1/MP2	0.60–0.71	0.69–0.85	0.75–0.85
MP3/MP2	1.85–2.24	1.69–1.73	1.40–1.50
GA/MP1	2.75–2.91	2.44–2.89	2.53–2.80
MP/LP	0.78–0.83	0.74–0.76	0.74–0.76
LP2/LP1	0.93–0.95	0.79–0.83	0.70–0.80
L3 (mm)	3.11–3.25	4.76–4.92	7.19–7.46
L3/L1	1.03–1.05	1.07–1.09	1.12–1.14
L3/L2	0.97–1.02	0.99–1.00	1.01–1.04
L3/HW	2.62–2.68	2.76–2.81	3.00–3.05
L3 (CO/FE)	0.69–0.76	0.77–0.78	0.84–0.86
L3 (TI/FE)	0.75–0.76	0.71–0.73	0.69–0.70
L3 (TA/FE)	0.53–0.57	0.50–0.51	0.46–0.47
L3 (CL/TA)	0.40–0.42	0.28–0.29	0.22–0.24
LAS (mm)	1.50–1.63	2.28–2.30	3.18–3.28
LAS/HW	1.26–1.38	1.30–1.33	1.30–1.36
U (mm)	0.59–0.64	0.86–0.88	1.18–1.23
U/LAS	0.38–0.39	0.38	0.36–0.39
U/HW	0.49–0.53	0.49–0.51	0.49–0.51

Results

Description of the larvae of *Thermonectus alfredi* GRIFFINI, 1898

A detailed description of all instars of *Thermonectus succinctus* (AUBÉ, 1838) was published by MICHAT & TORRES (2005). For this reason, the morphological and chaetotaxic characters common to both species are not included in the present paper, and only diagnostic features are mentioned.

Diagnosis:

Instar I. Measurements and ratios that characterize the body shape are shown in Table 1; FR with 93–123 well developed lamellae clypeales on anterior margin; pore ANa located more distally; stipes with a row of 17–21 additional spine-like setae on dorsal surface (Fig. 1); prementum with 2–3 additional spine-like setae on each side of anterodorsal surface (Fig. 2); L2 and L3 the longest, subequal, L1 somewhat shorter; pro-, meso- and metafemur with 1–4, 2–3 and 2–5 additional anterodistal setae respectively (Fig. 3).

Instar II. Measurements and ratios that characterize the body shape are shown in Table 1; FR with about 140–180 lamellae clypeales on anterior margin; PA with 9–14 temporal and 11–14 ventral spine-like setae on each side; A with 7–9 secondary hair-like setae; MN with a row of 30–44 secondary hair-like setae on basoexternal margin; stipes with a row of 30–35 dorsal secondary spine-like setae and 20–25 external and 26–44 dorsoexternal secondary hair-like setae; prementum with 3–6 secondary spine-like setae on each side of anterodorsal surface, and with dorsal spinulae on basal 2/3; secondary leg setation detailed in Table 2.

Instar III. Measurements and ratios that characterize the body shape are shown in Table 1; FR with about 200–220 lamellae clypeales on anterior margin (Fig. 4); PA with 11–12 temporal and 16–25 ventral spine-like setae on each side (Fig. 5); A1 with 7–8 secondary hair-like setae; MN with a row of 38–51 secondary hair-like setae on basoexternal margin, and several minute secondary setae on apicoexternal margin (Fig. 6); stipes with a row of 31–37 dorsal secondary spine-like setae, 21–25 external and 36–48 dorsoexternal secondary hair-like setae, and 4–6 secondary, minute, ventroexternal setae (Fig. 7); prementum with 6–7 secondary spine-like setae on each side of anterodorsal surface; L3 somewhat longer than L2; posterior surface of CO with 3–5 secondary pores; secondary leg setation detailed in Table 2.

