

ORIGINAL ARTICLE

Description of the first South American species of *Neocyloepus* Brown (Coleoptera: Elmidae): *N. chaparensis* sp. nov. from Bolivia

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A new species of riffle beetle from Bolivia, *Neocyloepus chaparensis* sp. nov., is described and illustrated from adults of both sexes and the larva. This is the first species of *Neocyloepus* Brown described from South America. The new species is compared with other species described in the genus. Distributional records, diagnoses and a key to distinguish the species of genus are included.

Se describe una nueva especie de élmido de Bolivia, *Neocyloepus chaparensis* sp. nov. Se describe e ilustra los adultos de ambos sexos y la larva. Esta es la primera especie del género descrita para América del Sur. La nueva especie es comparada con todas las otras especies conocidas de *Neocyloepus*. Se incluyen nuevos datos de distribución, diagnóstico y claves para identificar adultos y larvas del género.

Keywords: Bolivia; Elmidae; larvae; *Neocyloepus*; South America; water beetle

Introduction

Elmidae (riffle beetles) is a large cosmopolitan family, very common in lotic habitats. The family includes two subfamilies, Elminae and Larinae. The knowledge of this family is still poor in South America, but studies of elmids have increased in recent years (Spangler & Staines 2002, 2004; Springer & Rivas 2003; Manzo 2005; Archangelsky & Manzo 2006; Manzo 2006a). It is to be expected that further studies of South American riffle beetles will result in the description of new genera and species, since this large and diverse region, which includes several biodiversity hotspots, has not been sampled broadly. The genus *Neocyloepus* Brown, 1970 is included within the subfamily Elminae, which includes about 330 described species in 44 genera distributed in the Neotropical region (Kodada & Jach 2005; Manzo 2006b). *Neocyloepus* is known from southern North America throughout Central America; at present the genus includes six species. The genus was erected by Brown (1970), who designated *Neocyloepus sculptipennis* as the type species (this species had been previously assigned to *Elmis* by Sharp (1882) and later to *Cyloepus* by Hinton (1940a)). This species occurs from western Mexico to Nicaragua. Brown (1970) also described five other new species (*N. petersoni*, *N. arringtoni* and *N. hintoni* from Mexico; *N. sandersoni* from Costa Rica and Panama, and *N. boeseli* from Texas and Mexico), and provided a key for the six species.

The preimaginal stages of Elmidae remain undescribed for most Neotropical species. However, larvae are known for three of the six species of this genus. Brown (1970) described the generic characters of *Neocyloepus* larvae and described the larvae of *N. boeseli*, *N. sculptipennis* and *N. sandersoni*.

No additional species had been recorded or described in the last 37 years, until Moya et al. (2003), working on the typology of the Andean rivers from Cochabamba (Bolivia), recorded the presence of *Neocyloepus*. These authors gave a list of genera of Elmidae from those rivers which included three specimens of *Neocyloepus*. More recently, Arias-Díaz et al. (2007) also recorded *Neocyloepus* in Colombia and W. Shepard (personal communication) in Peru, but these authors did not assign those specimens to any species.

Lastly, only 29 species and three subspecies of Elmidae have been recorded for Bolivia; most of them were described by Hinton (1935, 1940b, 1940c, 1972, 1973). The most recently described species for this country (Hinton 1973) correspond to the genera *Epodelmis* and *Holcemis*. No other elmid species has been described since that time. In this paper a new species of *Neocyloepus* from Bolivia is described based on adults of both sexes and larvae. This is the first *Neocyloepus* species described for South America.

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Material and methods

The material was fixed in the field and stored in 75% ethyl alcohol. Specimens were cleared in lactic acid, dissected and mounted on slides in Hoyer's mounting medium for observation and description. Drawings were done using a Leica DMLB and Olympus BH-2 compound microscope, and a Leica Wild M3Z, all with camera lucida. We follow the larval morphology nomenclature of Lawrence (1991) and Kodada & Jach (1999).

Type and paratypes are deposited in the collection of Universidad Mayor de San Simón de Bolivia, Unidad de Limnología y Recursos Acuáticos (UMSS – ULRA), Cochabamba, Bolivia. Two paratypes and 10 larvae are deposited in the collection of Instituto – Fundación Miguel Lillo (IFML), Tucumán, Argentina.

For comparative observations, adults of *Neocyloopus sculptipennis* and *N. sandersoni* were borrowed from IFML and larvae of *Neocyloopus* sp. were borrowed from Laboratorio de Investigaciones en Zoología, Colección Zoológica de Referencia de Macroinvertebrados Acuáticos (CZUT-Ma), Facultad de Ciencias, Universidad del Tolima (Ibague, Colombia). *Helmis cervina* Grouvelle, 1896 and *Helmis longior* Grouvelle, 1896 deposited at the Muséum national d'Histoire naturelle, were not available for direct examination; therefore, Grouvelle's (1896) original description was used for comparative purposes.

