

A key to the known larvae of South American Elmidae (Coleoptera: Byrrhoidea), with a description of the mature larva of *Macrelmis saltensis* Manzo.

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A key to identify the known mature larvae of the South American genera of the family Elmidae is provided. The key includes seven genera presently assigned to the subfamily Larainae and 15 genera assigned to the subfamily Elminae. New distributional data for all genera and a checklist of described larvae are also included. The mature larva of *Macrelmis saltensis* Manzo is described and illustrated for the first time, and compared to other known larvae of the *granigera* species-group. Distributional notes for *M. saltensis* increase its known range to the north, this being the first citation of the species for Bolivia. *Macrelmis isis* (Hinton) is also cited for the first time for Bolivia.

Keywords: Elmidae, larvae, identification key, *Macrelmis*, South America.

Introduction

The family Elmidae (riffle beetles) is a large cosmopolitan family divided into two subfamilies, Elminae and Larainae, both of which are present in the Neotropical Region. With more than 330 described species in 44 genera in this region (Manzo 2006a), riffle beetles are very common, especially in lotic habitats. Larvae and adults are found together in streams and rivers all year long. Despite being so widely distributed and very common, preimaginal stages of elmids are poorly known in South America. Descriptions of elmid larvae, especially from tropical regions, are rarely found in the literature (Çiampor & Ribera 2006). For the Neotropical region, at a specific level, less than 10% of the larvae have been described (Table 1). However in recent years larval studies of elmids have increased (Archangelsky & Manzo 2006, 2007, Manzo & Archangelsky 2001, Springer & Rivas 2003, Manzo 2006a, b).

A key to identify adults of all known South American genera has been recently published (Manzo 2005), but a similar key for larvae is lacking. Nevertheless some

useful references exist. Hinton (1940) described the larvae of several genera from Mexico. Other important contributions are those by Spangler & Santiago (1987) and Spangler & Santiago-Fragoso (1992) who studied the Larainae of Central America, describing the larvae of several genera. Additional studies dealing with larval descriptions are those by Brown (1970, 1971, and 1981) and Spangler (1966, 1990). Other important contributions are those by Bertrand (1956, 1965, 1972) in which he summarizes the knowledge of the immature stages of Byrrhoidea including Elmidae as part of Dryopidae. Finally Archangelsky & Manzo (2006) provide a key to identify the larvae of all known American Larainae.

Even though the larvae of only 22 genera (56%) of the 39 genera present in South America are known, we consider it important to publish a key for the known mature larvae of this family. This preliminary key will allow separating those larvae that are unknown from those already described, and will help in the association between adults and larvae. It will also be an important tool for many ecologists. It is important to point out that the 17 unknown genera are mainly in the northern half of South America, so the key is particularly useful in the southern half of South America. Since no character allows separating

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Table 1. Checklist of genera and species with larvae described from the Neotropical region and number of species in each genus cited.

Genus	Number of species
Subfamily Larainae	
<i>Disersus</i> Sharp 1882	10
<i>D. longipennis</i> Sharp 1882	
<i>Hexanchorus</i> Sharp 1882	14
<i>H. gracilipes</i> Sharp 1882	
<i>H. caraibus</i> (Coquerel 1851)	
<i>Hispaniolara</i> Brown 1981	1
<i>H. farri</i> Brown 1981	
<i>Hydora</i> Broun 1882	2
<i>H. annectens</i> Spangler & Brown 1981	
<i>Pseudodisersus</i> Brown 1981	1
<i>P. goudotii</i> (Guérin – Méneville 1843)	
<i>Phanocerus</i> Sharp 1882	4
<i>P. clavicornis</i> Sharp 1882 and 1 larvae not assigned to any known species	
<i>Pharceonus</i> Spangler & Santiago 1992	1
<i>P. volcanus</i> Spangler & Santiago 1992	
<i>Roraima</i> Kodada & Jäch 1999	1
<i>R. carinata</i> Kodada & Jäch 1999	
Subfamily Elminae	
<i>Austrelmis</i> Brown 1984	21
<i>A. lata</i> (Hinton 1940)	
<i>Austrolimnius</i> Carter & Zeck 1829	18
1 larva not assigned to any known species	
<i>Cylloepus</i> Erickson 1847	50
1 larva not assigned to any known species	
<i>Heterelmis</i> Sharp 1882	14
<i>H. longula</i> Sharp 1887 and 2 larvae not assigned to any known species	
<i>Hexacylloepus</i> Hinton 1940	20
<i>H. ferrugineus</i> (Horn 1870)	
<i>Huleechius</i> Brown 1981	2
<i>H. spinipes</i> (Hinton 1936)	
<i>H. marroni</i> Brown 1981	
<i>Luchoelmis</i> Spangler & Staines, 2001	4
<i>L. cekalovici</i> Spangler & Staines, 2001	
<i>Macrelmis</i> Mostchulsky 1859	39
<i>M. striata</i> (Sharp 1882)	
<i>M. granigera</i> (Sharp 1882)	
<i>M. isis</i> Hinton 1946	
<i>M. saltensis</i> Manzo 2003 and 3 larvae not assigned to any known species	
<i>Microcylloepus</i> Hinton 1935	21
<i>M. inaequalis</i> (Sharp 1882)	
<i>Neocylloepus</i> Brown 1970	6

Table 1. (continued).

Genus	Number of species
<i>N. boeseli</i> Brown 1970	
<i>N. sculptipennis</i> (Sharp 1882)	
<i>N. sandersoni</i> Brown 1970	
<i>Neoelmis</i> Musgrave 1935	47
2 larvae not assigned to any known species	
<i>Phanoceroides</i> Hinton 1939	1
<i>P. aquatica</i> Hinton 1939	
<i>Stegoelmis</i> Hinton 1939	11
<i>S. selva</i> Spangler 1990	
<i>Stethelmis</i> Hinton, 1945	2
<i>S. kaszabi</i> Hinton, 1970	
<i>Tolriolus</i> Hinton 1940	1
<i>T. ungulatus</i> Hinton 1940	
<i>Xenelmis</i> Hinton 1936	13
<i>X. bufo</i> (Sharp 1882)	
<i>X. sandersoni</i> Brown 1985	
<i>X. uruzuensis</i> Manzo 2006	

between larvae of the two subfamilies, this key includes all known elmids larvae of South America.

