

ORIGINAL ARTICLE

**Descriptions of the preimaginal stages of *Lancetes marginatus* (Steinheil) and *L. biremis* Ríha (Coleoptera: Dytiscidae), and comparative notes with other *Lancetes* larvae**

MARIANO C. MICHAT<sup>1</sup>, MIGUEL ARCHANGELSKY<sup>2</sup>, & PATRICIA L. M. TORRES<sup>1</sup>

<sup>1</sup>Departamento de Biodiversidad y Biología Experimental, Universidad de Buenos Aires, Argentina, and <sup>2</sup>CONICET – LEA, Universidad Nacional de La Patagonia San Juan Bosco, Esquel, Chubut, Argentina

(Received 24 March 2004; accepted 9 February 2005)

**Abstract**

All the preimaginal stages of *Lancetes marginatus* (Steinheil) and third instar larva of *L. biremis* Ríha are described and figured for the first time. Detailed analyses of the morphometry, chaetotaxy and porotaxy are provided, and comparisons with the immatures of other species of the genus are included. The larvae described have multifragmented urogomphi, the only larval synapomorphy that defines the genus *Lancetes* Sharp. Third instars also present a secondary subdivision in some of the cephalic appendages, which is a synapomorphy of *Lancetes* plus Dytiscinae. First instar larva of *L. marginatus* is distinguished from the remaining known first instars of *Lancetes* by the absence of primary pores FRe and MXa, and the presence of one additional minute seta on the dorsal surface of antennomere 4 and one additional pore on the urogomphus. The third instar of *L. marginatus* is unique by the absence of secondary dorsal setae on the femur. The pupa of *L. marginatus* differs from that of *L. angusticollis* by the presence of fewer setae on the head, pronotum and abdominal terga V to VIII.

**Keywords:** Coleoptera, Dytiscidae, *Lancetes*, larvae, Argentina

**Introduction**

The transantarctic genus *Lancetes* Sharp comprises 22 species of medium-sized Dytiscidae, distributed mainly in southern South America and subantarctic islands (Ríha 1961; Nilsson 2001). Adults of this genus have been revised by Bachmann and Trémouilles (1981), who recognized 16 species (including four subspecies) for continental Argentina.

Several descriptions of *Lancetes* larvae can be found in the literature, but the degree of detail used by the different authors is variable. The most complete and detailed descriptions of the larval morphology for the genus were provided by Alarie et al. (2002). The third instar larva and the pupa of one species of *Lancetes* were described from Chile by Cekalovic and Spano (1981) as *L. flavoscutatus* Enderlein. These descriptions probably refer to another species, *L. arauco* Bachmann and Trémouilles, since the distribution of *L. flavoscutatus* is restricted to the Malvinas

islands (Bachmann, pers. comm.). The mature larva of *L. angusticollis* (Curtis) was described for the first time by Mjöberg (1906) as *Anisomera clausi* Müller, and was redescribed by Beier (1928), Brinck (1945) and Gressitt (1970) as *Lancetes clausi* (Müller), and by Bertrand (1928). Brinck (1948) described the young larva of this species and Alarie et al. (2002) gave a description of the first and third instars. A description of the pupa of *L. angusticollis* was presented by Brancucci and Ruhnau (1985). First and second instar larvae of *L. varius rotundicollis* (Babington) were described by Bertrand (1934). The larvae of *L. lanceolatus* (Clark) were briefly described by Watts (1963), and second and third instars by Alarie et al. (2002). Brinck (1948) described the first and third instar larvae of *L. dacunhae* Brinck. The mature larva of *L. nigriceps* (Erichson) was described for the first time by Brinck (1948). Alarie et al. (2002) redescribed the mature larva of *L. nigriceps*; according to the collecting site of these larvae, they may

belong to *L. nigriceps nordenskjoldi* Zimmermann (Bachmann & Trémouilles 1981). All instar larvae of *L. delkeskampii* Řiha and *L. subseriatus* Zimmermann, and the mature larva of *L. flavoscutatus*, were described by Alarie et al. (2002). Finally, a description of the third instar larva of *L. arauco* was provided by Crespo (1987).

Since Sharp (1882) erected the genus, the phylogenetic placement of *Lancetes* within the Dytiscidae has been a topic of controversy. Recent works on the phylogeny of this family based on characters from adults (Miller 2001) and larvae (Ruhnau & Brancucci 1984; Alarie et al., 2002) postulate a sister-group relationship between *Lancetes* and members of the subfamily Dytiscinae. However, detailed studies of the larval morphology of more species of *Lancetes* are needed to support this hypothesis. In the context of modern works on Dytiscidae, the system of nomenclature of larval chaetotaxy and porotaxy developed for the subfamily Colymbetinae (Nilsson 1988; Alarie 1995, 1998) and the genus *Lancetes* (Nilsson 1988; Alarie et al. 2002), combined with a detailed analysis of the morphometric relationships among different structures of the larvae, provides a useful basis to distinguish larvae of different species and to determine characters that enable one to establish phylogenetic relationships among the taxa.

In this paper we describe all the preimaginal stages of *L. marginatus* (Steinheil) and the third instar larva of *L. biremis* Řiha, both from Argentina. Analyses of the morphometry and primary and secondary chaetotaxy and porotaxy of the head capsule, head appendages, legs, last abdominal segment and urogomphi are provided, following that employed in previous papers dealing with larval morphology of the genus *Lancetes* (Alarie et al. 2002) and the subfamily Colymbetinae (Alarie 1995, 1998). Comparisons with the immatures of other species of the genus are included.

## Materials and methods

Larvae of *L. marginatus* (27 instar I) were brought alive to the laboratory and reared in small plastic aquaria (40 mm diameter) with 5–10 mm tap water. As food, mosquito and ephemeropteran larvae were supplied every day. Remaining larval instars, pupae and five adults were obtained. Larvae of *L. biremis* (14 instar III) were captured in association with adults and fixed after collection. Specimens of both species were cleared in warm lactic acid, disarticulated and mounted on standard glass slides with Hoyer's medium. Observation (at magnifications up to 1000x) and drawings were made using a compound microscope equipped with camera lucida. Setae located at the apex of maxillary and labial palpi were extremely difficult to individualize due to their

position and small size; accordingly, they were not thoroughly represented. The material studied is deposited in the larval collection of M. C. Michat (Laboratory of Entomology, Buenos Aires University, Argentina).

For morphometric and chaetotaxic analyses, we followed the terminology employed by Alarie (1995, 1998) and Alarie et al. (2002). The ground-plan condition for the larvae of the genus *Lancetes* was established by Alarie et al. (2002); for this reason, characters common to all species of the genus are not included in the descriptions, and only diagnostic features are presented here. Paired structures of each individual were considered independently. The following measures were taken: head length (HL): total head length including the frontoclypeus, measured medially along epicranial stem. Head width (HW): maximum width measured posterior to stemmata. Length of frontoclypeus (FCL): from apex of nasale to back of ecdysial suture. Occipital foramen width (OcW): maximum width measured along dorsal margin. Length of antenna: derived by adding the length of each antennomere; A3' is used as an abbreviation for the lateral elongation of antennomere 3. Length of maxillary and labial palpi: derived by adding the length of each palpomere. Length of galea: measured from apex of galea to margin of stipes. Length of palpifer: measured along lateral margin. Length of legs: derived by adding the length of each segment including the longest claw; the length of each segment was taken at the longest point except for the trochanter, which includes only the proximal portion (the length of distal portion is included in the femoral length). Dorsal length of last abdominal segment (LLAS): measured along mid-line from anterior to posterior margin. Length of urogomphus: total length from base to apex. These individual measurements were used to calculate several ratios, which characterize the body shape.

Primary and secondary setae and pores were identified for the head capsule, head appendages, legs, last abdominal segment and urogomphi. Sensilla were coded by two capital letters, in most cases corresponding to the first two letters of the name of the structure on which they are located, and a number (setae) or a lower case letter (pores). The following abbreviations were used: AB: eighth abdominal segment, AN: antenna, CO: coxa, FE: femur, FR: frontoclypeus, LA: labium, MN: mandible, MX: maxilla, PA: parietal, TA: tarsus, TI: tibia, TR: trochanter, UR: urogomphus. When counting secondary setae and pores on the legs of second and third instar larvae, both legs of each individual were considered independently. Additional setae on femora and tibiae of first instar larvae were included in the count of secondary setae of second and third instars.

Adult specimens were identified using the key provided by Bachmann and Trémouilles (1981).

## Results

### *Lancetes marginatus* (Steinheil)

#### Source of material

20 instar I, 3 instar II, 6 instar III and 2 pupae were used for descriptions. Larvae were collected throughout a one-year sampling period at Buenos Aires City, Argentina, but they were most common in winter. The habitats sampled were temporary pools with abundant vegetation. For rearing purposes several first instar larvae were collected on 25.VI.2001 in a shallow temporary rain pool.

