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RESEARCH PAPER

Morphology of the larvae and biology of the adults of *Psilorrhynchus bifasciatus* do not confirm previous hypotheses about systematics and feeding habits (Coleoptera: Cantharidae)

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Abstract. *Psilorrhynchus bifasciatus* (Blanchard, 1844) is broadly distributed through South America, but its biology, behaviour and life cycle are unknown. The most characteristic feature of the adults is slender rostrum, presumably associated to a specialised feeding habit. However, new observations of *P. bifasciatus* feeding on nectar in inflorescences of *Matayba guianensis* Aubl. (Sapindaceae) do not support such a hypothesis. Here, we describe and illustrate their early larval instars in details and compare them with the other Chauliognathini. The larvae are remarkably characterised especially by a long and thick pubescence, conspicuous roughness on the head and thoracic terga, and head with sharp lateral projections. These features are unique amongst the known Cantharidae larvae and do not confirm a previous hypothesis of close affinity between *Psilorrhynchus* Gemminger & Harold, 1869 and bromeliad-inhabiting Chauliognathini species.

Key words. Coleoptera, Cantharidae, Chauliognathinae, Chauliognathini, behaviour, biology, flower visitor, immatures, *Matayba guianensis*, Brazil, Neotropical Region

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Introduction

The immature forms of Cantharidae are poorly known when compared to the high diversity of species described in the family. The most recent and very outdated world catalogue of Cantharidae (Delkeskamp 1977, 1978) lists about 5,100 species. In contrast, only 43 species have their immature forms described or illustrated.

Even with such a limited knowledge, the morphology of the cantharid larvae enables a fairly direct association to their corresponding subfamilies (Böving & Craighead 1931, Crowson 1972, Klausnitzer 1997, Biffi & Casari 2017). For instance, the larvae of Chauliognathinae can be readily distinguished from any other cantharid especially by the maxillary palpi with three palpomeres, galea minute and almost indistinct, and the anterior margin of nasale without a central tooth (Biffi & Casari 2017). Moreover, larval and pupal features provide evidence of the systematic position of genera and groups of species (Biffi & Casari 2017, Biffi & Rosa 2019).

Despite these multiple variable features and traits of immatures that enable morphological comparison and systematic hypotheses among subfamilies, within Chauliognathinae there is a general similarity among the known members of the long-elytra lineage of Chauliognathini (sensu Magis & Wittmer (1974)). Within this group, larvae of species currently classified in *Chauliognathus* Hentz, 1830, *Daiphron* Gorham, 1881 and *Microdaiphron* Pic, 1926 (Biffi in prep.) cannot be reliably distinguished without a close morphological examination. Despite minor specific diagnostic differences, their larvae show rather similar characteristics, like the head capsule subquadrate, clearly divided into the smooth and glabrous anterior region and the densely pubescent posterior region, body evenly covered with velvety pubescence, and well defined thoracic and abdominal ampullae. Thus, it was expected that larvae of any other long-elytra Chauliognathini would fit this general appearance outlined for *Chauliognathus* and *Daiphron* species (Biffi & Casari 2017, Biffi & Rosa

2019). This assumption has been confronted with the recent discovery of the outstanding larva of *Psilorrhynchus bifasciatus* (Blanchard, 1844), which remarkably differs from the other known Chauliognathini species in an evident set of characters, especially in the head with sharp projections laterally, conspicuous roughness of the head and thoracic terga, body covered with very long and thick setae, and abdominal ampullae weakly defined. These characteristics are unique among the known cantharid larvae.

Although the systematics of Chauliognathini is not well established, *Psilorrhynchus* Gemminger & Harold, 1869 seems to arise from within the polyphyletic *Chauliognathus* and *Daiphron* (Biffi 2017a, b). The genus *Psilorrhynchus* has been recently revised (Biffi 2017a) and two species are recognised as valid: *P. abdominalis* (Perty, 1830), distributed through the Atlantic forests of the south and southeast Brazil, and *P. bifasciatus* (Figs 1–2), which is broadly distributed in South America, from northern Argentina to Trinidad and Tobago through a wide variety of environments and vegetation types. Despite being broadly distributed and relatively well represented in collections, nothing was known about their biology, ecology and life cycle. The most conspicuous diagnostic character for adults of the genus is the head elongated anteriorly (Fig. 2), forming a narrow rostrum, presumably associated with specialised feeding behaviour.

The collection of adult specimens of *P. bifasciatus* visiting inflorescences of *Matayba guianensis* Aubl. (Sapindaceae, Cupanieae) in central Brazil (Mato Grosso do Sul state) enabled the observation of various aspects of feeding, mating, oviposition, egg hatching and larval behaviour for the first time. Herein, we describe and illustrate in detail their early larval instars and compare them to the other known Chauliognathini.

Material and methods

We collected eight adults of *Psilorrhynchus bifasciatus* on inflorescences of *Matayba guianensis* in Selvíria, Mato Grosso do Sul state, Brazil, in mid spring and reared them in the laboratory at Museu de Zoologia da Universidade de São Paulo (MZSP, São Paulo, Brazil) to obtain eggs and larvae. One additional larva of *P. bifasciatus* was collected in the soil with leaf litter in Corumbá, Mato Grosso do Sul. We identified the larva from Corumbá (presumably of the third instar) based on the dimensions and morphological similarity with the larvae obtained in the laboratory. The observations of adults and larvae were occasional and did not follow any protocol or methodology.