Results

Neocyloopus chaparensis sp. nov. (Figures 1–3)

Diagnosis

The new species may be distinguished from all the other known *Neocyloopus* species by the following combination of aedeagus characters: (1) penis broader than parameres, slender apically and with apex slightly folded forward (in dorsal view); (2) parameres almost as long as penis, with apices rounded; (3) phallobasis longer than penis, open dorsally.

Description

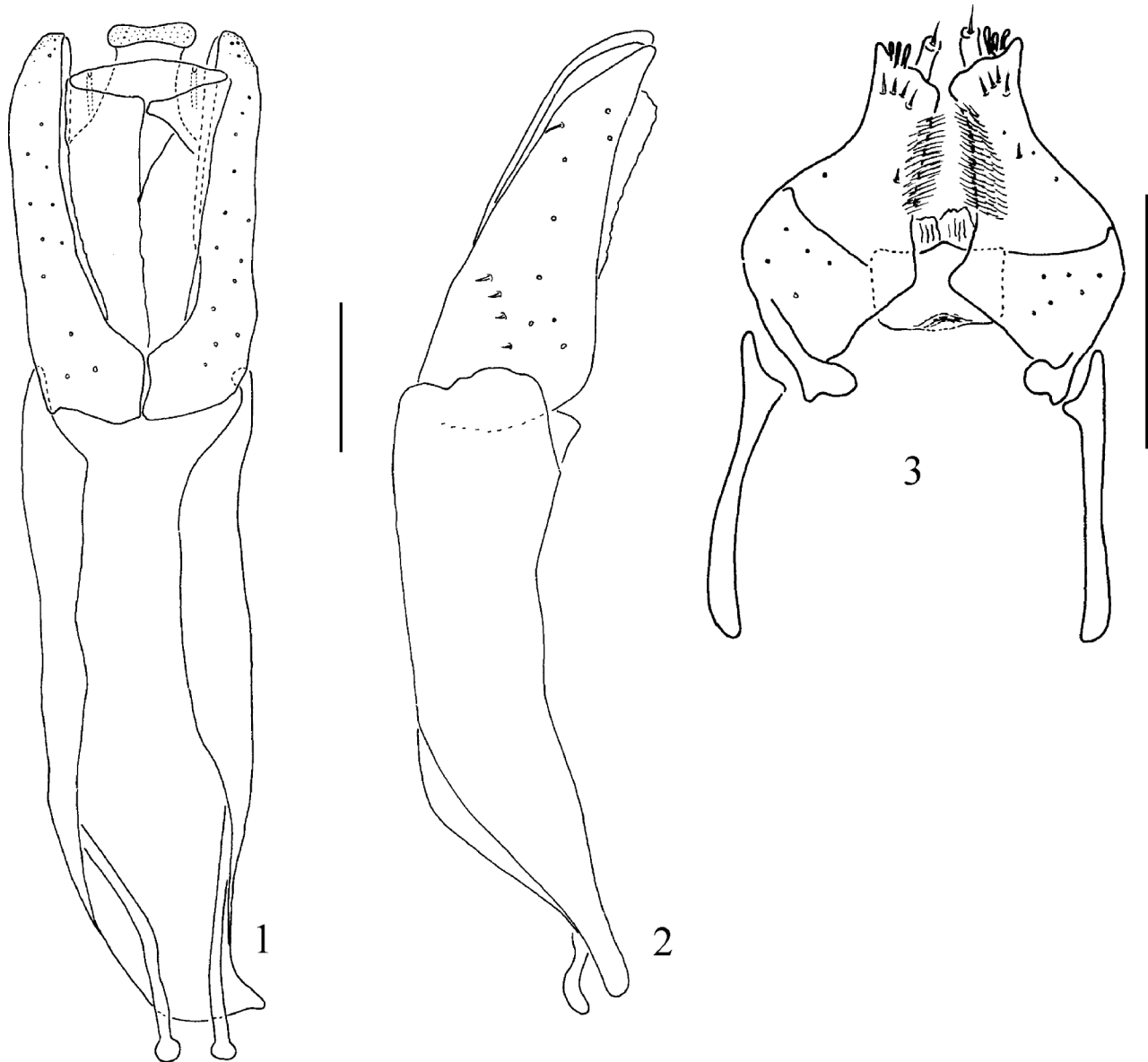
Holotype: male. Body rectangular, moderately convex; length 2.50 mm; greatest width 0.80 mm. Color: cuticle shiny. Body reddish brown, legs and antennae lighter in color. Plastron: covers integument of genae, epipleura, sides of prosternum and meso- and metaventrite, sides of abdominal sterna, all femora.

Head: partially retractable, without distinct impressions. Surface densely microreticulated and granulated; granules rounded; with golden, fine, short and sparse setae. Fronto-clypeal suture straight,

clypeus broad, as granulated and microreticulated as rest of head. Labrum subrectangular, transverse, anterior angles rounded; anterolateral margins with short, golden setae, surface as rest of head. Antenna 11-segmented, apical segment longest with cluster of apical setae, segment I next to longest.