#### Description

Instar I larva. Color. Dorsal surface of head light brown, except for darker brown areas centrally and behind stemmata; ventral surface evenly light brown. Head appendages yellowish, fourth antennomere and distal portion of last maxillary and labial palpomeres dark, mandibles light brown. Thoracic and abdominal tergites greenish, membranous parts yellowish. Legs evenly yellowish to light brown. Urogomphi greenish except for the base yellowish.

**Body** (Figure 1). Subcylindrical, total length (excluding urogomphi) = 3.0–4.7 mm ( $n=6$ ), maximum width at level of metathorax = 0.6–0.7 mm ( $n=6$ ).

**Head.** HL = 0.88–0.97 mm ( $n=6$ ), HW = 0.65–0.74 mm ( $n=6$ ), FCL = 0.38–0.44 mm ( $n=12$ ), OcW = 0.29–0.38 mm ( $n=6$ ).

**Head capsule** (Figures 2 and 3). Flattened, subovate, longer than broad (HL/HW = 1.22–1.35,  $n=6$ ), maximum width at stemmata, slightly constricted at level of occipital region (HW/OcW = 1.90–2.26,  $n=6$ ); coronal suture 0.38 times as long as HL ( $n=1$ ). Frontoclypeus subtriangular, 0.42–0.45 times as long as HL ( $n=6$ ); lateral lobes rounded, projecting slightly beyond nasale.

**Antenna** (Figures 4 and 5). Slender, longer than HW (length of antenna/HW = 1.34–1.50,  $n=5$ ); A3'/antennomere 4 = 0.07–0.10 ( $n=22$ ).

**Mandible** (Figure 6). Prominent, 1.25–1.67 times as long as broad ( $n=12$ ), 0.26–0.27 times as long as HL ( $n=2$ ).

**Maxilla** (Figures 7 and 8). Cardo small, narrow; stipes well developed, with spinulae on internal and ventral margins; palpifer short, broad, 0.14–0.21 times as long as palpomere 1 ( $n=25$ ); length of antenna/length of maxillary palpus = 1.80–2.00 ( $n=21$ ); length of palpomere 3/length of palpomere

2 = 1.55–1.76 ( $n=26$ ); galea 0.23–0.29 times as long as palpomere 1 ( $n=22$ ).

**Labium** (Figures 9 and 10). Anterior margin of prementum broadly indented medially, with spinulae on dorsal surface; palpus long, slender (length of maxillary palpus/length of labial palpus = 0.96–1.06,  $n=24$ ), palpomere 1 slightly curved at base; palpomeres subequal in length (palpomere 2/palpomere 1 = 0.94–1.13,  $n=24$ ).

**Thorax.** Terga convex, lateral margins curved; pronotum as long as meso- and metanotum combined, metanotum the shortest and narrowest; tergites subrectangular, transversal, sagittal line strongly marked.

**Legs** (Figures 11 and 14). Total length of metathoracic leg = 2.79–2.95 mm ( $n=4$ ), 1.47 times as long as prothoracic leg ( $n=1$ ), 1.25 times as long as mesothoracic leg ( $n=1$ ), 4.03 times HW ( $n=1$ ); metacoxa 0.75–0.88 times as long as metafemur ( $n=7$ ), metatibia 0.75–0.80 times as long as metafemur ( $n=16$ ), metatarsus 0.86–0.96 times as long as metafemur ( $n=15$ ), longest claw 0.54–0.61 times as long as metatarsus ( $n=16$ ).

**Abdomen.** Segments I–VII sclerotized dorsally, membranous ventrally, progressively narrowing to apex; tergites I–V similar to each other, strongly transversal; tergites VI and VII somewhat more developed; segment VIII (Figures 15 and 16) completely sclerotized, ring-like, LLAS = 0.32–0.35 mm ( $n=5$ ), LLAS/HW = 0.43–0.49 ( $n=2$ ).

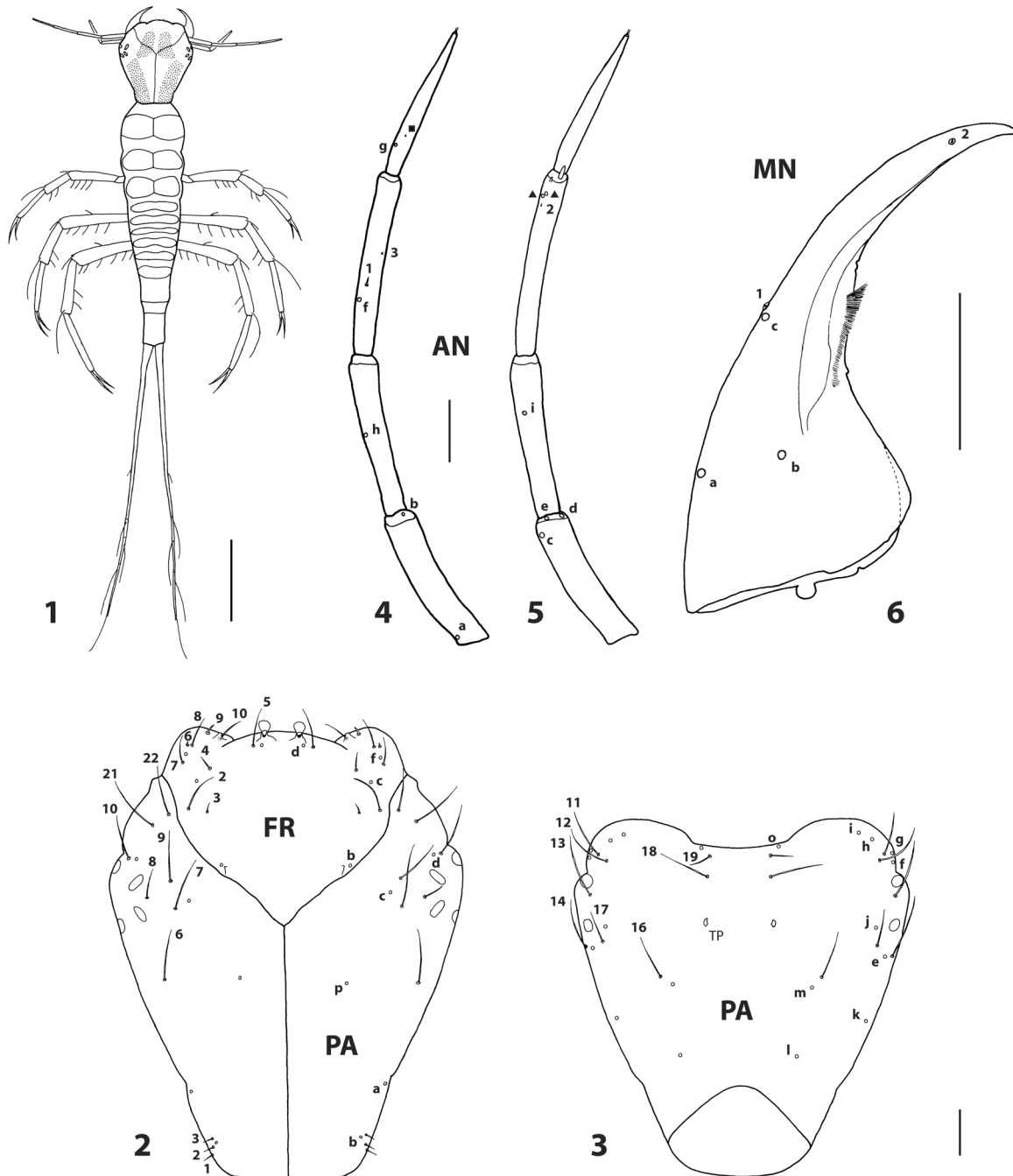
**Urogomphus** (Figure 19). Very long (total length = 2.34–3.10 mm,  $n=14$ ), one-segmented, with three divisions in distal half; length of urogomphus/LLAS = 7.50–8.13 ( $n=5$ ), length of urogomphus/HW = 3.43–3.83 ( $n=3$ ).

**Chaetotaxy and porotaxy.** Similar to that of generalized *Lancetes* larva (Alarie et al. 2002) except as follows: pores FRe and MXa absent; a minute seta on dorsal surface of antennomere 4; seta TI4 inserted more proximally and posteriorly on prothoracic leg; additional setae on femur, tibia and occasionally on metatrochanter (Table I); seta UR8 inserted subapically; setae UR2 and UR3 occasionally arising contiguous; one additional pore distal to seta UR4.

#### Description

Instar II larva. Similar to first instar larva except for the following features.

**Color.** Dorsal surface of head yellowish to light brown, except for dark brown areas centrally and behind stemmata (dark brown areas behind stemmata with light brown spots); ventral surface evenly yellowish to light brown. Thoracic and abdominal tergites yellowish to light brown. Legs evenly yellowish. Urogomphi evenly light brown.