We kept the specimens alive in the Coleoptera laboratory at the MZSP in a terrarium containing branches and inflorescences of *M. guianensis*. After mating, we kept males and females separately in plastic containers with humid soil for oviposition. We fixed some first instar larvae immediately after hatching. Initially, we kept the larvae together in the same container where the oviposition took place and later transferred them to individual plastic containers with soil in the bottom. They fed on Collembola and pieces of flies. The larvae were fixed in 96% ethanol and adults either in ethanol or dry mounted. All specimens are deposited in the Coleoptera Immatures Collection and in the general Coleoptera collection of the MZSP.

Photographs were taken with a Canon EOS Rebel T3i camera equipped with a Canon MP-E 65 mm macro-lens and additional extension tubes. The camera was attached to a Stack Shot macro-rail. Multi-focal images were processed with Zerene Stacker software (version 1.04). The final artwork was edited in Adobe Photoshop CC. Illustrations from slides were made with the aid of a camera lucida, attached to a microscope, and edited in Adobe Illustrator. For better visualisation, some larvae were stained with 5% iodine solution.

The morphological terminology for the larvae follows Biffi & Casari (2017). Each larval instar may exhibit morphological differences, and the description and comparison presented herein were based on the third instar larva of *P. bifasciatus* and the last instar larvae of the remaining Chauliognathini. In some Palaearctic species of *Cantharis* Linnaeus, 1758, the diagnostic features of larvae are recognised from the third through the sixth (last) instars, with minor differences in the shape of nasal teeth, abdominal sclerites and proportion of mouthparts and antennae (Janssen 1963, Traugott 2000). Thus, we assume that the diagnostic features introduced here for *P. bifasciatus* should not considerably vary trough instars, which should still be somewhat comparable.

Results

Psilorrhynchus bifasciatus (Blanchard, 1844)

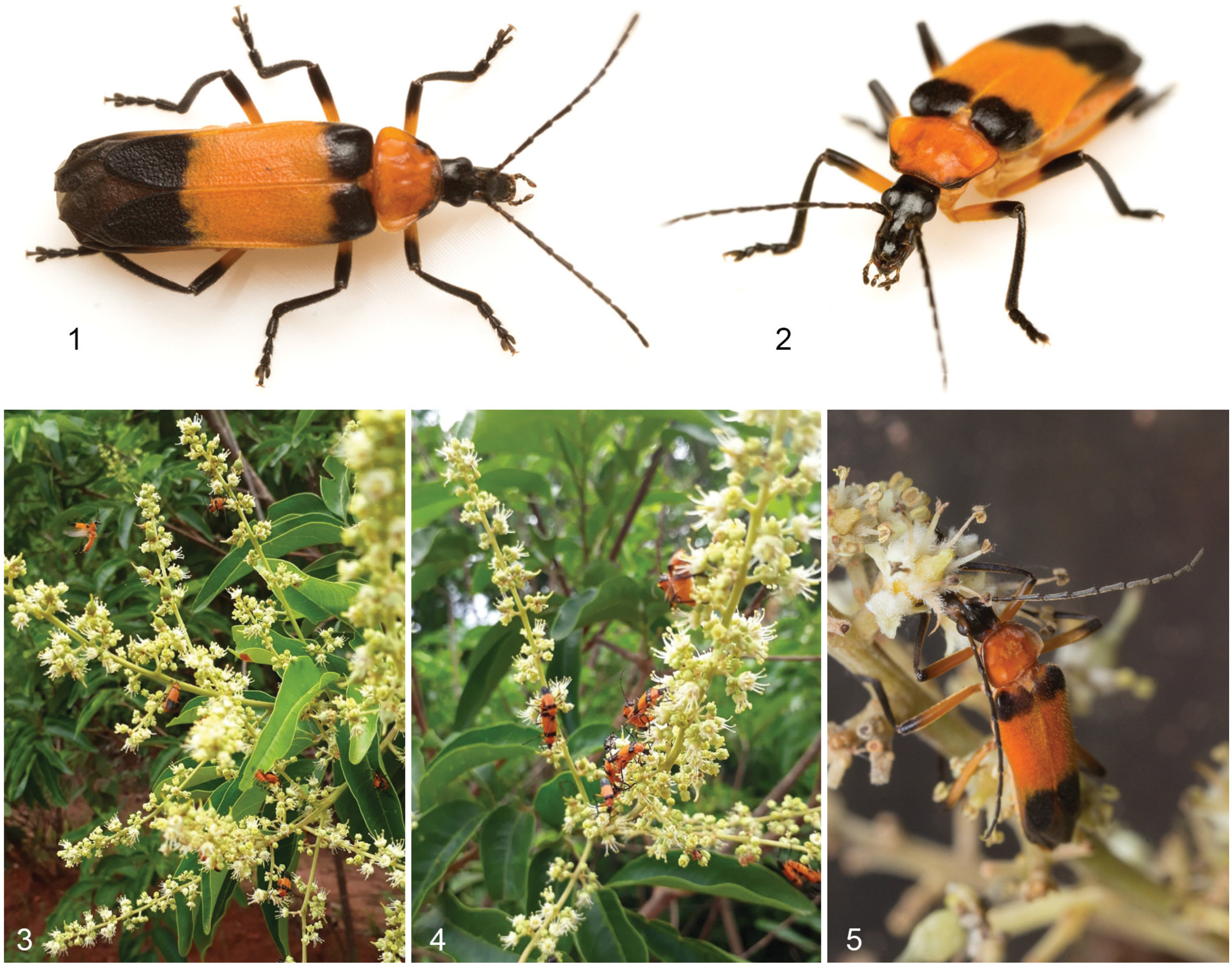
(Figs 10–49)

Material examined. BRAZIL: Mato Grosso do Sul: Selvíria, Fazenda Bovinocultura da UNESP, 20°20′28.18″S, 51°24′16.86″W, 22.x.2018 (on *Matayba guianensis* inflorescence), L. Migliore leg. (4 ♂♂, 4 ♀♀, MZSP 45585–45592, 5 E, 10 L1, 2 L2, 6 L3 MZSP Im. Col. 10369); Maciço do Urucum, 19°12′13.5″S 57°37′46.3″W, 12.–15.i.2019, winkler, M. A. Ulysséa leg. (1 L3, MZSP Im. Col. 10370).