We also include the description of the larva of *Macrelmis saltensis*, compare it to other known larvae of the *granigera* species - group, and add some distributional notes of *M. saltensis* and *M. isis*.

Material and methods

Most of the material examined for this key is from the entomological collections in the Fundación – Instituto Miguel Lillo, Tucumán, Argentina (FIML). Additional specimens were borrowed from National Museum of Natural History, Smithsonian Institution, USA (NMNH, SI) and Universidad Mayor de San Simón de Bolivia, Unidad de Limnología y Recursos Acuáticos (UNSS - ULRA), Cochabamba, Bolivia. Information about some genera for which specimens were not available was obtained from literature (see Table 2).

Specimens of *Macrelmis saltensis* were fixed in the field and stored in 75% ethyl alcohol. Specimens were then cleared in lactic acid, dissected and mounted on slides in Hoyer's medium for observation and description. Drawings were done using Leica DMLB and Olympus BH-2 compound microscopes, and a Leica Wild M3Z, all with camera lucida. To be consistent with larval morphological nomenclature, we follow Lawrence (1991) and Kodada & Jäch (1999).

Results

Key for the identification of the known mature larvae of South American Elmidae*

1- Body strongly flattened dorsoventrally (platyform larvae); lateral margins of thorax and abdomen falcate; abdomen with pleural sclerites on segments I-VIII (Fig. 1)... **2**

- Body cylindrical, subcylindrical or slightly flattened dorsoventrally (eruciform larvae); lateral margins of thorax and abdomen never falcate (Fig. 3); abdomen with pleural sclerites on segments I-IV, I-V, I-VI, I-VII, I-VIII or pleural suture on abdominal segments I-IX ... **4**

2- Ventral region of prothorax with two large anterolateral sclerites, one on each side and a prosternal sclerite (Fig. 8); margins of thoracic sclerites rounded; margins of abdominal sclerites slightly falcate. Brazil... **Phanoceroides**

- Ventral region of prothorax with five sclerites, one anterolateral pair, one lateral pair and one posteromedian sclerite (Fig. 1); lateral margins of thoracic and abdominal sclerites strongly falcate... **3**

* Genera not included in this key: *Neblinagena*, *Potamophilops*, *Epodelmis*, *Gyrelmis*, *Hintonelmis*, *Holcelmis*, *Jolyelmis*, *Neolimnius*, *Notelmis*, *Onychelmis*, *Oolimnius*, *Pagelmis*, *Pilielmis*, *Portelmis*, *Stenhelmoides*, *Tolmerelmis* and *Tyletelmis*.

Table 2. Distribution and bibliographic references of the species examined.

Subfamily Larinae	Distributions and References
<i>Disersus</i> spp Sharp 1882	Brazil – Peru (FIML and NMNH, SI)
<i>Hexanchorus</i> sp Sharp 1882	Argentina (FIML)
<i>Hispaniolara farri</i> Brown 1981	Spangler & Santiago – Fragoso 1992
<i>Hydora annectens</i> Spangler & Brown 1882	Argentina (FIML)
<i>Pseudodisersus</i> sp Brown 1981	Brazil – Colombia (FIML and NMNH, SI)
<i>Phanocerus</i> spp Sharp 1882	Argentina (FIML)
<i>Pharceonus volcanus</i> Spangler & Santiago 1992	Colombia (FIML)
<i>Roraima carinata</i> Kodada & Jäch 1999	Kodada & Jäch 1999
Subfamily Elminae	
<i>Austrelmis</i> spp Brown 1984	Argentina – Bolivia – Peru (FIML and UNSS, ULRA)
<i>Austrolimnius</i> spp Carter & Zeck 1829	Argentina – Bolivia - Colombia (FIML)
<i>Cylloepus</i> sp Erickson 1847	Argentina (FIML)
<i>Cylloepus parkeri</i> Sanderson 1953	USA (FIML)
<i>Heterelmis</i> spp Sharp 1882	Argentina – Bolivia (FIML and UNSS, ULRA)
<i>Hexacylloepus</i> sp Hinton 1940	Argentina (FIML)
<i>Huleechius</i> sp Brown 1981	Bolivia (FIML)
<i>Huleechius marroni</i> Brown 1981	Mexico (FIML)
<i>Luchoelmis cekalovici</i> Spangler & Staines 2001	Argentina (FIML)
<i>Macrelmis</i> sp Mostchulsky 1859	Colombia (FIML)
<i>Macrelmis saltensis</i> Manzo 2003	Bolivia (FIML)
<i>Macrelmis isis</i> Hinton 1946	Argentina and Bolivia (FIML)
<i>Microcylloepus</i> Hinton 1935	Argentina – Bolivia (FIML and UNSS, ULRA)
<i>Neocylloepus</i> sp Brown 1970	Bolivia (FIML)
<i>Neoelmis</i> spp Musgrave 1935	Argentina – Bolivia and Colombia (FIML and UNSS, ULRA)
<i>Phanoceroidea acuatica</i> Hinton 1939	Hinton 1939
<i>Stegoelmis</i> sp Hinton 1939	Brazil (FIML)
<i>Stethelmis kaszabi</i> Hinton 1970	Argentina (FIML)
<i>Tolriolus ungulatus</i> Hinton 1940	Hinton 1940
<i>Xenelmis uruzuensis</i> Manzo 2006	Argentina (FIML)