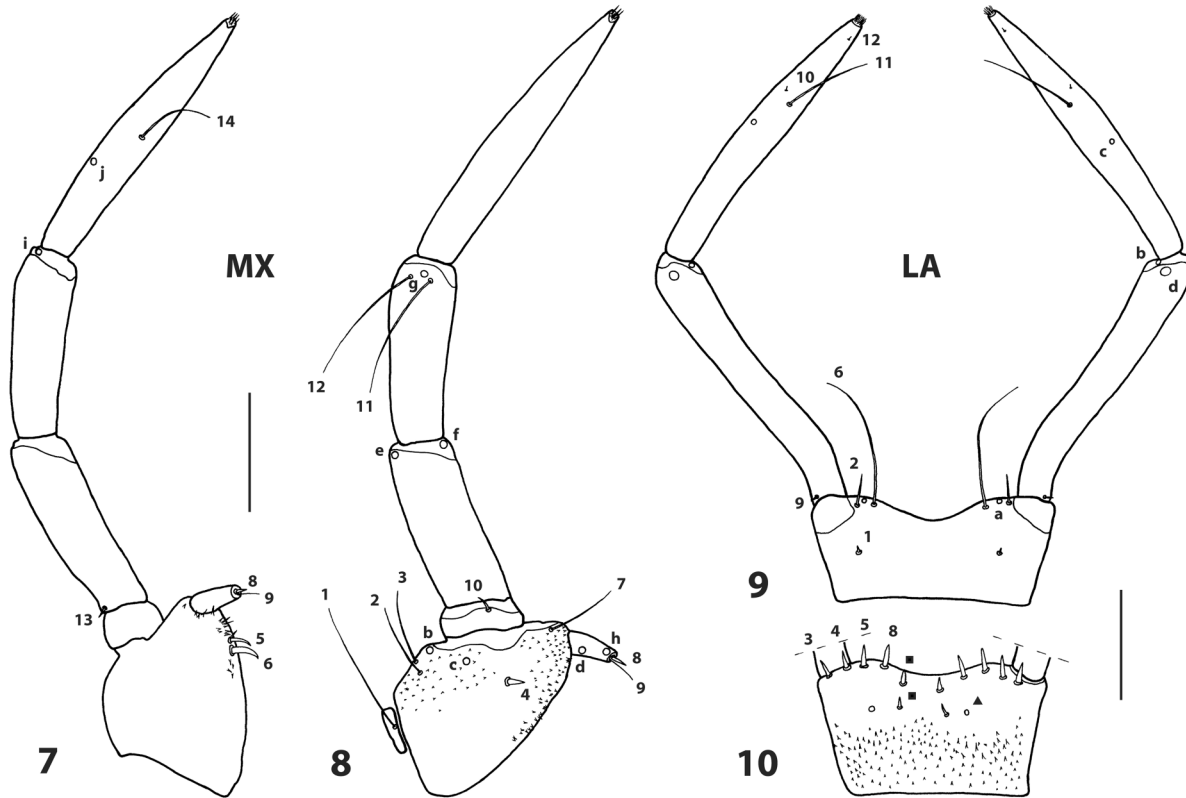


Figures 1–6. *L. marginatus* (instar I larva). 1. Habitus, dorsal aspect. 2–3. Cephalic capsule, dorsal and ventral aspects, respectively. 4–5. Left antenna, dorsal and ventral aspects, respectively. 6. Left mandible, dorsal aspect. AN: antenna, MN: mandible, FR: frontoclypeus, PA: parietal, TP: tentorial pit. Numbers and lowercased letters refer to primary setae and pores respectively. Solid square and solid triangles refer to additional seta and pores respectively. Scale bars = 0.10 mm except for Figure 1 which is 1 mm.

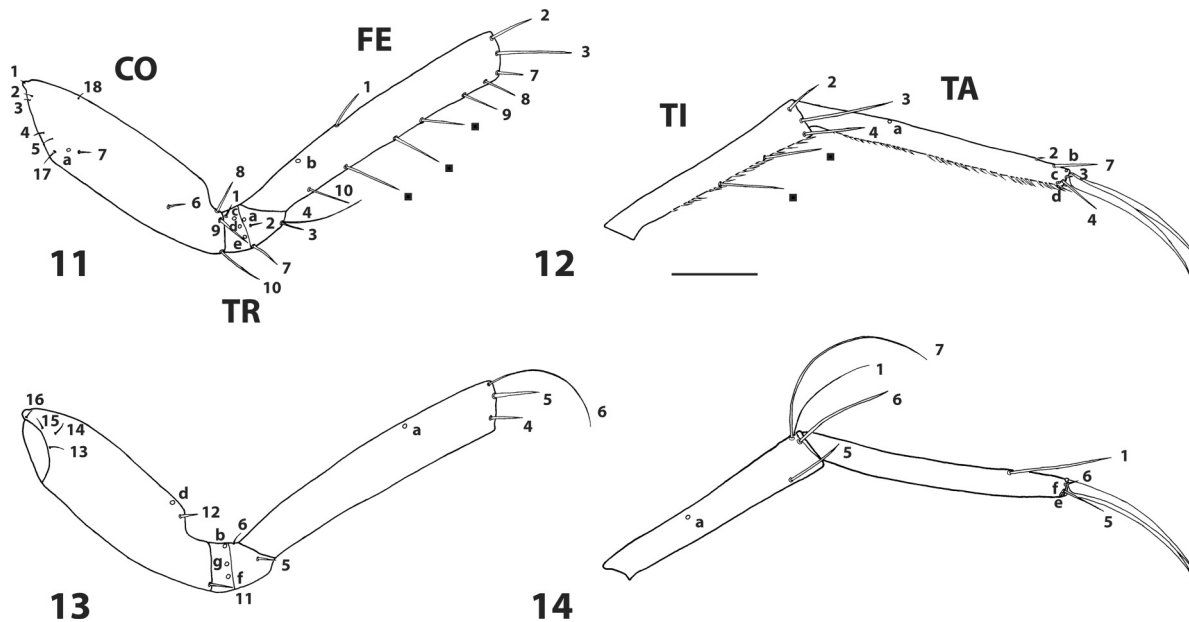
**Body.** Slightly flattened dorsoventrally, total length (excluding urogomphi) = 3.5–8.3 mm ( $n=14$ ), maximum width at level of metathorax = 0.9–1.0 mm ( $n=2$ ).

**Head.** HL = 1.40 mm ( $n=1$ ), HW = 1.18 mm ( $n=1$ ), FCL = 0.59 mm ( $n=1$ ), OcW = 0.56 mm ( $n=1$ ).

**Head capsule.** Subrectangular (HL/HW = 1.19,  $n=1$ ), strongly constricted at level of occipital region (HW/OcW = 2.11,  $n=1$ ); coronal suture 0.38 times as long as HL ( $n=1$ ). Frontoclypeus 0.42 times as long as HL ( $n=1$ ), with 29–33 ( $n=3$ ) prominent spatulate setae on apical margin. Parietals with 8–10 ( $n=3$ ) temporal spine-like setae behind stemmata.



Figures 7–10. *L. marginatus* (instar I larva). 7–8. Maxilla, dorsal and ventral aspects, respectively. 9. Labium, ventral aspect. 10. Prementum, dorsal aspect. MX: maxilla, LA: labium. Numbers and lowercased letters refer to primary setae and pores respectively. Solid squares and solid triangle refer to additional setae and pore respectively. Scale bars = 0.10 mm.