Description of colour:

Instar I. Background colour of cephalic capsule testaceous, anterior half of FR and stemmatal areas brown, neck and dorsomedial portion of PA light brown; antenna testaceous except for A4, distal third of A1 and A2, and distal 2/3 of A3 light brown; basal half of MN brown, distal half light brown; GA, PPF, distal half of stipes, and distal 2/3 of MP3 light brown to brown; cardo, MP1, MP2, basal half of stipes, and basal third of MP3 testaceous; labium testaceous to light brown except for median process of prementum and distal 2/3 of LP2 brown; thoracic tergites light brown with diffuse testaceous maculae on laterals; legs testaceous except for TI, TA, and distal 2/3 of FE brown; abdominal sclerites I–VII light brown, abdominal sclerite VIII testaceous in basal 1/3, brown in distal 2/3; membranous parts testaceous; U brown with a narrow ring-like testaceous band at mid length.

Instar II. As instar I except: brown areas of cephalic capsule darker, PA brown posterior to stemmata; head appendages darker in general, evenly light brown to brown; colour pattern of legs less evident, FE, TI and TA only a little darker than CO and TR; distal 2/3 of abdominal sclerite VIII dark brown; U without ring-like testaceous band.

Table 2: Number and position of secondary setae on the legs of larvae of *Thermonectus alfredi*. Numbers between slash marks 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).

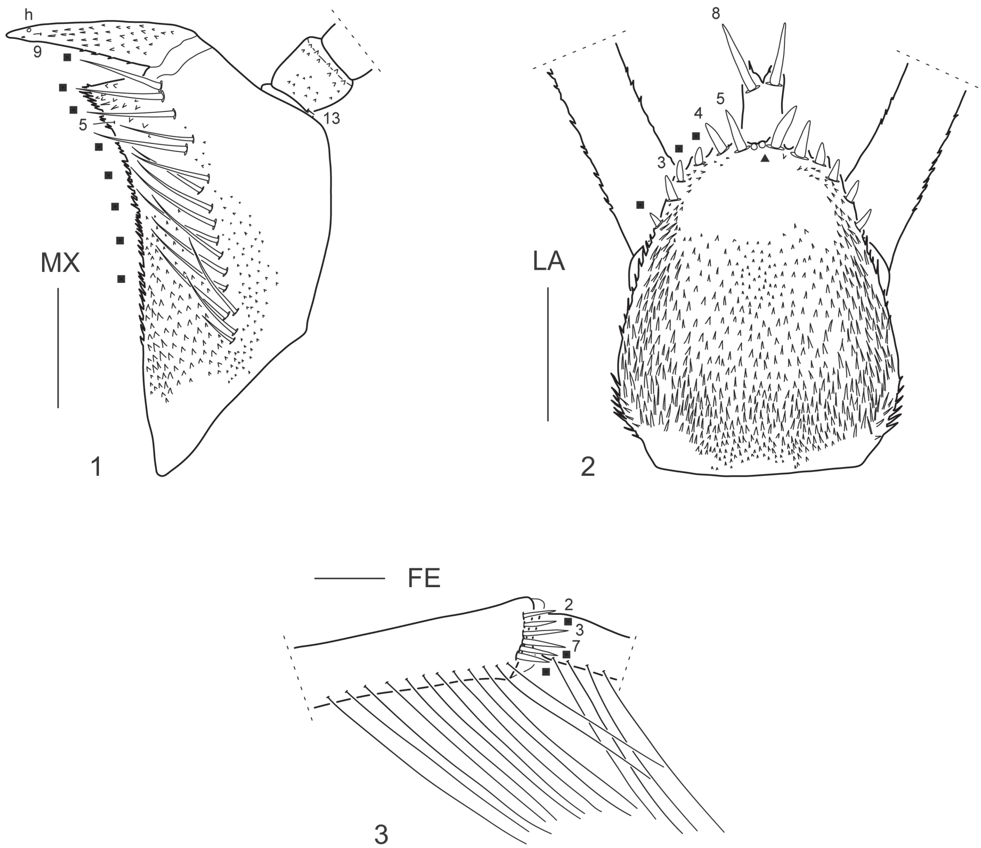
Segment	Position	Instar II (n = 3)	Instar III (n = 3)
Coxa	P	4–10 / 5–11 / 0–2	12–18 / 14–18 / 6–9
	V	6–10 / 8–11 / 3–10	13–20 / 18–25 / 15–21
	Total	11–19 / 13–21 / 4–12	31–36 / 34–41 / 21–30
Trochanter	Di	0–1 / 0 / 0	0–1 / 1–4 / 1–5
	Pr	0–1 / 1–3 / 2–4	5–8 / 7–9 / 9–12
	Total	0–1 / 1–3 / 2–4	6–9 / 9–13 / 12–15
Femur	A	8–14 / 16–25 / 27–44	15–24 / 28–40 / 39–52
	ADi	2–5 / 3–5 / 4–7	6–7 / 6–9 / 6–10
	D	7–11 / 9–17 / 13–22	17–20 / 23–25 / 30–44
	PDi	0–1 / 1 / 1	1 / 1 / 1
	PV	22–32 / 28–33 / 28–33	26–35 / 37–41 / 30–40
	Total	46–53 / 59–76 / 80–103	68–82 / 97–116 / 122–139
Tibia	A	4–12 / 12–18 / 28–39	8–16 / 19–28 / 40–46
	ADi	2–3 / 2–3 / 1–4	4 / 3–6 / 4–7
	D	11–14 / 14–17 / 15–25	16–17 / 21–26 / 34–50
	PDi	1–2 / 1 / 1–2	1–2 / 1–3 / 1–2
	PV	0 / 0 / 0–1	1–7 / 6–9 / 7–10
	Total	19–28 / 30–37 / 46–66	31–44 / 53–64 / 89–111
Tarsus	D	4–7 / 4–6 / 4–7	5–8 / 3–8 / 6–12
	V	11–15 / 13–16 / 13–17	10–14 / 11–16 / 15–19
	Total	15–21 / 17–20 / 18–23	16–21 / 17–22 / 22–28