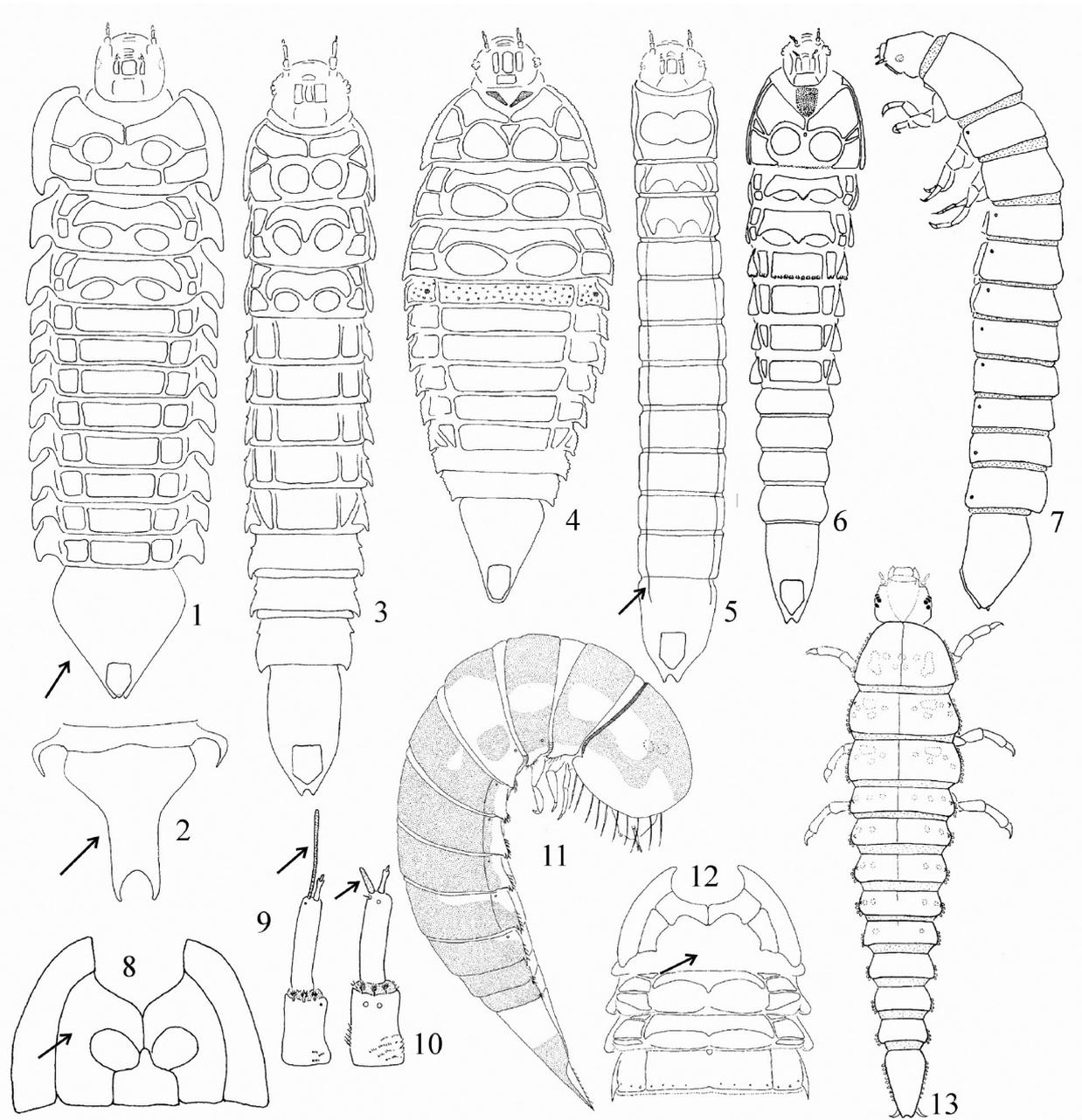
3- Last abdominal segment not abruptly narrowed at middle, apex slightly emarginated (Fig. 1). USA, Central America, West Indies, Colombia, Trinidad and Tobago, Peru, Paraguay and Argentina... ***Phanocerus***

- Last abdominal segment abruptly narrowed at middle, apex deeply emarginated (Fig. 2). Panama, Costa Rica, Venezuela, Colombia, Ecuador and Peru... ***Pharceonus***

4- Body cylindrical; pleural suture extending to middle of abdominal segment IX (Fig. 5). USA, Central America, Peru, Ecuador, Brazil, Bolivia, Paraguay and Argentina... ***Cylloepus***

- Body shape variable; abdominal segment IX without pleural suture... **5**

5- Sensory appendage of second antennomere very long, as long or longer than first antennomere (Fig. 9);



Figs. 1 – 13. Elmidae. Larinae (Figs 1 – 4), larvae. 1 *Phanocerus* sp., ventral view; 2 *Pharceonus* sp., dorsal view of last abdominal segments; 3 *Pseudodisersus* sp., ventral view; 4 *Hexanchorus* sp., ventral view. Elminae (Figs 5 – 13), larvae. 5 *Cylloepus* sp., ventral view; 6 – 7 *Luchoelmis cekalovici*, 6 ventral view, 7 lateral view; 8 *Phanocerooides acuatica*, thorax, ventral view (modified from Hinton 1939); 9 *Austrolimnius* sp., antenna; 10 *Macrelmis isis*, antenna; 11 – 12 *Xenelmis* sp., 11 lateral view, 12 thorax, ventral view; 13 *Stethelmis kaszabi*, dorsal view.

pleural sclerites on abdominal segments I-VII; tubercles on thoracic and abdominal segments arranged in a variable number of longitudinal rows. Central America, French Guiana, Colombia, Venezuela, Ecuador, Brazil, Bolivia, Paraguay, Chile and Argentina... *Austrolimnius*

- Sensory appendage of second antennomere short, shorter than first antennomere (Fig. 10); number of pleural sclerites on abdominal segments variable; arrangement of tubercles on thoracic and abdominal segments variable... **6**

6- Pleural sclerites on abdominal segments I-IV (Figs. 6 and 7). Chile and Argentina... *Luchoelmis*

- Pleural sclerites on abdominal segments I-V, I-VI, or I-VII... **7**

7- Pleural sclerites on abdominal segments I-V (Fig. 3)... **8**

- Pleural sclerites on abdominal segments I-VI or I-VII. **9**

8- Body elongate, subcylindrical; lateral margins of the terga of meso-, metathorax and abdominal segments slightly expanded; abdominal segment VI with an incomplete pleural suture. Mature larva up to 15.5 mm in length (Fig. 3). Costa Rica, Panama, Colombia and Ecuador... *Pseudodisersus*

- Body elongate, narrowing behind abdominal segment I; lateral margins of the terga of meso-, metathorax and abdominal segments not expanded; abdominal segment VI without a pleural suture. Mature larva up to 6.0 mm in length. (Fig. 13). Chile and Argentina... *Stethelmis*

9- Pleural sclerites on abdominal segments I-VI, sometimes segment VII may have a partial pleural suture; procoxal cavities open... **10**