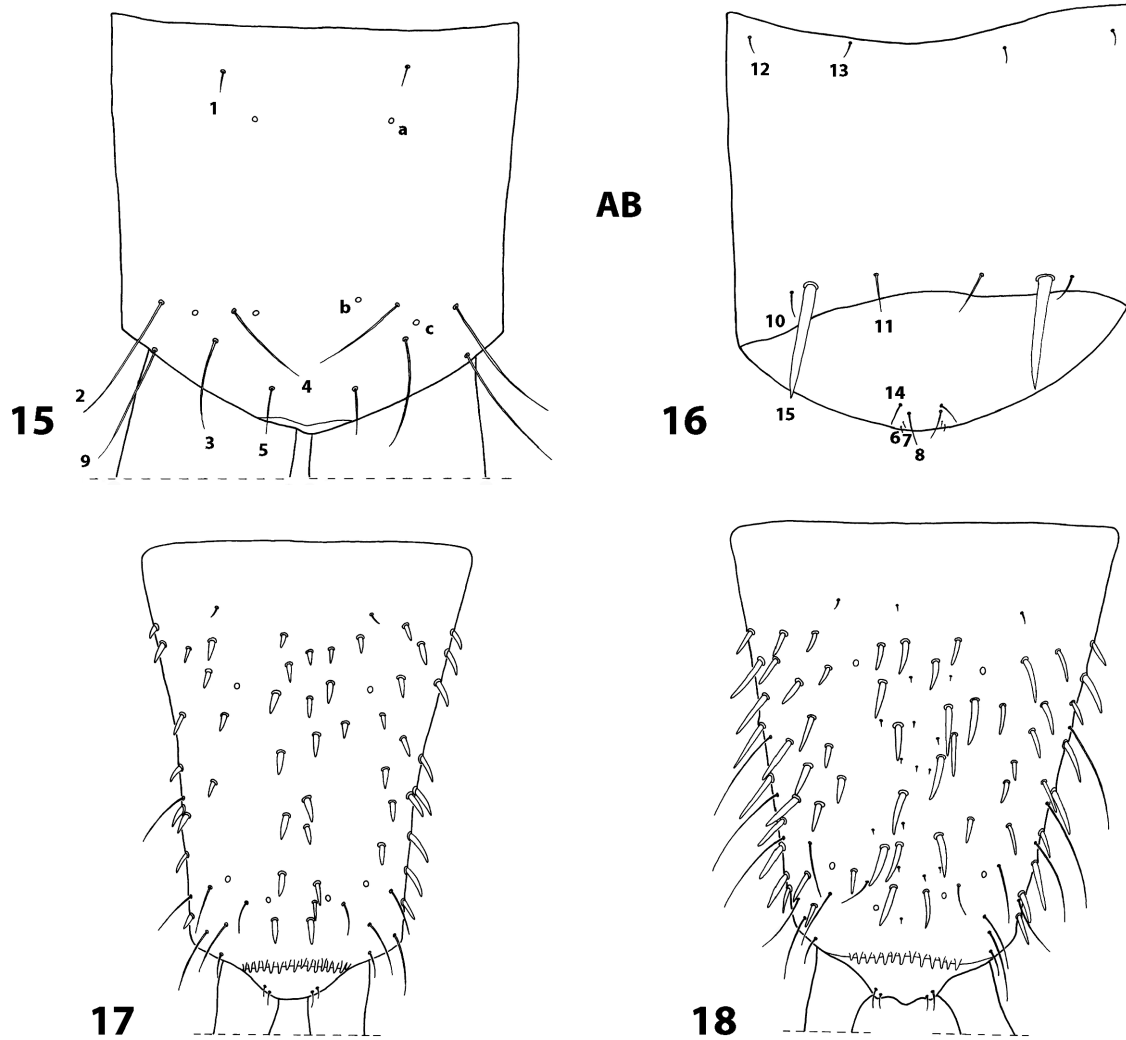


Figures 11–14. *L. marginatus* (instar I larva), metathoracic leg. 11–12. Anterior aspect. 13–14. Posterior aspect. CO: coxa, TR: trochanter, FE: femur, TI: tibia, TA: tarsus. Numbers and lowercase letters refer to primary setae and pores respectively. Solid squares refer to additional setae. Scale bar = 0.20 mm.

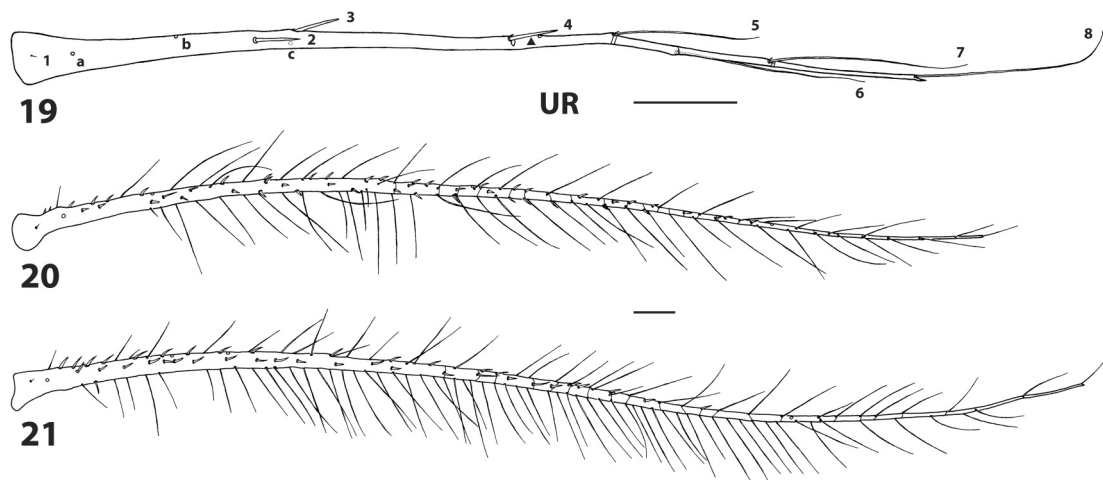
*Antenna.* Length of antenna/HW = 1.13 ( $n=1$ ), A3'/antennomere 4 = 0.08–0.09 ( $n=4$ ).

*Mandible.* 1.55 times as long as broad ( $n=2$ ), 0.33 times as long as HL ( $n=1$ ).

*Maxilla.* Stipes without ventral spinulae; palpifer 0.21–0.26 times as long as palpomere 1 ( $n=3$ ); length of antenna/length of maxillary palpus = 1.79–2.69 ( $n=4$ ); length of palpomere 3/length of



Figures 15–18. Eighth abdominal segment. 15–16. *L. marginatus* (instar I larva), dorsal and ventral aspects, respectively. 17. *L. marginatus* (instar III larva), dorsal aspect. 18. *L. biremis* (instar III larva), dorsal aspect. AB: eighth abdominal segment. Numbers and lowercase letters refer to primary setae and pores respectively. Scale bars = 0.10 mm.



Figures 19–21. Urogomphus (dorsal aspect). 19. *L. marginatus* (instar I larva). 20. *L. marginatus* (instar III larva). 21. *L. biremis* (instar III larva). UR: urogomphus. Numbers and lowercase letters refer to primary setae and pores respectively. Solid triangle refers to additional pore. Scale bars = 0.30 mm.

palpomere 2 = 1.34–1.39 ( $n=4$ ); galea 0.25–0.32 times as long as palpomere 1 ( $n=3$ ).

*Labium*. Length of maxillary palpus/length of labial palpus = 0.66–0.97 ( $n=4$ ); palpomere 2/palpomere 1 = 0.91–0.96 ( $n=4$ ).

*Thorax*. Pronotum markedly convex, somewhat shorter than meso- and metanotum combined, meso- and metanotum subequal in length; protergite much more developed than meso- and metatergites; meso- and metanotum with anterotransverse carina.

*Legs*. Total length of metathoracic leg = 4.56–4.85 mm ( $n=3$ ), 1.44–1.47 times as long as prothoracic leg ( $n=3$ ), 1.15–1.19 times as long as mesothoracic leg ( $n=3$ ), 4.11 times HW ( $n=1$ ); ventral spinulae on pro- and mesofemur long, in two parallel rows (posterior row shorter); metacoxa 0.82–0.89 times as long as metafemur ( $n=3$ ), metatibia 0.74–0.76 times as long as metafemur ( $n=4$ ), metatarsus 0.74–0.79 times as long as metafemur ( $n=4$ ), longest claw 0.59–0.60 times as long as metatarsus ( $n=4$ ).

*Abdomen*. Tergites I–VI with anterotransverse carina; segment VII completely sclerotized, ring-like, with anterotransverse carina dorsally; LLAS = 0.70–0.75 mm ( $n=2$ ), LLAS/HW = 0.59 ( $n=1$ ).

*Urogomphus*. Total length = 2.94–4.44 mm ( $n=3$ ), with several divisions in distal half; length of urogomphus/LLAS = 3.92–6.26 ( $n=2$ ), length of urogomphus/HW = 3.71 ( $n=1$ ).

*Chaetotaxy and porotaxy*. Head capsule with several secondary setae and pores; mandible with 1–2 ( $n=4$ ) secondary hair-like setae posterior to pore MNa, one pore in the place of seta MN1 (seta MN1 probably missing), and a row of 6–7 ( $n=4$ ) secondary minute setae posterior to seta MN2; labium with one secondary ventral pore on prementum (contiguous to seta LA1); secondary setation present on each tergum; secondary setae on coxa, trochanter, femur and tibia (Table I); one secondary pore on posterior surface of coxa, and one on proximal surface of trochanter; rows of natatory setae on dorsal margin of tibia and tarsus; secondary setae on each abdominal sclerite; urogomphus with numerous spine-like and hair-like secondary setae.

### Description

Instar III larva. Similar to second instar larva except for the following features.

*Color*. Dorsal surface of head yellowish, except for dark brown areas centrally and behind stemmata (dark brown areas with yellowish spots); ventral surface evenly yellowish. Basal half of mandibles yellowish, distal half light brown. Urogomphi evenly yellowish to light brown.

