



REVISTA BRASILEIRA DE  
**Entomologia**  
A Journal on Insect Diversity and Evolution

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Systematics, Morphology and Biogeography

## Description of the third instar larva of *Saccharoscaptus laminifer* (Dechambre) (Coleoptera: Melolonthidae: Dynastinae)



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### ARTICLE INFO

#### Article history:

Received 4 April 2017

Accepted 17 July 2017

Available online 29 July 2017

Associate Editor: Adriana Marvaldi

#### Keywords:

Morphology

Taxonomy

Biology

White grubs

Sugarcane

### ABSTRACT

The larva of pentodontine *S. laminifer* is described for first time based on specimens collected under roots of sugarcane in Santa Cruz, Bolivia. Diagnostic structures are illustrated and the differences and similarities with other previously described larvae of South American genera of Pentodontini are outlined. A key to the larvae of some American genera of pentodontines is included.

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### Introduction

In the Americas, the tribe Pentodontini includes 32 genera and 151 species that occur from southern Canada to Argentina, with four genera and nine species in the West Indies (Endrödi, 1969, 1985; Morón and Grossi, 2015; Ratcliffe and Cave, 2015; López-García et al., 2016), but only the larvae of nine genera (*Aphonus* LeConte, *Bothynus* Hope, *Coscinocephalus* Prell, *Euetheola* Bates, *Ligyris* Burmeister, *Neoryctes* Arrow, *Orizabus* Fairmaire, *Oxygrilius* Casey, *Philoscaptus* Bréthes) represented by 15 species are described (Ritcher, 1966; Morón, 1976; Lumaret, 1991; Morón and Ratcliffe, 1996; Morelli, 1997; Ramírez-Salinas et al., 2004, 2010; Pereira et al., 2013), including scarce data about the biology of each species.

During 2012, the author received samples of medium size white grubs collected under roots of sugarcane fields of Santa Cruz province, Bolivia. After breeding in the laboratory of *Instituto de Investigaciones Agrícolas El Vallecito* (IIAV), *Universidad Autónoma Gabriel René Moreno*, Santa Cruz, these larvae were identified as *Philoscaptus laminifer* Dechambre, 1979 (Copa-Bazan and Morón, 2014). This species was known only by the male holotype collected in "Para, Brazil" during XIX century. Recently, this species became the type species of *Saccharoscaptus* (Morón and Grossi, 2015). The aims of the present work are to describe the third-instar larva of *S. laminifer*, and to provide an updated key to the larvae of American Pentodontini.

### Material and methods

The classification of families of Scarabaeoidea used in the present paper was proposed by Endrödi (1966) and updated by Morón (2010) and Cherman and Morón (2014). Terms and characters used in the description of larva are those of Ritcher (1966), Morón (1987), and Morón et al. (2014). Drawings of diagnostic structures were made using a Leica stereomicroscope 0.8–5.0× associated with a camera lucida, and measurements were obtained with an ocular micrometer. Photographs were obtained with aid of a video system associated to a Celestron 44206 stereomicroscope. Voucher specimens were deposited at the reference collection of IIAV, Santa Cruz, Bolivia, and *Colección Entomológica Instituto de Ecología*, A. C. Xalapa, Mexico (IEXA).

### Results

It is difficult to offer a set of clear cut diagnostic characters to distinguish the larvae of the tribe Pentodontini from those of other tribes of Dynastinae. But as a preliminary introduction based on Ritcher (1966), Morón (1987), Morón and Ratcliffe (1996), and recent experience of the author, the following diagnostic combination of larval characters of American Pentodontini is proposed: maximum width of head capsule 3–8 mm; with 0–2 anterior frontal setae; labrum slightly asymmetrical, both lateral margins of epipharynx rounded; apex of lacinia with transverse row of 3 unci fused basally, the intermediate unci smaller than lateral unci; left mandible with S4 reduced or absent; last antennomere with 1–8

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sensory spots; each tarsal claw with 2 setae; dorsa of abdominal segments VIII and IX without short, spiniform setae.