Pronotum: broader than long (0.78 and 0.66 mm), moderately convex; lateral margin subparallel, crenated and granulated. Base trisinate. Surface microreticulated and densely granulated; granules like those on head, separated by 1 or 1.5 times their diameters; with short, golden and sparse setae. Sublateral carina on each side extending from base to apex. Disc of pronotum with deep transverse impression. Median longitudinal impression present; extending from base to transverse impression; longitudinal impression deep, as wide as scutellum (0.12 mm). Prosternum as wide as procoxa, with lateral carinae extending from procoxa to two-fifths of anterior margin; prosternal process wide, with obtuse apex. Hypomeron without tomentum; surface like that on pronotum. Mesoventrite with a groove for reception of prosternal process. Metaventrite granulated, granules separated by one to two times their diameter; with a median longitudinal impression, extending from base to center of metasternum. Legs: all with sparse rounded granules. Pro- and mesocoxae globular and shiny; trochanters subtriangular without tomentum; metacoxae transverse, tomentose and subtriangular, trochanter with tomentum near femur. Pro-, meso- and metafemora shorter than tibiae, tomentose. Protibia with a single apicolateral cleaning fringe (occupying apical half); mesotibia with apicolateral and lateroventral cleaning fringes (occupying one-third and two-thirds, respectively), metatibia with a single apicolateral cleaning fringe (occupying apical half). Tarsal claws long, without teeth. Elytra: two times longer than length of pronotum, lateral margins crenate, apices weakly protruded and truncated. Each elytron with eight coarse striae formed by deep, round punctures; with one sublateral carina on sixth interval. Intervals flat, with micropunctures. Epipleura tomentose, microreticulated, without granules. Scutellum subpentagonal, flat, microreticulated.

Abdomen: lateral sides of all segments tomentose, with rounded sparse granules. Disc of ventrite I depressed, depression deep, with large punctures, without granules; surface shiny, without tomentum; depression bounded laterally by longitudinal tuberculate carina on each side; carinae parallel and complete. Depression of ventrite I extending across ventrite II (occupying apical), surface shiny, without tomentum, with punctures smaller than first sternum. Ventrite V completely tomentose, lateral margin produced as prominent tooth; apex rounded.



Figures 1–3. *Neocylloepus chaparensis* sp. nov., adults. (1) Male genitalia, dorsal view. (2) Male genitalia, lateral view. (3) Female genitalia, dorsal view. Scale bars: 0.10 mm.

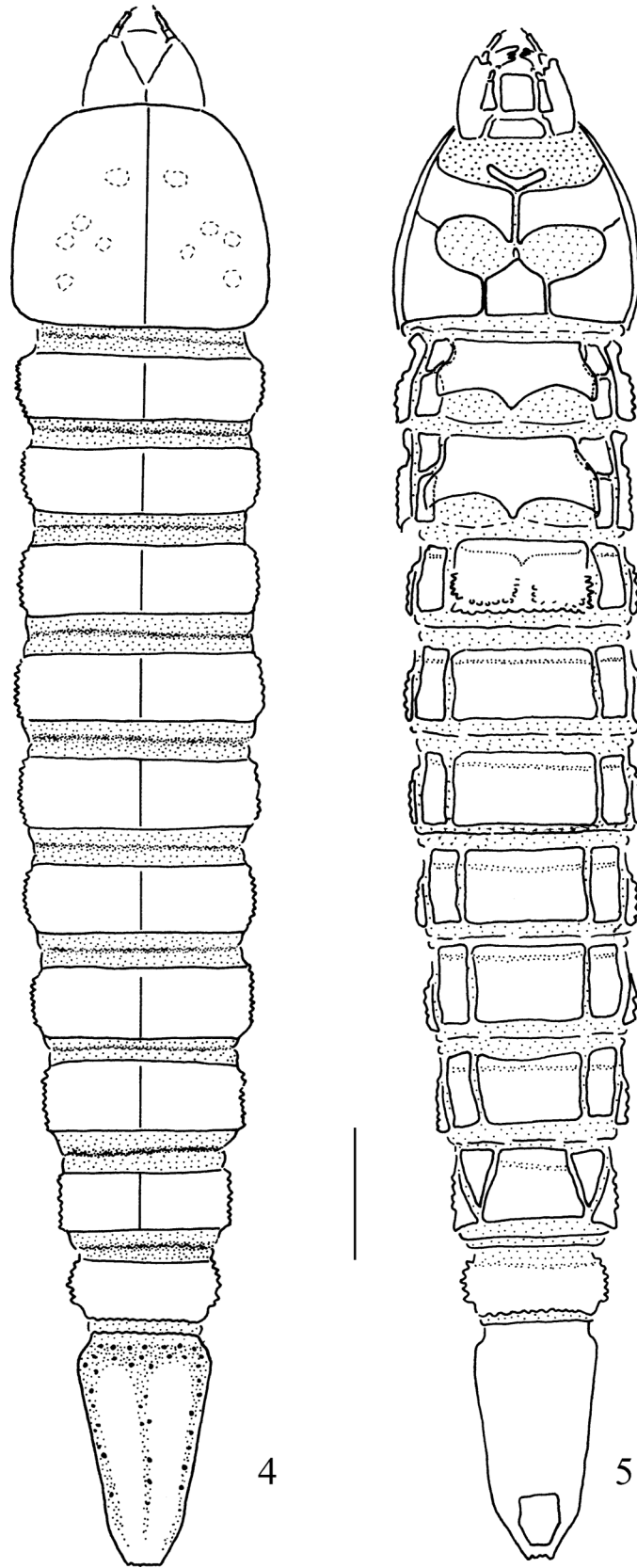
Male genitalia: aedeagus (Figures 1, 2) long and moderately broad. Penis broader than parameres, slender apically (narrower towards apex) and apex slightly folded forward (in dorsal view); ventral sac well developed; fibula and corona absent. Parameres almost as long as penis, with apices rounded. Phallobasis moderately large, longer than penis; open dorsally.