*Body*. Total length (excluding urogomphi) = 8.0–15.0 mm ( $n=7$ ), maximum width at level of metathorax = 1.9–2.0 mm ( $n=2$ ).

*Head* (Figure 22). HL = 2.04–2.10 mm ( $n=2$ ), HW = 1.76–1.77 mm ( $n=2$ ), FCL = 0.78–0.90 mm ( $n=3$ ), OcW = 0.86 mm ( $n=1$ ).

*Head capsule*. HL/HW = 1.16–1.19 ( $n=2$ ), HW/OcW = 2.05 ( $n=1$ ); coronal suture 0.69 times as long as HL ( $n=1$ ). Frontoclypeus 0.42 times as long as HL ( $n=1$ ), with 52–55 ( $n=2$ ) prominent spatulate setae on apical margin. Parietals with 9–10 ( $n=6$ ) temporal spine-like setae behind stemmata.

*Antenna*. Length of antenna/HW = 0.98 ( $n=2$ ); antennomeres 2, 3, and 4 fractured basally; A3'/antennomere 4 = 0.17–0.21 ( $n=5$ ).

*Mandible*. 1.72–2.11 times as long as broad ( $n=6$ ), 0.30 times as long as HL ( $n=1$ ).

*Maxilla*. Stipes with spinulae on internal and ventral margins; palpifer 0.21–0.26 times as long as palpomere 1 ( $n=6$ ); length of antenna/length of maxillary palpus = 1.77–1.84 ( $n=5$ ); palpomeres 1, 2 and 3 subequal in length (length of palpomere 3/length of palpomere 2 = 1.07–1.12,  $n=6$ ); palpomeres 2 and 3 fractured basally; galea 0.28–0.30 times as long as palpomere 1 ( $n=6$ ).

*Labium*. Length of maxillary palpus/length of labial palpus = 0.93–0.96 ( $n=6$ ); palpomere 2 fractured basally, 0.79–0.86 times as long as palpomere 1 ( $n=6$ ).

*Legs* (Figures 24 and 25). Total length of metathoracic leg = 6.37–6.70 mm ( $n=4$ ), 1.45 times as long as prothoracic leg ( $n=1$ ), 1.17–1.19 times as long as mesothoracic leg ( $n=4$ ), 3.81 times HW ( $n=1$ ); metafemur without spinulae; metacoxa 0.85–0.89 times as long as metafemur ( $n=6$ ), metatibia 0.68–0.73 times as long as metafemur ( $n=5$ ), metatarsus 0.66–0.72 times as long as metafemur ( $n=5$ ), longest claw 0.43–0.51 times as long as metatarsus ( $n=5$ ).

*Abdomen*. LLAS = 1.28–1.47 mm ( $n=3$ ), LLAS/HW = 0.75–0.83 ( $n=2$ ).

*Urogomphus* (Figure 20). Total length = 6.40–7.02 mm ( $n=3$ ), with numerous divisions in distal half; length of urogomphus/LLAS = 5.09–5.20 ( $n=2$ ), length of urogomphus/HW = 3.77 ( $n=1$ ).

*Chaetotaxy and porotaxy*. Head capsule with numerous secondary setae and pores; mandible with one ( $n=2$ ) secondary hair-like seta posterior to pore MNa, 9–10 ( $n=2$ ) secondary pores on external margin, and a row of 11–13 ( $n=2$ ) secondary minute setae posterior to seta MN2; stipes with four secondary setae on ventral surface; secondary setae on coxa, trochanter, femur and tibia (Table I); two secondary pores on posterior surface of coxa; eighth abdominal segment with numerous secondary spine-like setae (Figure 17).

Table I. Number and position of additional (instar I) and secondary (instars II–III) setae and pores on the legs of larvae of *L. marginatus* and *L. biremis*. Numbers in parenthesis denote secondary pores. A: anterior, D: dorsal, Di: distal, P: posterior, Pr: proximal, V: ventral. NS: natatory setae.

Segment	Position	<i>Lancetes marginatus</i>			<i>Lancetes biremis</i>
		Instar I (n = 6)	Instar II (n = 2)	Instar III (n = 3)	Instar III (n = 3)
Procoxa	A	0	0	5	5–7
	ADPr	0	0	3	0
	D	0	4–6	11	11
	DDi	0	1	1	1
	P	0	(1)	(2)	(2)
Protrochanter	Di	0	0	1	0
	Pr	0	(1)	3 (1)	2 (1)
Profemur	ADi	0	0	2	0
	AV	1	6–8	8	17–20
	D	0	0	0	2
	PV	0	6–7	5	7–8
Protibia	D	0	0	0	2
	NS (PD)	–	+	+	+
Protarsus	D	0	0	0	1
	NS (PD)	–	+	+	+
Mesocoxa	A	0	0	6	7–8
	ADPr	0	0	2	0
	D	0	5–7	9	10
	DDi	0	1	1	1
	P	0	(1)	(2)	(2)
Mesotrochanter	Di	0	0–1	0–1	0
	Pr	0	(1)	3 (1)	1–2 (1)
Mesofemur	ADi	0	2	1–2	2
	AV	3	11–12	15–16	18–19
	D	0	0	0	2–4
	PV	0	7–10	5–11	8–11
Mesotibia	AV	2	1–2	2–4	3–5
	D	0	0	0	3–4
	NS (PD)	–	+	+	+
Mesotarsus	D	0	0	0	3–4
	NS (PD)	–	+	+	+
Metacoxa	A	0	0	9	7
	ADPr	0	0	1	0
	D	0	3–5	8–10	8–11
	DDi	0	1	0–1	2
	P	0	(1)	(2)	(2)
Metatrochanter	Di	0–1	0	0	0
	Pr	0	1 (1)	1–3 (1)	2 (1)
Metafemur	ADi	0	1	2–5	1
	AV	3–4	11–14	16–19	14–20
	D	0	0	0	3–6
	PV	0	9–10	7–10	8–12
	Metatibia	AV	2–3	1–2	2–3
Metatarsus	D	0	0	0	5–7
	NS (PD)	–	+	+	+
	AV	0	0	0	3–5
	D	0	0	0	4–6
	NS (PD)	–	+	+	+

### Description

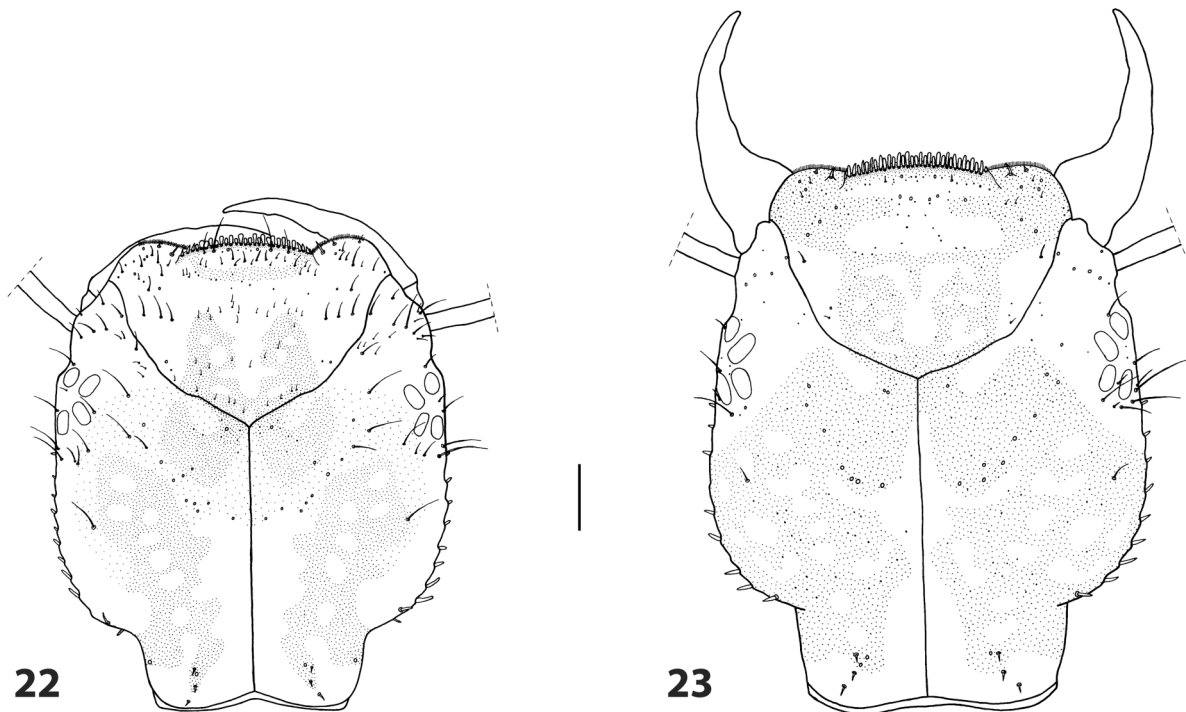
*Pupa* (n = 2). Color. Creamy-white, except for the eyes dark brown and distal two thirds of cerci light brown.