*Key to the third instar larvae of American Pentodontini*

(Modified from Pereira et al., 2013)

Note. *Diloboderus* is not included in the tribe Pentodontini, because based on larval characters, it was transferred to the tribe Agaoccephalini (Pardo-Locarno and Morón, 2006; Neita-Moreno et al., 2014; Morón and Grossi, 2015).

1. Raster with palidia and septula. . . . . 2
- 1'. Raster without palidia and septula. . . . . 3
2. Palidia monostichous, each palidium consisting of 7–10 compressed pali whose tips are slightly hooked. Palidia and septula not extending across lower anal lip. Last antennomere with 2 dorsal sensory spots. . . . . *Euethela*
- 2'. Palidia polystichous, each palidium consisting of a patch of 5–7 irregular, longitudinal rows of sharp, cylindrical, spine-like pali. Palidia and septula extending across lower anal lip. Last antennomere with 2–4 dorsal sensory spots. . . . . *Ligyru*(*Ligyrodes*)
3. Inner margin of left mandible (between scissorial and molar areas) with a small tooth (S4). . . . . 4
- 3'. Inner margin of left mandible between scissorial and molar areas smooth or slightly irregular but not dentate. . . . . 8
4. Last antennomere with 2 dorsal sensory spots. . . . . 6
- 4'. Last antennomere with 5–12 dorsal sensory spots. . . . . 5
5. Ocelli absent. Last antennomere with 5–6 dorsal sensory spots. Maximum head capsule width 4.7 mm. . . . . *Neoryctes*
- 5'. Ocelli present. Last antennomere with 12 dorsal sensory spots. Maximum head capsule width 10.9 mm. . . . . *Bothynus*
6. Respiratory plates of abdominal segments I–VIII similar in size. . . . . 7
- 6'. Respiratory plates of abdominal segments I and VIII slightly smaller than those of segments II–VII, which are similar in size. . . . . *Ligyru* (*s.str.*)
7. Color of cranium yellowish-brown, surface with numerous small pits. Each side with 1 prominent, exterior frontal seta. Ocelli vague. . . . . *Oxygrylius*

7'. Color of cranium reddish-brown, surface deeply and sparsely punctate. Each side without exterior frontal setae. Ocelli well defined. . . . . *Coscinocephalus*

8. Last antennomere with 1 dorsal sensory spot. Maxillary stridulatory teeth with anteriorly projecting points. . . . . 10

8'. Last antennomere with 4–8 dorsal sensory spots. Maxillary stridulatory teeth truncate, without anteriorly projecting points. . . . . 9

9. Respiratory plates of abdominal segments I–VIII nearly similar in size. Last antennomere with 4–5 dorsal sensory spots. Frons with many secondary short setae. . . . . *Philoscaptus*

9'. Respiratory plates of abdominal segments I–IV similar in size, those of abdominal segments V–VIII progressively smaller posteriorly. Last antennomere with 6–8 dorsal sensory spots. Frons with scarce secondary minute setae. . . . . *Saccharoscaptus*