- Pleural sclerites on abdominal segments I-VII; procoxal cavities open or closed... **13**

10- Ventral region of prothorax with four sclerites: one anterior pair, one posterior pair; ventral region of meso- and metathorax with seven sclerites: one anterior and three lateral pairs (Fig. 12); body convex, hemispherical in cross section. Mature larva at most 3.0 mm long (Fig. 11). USA; Central America, Ecuador, Peru, Brazil, Paraguay, Bolivia and Argentina... *Xenelmis*

- Ventral region of prothorax with seven sclerites: one anterolateral pair, two lateral pairs, and one anteromedian sclerite; ventral region of meso- and metathorax with five sclerites: one anterior sclerite and two lateral pairs (Fig. 4); body shape variable. Mature larvae over 4.0 mm long... **11**

11- Body fusiform, slightly depressed dorsoventrally; (Fig. 4); apex of last abdominal segment rounded; posterior margin of abdominal segment VIII with a large tubercle on each side; abdominal terga I-VIII without tubercles arranged in longitudinal rows. Length up to 5.0 mm. Central America, Caribbean, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay and Argentina... *Hexanchorus*

- Body cylindrical or subcylindrical, sides subparallel; apex of last abdominal segment emarginated; posterior margin of abdominal segment VIII without large tubercles; abdominal terga I-VIII with tubercles arranged in longitudinal rows. Length up to 10.0 mm... **12**

12- Body cylindrical, sides subparallel; tergal tubercles of prothorax and abdominal segments I-VIII arranged in four longitudinal rows, those of meso- and metathorax arranged in six rows; length of abdominal segment IX less than the length of abdominal segments V-VIII combined (Fig. 14). Length up to 16.0 mm. Guatemala, Costa Rica, Panama, Ecuador, Peru, Venezuela, Colombia and Ecuador... *Disersus*

- Body subcylindrical; tergal tubercles of thorax and abdominal segments I-VIII arranged in one longitudinal row on each side of the median line (sometimes absent); length of abdominal segment IX more than the length of abdominal segments V-VIII combined (Fig. 16). Length up to 10.0 mm. French Guiana, Venezuela, Colombia, Ecuador, Peru and Brazil... *Stegoelmis*

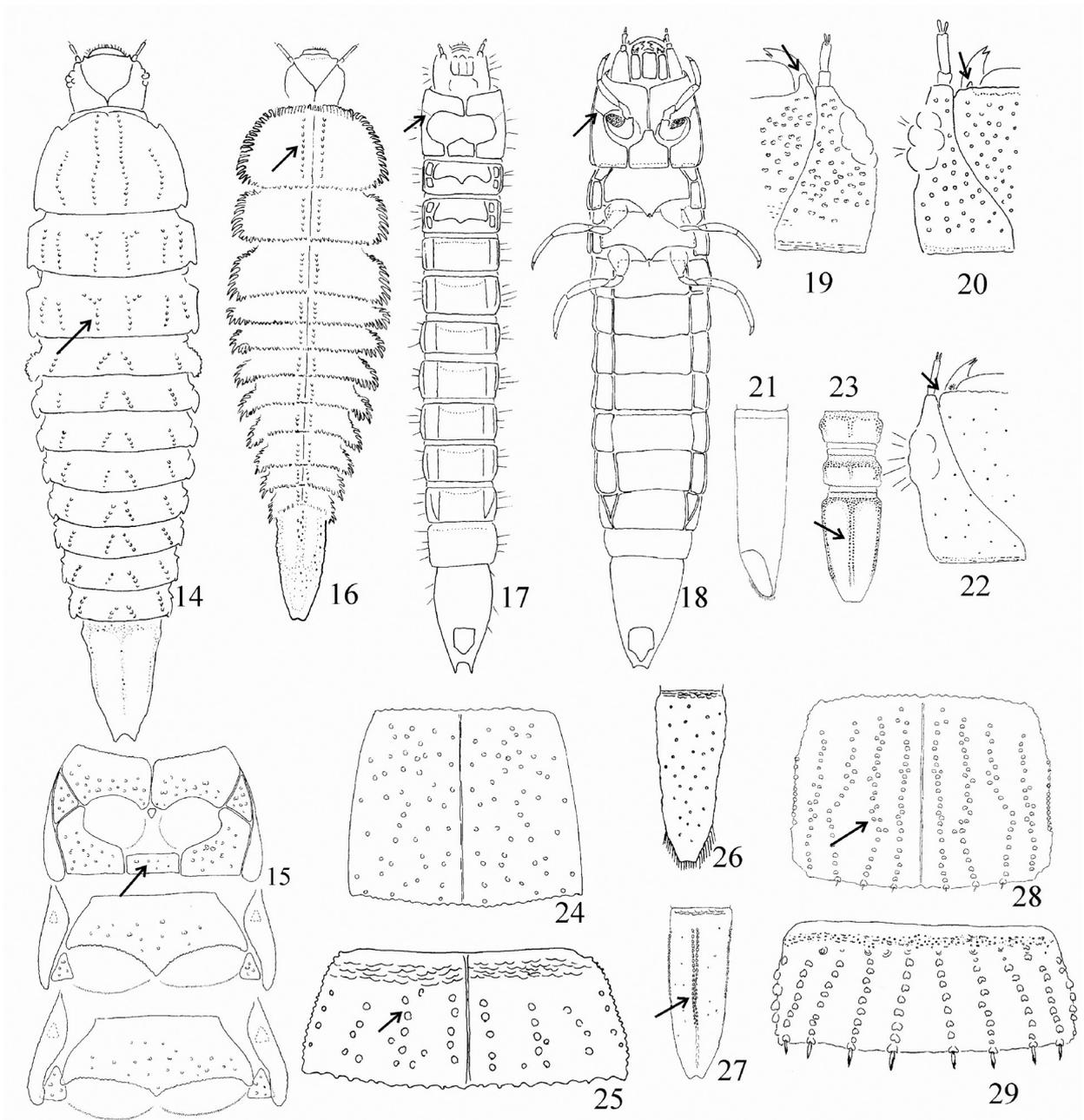
13- Last abdominal segment long and slender, three times longer than wide (Fig. 21). USA, Central America, Caribbean, French Guiana, Venezuela, Peru, Brazil, Paraguay and Argentina... *Hexacylloepus*