*Body* (Figures 26 and 27). Length (including cerci) = 8.3–9.9 mm, maximum width at level of metathorax = 3.3 mm.

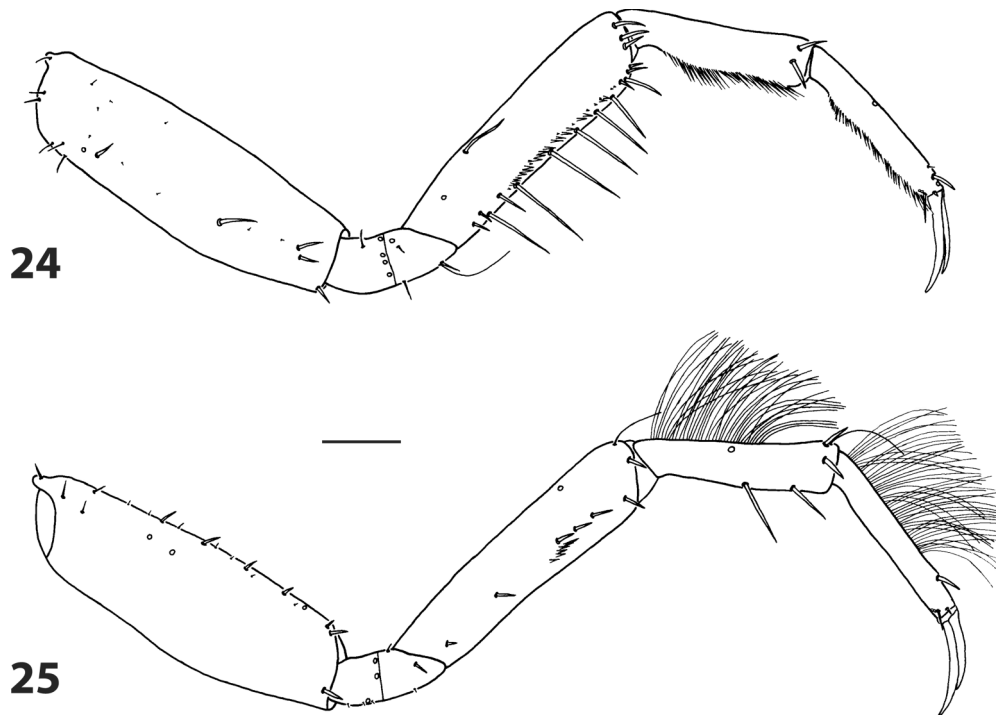
*Head*. With 30–35 long, thin setae arranged as follows: 1–2 on each anterolateral corner of clypeus, 3–5 near internal margin of each eye, and 20–21 on vertex, in a transverse crest.

*Pronotum*. With 74–85 setae distributed on anterior (40–45), lateral (6), posterolateral (22–25) and





Figures 22–23. Head, dorsal aspect (instar III larva). 22. *L. marginatus*. 23. *L. biremis*. Scale bar = 0.30 mm.



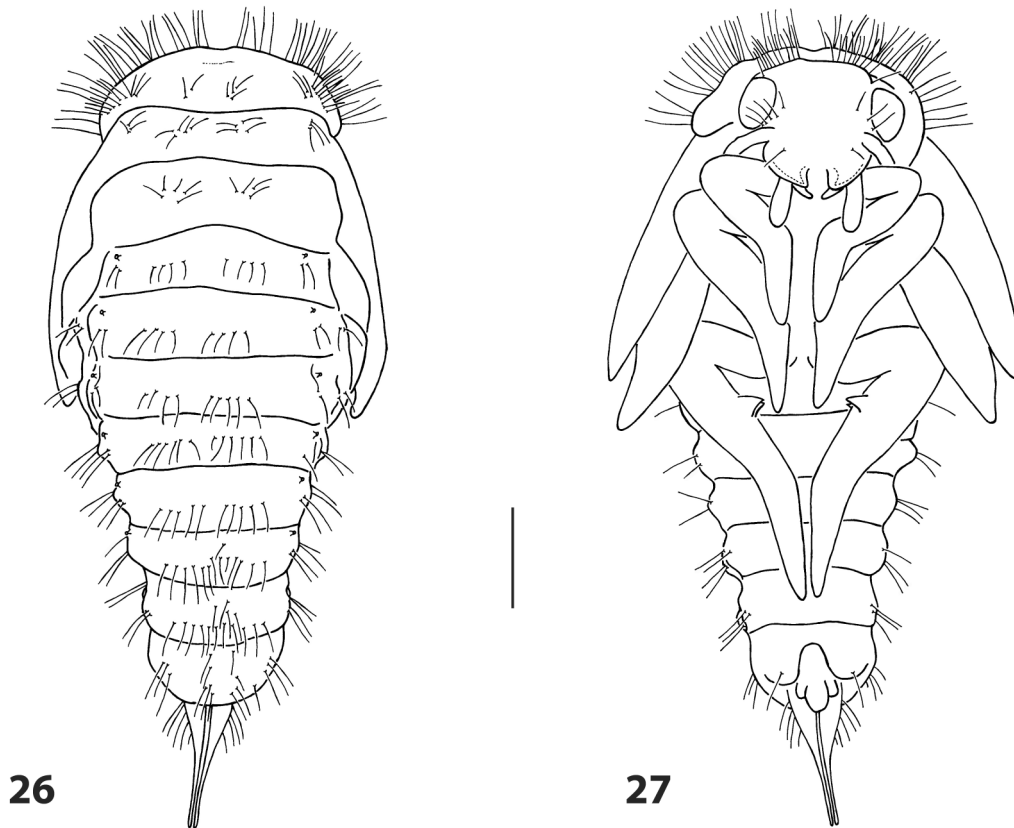
Figures 24–25. *L. marginatus* (instar III larva), prothoracic leg. 24. Anterior aspect. 25. Posterior aspect. Scale bar = 0.30 mm.

posteromedial (6–9) margins; pronotal disc and sublateral areas without setae; anterior margin with a weak crest.

*Mesonotum*. With 15–16 setae: 9–10 on central portion of tergum and three laterally at each wingpad base; laterotergal setae absent.

*Metanotum*. With 11–14 setae: 5–9 on central portion of tergum and 2–3 laterally at each wingpad base; laterotergal setae absent.

*Abdomen*. With a total of 143–149 setae; 86–87 setae near midline of terga I–VIII, distributed as follows: tergum I (4), tergum II (4), tergum III



Figures 26–27. *L. marginatus* (pupa), habitus. 26. Dorsal aspect. 27. Ventral aspect. Scale bar = 1 mm.

(4–6), tergum IV (6–7), tergum V (5–6), tergum VI (6–7), tergum VII (6–8), tergum VIII (3–5); narrow paratergal swellings posterior to each spiracle developed on segments I to VII, each carrying two (in few cases one) setae; segment VIII lacking paratergal swelling, with a group of 3–4 setae on each lateral. Pleural swelling developed on segments II to VI, bearing two (rarely one) setae on each side; segment VII with two setae on each pleura but without swelling; pleura of segment VIII lacking setae; as noted by Brancucci and Ruhnau (1985), the pleural groups of setae change their position progressively to the ventral side towards the caudal region but never to a true sternal position. Sterna of segments I–VII without setae; sternum of segment VIII with two setae.

**Spiracles.** Those of segments I–VI functional, slightly elevated, with dark peritremata; spiracles of segment VII closed, without peritremata; spiracles of segment VIII hardly visible; we were not able to find the parastigmata mentioned for *L. angusticollis* by Brancucci and Ruhnau (1985).

**Cerci.** Long (1.2–1.4 mm), rough, subparallel, progressively tapering towards thin apices; each cercus with 3–7 setae inserted laterally to ventrally on basal third, apical portion without setae.

### *Lancetes biremis* Říha

The secondary setation in third instar larvae of *L. biremis* should be considered tentative since we have not seen first instars of this species. We have based our comparisons on the ground-plan chaetotaxy established for the first instar larva of the Colymbetinae (Alarie 1995, 1998) and the genus *Lancetes* (Alarie et al. 2002).

### Source of material

Five instar III were used for descriptions. Larvae were collected in mid-spring, in association with 15 adults, from an oval-shaped pond about 60 m long, with clear water, muddy bottom and abundant littoral vegetation, at El Cóndor, Córdoba, Argentina, 2000 m, 11.XI.2001. Larvae were captured among the vegetation, at a depth of 5–30 cm. No other *Lancetes* species was collected in that locality.

### Description

Instar III larva. Similar to third instar larva of *L. marginatus* except for the following features.