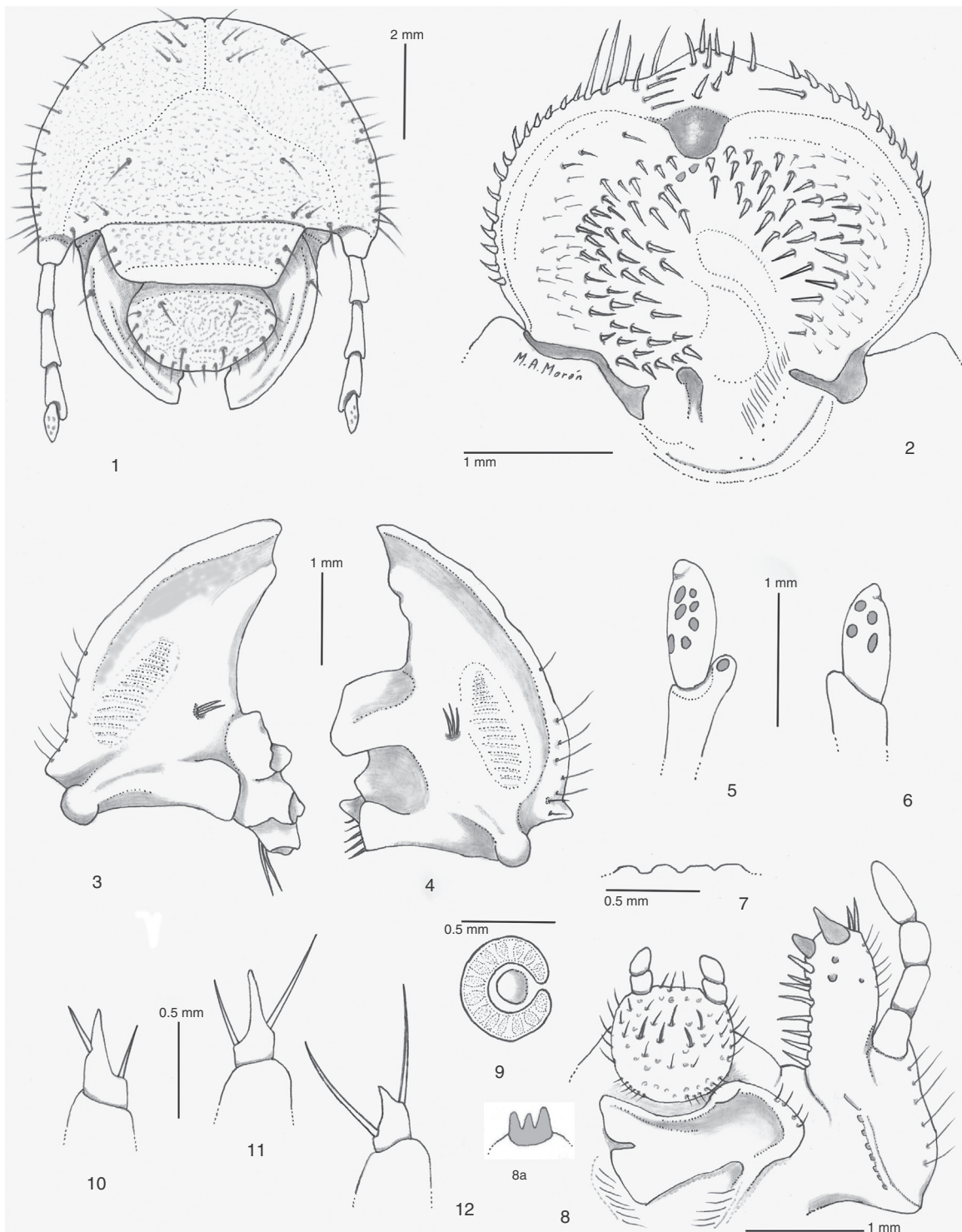
10. Respiratory plate with 13–25 oval micro-holes across any diameter. Maximum width of head capsule 6.0–6.5 mm. . . . . *Orizabus*

10'. Respiratory plate with 12–20 elongate, irregularly shaped micro-holes across any diameter. Maximum width of head capsule 3.8–5.2 mm. . . . . *Aphonus*

*Saccharoscaptus laminifer* (Dechambre, 1979). *Third-instar larva*

(Figs. 1–14)