Adult's behaviour. Adults of *Psilorrhynchus bifasciatus* were abundant on the inflorescences of *Matayba guianensis* Aubl. (Sapindaceae, Cupanieae) (Figs 3–5). Around 15:00 h (local time), the hottest time of the day, hundreds of specimens were observed in each of two nearby flowering bushes. By 16:30 h they were much less abundant, with only a few tens of remaining specimens on each bush. The next morning no more specimens were found in neither bush.

While in the plant, they were very active, rapidly and ceaselessly foraging throughout the flowers by inserting the elongate head to reach the nectar disc located between petals and stamens. The pollen in the elongate and conspicuous stamens was apparently despised. During collection, the specimens were transferred to plastic vials containing branches and inflorescences of *M. guianensis* for transportation. Immediately after the transfer, the specimens searched for the flowers and carried on foraging.

The copulation occurred on the plant while the females kept foraging. The time of each copulation and the possible change of couples could not be observed *in situ*. In the laboratory, the specimens continuously kept foraging in



Figs 1–5. Live adults of *Psilorrhynchus bifasciatus* (Blanchard, 1844). 1–2 – habitus of female; 3–5 – specimens in copula and foraging on *Matayba guianensis* Aubl. (Sapindaceae) in Selvíria, MS, Brazil.

the offered inflorescences, although apparently, no more nectar leftovers were available therein. Occasional copulation occurred only during the following two days after collection. Afterwards, the females were kept in individual plastic containers for oviposition. Two females laid eggs 7 and 10 days after the last copulation. Each female laid large piles of orange eggs directly on the soil (Figs 6–7), but only one pile was fertilized. Day after day, the fertilized eggs got clearer, turning white and slightly translucent, whereas the unfertilized eggs kept the orange colour for several days until they perished.

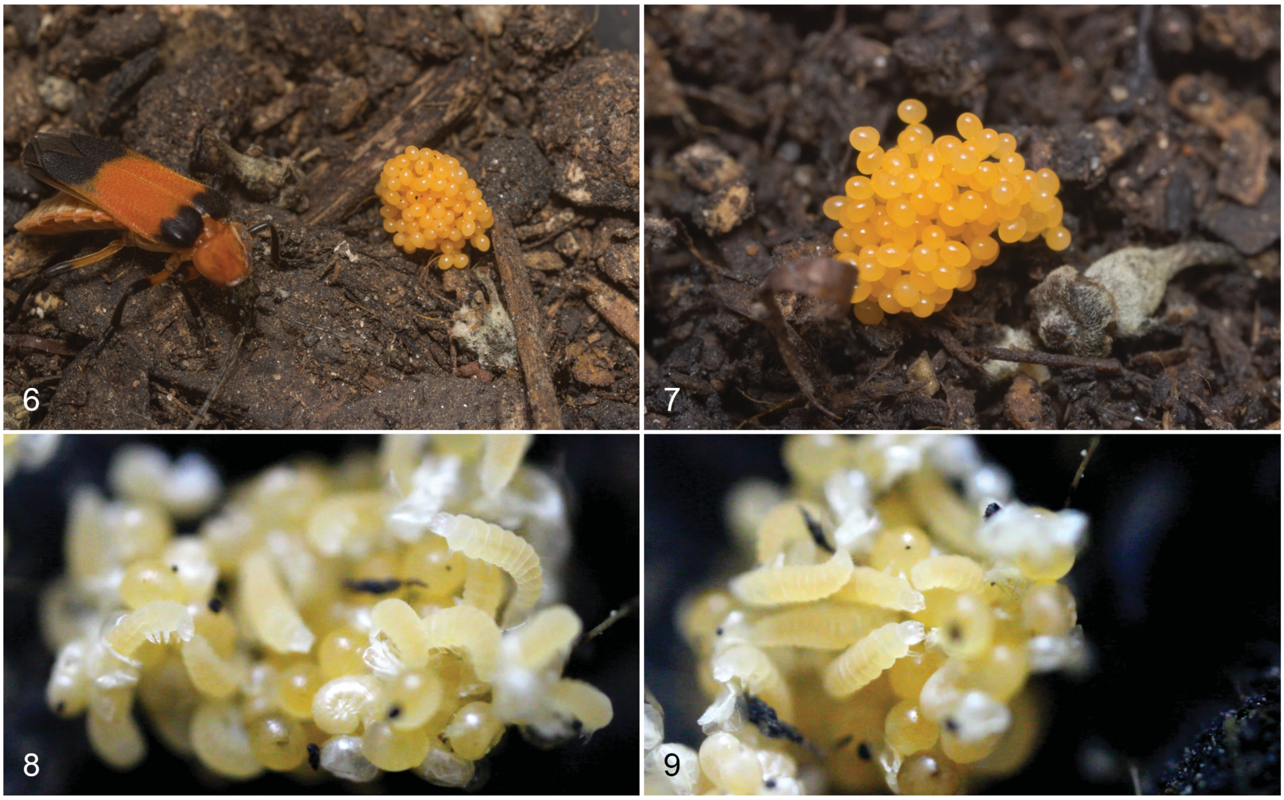
Egg hatching took place 9 days after the oviposition (Figs 8–9). In the beginning, a few larvae hatched, and then 5–6 hours later, many other larvae started hatching simultaneously. The first instar larvae were moveable since the hatching, moving legs and mouthparts and curving the body, although having the apex of the abdomen still attached to the chorion. After detachment, the first exploratory surveys carried out by the larvae were within the egg pile, apparently feeding on the chorion remains. One day after hatching, the larvae started exploring the soil around the egg pile. The next day, most larvae were dispersed and mostly inside the soil. Several cases of cannibalism were observed, with various larvae preying on the same prey.