- Last abdominal segment variable in shape and length, but never three times longer than wide... **14**

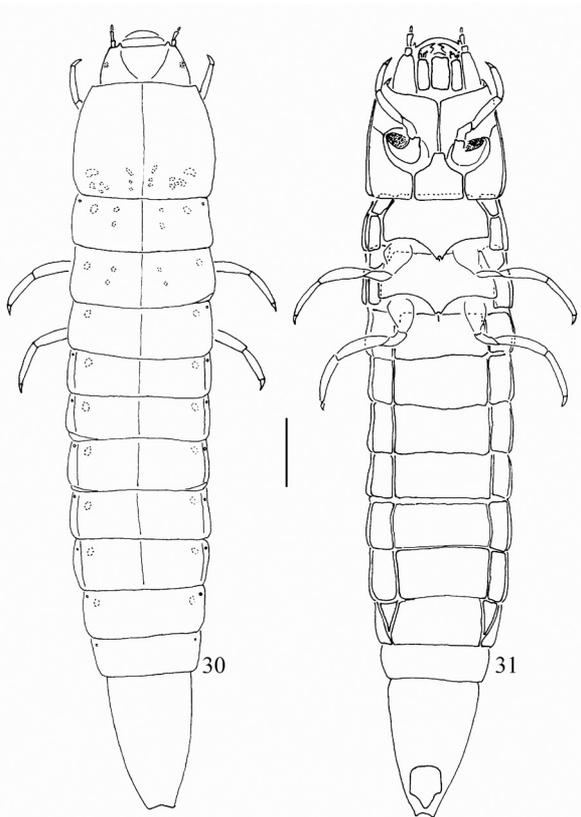
14- Procoxal cavities open. Cuticle with modified setae and granules: prominent, round granules, each granule with rounded, adpressed scale with vein-like surface structures; papillate projections, each projection with an elongate scale with vein-like surface structures; small, flat, elliptical granules with short, fringed setae; clavate setae with setose surface and fine, moderately long, hair-like setae. Venezuela... *Roraima*

- Procoxal cavities closed (Fig. 15); cuticle with tubercles and setae but not as above... **15**

15- Ventral region of meso- and metathorax with five sclerites (Fig. 15): one anterior subpentagonal, and two lateral pairs; thoracic and abdominal terga with setiferous tubercles, sometimes arranged in longitudinal rows... **16**



Figs. 14 – 29. Elmidae. Larinae (Figs 14 – 15), larvae. 14 *Disersus* sp., dorsal view (modified from Spangler & Santiago – Fragoso 1992); 15 *Hydora annectens*, thorax, ventral view. Elminae (Figs 16 – 29), larvae. 16 *Stegoelmis* sp., dorsal view (modified from Spangler 1990); 17 *Huleechius* sp., ventral view; 18 – 19 *Macrelmis* sp., 18 ventral view, 19 head capsule, dorsal view; 20 *Austrelmis* sp., head capsule, dorsal view; 21 *Hexacylloepus* sp., lateral view of last abdominal segment; 22 *Neoelmis* sp., dorsal view, head capsule.; 23 *Neocyllloepus* sp., last abdominal segments; 24 – 26 *Microcyllloepus* sp., 24 pronotum, 25 first abdominal tergum, 26 last abdominal segment; 27 – 29 *Heterelmis* sp., 27 last abdominal segment; 28 pronotum, 29 first abdominal tergum.



Figs. 30 – 31. *Macrelmis saltensis* Manzo, larva. 30 habitus, dorsal view; 31 habitus, ventral view. Scale bars = 0.50 mm.

- Ventral region of meso- and metathorax with seven sclerites: one anterior subpentagonal, and three lateral pairs; thoracic and abdominal terga with setiferous tubercles arranged (although sometimes partially) in longitudinal rows... **21**

16- Lateral margins of meso- and metathoracic terga strongly bent ventromedially; meso- and metathorax with five ventral sclerites: one anterior, subpentagonal, and two lateral pairs subtriangular (one pair inconspicuous, under the edge of the tergite) (Fig. 15). Chile and Argentina... *Hydora*

- Lateral margins of meso- and metathoracic terga not bent ventromedially; meso- and metathorax with five ventral sclerites: one anterior, subpentagonal, and two lateral pairs conspicuous, subrectangular... **17**

17- Anterior border of head capsule with a tooth on each side, between base of antennae and clypeus or on the sides of the clypeus (Figs. 19 and 20)... **18**

- Anterior border of head capsule without teeth (Fig. 22). USA, Mexico, Central America, Caribbean, Ecu-

dor, Trinidad and Tobago, Venezuela, Peru, Colombia, Bolivia, Brazil, Paraguay, Chile and Argentina... *Neoelmis*

18- Anterior border of frons with a large blunt tooth on each side, between base of antennae and clypeus (Fig. 19); lateral margin of clypeus without teeth; body shape variable... **19**

- Anterior border of frons without teeth between base of antennae and clypeus; lateral margin of clypeus with a small tooth on each side (Fig. 20); body subtriangular; cuticle usually with dark markings; tergum of abdominal segment IX usually with a median keel. Ecuador, Peru, Bolivia, Chile and Argentina... *Austrelmis*

19- Body flattened dorsoventrally; thoracic and first eight abdominal terga wider than long; suture from procoxal cavity to lateral margin conspicuous (Fig. 18); mature larva dark brown, almost black. USA, Mexico, Central America, French Guiana, Colombia, Venezuela, Trinidad and Tobago, Peru, Ecuador, Brazil, Bolivia, Paraguay, Chile and Argentina... *Macrelmis*

- Body subcylindrical, not flattened; thoracic and first eight abdominal terga as wide as long... **20**

20- Tergum of abdominal segment IX with a median keel (Fig. 23); suture from procoxal cavity to lateral margin conspicuous. USA, Central America, and Bolivia... *Neocylloepus*