Head (Fig. 1): Width of head capsule 7.0–7.3 mm. Surface reddish brown, moderately rugo-punctate. Frontal suture and clypeofrontal suture distinct. *Frons* (Fig. 1): with 2 exterior frontal seta and 1 posterior frontal seta on each side; each anterior angle of frons with 1 seta, and anterior frontal setae absent; remaining cranial surface with 3–5 dorso-epicranial setae, 4–6 epicranial setae, 4–6 para-ocellar setae on each side. Ocelli absent. *Clypeus*: Form trapezoidal, with 2 lateral setae at each side, without central setae. Surface of postclypeus reddish-brown, well sclerotized and rugo-punctate; surface of preclypeus light brown. *Labrum* rugo-punctate, slightly asymmetrical, 2 posterior setae, 3–4 lateral setae on each side and 2 central setae. *Epipharynx* (Fig. 2): form suboval, wider than long, asymmetrical, both lateral edges rounded. Haptomeral process of epipharynx prominent and entire; right chaetoparia with 45–50 stout setae; left chaetoparia with 30–35 stout setae, without sensillae; gymnoparia wide, with some scattered slender, small setae; acroparia with 8–10 straight, long, thick setae; right acanthoparia with 12–14 short, curved, spine-like setae; left acanthoparia with 10–11 short, curved, spine-like setae; pedium wide, elongate. Dextiotorma narrow and sinuose; laeotorma narrow, straight, shorter than dextiotorma; epitorma curvate toward center of pedium; pternotorma rounded. Dextiophoba absent; laephoba clearly developed between haptotolechus and inner side of laeotorma, formed by 12–16 long slender fimbriae. Sclerotized plate of right nesium, nearly fused with dextiotorma, triangular, with acute apex; sense cone on left nesium represented by longitudinal, slightly curved, well-sclerotized plate, apex with 3–4 sensilla scarcely defined. Crepis well-marked. *Right mandible* (Fig. 3): scissorial area with, rounded apical tooth (S<sub>1</sub> + S<sub>2</sub>) and 1

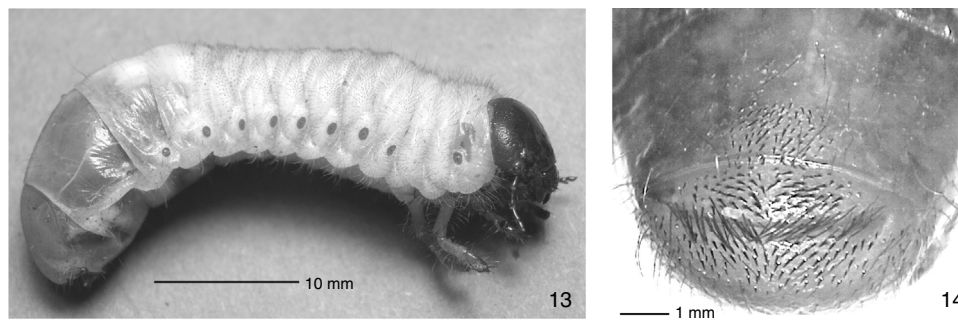


**Figs. 1–12.** Third instar of *Saccharoscyptus laminifer*. 1, head, frontal view. 2, epipharynx. Mandibles, ventral view: 3, right. 4, left. Last antennomere: 5, dorsal. 6, ventral. 7, detail, maxillary stridulatory teeth, lateral view. 8, labium, hypopharynx and right maxilla, dorsal view. 8a, detail, unci at apex of lacinia, mesial view. 9, prothoracic respiratory plate. 10, protarsal claw. 11, mesotarsal claw. 12, metatarsal claw.