The larvae were reared in the laboratory for about 20 days, until the third instar, when they died. The larvae hardly ever accepted the offered food sources, consisting of Collembola, pieces of flies or other insects, or artificial fish ration.

Description of immatures. ***Third instar larva*** (Figs 10–35). *Colouration*. Body mostly white to light grey, slightly translucent, except for light brown head, mouthparts and rough areas in pro-, meso- and metanotum (illustrated larva stained with iodine).

Pubescence. Very long, thick and sparse; setae erect, inserted in dark punctures; secondary layer of very short, thin and dense pubescence; abdominal segments II–VIII with pairs of tufts of long setae ventrally.

Structure. Head (Figs 10–12, 19) wider than long, not retracted into prothorax; prognathous, flattened dorsoventrally, vertex convex; lateral margins arched, slightly narrowed posteriorly, each side with prominent sclerotised irregular process near middle, forming straight parallel flaps; posterior edges of flaps forming irregular nodules;

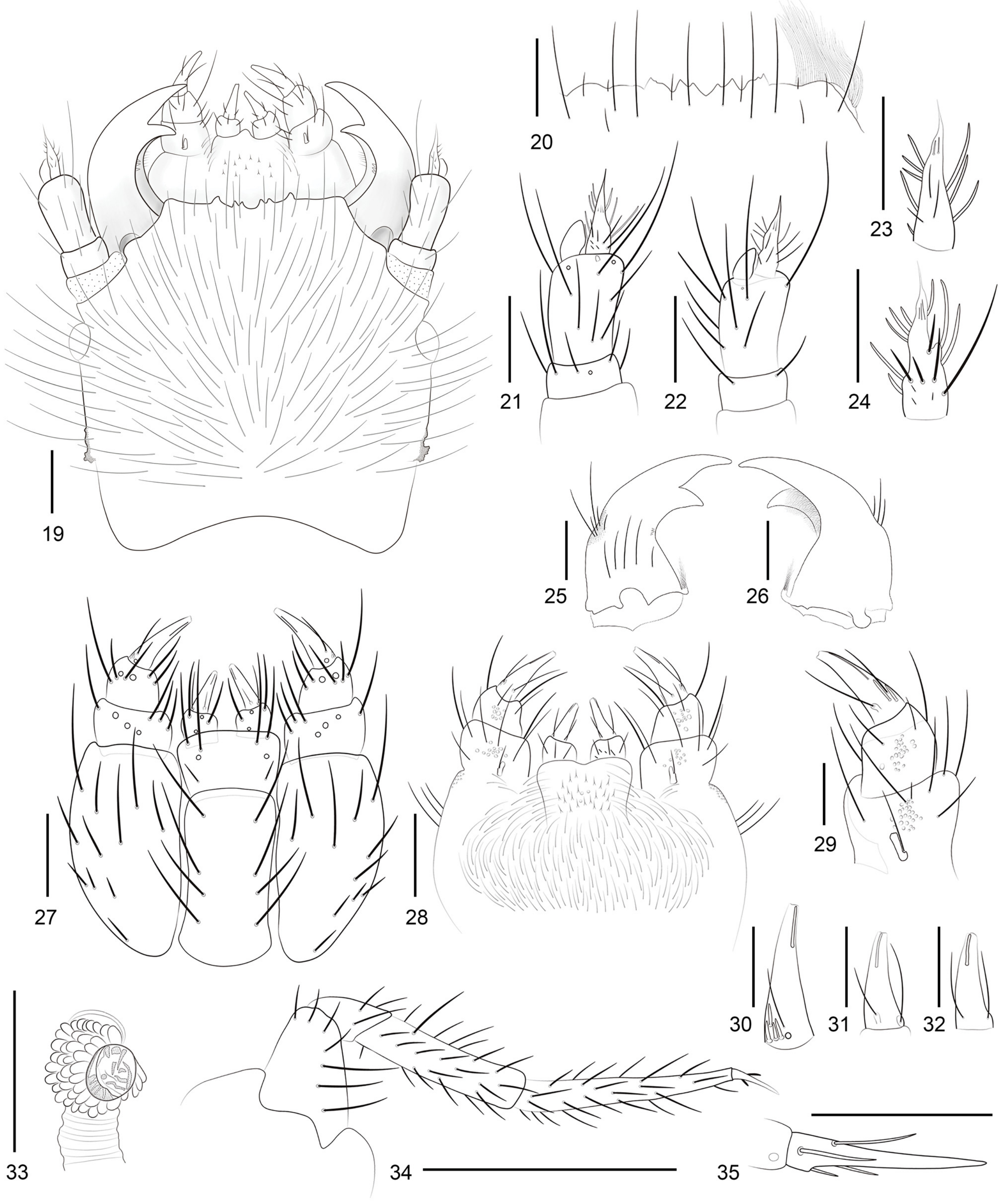


Figs 6–9. Eggs and larvae of *Psilorrhynchus bifasciatus* (Blanchard, 1844), 6–7 – eggs pile laid on the soil; 8–9 – first instar larvae hatching.