*Color.* Dorsal surface of head yellowish to pale reddish testaceous, except for dark brown areas centrally, behind stemmata (continued in the occipital region) and near apical margin of frontoclypeus (dark brown areas with yellowish to pale reddish testaceous spots); ventral surface evenly yellowish to pale reddish testaceous. Distal half of mandibles dark brown. Thoracic and abdominal tergites pale reddish testaceous, membranous parts yellowish. Legs and urogomphi evenly yellowish.

*Body.* Total length (excluding urogomphi) = 9.5–19.0 mm ( $n=13$ ), maximum width at level of metathorax = 2.9–3.1 mm ( $n=4$ ).

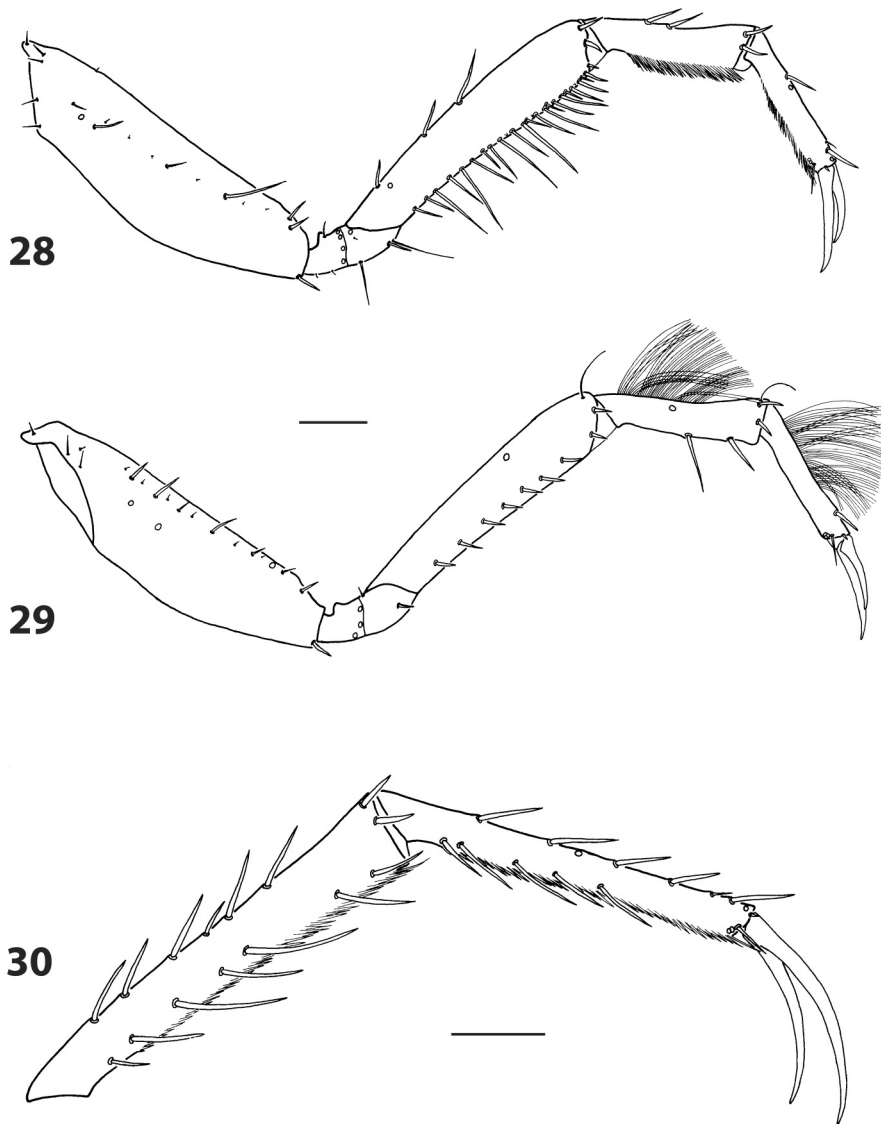
*Head* (Figure 23). HL = 2.42–2.48 mm ( $n=3$ ), HW = 2.06–2.16 mm ( $n=2$ ), FCL = 0.94–0.98 mm ( $n=3$ ), OcW = 1.20 mm ( $n=1$ ).

*Head capsule.* HL/HW = 1.12–1.20 ( $n=2$ ), HW/OcW = 1.72 ( $n=1$ ); coronal suture 0.66 times as long as HL ( $n=1$ ). Frontoclypeus 0.38–0.40 times as long as HL ( $n=3$ ), with 54–62 ( $n=3$ ) prominent spatulate setae on apical margin. Parietals with 7–10 ( $n=3$ ) temporal spine-like setae behind stemmata.

*Antenna.* Length of antenna/HW = 0.73–0.80 ( $n=2$ ); A3'/antennomere 4 = 0.08–0.09 ( $n=6$ ).

*Mandible.* 1.95–2.05 times as long as broad ( $n=6$ ), 0.33–0.35 times as long as HL ( $n=2$ ).

*Maxilla.* Palpifer 0.27–0.30 times as long as palpomere 1 ( $n=6$ ); length of antenna/length of maxillary palpus = 1.57–1.66 ( $n=6$ ); length of palpomere 3/length of palpomere 2 = 0.95–1.05 ( $n=6$ ); galea 0.25–0.28 times as long as palpomere 1 ( $n=6$ ).



Figures 28–30. *L. biremis* (instar III larva). 28–29. Prothoracic leg, anterior and posterior aspects, respectively. 30. Metatibia and metatarsus, anterior aspect. Scale bars = 0.30 mm.

*Labium.* Length of maxillary palpus/length of labial palpus = 0.94–0.99 ( $n = 6$ ); palpomere 2/palpomere 1 = 0.73–0.75 ( $n = 6$ ).

*Legs* (Figures 28 and 30). Total length of metathoracic leg = 7.34–7.86 mm ( $n = 6$ ), 1.45–1.68 times as long as prothoracic leg ( $n = 6$ ), 1.15–1.19 times as long as mesothoracic leg ( $n = 6$ ), 3.44–3.80 times HW ( $n = 2$ ); ventral spinulae on profemur short, disperse, meso- and metafemur without spinulae; metacoxa 0.86–0.92 times as long as metafemur ( $n = 6$ ), metatibia 0.70–0.74 times as long as metafemur ( $n = 6$ ), metatarsus 0.62–0.66 times as long as metafemur ( $n = 6$ ), longest claw 0.52–0.55 times as long as metatarsus ( $n = 6$ ).

*Abdomen.* LLAS = 1.32–1.42 mm ( $n = 3$ ), LLAS/HW = 0.64–0.65 ( $n = 2$ ).

*Urogomphus* (Figure 21). Total length = 7.60–7.68 mm ( $n = 2$ ); length of urogomphus/LLAS = 5.42–5.76 ( $n = 2$ ), length of urogomphus/HW = 3.69 ( $n = 1$ ).

*Chaetotaxy and porotaxy.* Mandible with numerous secondary minute setae on dorsal and lateral margins; stipes with five secondary setae on ventral surface; secondary setae on coxa, trochanter, femur, tibia and tarsus (Table I); eighth abdominal segment with numerous secondary spine-like setae (Figure 18).

#### Comparative notes

The larvae described in this paper have multifragmented urogomphi, the only larval synapomorphy that defines the genus *Lancetes* (character 56 in Alarie et al. 2002). Third instars also present a secondary subdivision in some of the cephalic appendages (antennomeres 2, 3, and 4, maxillary palpomeres 2 and 3, and labial palpomere 2); this character is a synapomorphy of *Lancetes* and Dytiscinae (character 55 in Alarie et al. 2002). On the other hand, several differences can be marked as distinctive of the larvae

Table II. Summary of characters differentiating among first instar larvae of four species of the genus *Lancetes*. D: dorsal, P: posterior, V: ventral.

Character	<i>L. marginatus</i>	<i>L. angusticollis</i> *	<i>L. delkeskampi</i> *	<i>L. subseriatus</i> *
HL/HW	≥ 1.22	< 1.22	< 1.22	≤ 1.22
Egg bursters	Spine-like	Spine-like	Spine-like	Blade-like
Pore FRe	Absent	Present	Present	Present
Length of antenna/HW	> 1.3	< 1.2	< 1.2	< 1.2
Pore MXa	Absent	Present	Present	Present
Labium (palpomere 2/palpomere 1)	< 1.2	> 1.4	< 1.2	< 1.2
Length of metathoracic leg/HW	≈ 4.0	≈ 3.8	≈ 3.5	≈ 4.1
Additional D setae on femur	Absent	Absent	Present	Absent
Additional PV setae on femur	Absent	Present	Present	Absent
Additional PV setae on protibia	Present	Present	Absent	Absent
Additional PV setae on meso- and metatibia	Absent	Present	Absent	Absent
LLAS/HW	< 0.5	> 0.5	< 0.5	< 0.5
Length of urogomphus/LLAS	7.5–8.1	5.4	9.1–9.3	9.3–10.0
Additional setae on urogomphus	Absent	Absent	Present	Absent
Additional pore on urogomphus	Present	Absent	Absent	Absent

\*Data taken from Alarie et al. (2002).