rounded tooth ( $S_3$ ) after scissorial notch weakly defined; scrobe with 3–4 stout setae. Dorsal surface with row of 7–8 slender, long setae. Ventral surface with elongate-oval stridulatory area formed by 14–16 narrowly separated ridges; ventral process well-developed, curved, rounded. Brustia with 2–3 stout, long setae. Calx large, 2 basolateral setae. Molar area with 3 wide, convex, ridged lobes ( $M_{1-3}$ ) without setae. *Left mandible* (Fig. 4) Scissorial region with 3 teeth; teeth 1 and 2 vaguely separated from tooth 3 by

scissorial notch. Scrobe with 5–6 slender, long setae. Dorsal surface with row of 7–9 slender, long setae; acia well-developed, triangular, and apical setae absent, 11–12 basolateral setae. Ventral surface with elongate-oval stridulatory area formed by 15–17 narrowly separated ridges; ventral process well-developed, rounded; dorsomolar area with row of 6 slender, moderately long setae; brustia with 4–5 stout, short setae. Molar area with 2 lobes, first molar lobe ( $M_1$ ) large, obliquely truncate. *Maxilla* (Fig. 8). Cardio





**Figs. 13–14.** Third instar of *Saccharoscaptus laminifer*. 13, lateral view of living larva. 14, raster, ventral view.

subrectangular. Stipes larger than wide. Galea with many stout setae and 1 well-developed uncus at apex. Lacinia with many stout setae and apical transverse row of 3 unci (middle uncus shorter than others), basally fused (Fig. 8a). Maxillary palpus 4-segmented, segment 4 as long as segment 2. Stridulatory area with 7 blunt, truncate ridges and anterior truncate process (Figs. 7–8). *Hypopharynx* (Fig. 8). Glosa with 20–55 slender, long setae and 14–18 short setae. *Hypopharyngeal sclerome* asymmetrical, concave medially, dentiform process produced dorsally with rounded apex; left lateral lobe without setae; right lateral lobe with 4 slender, moderately long setae. Left margin with row of 10–12 moderately long fimbriae directed toward center of sclerome and row of 5–6 fimbriae on right margin. *Antenna*: with 4 antennomeres, 1 to 3 nearly with same length each to other; apical antennomere twice long than antennomere 1. Apical antennomere nearly oval in dorsal or ventral view; dorsal surface with 6–8 sensory spots (Fig. 5); ventral surface with 4–5 sensory spots (Fig. 6).

**Thorax** (Fig. 13): Pronotal sclerome wide, irregularly and weakly sclerotized, with 4–5 slender, long setae. Prothoracic spiracle (Fig. 9) 0.25 mm long, 0.20 mm wide; respiratory plate reddish brown, regularly shaped as a closed “C”, bulla slightly prominent, convex; distance between respiratory lobes much less than diameter of bulla; plate with 25–30 microholes across diameter at middle, holes with irregular edges (400 $\times$ ). Dorsum of prothorax with 3–4 irregular transverse rows of 24–38 long, slender setae, without spiniform setae. Mesoprescutum with transverse, irregular rows of 16–22 long, slender setae; mesoscutellum with transverse rows of 14–18 long, slender setae. Metaprescutum with irregular rows of 26–34 long, slender setae; metaescutellum with rows of 18–22 long, slender setae. *Legs*: Tarsal claws with enlarged apical process, 1 basoexternal seta, and 1 internal, preapical seta (Fig. 10). Tarsal claw on mesothoracic leg slightly longer than those of prothoracic leg (Fig. 11). Tarsal claw of metathoracic leg shorter than claws of precedent legs (Fig. 12). Coxa, trochanter, and tibiotarsus of all legs with many slender setae.

**Abdomen** (Fig. 13): abdominal spiracles I–IV 2.5 mm long and 2.0 mm wide. Spiracles on segments V–VI equal in size (2.3 mm long and 1.9 mm wide); spiracle on segment VII slightly smaller than preceding (2.2 mm long and 2.0 mm wide) and spiracle on segment VIII smaller than all preceding (1.8 mm long and 1.8 mm wide). Abdominal segment I on prescutum with irregular transverse rows of 10–14 long, slender setae and 20–26 short, spiniform setae; subscutum with 10–12 long, slender setae, without spiniform setae; scutum with about 38–44 short, spiniform setae and 18–20 long, slender setae; scutellum with about 10–14 short, spiniform setae and 26–34 long, slender setae. All spiracular areas with 14–16 long, slender setae. Abdominal segments II–VI on prescutum with irregular rows of 14 long, slender setae and 28 short, spiniform setae; subscutum with 14–16 long setae, without short setae; scutum with 30–32 long, slender setae and 24–28 short, spiniform setae; scutellum with 16–18 long, slender setae and 50–54