head constricted behind flaps, arched and slightly convergent posteriorly; posterior margin of head notched dorsally and ventrally; occipital foramen very wide; epicranial and gular sutures absent. Head with two distinct regions: anterior third of dorsal surface and nasale smooth, with sparse setae; posterior two thirds and ventral surface strongly rough, stronger medially in dorsal surface, covered with long setae and dense short pubescence; anterior and posterior regions feebly delimited by sinuous margins. One large stemma on each side, behind antennae. Nasale (Fig. 20) prominent, nearly as long as paranasal lobes, with median incision and three irregular teeth on each side, and nearly straight margin between teeth and paranasal lobe; long longitudinal dark line behind median incision; seven pairs of setae near anterior margin: three setae short and four setae long. Transverse, oblique, sclerotised plate ventrally, with deep irregular grooves on each side; median groove very wide with small rounded central protuberance; fringe of long, ramified setae, longer laterally, appearing dorsally below paranasal lobes. Antennae (Figs 21–24): antennomere I transverse with three setae and one campaniform sensillum near apex dorsally and two setae near apex ventrally; antennomere II elongate, with seven long setae, two campaniform sensilla and one sensorium dorsally and six setae and one campaniform sensillum ventrally, apex bearing antennomere III and one membranous, elongate sensorium; antennomere III elongate, narrowed apicad, shorter than II; in dorsal view, outer margin with two basal setae and group of three setae near apex; inner margin with three setae; dorsally, with group of three short setae near apex and three short setae near base, and five long setae distributed near median region; ventrally, two short setae near apex and two long setae in basal half. Mandibles (Figs 25–26) elongate, curved with well developed retinaculum; fringe of fine and long setae ventrally at base of subapical tooth; three tiny teeth dorsally at base of subapical tooth; dorsally, with 5–7 setae above acetabulum and setae of varied sizes near basal third laterally; penicillus formed by tuft of long setae. Maxillo-labial complex (Figs 27–28): stipes elongate; ventrally, with lateral margin rounded, with five long setae distributed on anterior half and six shorter on posterior half. Maxillary palpi (Figs 29–30) with three palpomeres: basal palpomere wider than long, slightly narrower than stipes at distal margin; ventrally, with three long setae near inner margin, one seta near outer margin, and three campaniform sensilla; dorsally, with five long setae; median palpomere slightly narrower than basal palpomere, narrowed apicad; with six setae and two campaniform sensilla ventrally, and two long setae dorsally; distal palpomere elongate, longer and narrower than median, gradually narrowed apicad, with one long seta and one campaniform sensillum near base ventrally, and one seta in groove near apex, outer margin with group of thick, short and decumbent setae near base; dorsally, with two long setae near base: one seta near outer margin and one pedunculate seta near inner margin; one long seta in groove near apex laterally. Galea minute, dorsal, with long lateral seta. Lacinia dorsal, formed by fringe of setae. Labium (Figs 27–28): postmentum elongate, rectangular with basal margin rounded and eight long setae; prementum

Figs 10–13. *Psilorrhynchus bifasciatus* (Blanchard, 1844), third instar larva in dorsal (10), lateral (11), ventral (12) and dorso-lateral views (13). Specimen stained in iodine. Scale bar = 1.0 mm.

Figs 14–18. Morphology of *Psilorrhynchus bifasciatus* (Blanchard, 1844), third instar larva. 14 – head and pronotum in dorsal view; 15 – head, ventral view; 16 – head in lateral view; 17–18 – abdominal segments VIII–X in dorsal (17) and ventral views (18). Scale bars = 0.5 mm.



Figs 19–35. Morphology of *Psilorrhynchus bifasciatus* (Blanchard, 1844), third instar larva. 19 – head, dorsal view; 20 – nasale; 21–22 – antenna (dorsal and ventral views); 23–24 – third antennomere (ventral and dorsal views); 25–26 – mandibula (dorsal and ventral views); 27 – maxillo-labial complex; 28 – hypopharynx; 29 – maxillary palp (dorsal view); 30 – third maxillary papomere (ventral view); 31–32 – second labial palpomere (ventral and dorsal views); 33 – mesothoracic spiracle; 34 – foreleg; 35 – pretarsus. Scale bars = 0.1 mm, except 29 = 0.05 mm, 33 = 0.5 mm, and 34 = 0.5 mm.