Female: externally similar to male except as follows: (1) median longitudinal impression of metaventricle longer, extending from base to apical two-thirds and (2) depression of abdominal ventrite I and II shallow. Female genitalia: inconspicuous and delicate, as in Figure 3.

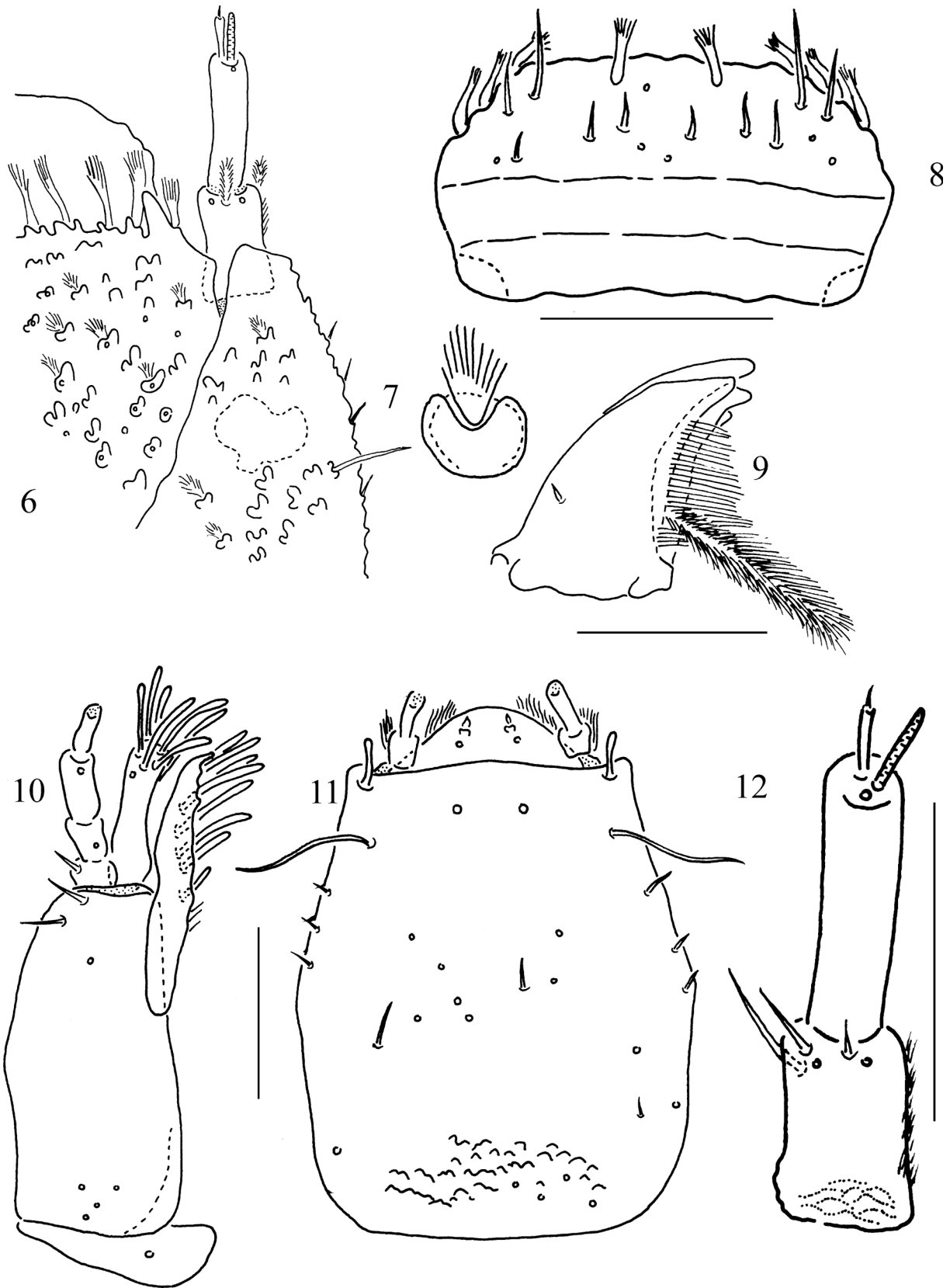
Description of the mature larva (Figures 4–17)

Body (Figures 4, 5): elongate, subcylindrical except abdominal segment IX, which is pentagonal in cross-section. Length 5.70 mm, width 0.72 mm (at base of metathorax). Cuticle shiny, brown; antennae, mouthparts, distal margin of clypeus and legs lighter in color. Surface densely tuberculate.