Instar III. As instar II except: cephalic capsule entirely brown except for one small macula on each lateral margin of FR and two small maculae on each side of PA (one contiguous to largest stemma and one posteromedial to it); abdominal sclerite VIII evenly brown, of similar colour as sclerites I–VII.

Habitat:

The larvae were captured in Ernesto Tornquist Park, Buenos Aires Province, Argentina. The park covers an area of more than 6500 ha in the Ventania orographic system, which is composed of an isolated mountain chain (maximum altitude: 1247 m a.s.l.) that emerges from the Pampas plains in Southwest Buenos Aires Province (FERNÁNDEZ et al. 2010). These mountains are part of the so-called 'arco serrano peripampásico' (FRENGUELLI 1950), which comprises southern Brazil, part of Uruguay, northwestern Argentina, and the isolated Tandilia and Ventania systems in Buenos Aires Province. It has been postulated that the Ventania system functions as a kind of environmental trap (orographic island), with a high level of endemism and unusual species not found in the surrounding areas (see FERNÁNDEZ et al. 2010). Actually, the presence of some Hydradephaga species typical of the sub-Andean zones of northwestern Argentina (as *T. alfredi*, *Desmopachria punctatissima* ZIMMERMANN, 1923 and *Gyrinus monrosi* MOUCHAMPS, 1957) reinforces the hypothesis of the 'arco serrano peripampásico', which postulates that the mountain range covering parts of Brazil, Uruguay and Argentina once formed a single biotic unit, of which today there are only fragments left.