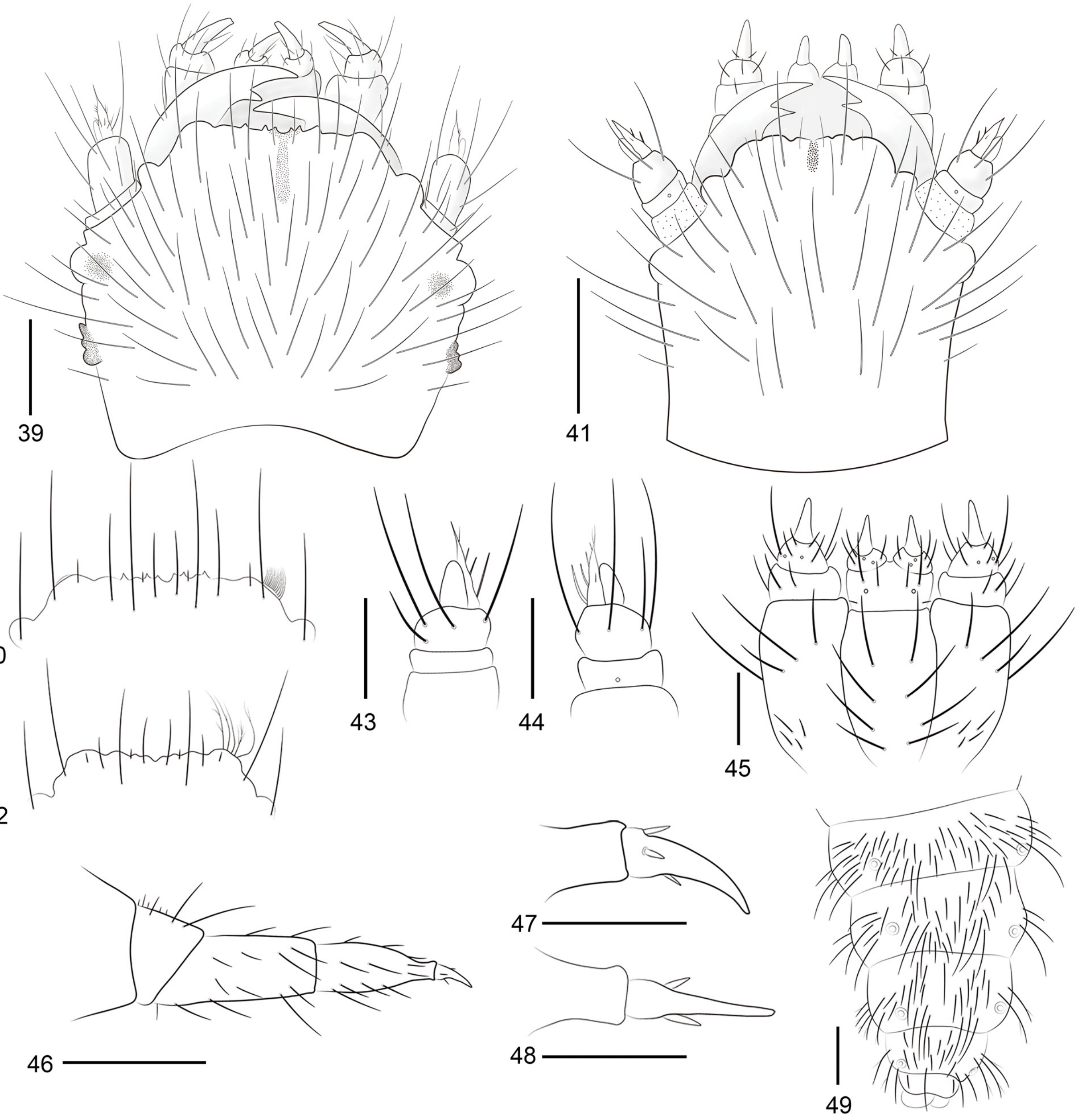
Figs 36–38. Morphology of *Psilorrhynchus bifasciatus* (Blanchard, 1844), second instar larva (dorsal, ventral, lateral views). Scale bar = 0.5 mm.

wider than long, slightly narrowed basally, with anterior angles rounded, and with two long setae near each anterior angle, one short seta on each side near base and one campaniform sensillum on each side. Dorsal setae of labium wider than ventral ones. Labial palpi with two palpomeres: basal palpomere almost as wide as long, narrower at apex, with two long setae and two campaniform sensilla ventrally and with two long setae dorsally; distal palpomere (Figs 31–32) elongate, longer and narrower than basal palpomere, gradually narrowed apicad, ventrally and dorsally with two long setae on each side, near base, one of them pedunculate, and wide, decumbent and short setae near base laterally. Hypopharynx (Fig. 28) densely setose. Thorax (Figs 10–14): pro-, meso- and metathorax wider than long, slightly wider than head, strongly constricted anteriorly; sides with broad and rounded ampullae. Prothorax with pair of large glandular pores near anterior corner, tergum with strong cordiform roughness; meso- and metathorax with glandular pores laterally, on lateral ampullae, notal roughness round and smaller. Narrow dorsal ampullae between segments. Mesothoracic spiracle (Fig. 33) circular, marginated by stout setae. Legs (Fig. 34) broadly separated, narrow, elongate and densely setose; pretarsus (Fig. 35) elongate with four short setae. Abdomen (Figs 10–13, 17–18): segments gradually tapering posteriorly, wide, band-like, longer posteriorly; segments I–VIII with rounded latero-dorsal ampullae bearing glandular openings, conical projecting lateral ampullae, and broad and narrow dorsal intersegmental ampullae; segment IX (Figs 17–18) narrowed anteriorly, sides broadly rounded and pair of glandular pores posteriorly on large latero-dorsal lobes; segment X membranous, bilobed; abdominal sternites I–VIII with long and thick ventral setae in pair of tufts per segment; segment IX with long ventral setae, more concentrated near apex. Abdominal spiracles small, rounded, located between lateral and dorso-lateral ampullae.

Second instar larva (Figs 36–40). *Colouration.* Integument translucent, mostly whitish, except for head capsule, mouthparts, antennae, roughness of thorax, setae insertion and weakly sclerotised areas that are light brown.

Pubescence. Two layers of setae; body densely covered with very short and thin pubescence, giving the larva velvety aspect (seen under high magnification), and tufts of long and thick dorsal, lateral and ventral setae.

Structure. Head capsule wider than long; lateral margins slightly narrowed basally, each side with prominent



Figs 39–49. Morphology of *Psilorrhynchus bifasciatus* (Blanchard, 1844), second and first instar larvae. 39 – head, second instar; 40 – nasale, second instar; 41–49 – first instar; 41 – head; 42 – nasale; 43–44 – antenna (ventral, dorsal views); 45 – maxillo-labial complex; 46 – foreleg; 47–48 – pretarsus (lateral, ventral views); 49 – apex of abdomen (dorsal view). Scale bars = 0.05 mm, except 39, 41, 46, 49 = 0.1 mm.