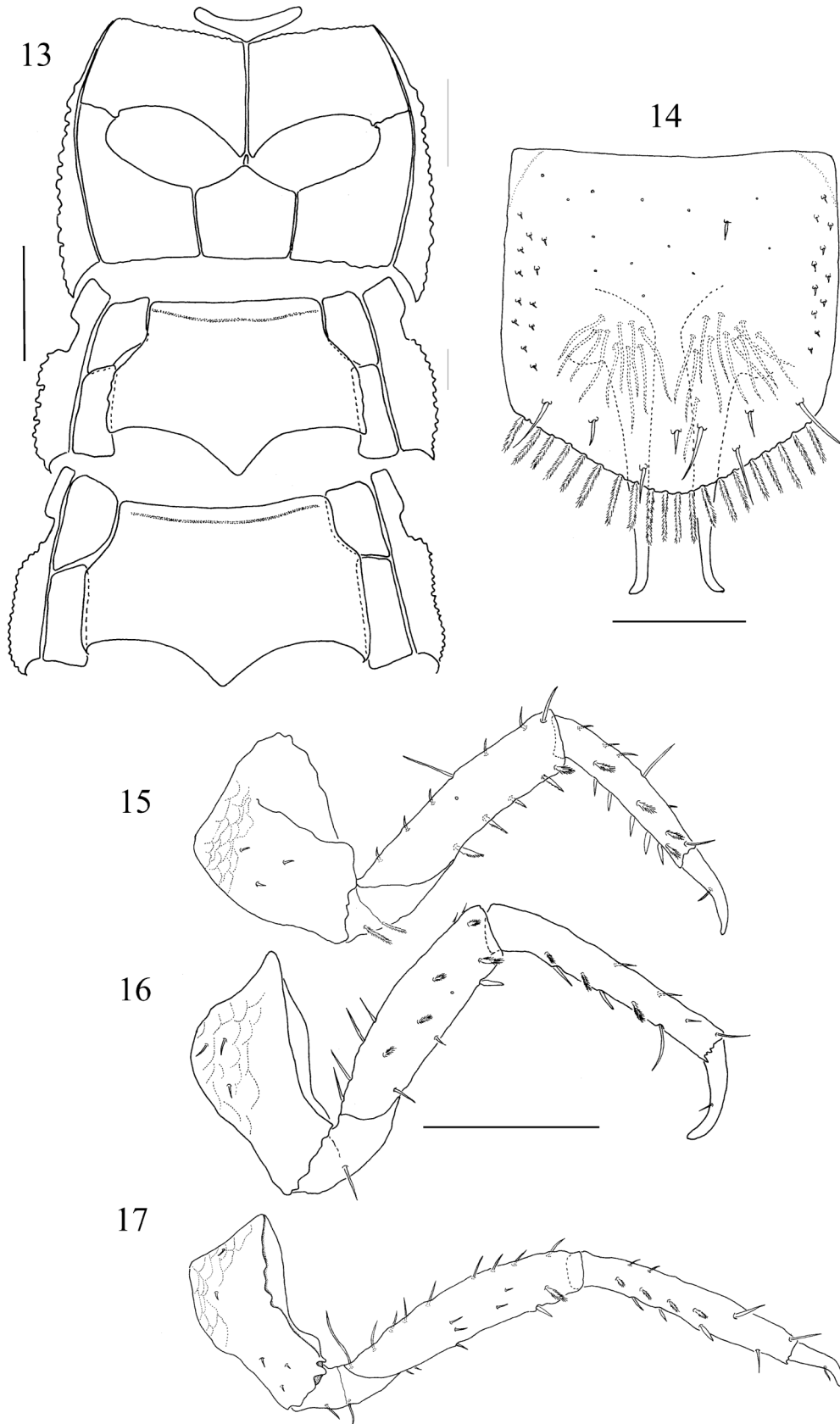
Head capsule (Figure 6): wider at base, exposed. Anterior margin with a large lateral blunt tooth on each side; surface with setiferous tubercles densely distributed (Figure 7). Coronal suture short, frontal sutures long, curved, extending to base of antennae; frontoclypeal suture absent. Gula well developed;



Figures 4–5. *Neocylloepus chaparensis* sp. nov., larva. (4) Habitus, dorsal view. (5) Habitus, ventral view. Scale bar: 0.50 mm.



Figures 6–12. *Neocylloepus chaparensis* sp. nov., larva. (6) Head, dorsal view. (7) Setiferous tubercle of head. (8) Labrum, dorsal view. (9) Left mandible, dorsal view. (10) Right maxilla, ventral view. (11) Labium, ventral view. (12) Left antenna. Scale bars: 0.10 mm.