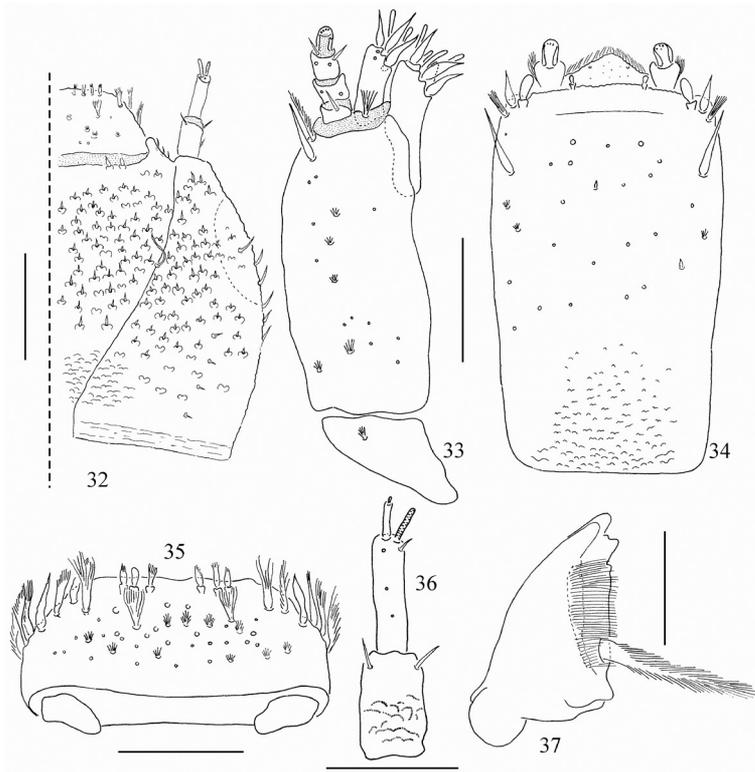
- Tergum of abdominal segment IX convex, without median keel; suture from procoxal cavity to lateral margin inconspicuous (Fig. 17). USA, Mexico, Ecuador, Bolivia and Argentina... *Huleechius*

21- Tergal tubercles of pronotum and abdominal segment IX randomly distributed (Figs. 24 and 26), not forming longitudinal rows; tubercles on remaining terga arranged in longitudinal rows (Fig. 25). USA, Central America, Caribbean, Trinidad and Tobago, French Guiana, Brazil, Peru, Chile, Paraguay and Argentina... *Microcylloepus*

- Tergal tubercles of thorax and first eight abdominal segments arranged in 8 or 10 longitudinal rows (Figs. 28 and 29); tergal tubercles of abdominal segment IX arranged in two median and two lateral rows (Fig. 27). USA, Mexico, Central America, Caribbean, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Chile and Argentina... *Heterelmis*

Description of the mature larvae of *Macrelmis saltensis* Manzo

Body (Figs. 30 and 31): elongate, flattened dorsoventrally, subtriangular in cross-section, sides of body subparallel. Length 5.70 mm, width 1.15 mm (at base of



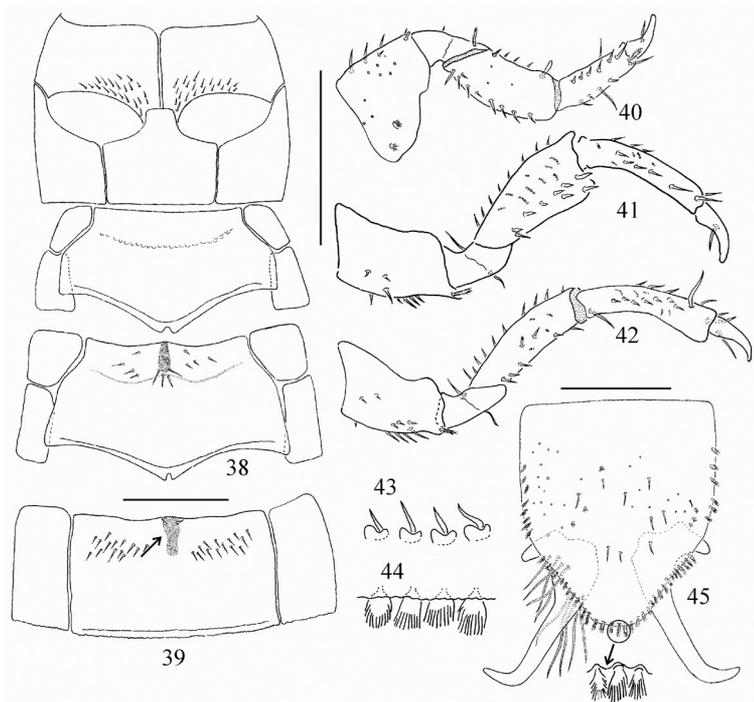
Figs. 32 – 37. *Macrelmis saltensis* Manzo, larva. 32 head capsule, dorsal view; 33 maxilla, ventral view; 34 labium, ventral view; 35 labrum, dorsal view; 36 right antenna; 37 mandible, dorsal view. Scale bars: figs 32, 35 and 37 = 0.20 mm; figs 33, 34 and 36 = 0.10 mm.

metathorax). Cuticle shiny, brown; antennae, mouthparts, distal margin of clypeus and legs lighter in color; ocular area yellowish. Posterior margin of all segments, except ninth, with a complete ring of tubercles from which arise flat setae branched distally (Fig. 44).

Head capsule (Fig. 32) wider at middle, partially retracted within thorax. Anterior margin with a large lateral blunt tooth on each side; surface with setiferous tubercles densely distributed. Ocular area yellowish; stemmata clustered. Coronal suture short, frontal sutures long, curved, extending to base of antennae; frontoclypeal suture absent. Gula well developed subquadrangular. Antennae (Fig. 36) short, three-segmented; basal segment elongate, distal area with two setae; second segment longest, bearing an elongated sensorium and a short seta; third segment as long as sensorium, with short distal seta. Mandibles (Fig. 37) symmetrical, apex tridentate; ventral surface with comb of long setae extending from near base to near apex; inner margin with long prosthema projecting mediad. Labrum (Fig. 35) subrectangular, transverse, anterior angles rounded; basal third smoother, distal two thirds with numerous short ramose

setae; anterolateral margins with long ramose setae. Maxillae (Fig. 33): cardo short, subtriangular, transverse, bearing a short fringed seta; stipes long, subrectangular, distal third with two long setae on outer margin; disc with several short fringed setae; lacinia and galea well developed, lacinia with 6-7 long setae on mesal margin, galea, elongated, with 5-6 apical setae; palp 4-segmented, first segment the shortest, with one ventral seta, remaining segments subequal in length, third segment with one lateral seta, last segment with one basal seta and apex with several short sensilla. Labium (Fig. 34) large, formed by prementum and postmentum; postmentum large, undivided, subrectangular, longer than wide, ventral surface with rugose area at base, distal third with ramose setae on lateral margin, apical corners with stout palp-like projection 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 shorter, bearing several setae and sensoria.