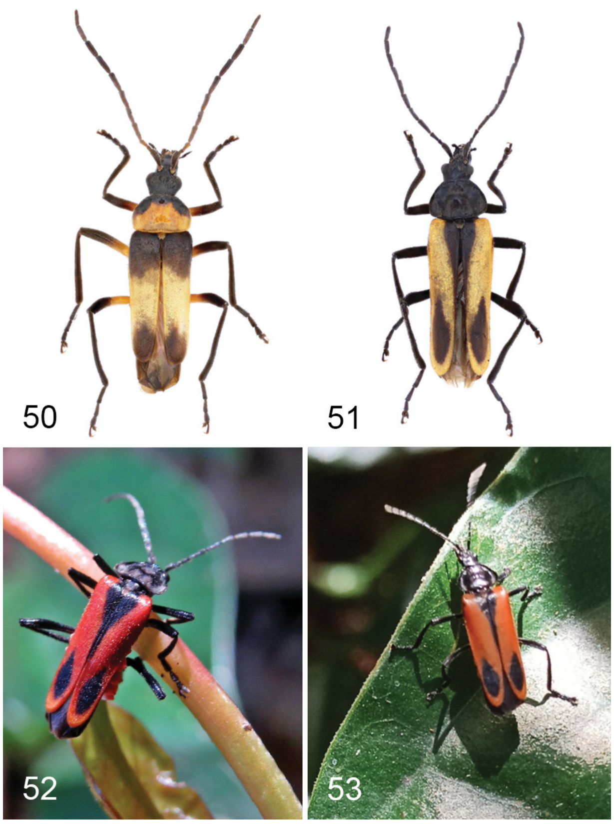
sclerotized irregular process near middle; head densely covered with long and dense setae, except for narrow basal band. Stemmata prominent. Nasale with median incision and three asymmetrical and sharpened teeth on each side; two short and four long pairs of setae near anterior margin. Epipharynx with short fringe of ramified setae on each side seen from above. Thorax wider than long, slightly wider than head, each segment constricted anteriorly and posteriorly; sides with broad and rounded ampullae. Prothorax with pair of large glandular pores near anterior corner, tergum with weakly sclerotised area, rough; meso- and metathorax with glandular pores laterally, on lateral ampullae, tergal roughness weakly defined. Narrow dorsal ampullae between segments. Abdomen slightly tapering posteriorly, lateral ampullae rounded and laterally projected; dorsal and dorso-lateral ampullae weakly defined.

First instar larva (Figs 41–49). *Colouration.* Integument translucent, entirely whitish, except for light brown apex of mandibles.

Pubescence. body covered with very short and dense pubescence and medium length setae; each thoracic and abdominal segment with three pairs of dorsal, and two or three pairs of lateral long setae.

Structure. Head capsule (Fig. 41) almost as long as wide; lateral margins almost straight; stemmata prominent. Head covered with moderately dense pubescence of long setae, except in posterior fourth. Nasale (Fig. 42) irregular, slightly sinuous; each side with six pairs of setae near anterior margin and one at base dorsally; epipharynx with five long ramified setae on each side. Antennae (Figs 43–44) short and very wide; antennomere I transverse, band-like, with one campaniform sensillum dorsally; antennomere II wider than long, with three long dorsal setae and four ventral setae (some surpassing antennal length) and apex bearing antennomere III and one elongate, membranous sensorium; antennomere III elongate, gradually narrowed apicad, with four latero-internal setae and one dorsal seta. Maxillo-labial complex (Fig. 45): stipes elongate with eight setae, four basal setae shorter. Palpi very robust, except for distal palpomere; three palpomeres: basal palpomere wider than long, band-like with three long setae; median palpomere wider than long, strongly narrowed apicad, with eight setae and two campaniform sensilla; distal palpomere elongate and narrow, narrower apicad. Labium: postmentum elongate with eight long setae; prementum wider than long, band-like, each side with one short and two long setae and one campaniform sensillum. Palpi with two palpomeres: basal palpomere very wide, band-like with three long setae and two campaniform sensilla; distal palpomere elongate and strongly narrower than basal palpomere, slightly narrowed apicad. Legs (Fig. 46) robust with apex of tibia abruptly narrowed, setae sparse; pretarsus (Figs 47–48) with very short and stout setae. Integument with setae moderately long and dense, more concentrated dorsally near middle of each tergite and with scattered longer setae; ramified setae on apex of abdomen (Fig. 49).

Eggs (Figs 6–9). *Description.* Eggs light orangish, progressively turning whitish when fertilized; slightly oval, surface smooth, without ornamentations; eggs adhering to each other, disposed in large masses on the soil.



Figs 50–53. Habitus of fixed and live *Psilorrhynchus* specimens. 50–51 – museum specimens of *P. bifasciatus* (Blanchard) (50) and *P. abdominalis* (Perty) (51) as presented in the genus revision (Biffi 2017a) showing a pale-yellow elytral background colouration. 52–53 – live specimens of *P. abdominalis* from Rio de Janeiro state, showing an intense reddish elytral colouration. Figs 50 and 51 adapted from Biffi (2017a); 52 by Diogo Luiz (available at inaturalist.org/observations/31961589); 53 by Eric Freitas de Abreu (available at inaturalist.org/observations/56266908).

Discussion

Adult's behaviour. The typical elongate head of *Psilorrhynchus* species, forming a slender rostrum, suggests that the species have some kind of specialised feeding habit. *Psilorrhynchus bifasciatus* is reported here feeding on the nectar from nectar rings located in the bottom of flowers of *Matayba guianenis* (Sapindaceae). At first sight, the ability to reach such nectar rings seems to be thanks to their elongate rostrum. In addition, the distribution range of both *P. bifasciatus* and *M. guianensis* seems to overlap (c.f., Biffi 2017a, Coelho et al. 2017). However, the strict association between the peculiar cephalic morphology of *P. bifasciatus* and the habit of feeding on the nectar of *M. guianensis* is still premature and could not be confirmed.