Figures 13–17. *Neocyloepus chaparensis* sp. nov., larva. (13) Thoracic segments, ventral view. (14) Operculum, ventral view. (15) Prothoracic leg. (16) Mesothoracic leg. (17) Metathoracic leg. Scale bars: 0.20 mm (13, 15–17); 0.10 mm (14).

subquadrangular. Antennae (Figure 12) short, three-segmented; basal segment elongate with three apical setae; second segment longest, bearing elongate sensorium; third segment shortest, with short distal seta. Mandibles (Figure 9) symmetrical, apex with four teeth; dorsal surface with a comb of long setae extending from base to apex; inner margin with long prosthema projecting mediad. Labrum (Figure 8) transverse, anterior angles rounded; basal two-thirds smooth, distal one-third with dispersed short setae; anterolateral margins with ramose setae. Maxillae (Figure 10): cardo short, subtriangular, transverse; stipes long, subrectangular, distal one-third with two setae on outer margin; lacinia and galea well developed, lacinia with several long setae on mesal margin; galea elongate, with six or seven apical setae; palp four-segmented, first segment shortest, with one ventral seta, remaining segments subequal in length. Labium (Figure 11) large, formed by prementum and postmentum; postmentum large, undivided, subrectangular, longer than wide, ventral surface with rugose area at base, distal one-half with long setae on lateral margin, apical corners with stout blunt seta on each side; prementum membranous, short, transverse, forming setose lobe between palpi; palpi two-segmented, basal segment subrectangular, with long setae on outer margin; second segment longest, bearing several apical sensoria. Thorax (Figures 4, 5, 13): strongly sclerotized, tergal plates with sagittal line. All tergal, pleural and ventral sclerites with setiferous tubercles densely distributed as on head. Pronotum the longest segment, convex, broader than long, with rounded angles. Pronotum with five pairs of small suboval areas without setiferous tubercles (dotted lines in Figure 4). Venter of prothorax with seven sclerites: episternum and epimeron on each side, one large posteromedial sclerite (sternellum), a subtriangular anterior sclerite (accessory sclerite) and an elongate, small sclerite between procoxa; procoxal cavity closed. Meso- and metathorax shorter than prothorax. Venter of meso- and metathorax each with large subpentagonal basisternum anteriorly; episternum and epimeron on each side; coxal cavities open; setiferous tubercles sparse. Legs (Figures 15–17) five-segmented, elongate, similar in shape; those of prothorax shortest. Coxa large, subtriangular; trochanter smaller, subtriangular; femur long; tibia longer and narrower than femur, bearing hooked tarsungulus. Chaetotaxy of legs as in Figures 15–17.

Abdomen: nine-segmented; terga I–VII with sagittal line; segments I–VII similar in shape, remaining segments tapering in width. Terga of all segments with setiferous tubercles similar to those of thorax. Pleural sclerites on segments I–VII (Figure 5). Segment VIII entire, ring-like. Segment IX elongate,

apex rounded; sternum bearing gill chamber and operculum; tergum with five longitudinal tuberculate carinae: median dorsal and paired dorso- and ventrolaterals (Figure 4). Operculum subpentagonal, with a pair of dorsal hooks (Figure 14).

Material examined

Holotype male, Bolivia, Cochabamba, Chapare, Chipiriri River, June 2004, N. Moya coll. Paratypes: one female with same data as holotype; one male and 39 larvae from Cochabamba, Chapare, Chipiriri River, 16°49.66'S, 65°22.06'W, 25 November 2004, N. Moya coll.; and six adults and three larvae from Cochabamba, Chapare, Chipiriri River, 16°51.97'S, 65°23.41'W, 9 July 2007, N. Moya coll. Type and paratypes deposited in the collection of UMSS – ULRA; except two paratypes and 10 larvae deposited in the collection of IFML.

Etymology

Named *chaparensis* for the region (Chapare) from which the type specimens were collected.

Additional material examined

Neocylloepus sculptipennis (Sharp): Mexico, Jalisco, Estanzuela, 13 January 2005, unnamed stream, 4580, William Shepard leg., three adults. *Neocylloepus sandersoni* Brown: Panama: Rio Majagua, Chiriqui, 3.9 km N of David, 26 August 2006, 1193, W.D. Shepard leg., one male. *Neocylloepus* sp. (CZUT-Ma 000524): Colombia, Tolima, Coello River, 4°17'08"N, 74°35'36"W, March 2003, D.M. Arias-Diaz, G. Reinoso-Florez, G. Guevara-Cardona and F. A. Villa-Navarro legs., three larvae.