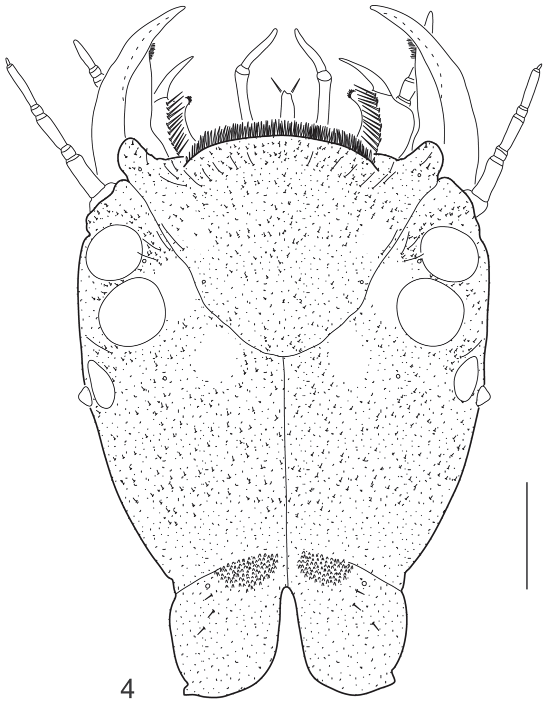
The larvae were captured in portions of stagnant water along a small mountain creek that originates in the southwestern slopes of the Ventania mountain system and flows to the Atlantic Ocean. The water was clear, cold (due to the shadow of the mountains during most of the day), with scarce variation in temperature and low evaporation, and the bottom was rocky with some organic matter (Figs. 8–9). Aquatic plants (mainly *Juncus* rushes) were scarce, present only in the margins of some portions.



Figs. 1–3: *Thermonectus alfredi*, first-instar larva, 1) right stipes, dorsal view, 2) prementum, dorsal view, 3) apex of left metafemur, anterior view. Solid squares refer to additional setae; solid triangle refers to additional pore. Scale bars = 0.10 mm.

Discussion

The larvae of *T. alfredi* are characterised by a median process of the prementum shortly bifid apically, which bears two spine-like setae (LA8). These two characters define the genus *Thermonectus* (MICHAT & TORRES 2005), as in the other Aciliini genera the median process is either unifid or deeply bifid and carries at least four spine-like setae (BERTRAND 1972, LARSON et al. 2000, ALARIE et al. 2011).



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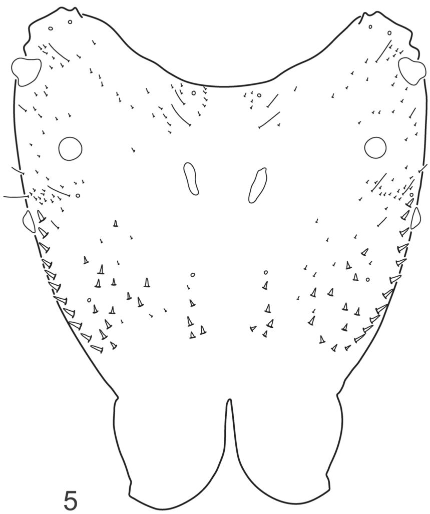

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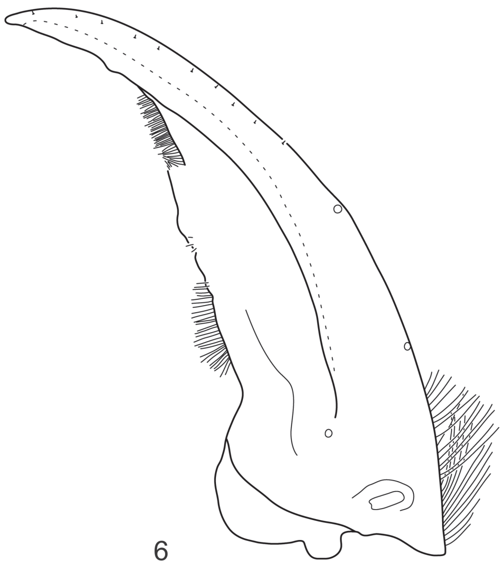

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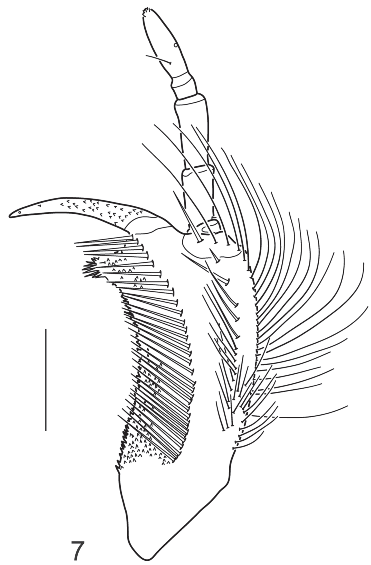

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Figs. 4–7: *Thermonectus alfredi*, third-instar larva, 4) head, dorsal view, showing colour pattern, 5) head, ventral view, 6) right mandible, dorsal view, 7) right maxilla, dorsal view. Scale bars: 4–5 = 0.60 mm, 6–7 = 0.30 mm.