Thorax (Fig. 31 – 32, 38): strongly sclerotized, tergal plates with sagittal line. All tergal, pleural and ventral



Figs. 38 – 45. *Macrelmis saltensis* Manzo, larva. 38 thoracic segments, ventral view; 39 first abdominal segment, ventral view; 40 prothoracic leg; 41 mesothoracic leg; 42 metathoracic leg; 43 – 44 different setae: 43 setae from head, thorax and abdomen; 44 setae posterior margin of all segments; 45 operculum, ventral view. Scale bars: figs 38, 39, 40, 41 and 42 = 0.40 mm; fig 45 = 0.20 mm.

sclerites with setiferous tubercles densely distributed like those on head (Fig. 43); tergal sclerites with small basal and lateral areas lacking tubercles (dotted lines in Fig. 30). Pronotum largest, convex, broader than long, with rounded angles. Venter of prothorax (Fig. 38) with five sclerites: episternum and epimeron on each side, and one large posteromedial sclerite (sternellum); procoxal cavity closed; setiferous tubercles more sparsely distributed than terga. Meso- and metanota shorter than prothorax (Figs 31, 38). Venter of meso- and metathorax each with large subpentagonal basisternum anteriorly; episternum and epimeron on each side; coxal cavities open; setiferous tubercles sparse. Posterior margin of basisterna of meso- and metasterna with a concavity that fits into short carina of the metabasisternum and first abdominal sternite, respectively. Legs (Figs. 40 - 42) five segmented, similar in shape, those of prothorax the shortest. Coxa large, subtriangular; trochanter smaller, subtriangular; femur long, tibia long, narrower than femur, bearing hooked tarsungulus. Chaetotaxy of legs as in Figures 40, 41 and 42.

Abdomen: nine-segmented (Figs 30 – 31); terga I-VI with sagittal line; segments I-VII similar in shape, subrectangular, remaining segments tapering in width.

Terga of all segments with setiferous tubercles similar to those of thorax. Terga of segments I-VII with small sub-oval areas lacking tubercles. Pleural sclerites on segments I-VII; sternal sclerites of segments I-VII subrectangular; sternal plate of segment I (Fig. 39) with a longitudinal carina on middle of the anterior third. Segment VIII entire, ring-like. Segment IX elongate, conical, apex feebly emarginated; sternal area bearing gill chamber, operculum and a pair of hooks; operculum sub-pentagonal (Fig. 45).

Material Examined: BOLIVIA: Departamento Tarija, Itaú River, (debajo del pueblo de Itaú), 21°41'57.4" S 63°53'02.1" W, 993, m 8/iii/2006, E. Domínguez and C. Nieto colls, 1 ♂ and 5 larvae. All material deposited in collection of Instituto – Fundación Miguel Lillo, Tucumán, Argentina. ARGENTINA: Salta province: Finca Jakulica, A° I, 22°41'01" S 65°30'40" W, 14/xii/1999, E. Domínguez, F. Romero and V. Manzo colls., 1 ♂ (holotype), 2 ♀♀ (paratype) and 1 larva (IFML).

Comparative Notes

When *Macrelmis saltensis* was described one larva was collected along with adults. However this larva was

an early instar. Formal description was postponed until new material became available (Manzo 2003). Now, adults and mature larvae of *M. saltensis* were collected in Bolivia for first time.

Macrelmis was established by Motschulsky in 1859 and includes 39 species (Manzo, 2006a). The known distribution of *Macrelmis* includes southern United States, Central America, French Guiana, Trinidad and Tobago, Colombia, Venezuela, Ecuador, Peru, Bolivia, Brazil, Paraguay, Chile and Argentina. Hinton (1940), working with adults, separated two species-groups: *granigera* and *striata*. More recently Spangler (1997) designated the species-group: *milleri*. The preimaginal stages of this genus are poorly known. Bertrand (1956, 1972) distinguished two groups, or types, of larvae within *Macrelmis*: *striata*-type and *granigera*-type, based mostly on Hinton's work. So far only the larvae of three species have been described for the Neotropical region. Two species of the *striata*-type: *M. striata* from Mexico (Hinton 1940) and *M. isis* from Brazil and Argentina (Manzo & Archangelsky 2001); and one species of the *granigera*-type: *M. granigera* from Mexico (Hinton, 1940). Larvae of three other species have also been described, but they were not assigned to any known species: two from Mexico (Hinton, 1940) and one from Peru (Spangler 1966).

The larvae of *M. saltensis* have all the characters of the *granigera* species-group: anterior corner of pronotum blunt, emargination of segment IX shallow and first ventrite with short longitudinal carina (character not mentioned by Bertrand). Therefore the larva of *M. saltensis* becomes the second known species of the *granigera*-species group.

Based on the original description of *M. granigera* (Hinton 1940), this species can be distinguished from larvae of *M. saltensis* by: (1) outer margin of mandibles with long seta; (2) labium with subrectangular prementum, not forming a lobe between palpi; (3) maxillae with cardo lacking seta, and galea with 4 long setae (*M. saltensis* has 5-6 setae); (4) larger size (8.00 mm *M. granigera* – 5.7 mm *M. saltensis*).