Keys

Brown (1970) included a very helpful key for all the species of *Neocylloepus* based primarily upon male genitalia. To add *Neocylloepus chaparensis* sp. nov. to his key, we insert the following between couplets 1 and 2:

1. Penis (dorsal aspect) shaped like a slender, long-necked French wine bottle, slightly dilated apically, pronotal impressions inconspicuous or absent (Mexico). *N. petersoni* Brown
- Penis broader or without apical enlargement; one or both pronotal impressions (median and transverse) usually conspicuous 2
2. Parameres almost as long as penis, with apices rounded. Basal piece dorsally open (Bolivia). *N. chaparensis* sp. nov.

- Parameres shorter than penis. Basal piece generally closed. 3
- 3. Parameres (lateral aspect) rather plump, almost ovate; fulcrum of basal piece not prominent 4
- Parameres more elongate; fulcrum of basal piece rather prominent 5
- 4. Penis (dorsal aspect) conspicuously broader than paramere (Mexico). *N. arringtoni* Brown
- Penis rather slender apically (Mexico) *N. hintoni* Brown
- 5. Parameres (dorsal aspect) apically narrowed or pointed (Mexico and Nicaragua) *N. sculptipennis* (Sharp)
- Parameres rather blunt apically 6
- 6. Penis (dorsal aspect) narrows abruptly toward apex; parameres hardly taper at all (Costa Rica, Panama and Colombia). *N. sandersoni* Brown
- Penis narrows gradually; parameres taper noticeably (southern USA and Mexico). *N. boeseli* Brown

Key to the known mature larvae of *Neocyloepus* Brown

- 1. Abdominal segment IX with prominent apical teeth 2
- Abdominal segment IX without apical teeth 3
- 2. Large size (5–6 mm). Pronotum with two pairs of small suboval areas without setiferous tubercles on each side. Tubercles on the posterior margins of abdominal sternites tricuspid (middle cusp predominant). *N. boeseli*
- Small size (3.4–4.2 mm). Pronotum with several small suboval areas without setiferous tubercles on each side (three or four). Tubercles of posterior margins of abdominal sternites bicuspid (if tricuspid the middle cusp not prominent). *N. sculptipennis*
- 3. Pronotum with two areas without setiferous tubercles on each side. Size 3.50–4.20 mm *N. sandersoni*
- Pronotum with five (eventually four) suboval areas without setiferous tubercles on each side. Size 5.70 mm *N. chaparensis* sp. nov.

Comparative notes

Adults

The Bolivian fauna includes 29 species (see Table 1). The first records for this country were those provided by Grouvelle in 1896, in a work that also included descriptions of several elmids species from

Brazil and Ecuador. Grouvelle (1896) described eight species from Bolivia, all from the locality Cochabamba (Table 1). Of these, four species were originally assigned to the genus *Helmis* as *H. thoracica*, *H. tibialis*, *H. cervina* and *H. longior*. Hinton (1940d) transferred the first of these species to the genus *Neohelmis*, and Wiezlak (1987) transferred the second to the genus *Austrelmis*. *Helmis cervina* and *H. longior* were never revised. Because these two species clearly do not belong to the genus *Elmis* (restricted to the Palearctic region), it could be supposed that one of them could actually be *N. chaparensis* sp. nov. Grouvelle (1896) mentioned some important morphological features that allow these species to be differentiated from *N. chaparensis* sp. nov. Thus, *H. cervina* presents two sublateral carinae on the elytra instead of one as in all the species of *Neocyloepus*. Regarding *H. longior* and according to its original description, this species is more similar to the species of genus *Heterelmis* than to those of *Neocyloepus*. *Helmis longior* has an oval body and the base of the elytra is wider than the prothorax (a common feature in several South American species of *Heterelmis*), whereas in all known species of *Neocyloepus* the body is elongate and subrectangular, with the elytra bases and prothorax of equal width. In fact, Grouvelle (1896) describes *Heterelmis* species (*H. neglecta*) for Cochabamba as well as another species for Ecuador as *Helmis apicata* which was later transferred to *Heterelmis* by Delève (1968). In *H. longior* the lateral carina is only evident at the base of the elytra, whereas in *N. chaparensis* sp. nov. the carina extends from the base almost to the apex of the sixth elytral interval. These species also differ in the shape of the scutellum, which is semicircular in *H. longior* and subpentagonal in *N. chaparensis* sp. nov. Maximum length is also different for these species: *N. chaparensis* is 2.5 mm long, with length for all the known species of *Neocyloepus* ranging between 2.10 and 3.25 mm, whereas *H. longior* is 4 mm long.

Neocyloepus chaparensis sp. nov. was compared with other species of this genus on the basis of Brown's (1970) original description and drawings. *Neocyloepus sculptipennis* (Sharp) from Mexico and *N. sandersoni* Brown from Panama were also examined. All these species are quite similar in external morphology and differ mainly in the male genitalia. Wide intraspecific variation occurs in some characters; for instance, the median longitudinal or transverse impressions of the pronotum are very distinct in some specimens but barely perceptible in others. Also, the median depression and longitudinal carinae of the first

Table 1. Checklist of species of Elmidae known from Bolivia.