Figs. 8–9: Habitat of *Thermonectus alfredi*, 8) portion of stagnant water along a small mountain creek in Ernesto Tornquist Park, Sierra de la Ventana, Argentina, 9) exact point of collection, near aquatic vegetation.

The descriptions of *Thermonectus* larvae by WILSON (1923), BERTRAND (1931) and SPANGLER (1966) refer mainly to general morphological characters that are similar among the species. As a consequence, it is difficult to find reliable characters to differentiate them from the other species. Larvae of *T. alfredi* differ from those of the other known species by their larger size (head length > 3 mm in instar III).

Chaetotaxy (both primary and secondary) has proven to be an important source of characters to separate taxa with a very similar morphology. Unfortunately, chaetotaxy was explored in detail only for *T. succinctus*, *T. alfredi*, and to a lesser extent *T. basillaris*. The third instar larva of *T. alfredi* (as well as those of *T. succinctus*, *T. circumscriptus*, and *T. basillaris*) differ from the third instar of *T. nigrofasciatus ornaticollis* in the relative length of the seta LA8, which is shorter than the median process of the prementum; the third instar of *T. nigrofasciatus ornaticollis* has the seta LA8 as long as the median process. From the mature larvae of *T. succinctus* and *T. basillaris*, the third instar of *T. alfredi* differs in its more numerous setation, in particular considering the following ranges. Secondary setae on the femur: *T. alfredi* (68–139), *T. basillaris* (32–53), *T. succinctus* (24–47); secondary setae on the metatibia: *T. alfredi* (89–111), *T. basillaris* (29–39), *T. succinctus* (28–36); secondary spine-like setae on each side of the ventral surface of the parietal: *T. alfredi* (16–25), *T. succinctus* (6–10); secondary hair-like setae on the basoexternal margin of the mandible: *T. alfredi* (38–51), *T. succinctus* (14–19); secondary spine-like setae on the dorsal surface of the stipes: *T. alfredi* (31–37), *T. succinctus* (21–26).

With the present description, the first instars of only two species are known at present: *T. alfredi* and *T. succinctus* (MICHAT & TORRES 2005, ALARIE et al. 2011). The first instar of *T. alfredi* differs from that of *T. succinctus* in the presence of 17–21 additional spine-like setae on the dorsal surface of the stipes (6–12 in *T. succinctus*), 2–3 additional spine-like setae on each side of the anterodorsal margin of the prementum (0–2 in *T. succinctus*), and 2–5 additional anterodistal setae on the metafemur (0–1 in *T. succinctus*). This last character is more similar to the condition found in first instars of the genera *Acilius* LEACH, 1817 and *Graphoderus* DEJEAN, 1833, in which 3–6 additional anterodistal setae are present on the femur (ALARIE et al. 2011).

Acknowledgements

Thanks to Helena Shaverdo for the critical review of the manuscript and valuable comments. This work was supported by projects PIP 2005–5924 and PIP 2008–2759 from CONICET, and project PICT–2010–0526 from ANPCyT.

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Es ist geplant, dieses Projekt auf das gesamte Faunengebiet Mitteleuropas im Sinne des Werkes „Die Käfer Mitteleuropas von Freude/Harde/Lohse“ auszudehnen.

Falls Sie Interesse haben, dieses Projekt aktiv zu unterstützen, registrieren Sie sich bitte auf der Web-Seite **www.colkat.de** und schicken sie eine Nachricht per E-Mail an Ortwin Bleich: **o.bleich@gmx.de**.

O. Bleich