Distributional notes

Macrelmis saltensis was described by Manzo (2003) based on adults from northwestern Argentina. New material of this species has been recently collected in the southern Bolivia, this becoming the first record of this species for Bolivia. Associated to *M. saltensis* were also collected adults and larvae of *M. isis* (Hinton 1946), a species previously only known from Brazil and Argentina (Manzo & Archangelsky 2001). The new records for *M. isis* from Bolivia are:

BOLIVIA: Departamento Tarija, Bermejo River, 22°13'29.1''S 69°36'12.6''W, 1035 m, 1/iii/2006, E. Domínguez and C. Nieto coll, 1 ♂; Salinas River (dejado del pueblo Entre Ríos), 21°32'15''S 64°06'55''W, 1216 m, 6/iii/2006, E. Domínguez and C. Nieto coll. 2 ♀♀ and 1 larva; Itaú River, 21°59'52.1''S 63°55'59.5''W, 9/iii/2006, E. Domínguez and C. Nieto coll. 1 ♂, 1 ♀ and 2 larvae; Sidras, Itaú River, 22°05'37.1''S 63°59'12.7''W, 593 m, 8/iii/2006, E. Domínguez and C. Nieto coll. 2 ♀♀ and 2 larvae.

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References

- Archangelsky M. & Manzo V. 2006. The larva of *Hydora annectens* Spangler & Brown (Coleoptera: Elmidae, Larinae) and a key to New World Larinae larvae. *Zootaxa*, 1204, 41 – 52.
- Archangelsky M. & Manzo V. 2007. – Descripción de las larvas maduras de los géneros *Stethelmis* Hinton y *Luchoelmis* Spangler & Staines (Insecta: Coleoptera, Elmidae). *Rev. Mus. Argentino Cienc. Nat., n.s.*, 79 – 87.
- Bertrand H.P.I. 1956. Notes sur les premiers états des dryopides d'Amérique. *Ann. Soc. Ent. France*, 124, 97 – 139.
- Bertrand H.P.I. 1965. Notes sur les premiers états des dryopides d'Amérique (Col.) (Addendum). *Bull. Soc. Ent. France*, 70, 163 – 166.
- Bertrand H.P.I. 1972. *Larves et nymphes des Coléoptères aquatiques du globe*. Abbeville, France: F. Paillart. 804 pages.
- Brown H.P. 1970. *Neocylloepus*, a new genus from Texas and Central America (Coleoptera: Dryopoidea: Elmidae). *Coleop. Bull.*, 24, 1 – 29.
- Brown H.P. 1971. Neotropical Dryopoids. III. New records of *Xenelmis*, with description of the larva (Coleoptera: Elmidae). *Coleop. Bull.*, 27, 95 – 101.
- Brown H.P. 1981. *Huleechius*, a new genus of riffle beetles from Mexico and Arizona (Coleoptera, Dryopoidea, Elmidae). *Pan – Pac. Entomol.*, 57, 228 – 244.
- Čiampor F. & Ribera I. 2006. *Hedyselmis opis*: Description of the larva and its phylogenetic relation to *Graphelmis* (Coleoptera: Elmidae: Elminae). *Eur. J. Entomol.*, 103, 627 – 636.
- Hinton H.E. 1939. – An inquiry into the natural classification of the Dryopoidea based partly on a study of their internal anatomy (Coleoptera). *Trans. R. Ent. Soc. London*, 89, 133 – 184.
- Hinton H.E. 1940. A monographic revision of the Mexican water beetles of the family Elmidae. *Novit. Zool.*, 42, 217 – 396.
- Hinton H.E. 1946. A synopsis of the Brazilian species of *Elsianus* Sharp. *Trans. R. Ent. Soc. London*, 96, 125 – 149.
- Kodada J & Jäch M.A. 1999. *Roraima carinata* gen. et sp. nov. and *Neblinagensa doylei* sp. nov., two Larinae from Mount Roraima, Venezuela (Coleoptera: Elmidae). *Entomol. Problems*, 30, 13 – 29.
- Lawrence J.F. 1991. Order Coleoptera. Pages 404 – 407 in *Immature Insects* 2. F.W. Stehr (ed.). Kendall/Hunt Publishing Co., USA.

- Manzo V. 2003. A new species of *Macrelmis* Motschulsky from Argentina (Coleoptera: Elmidae). *Aquat. Insects*, 25, 169-175.
- Manzo V. 2005. Key to the South America genera of Elmidae (Insecta: Coleoptera) with distributional data. *Stud. Neotr. Fauna Environ.*, 40, 201 – 208.
- Manzo V. 2006a. Sistemática y Biología de la Familia Elmidae (Insecta: Coleoptera) en Argentina. Universidad Nacional de Tucumán, 203 pp + anexo.
- Manzo V. 2006b. A review of the American species of *Xenelmis* Hinton (Coleoptera: Elmidae), with a new species from Argentina. *Zootaxa*, 1242, 53 – 68.
- Manzo V. & Archangelsky M. 2001. Description of the larva of *Macrelmis isis* (Hinton, 1946), with distributional notes of the species (Coleoptera: Elmidae). *Tijdschr. Entomol.*, 144, 45-54.
- Motschulsky V. 1859. Insectes des Indes orientales, et de contreés analogues. *Etudes Entomologiques*, 8, 25 – 118.
- Spangler P.J. 1966. – The Catherwood Foundation Peruvian – Amazon Expedition XIII. Aquatic Coleoptera (Dytiscidae, Noteridae, Gyrinidae, Hydrophilidae, Dascillidae, Helodidae, Psephenidae, Elmidae). *Monographs of the Academy of Natural Sciences of Philadelphia*, 14, 377 – 443.
- Spangler P.J. 1990. A revision of the Neotropical aquatic beetle genus *Stegoelmis* (Coleoptera: Elmidae). *Smithsonian Contributions to Zoology*, 502, 52 pp.
- Spangler P.J. 1997. – Two new species of the aquatic beetles genus *Macrelmis* Motschulsky from Venezuela (Coleoptera: Elmidae: Elminae). *Insecta Mundi*, 11, 1 - 8.
- Spangler P.J. & Santiago S. 1987. a revision of the Neotropical aquatic beetle genera *Disersus*, *Pseudodisersus* and *Potamophilops* (Coleoptera: Elmidae). *Smithsonian Contributions to Zoology*, 446, 40 pp.
- Spangler P.J. & Santiago – Fragoso S. 1992. The aquatic beetle Subfamily Larinae (Coleoptera: Elmidae) in Mexico, Central America and the West Indies. *Smithsonian Contributions to Zoology*, 528, 74 pp.
- Springer M & Rivas R.A. 2003. First description of the larva of *Pharceonus* Spangler et Santiago – Fragoso 1992 and new records for the genus (Coleoptera: Elmidae: Larinae) *Aquat. Insects*, 25, 219 – 223.