Elmidae	Localities in Bolivia	Reference
Larainae		
<i>Hexanchorus tibialis</i> Hinton, 1935	Cochabamba	Hinton (1935)
<i>Potamophilops cinereus</i> (Grouvelle, 1896)	Santa Cruz: Sara (Nueva Moka)	Costa et al. (1999)
Elminae		
<i>Austrelmis consors</i> (Hinton, 1940)	Choqueyapu River, near La Paz; Poopó; Pazña River.	Hinton (1940b)
<i>A. consors mohin</i> (Hinton, 1940)	Urmiri near Pazña	Hinton (1940b)
<i>A. woytkowskii</i> (Hinton, 1937)	La Paz	Janssens (1957)
<i>A. woytkowskii bicolor</i> Janssens, 1957	La Paz	Janssens (1957)
<i>A. gardineri</i> (Hinton, 1940)	Urmiri	Hinton (1940b)
<i>A. gilsoni</i> (Hinton, 1940)	Paton, Ancoraimes and Unduavi River	Hinton (1940b)
<i>A. peruana</i> (Hinton, 1940)	Paton	Hinton (1940b)
<i>A. flavitarsis</i> (Grouvelle, 1897)	Cochabamba	Grouvelle (1897); Wieszlak (1987)
<i>A. thermarum</i> (Hinton, 1940)	Urmiri near Pazña	Hinton (1940b)
<i>A. tibialis</i> (Grouvelle, 1896)	Cochabamba	Grouvelle (1897); Wieszlak (1987)
<i>Austrolimnius tarsalis</i> Hinton, 1941	Yungas Valley, Unduavi River, Chaco	Hinton (1941)
<i>Cylloepus punctatus</i> Hinton, 1940	Yungas Valley, Chaco	Hinton (1940c)
<i>C. ventralis</i> Hinton, 1940	Yungas Valley, Chulumani	Hinton (1940c)
<i>C. tubercularis</i> Hinton, 1940	Yungas Valley, Puente de la Vía and Chulumani	Hinton (1940c)
<i>C. sparsus</i> Hinton, 1940	Yungas Valley, Puente de la Vía	Hinton (1940c)
<i>C. consobrinus</i> Grouvelle, 1896	Cochabamba, Yungas Valley, Chulumani and Puente de la Vía	Grouvelle (1896); Hinton (1940c)
<i>C. vicinus</i> Hinton, 1940	Yungas Valley, Chulumani	Hinton (1940c)
<i>Epodelmis rosa</i> Hinton, 1973	Dep. Santa Rosa, Prov. Sara, Santa Rosa	Hinton (1973)
<i>Heterelmis neglecta</i> Grouvelle, 1896	Cochabamba	Grouvelle (1896)
<i>Holcelmis woodruffi</i> Hinton, 1973	Dep. Santa Cruz, Prov. Sara, Santa Rosa	Hinton (1973)
<i>H. mamore</i> Hinton, 1973	Mamoré River, near Guyara-Mirim	Hinton (1973)
<i>Macrelmis bicolor</i> (Hinton, 1939)	Yungas Valley	Hinton (1939a)
<i>M. germaini</i> (Grouvelle, 1896)	Cochabamba	Grouvelle (1896); Hinton (1936)
<i>Neoelmis thoracica</i> (Grouvelle, 1896)	Cochabamba	Grouvelle (1896); Hinton (1940d)
<i>N. grossa</i> Hinton, 1939	Yungas Valley, Chaco	Hinton (1939b)
<i>N. opis</i> Hinton, 1972	Dep. Santa Cruz, Prov. Sara, Santa Rosa	Hinton (1972)
<i>N. apicalis angusta</i> Hinton, 1939	Yungas Valley, Chulumani and Puente de la Vía	Hinton (1939b)
<i>Neocylloepus chaparensis</i> sp. nov.	Cochabamba	Present study
<i>Helmis cervina</i> Grouvelle, 1896	Cochabamba	Grouvelle (1896)
<i>H. longior</i> Grouvelle, 1896	Cochabamba	Grouvelle (1896)

abdominal sternite vary in depth and length within the same sex and species.

Larvae

Previous descriptions of larvae exist for three *Neocylloepus* species: *N. boeseli*, *N. sculptipennis* and *N. sandersoni*. *Neocylloepus chaparensis* sp. nov. can be distinguished by: (1) pronotum with five pairs of small suboval areas without setiferous tubercles on each side and (2) abdominal segment IX without apical teeth. While working at the Coello river (Colombia), Arias-Díaz et al. (2007) collected 17 *Neocylloepus* larvae. Of these, the three larvae examined for this work present all the characteristics of the larvae of *N. sandersoni* Brown, and consequently the geographic range of this species would extend to Colombia in addition to Costa Rica and Panama.

Habitat and biology

Both larvae and adults were collected in a first-order, tropical, forest stream located in the Chapare province, Bolivia (16°51.97'S, 65°23.41'W), at an altitude of 220 m. The following elmid genera were found associated with individuals of this species: larvae of *Xenelmis*, *Microcylloepus*, *Macrelmis*, *Heterelmis* and adults of *Austrolimnius*.

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