short, spiniform setae. Abdominal segment VII with 1 transverse row of 22–26 slender, long setae and 40–48 short, spiniform setae mixed. Abdominal segment VIII with irregular transverse rows of 18–20 slender, long setae, without spiniform setae. Abdominal segment IX with 2 irregular rows of 10–12 slender, long setae, without spiniform setae. Abdominal segment X with approximately 40–48 moderate to long, slender setae. Pleural lobes with 18–24 long, slender setae. *Raster*: without palidia (Fig. 14) campus with 6 slender, long setae; teges formed with 64–72 short setae, barbula with 14–18 long, slender setae. Anal slit widely curve, transverse. Lower anal lip with 80–94 stout, short and medium size setae on disk, and 76–84 stout, long setae along distal border. Upper anal lip with 90–110 stout, short and medium size setae. Approximate dorsal body length 38–52 mm.

**Remarks.** The following characters will separate the larvae of *S. laminifer* from those of all other known American Dynastinae: anterior frontal setae absent; external frontal setae present; posterior frontal setae present; clypeus without central setae; last antennomere with 6–8 dorsal sensory spots; ocelli absent; respiratory plates of abdominal segments V–VIII progressively smaller; raster without septula or palidia; lower anal lip with numerous stout setae, including long setae that form a fringe along the distal border.

**Studied specimens.** Ten third-instar larvae as part of a large sample of larvae reared to adult stage, collected in Bolivia, Santa Cruz, Warnes, La Jupia, 308 m, 10-VII-2011, F. Copa Bazán (IIAV, IEXA).

**Distribution.** This species is found in southern Brazil and eastern Bolivia (Morón and Grossi, 2015).

**Biology.** *S. laminifer* is a yearly cycle species. Larvae live in rich organic matter soils, and during four months may feed on the roots of sugarcane cultures. In Santa Cruz, Bolivia, oviposition occurs between December and March, first instar larvae hatch in February–March, second instar larvae are growing from March to May, and third instar larvae are active from May to July; the complete larval development lasts 130–158 days. Inside a cell build with soil particles compacted with its own fecal remains, prepupa requires 5–8 days and pupa another 21–31 days. When the adult is formed it remains inside the cell for 3–4 months. The male and female emergence and mating occurs between November and December (Copa-Bazan and Morón, 2014).

Probably, the very large numbers of larvae observed in the sugarcane fields of Santa Cruz, Bolivia during 2011 (150–200 larvae/m<sup>2</sup>) represent the unusual growth of populations of white grubs derived from some combination of facts, such as, scarce local rains, frequent fires in grasslands and sugarcane fields, use of compost as fertilizer, deforestation of surrounding lands and abuse of insecticides applied to soil during many years (Copa-Bazan and Morón, 2014). The most interesting observation is that this species known for near a century from the holotype, unexpectedly appears in thousands in an agricultural landscape.

## Conflicts of interest

The author declares no conflicts of interest.

## Acknowledgements

Fernando Copa Bazan (IIAV, Santa Cruz, Bolivia) collected and breed the studied specimens. Jorge Frana (INTA, Rafaela, Argentina) transported the samples. Paschoal Grossi and one anonymous reviewer provided helpful comments to a previous version of this manuscript. This paper is a contribution to the research line “Sistemática y Biología de Coleópteros Lamellicornios de América Latina” supported by Instituto de Ecología, A. C. Xalapa, Mexico (account 20030-10011).

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