Chauliognathinae is the only cantharid subfamily whose adults feed exclusively on pollen and nectar; predation is occasional (Ramsdale 2010). The scattered records of association between Chauliognathinae species and plants are mostly the result of general surveys on the diversity of flower visitors and pollinators. These records show that Chauliognathinae species (especially in the diverse and heterogeneous genus *Chauliognathus*) visit flowers of a wide spectrum of plant families (e.g. Frost 1965, Rausher & Fowler 1979, Schneider & Buchanan 1980, Lago & Mann 1987, Buchele et al. 1992, Senchina 2005, Díaz-Forestier et al. 2016). Pérez-Hernández (2018) provided comprehensive data on host plants and feeding behaviour for numerous Chauliognathinae species from Mexican tropical dry forests, demonstrating a generalist behaviour, with the same species feeding on nectar and/or pollen from flowers of various plant families.

Matayba guianensis, a host plant of *Psilorrhynchus bifasciatus*, has a generalist floral morphology, attracting a wide diversity of insects (Carvalho & Oliveira 2010). During a two-year survey on bees visiting flowers of *M. guianensis*, Carvalho (2009) reported the occurrence of at least three different *Chauliognathus* species*, C. flavipes* (Fabricius, 1781), *C. subapicalis* Pic, 1912 and *C. diamantinensis* Pic, 1912, with the former being the most abundant insect species in the inflorescences and also reported as a generalist plant visitor (Machado & Araújo 2001). The nectar rings are not located too deeply in the flower (Fig. 5) and these cantharid species do not have any remarkable cephalic specialization like the elongate rostrum of *Psilorrhynchus* species. Such rostrum, however, is also present in other species currently classified in *Chauliognathus* and *Daiphron* (e.g., *C. longiceps* Pic, 1947, *C. flavolineatus* Pic, 1947, *D. subdepressum* Pic, 1924, *D. bipartitus* Pic, 1934).

Hence, *Psilorrhynchus bifasciatus* is likely a generalist flower visitor, like most of the Chauliognathinae with known habits, and the elongate rostrum seems not to play a crucial role in obtaining food resources.

Rausher & Fowler (1979) described the agonistic behaviour of *Chauliognathus distinguendus* Waterhouse, 1878, which feeds on floral nectar of *Coccoloba floribunda* Benth. Lindau (Polygonaceae). The cantharids defended this limited resource against both male and female conspecific individuals for several hours, during the period when a certain quantity of nectar was available. After the period of nectar flow, the beetles would cease the agonistic behaviour and leave the inflorescences. Agonistic behaviour has not been investigated in *P. bifasciatus*, although the observations *in situ* and in the laboratory indicate an opposite interaction. Numerous mattings were observed, during which only females foraged. Couples and single beetles continuously moved amongst flowers and inflorescences, not defending their occupied inflorescences. Flowers of *M. guianensis* produce a low quantity of nectar (Carvalho & Oliveira 2010), and the rapid, uninterrupted foraging behaviour of *P. bifasciatus* followed by the sudden departure from the plants suggest a competition for nectar in each flower until this resource has desiccated.

Morphology. The larvae of *Psilorrhynchus bifasciatus* exhibit the diagnostic characters listed for Chauliognathinae, especially the nasale with a median incision and without a central grain-like tooth, maxillary palpi with three palpomeres and galea minute (Biffi & Casari 2017). However, they differ from any other Cantharidae larva in the lateral margins of the head forming straight parallel flaps with acute posterior angles; in the roughness on the dorsal surface of the head, pro-, meso- and metanotum; and in the very long and thick pubescence throughout the body.

Biffi & Rosa (2019) indicated a number of morphological similarities between the adults and bromeliad-inhabiting immatures of *Daiphron bipartitus* and *Chauliognathus humeralis* Pic, 1915 and, based on the adult features, suggested a potential close affinity with *Psilorrhynchus* species. Moreover, undescribed immatures of another bromeliad-inhabiting *Chauliognathus* species also exhibit similar colouration and morphological features attributed to *D. bipartitus* and *C. humeralis*, indicating congruence between morphology and substrate. Such a hypothesis of putative affinity between these species with *Psilorrhynchus* could be confirmed neither by the morphology of *P. bifasciatus* larva nor by the substrate inhabited by one of the studied specimens (soil with leaf litter in Corumbá, MS).

In addition to the peculiar features of the larvae of *P. bifasciatus*, they do not share some of the characteristics present in the bromeliad-inhabiting species, such as pretarsus with one long and three short setae (four short setae in *P. bifasciatus*) and dark colouration with yellow spots on some dorso-lateral abdominal ampullae. The only presumed diagnostic feature shared between *P. bifasciatus* and the bromeliad-inhabiting species is the anterior margin of nasale toothed medially and smooth laterally. The resembling elongate head and trapezoidal pronotum of their adults pointed out by Biffi & Rosa (2019) are probably the result of morphological convergence, which is also observed in other Chauliognathini lineages.

In the revision of *Psilorrhynchus* (Biffi 2017a) both species, *P. bifasciatus* and *P. abdominalis*, were diagnosed as having elytra pale yellow to orange yellow with black spots or bands (Figs 50–51). All the specimens examined therein were museum specimens, mostly collected many years ago. The present observations (Figs 1–2) and photographic records made by citizen naturalists and available online (Figs 52–53) reveal that live specimens exhibit a much more intense orange and red elytral colouration, which rapidly bleaches after death.

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