Table III. Summary of characters differentiating among larval instars of *L. marginatus*. A: anterior, P: posterior.

Character	Instar I	Instar II	Instar III
HW (mm)	0.65–0.74	1.18	1.76–1.77
Head capsule	Subovate	Subrectangular	Subrectangular
Spatulate setae on A margin of FR	2	29–33	52–55
Temporal spine-like setae	0	8–10	9–10
Head appendages	Not fractured	Not fractured	Fractured basally
Maxilla (palpomere 3/palpomere 2)	1.55–1.76	1.34–1.39	1.07–1.12
Anterotraverse carina on meso-, metanotum and abdominal segments I–VII	Absent	Present	Present
Spiracular openings on mesothorax and abdominal segments I–VII	Absent	Absent	Present
Secondary pores on P surface of coxa	–	1	2
Abdominal segment VII	Not sclerotized ventrally	Completely sclerotized	Completely sclerotized
Length of urogomphus (mm)	2.34–3.10	2.94–4.44	6.40–7.02
Number of subdivisions of urogomphus	3	Several	Numerous

Table IV. Summary of characters differentiating among third instar larvae of four species of the genus *Lancetes*. D: dorsal, V: ventral.

Character	<i>L. marginatus</i>	<i>L. biremis</i>	<i>L. delkeskampi</i> *	<i>L. nigriceps</i> *
HL (mm)	< 2.1	< 2.5	> 2.5	< 2.5
Length of antenna/HW	≈ 1	0.7 – 0.8	≈ 0.7	≈ 0.7
Labium (palpomere 2/palpomere 1)	≥ 0.79	≤ 0.75	≤ 0.75	≤ 0.75
Length of metathoracic leg/HW	≈ 3.8	3.4 – 3.8	≈ 3.1	≈ 3.1
Secondary D setae on femur	Absent	Present	Present	Present
Secondary D setae on tibia	Absent	Present	Absent	Absent
Secondary V setae on metatibia	2–3	6–8	1	1
Secondary setae on tarsus	Absent	Present	Absent	Absent
LLAS/HW	> 0.7	< 0.7	< 0.7	< 0.6

\*Data taken from Alarie et al. (2002).

we studied. First instar larva of *L. marginatus* exhibits several features that distinguish it from the other known first instars of the genus *Lancetes*. These differences are summarized in Table II. Primary pore FRe is present in first instar larvae of the Colymbetini genera *Rhantus* Dejean, *Colymbetes* Clairville and *Neoscutopterus* J. Balfour-Browne (Alarie 1998), and in the first instars of *Lancetes* known in detail (Alarie et al. 2002). This pore is absent in the Hydroporinae and in the genera *Agabus* Leach, *Ilybius* Erichson, *Agabimus* Crotch and *Matus* Aubé. The lack of FRe is considered a derived condition among the Adephaga. Its absence in the first instar larva of *L. marginatus* differentiates this species from the others. Other remarkable differences are the absence of primary pore MXa (which is shared with *Rhantus*, *Colymbetes* and *Neoscutopterus*), the presence of one additional minute seta on dorsal surface of antennomere 4, and the presence of one additional pore on urogomphus, distal to seta UR4.

There are many differences among the three larval instars of *L. marginatus*. Although the ranges for the body length are overlapped among stages (due to the fact that some larvae were contracted and other relaxed), they can be easily separated by head width. Second instar larvae are more similar to third instars than to first instars. The principal differences to separate all instars are summarized in Table III.

Together with the descriptions provided here the number of *Lancetes* species from continental Argentina with known larval stages rises to seven (the remaining known species are *L. arauco*, *L. angusticollis*, *L. varius rotundicollis*, *L. nigriceps* and *L. delkeskampi*). There are several valuable features to distinguish among third instars of some of these species, the principal are summarized in Table IV. The detail of descriptions and illustrations of other *Lancetes* larvae found in the literature do not allow more comparisons to be made.

Finally, in spite of being very similar to that of *L. angusticollis* (Brancucci & Ruhnau 1985), pupa of *L. marginatus* can be distinguished by its smaller size

and the presence of fewer setae on the head, pronotum and abdominal terga V–VIII.

### Acknowledgments

We thank Yves Alarie for his useful comments on some specific aspects of the chaetotaxy, and two anonymous reviewers whose suggestions helped improve this paper. M.C. Michat and P.L.M. Torres were supported by postgraduate scholarships from the Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina (CONICET).

### References

- Alarie Y. 1995. Primary setae and pores on the legs, the last abdominal segment, and the urogomphi of larvae of Nearctic Colymbetinae (Coleoptera: Adephaga: Dytiscidae) with an analysis of their phylogenetic relationships. *Can Entomol* 127:913–943.
- Alarie Y. 1998. Phylogenetic relationships of Nearctic Colymbetinae (Coleoptera: Adephaga: Dytiscidae) based on chaetotaxic and porotaxic analysis of head capsule and appendages of larvae. *Can Entomol* 130:803–824.
- Alarie Y, Archangelsky M, Nilsson AN, Watts CHS. 2002. Larval morphology of the genus *Lancetes* (Coleoptera: Adephaga: Dytiscidae): the hypothesis of sister-group relationship with the subfamily Dytiscinae revisited. *Can Entomol* 134:467–501.
- Bachmann AO, Trémouilles ER. 1981. El género *Lancetes* en la Argentina continental (Coleoptera, Dytiscidae). *Physis* 39(97):103–118.
- Beier M. 1928. Die Larve von *Lancetes claussi* Mull. (Col. Dytiscidae). *Zeitsch Insecten Biol* 23(5–7):164–172.
- Bertrand H. 1928. Les larves et nymphes de Dytiscides, Hygrobiides et Haliplides. *Encyclopedie Entomol ser A* 10:1–366.
- Bertrand H. 1934. Notes sur quelques larves de Coléoptères aquatiques. *Ann Soc Entomol France* 103:363–382.
- Brancucci M, Ruhnau S. 1985. Studies on the genus *Lancetes*. 1. Additional notes on *Lancetes angusticollis* (Curtis) and description of the pupa (Coleoptera, Dytiscidae). *Proc Acad Nat Sci Phil* 137:46–52.
- Brinck P. 1945. Coleoptera. Scientific Results of the Norwegian Antarctic Expeditions 1927–1929 No 24:1–23.
- Brinck P. 1948. Coleoptera of Tristan da Cunha. Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937–1938, No. 17. Oslo: A. W. Braggers. pp. 1–121.

- Cekalovic K, Spano E. 1981. Descripción de la larva y ninfa de *Lancetes flavoscutatus* Enderlein, 1912 (Coleoptera, Dytiscidae). Bol Soc Biol Concepción 51:61–66.
- Crespo FA. 1987. Los estados preimaginales de ditiscidos argentinos (Insecta-Coleoptera). PhD Dissertation, Universidad de Buenos Aires. pp. 1–184.
- Gressitt JL. 1970. Coleoptera: Dytiscidae and Lathridiidae of South Georgia. Pacif Ins Monogr 23:235–239.
- Miller KB. 2001. On the phylogeny of the Dytiscidae (Insecta: Coleoptera) with emphasis on the morphology of the female reproductive system. Insect Syst Evol 32:45–92.
- Mjöberg E. 1906. Zur Kenntnis der Insektenfauna von Süd-Georgien. Ark Zool 3(13):1–114.
- Nilsson AN. 1988. A review of primary setae and pores on legs of larval Dytiscidae (Coleoptera). Can J Zool 66:2283–2294.
- Nilsson AN. 2001. World Catalogue of Insects, vol. 3. Dytiscidae. Steenstrup, Denmark: Apollo Books. pp. 1–395.
- Říha P. 1961. Die Gattung *Lancetes* (Col., Dytiscidae). Acta Entomol Mus Nat Pragae 34:121–154.
- Ruhnau S, Brancucci M. 1984. Studies on the genus *Lancetes*. 2. Analysis of its phylogenetic position using preimaginal characters (Coleoptera, Dytiscidae). Entomol Basiliensia 9:80–107.
- Sharp D. 1882. On aquatic carnivorous Coleoptera or Dytiscidae. Sci Trans Roy Dublin Soc 2:179–1003.
- Watts CHS. 1963. The larvae of Australian Dytiscidae. Trans Roy Soc S Aust 87:24–40.

Copyright of *Studies on Neotropical Fauna & Environment* is the property of Taylor & Francis Ltd. The copyright in an individual article may be maintained by the author in certain cases. Content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.