

Pelidnota granulata (Gory, 1834) (Coleoptera, Scarabaeidae, Rutelinae): description of the pupa and new records from Amazonas state, Brazil

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Abstract. The Neotropical ruteline genus *Pelidnota* MacLeay currently includes 194 species and subspecies with a few described preimaginal stages. Here we describe the pupa of *Pelidnota granulata* (Gory, 1834), provide illustrations, comparative notes on other known pupae of Rutelini and comments on its geographical distribution. The key to known pupae of Rutelini is updated.

Key-Words. Amazon; Neotropical; Immature; Chafers; White grub.

INTRODUCTION

The genus *Pelidnota* MacLeay (Coleoptera: Scarabaeidae: Rutelinae: Rutelini: Rutelina) currently includes 194 species and subspecies distributed in the New World (Moore *et al.*, 2017). This genus is diagnosed by the clypeus not fused to the labrum, outer margin of mandible with two reflexed teeth, apex of elytra with no spiny projections, pronotum with anterior margin completely beaded, prosternal process produced to level of procoxae, apex of thoracic ventrite process anterior to mesocoxae, metatibia not laterally flattened, and metatarsus as long as metatibia or almost so (Soula, 2006; Moore *et al.*, 2017).

Descriptions of preimaginal stages are scarcely provided to species of *Pelidnota* (*cf.*, Albertoni *et al.*, 2014). Biological data were added to some *Pelidnota* species with economic importance (Hoffmann, 1936; Lordello, 1951; Morón & Deloya, 2002; Rodrigues & Falco, 2011). However, larvae of only four species are known: *Pelidnota fulva* Blanchard, 1850 described by Rodrigues & Morón (2012), *Pelidnota lugubris* LeConte, 1874 described by Lugo-García *et al.* (2019), *Pelidnota punctata* (Linnaeus, 1758) figured by Isaac (1907: fig. 92) and described by Ritcher (1948, 1966), and lastly *Pelidnota virescens* Burmeister, 1844 described by Morón (1976). Until the present study, the pupae of two species were known: *P. lugubris*, described by Lugo-García *et al.* (2019), and *P. punctata*, figured by Isaac (1907).

Pelidnota granulata (Gory, 1834) belongs to *granulata*-group *sensu* Soula (2010), a group that includes nine species (see Moore *et al.*, 2017), four of them occur in the Brazilian Amazon: *P. granulata* (Gory, 1834), *P. osculatii* Guérin-Ménéville, 1855, *P. egana* Ohaus, 1912, and *P. pennata* Ohaus, 1912. Little is known about the biology of these metallic green beetles. Label data indicates that adults are attracted by lights at night and their larvae have saproxylophagous habits like other ruteline species.

Here we describe the pupa of *Pelidnota granulata* based on one female pupa and one reared male adult and give additional locality records in Amazonas state, Brazil. The preexisting identification key to known Rutelini pupae is updated.

MATERIAL AND METHODS

Two pupae of *P. granulata* were collected in a decaying trunk in Museu da Amazônia (MUSA) (Manaus, Amazonas state, Brazil). One male pupa was reared to adult, and one female pupa was killed in boiled water and conserved in 80% ethanol. The reared adult was identified based on Bouchard (2003) and Soula (2006, 2010). The studied specimens of *P. granulata* included in this paper are deposited in the Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA; Dr. Márcio Luiz de Oliveira), the Laboratório de Sistemática e Ecologia de Coleoptera of INPA

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The images were taken using a Leica DFC295 camera attached to a Leica M165C stereomicroscope and were processed using the Leica Application Suite (LAS) software version 4.1. Plates were made using Adobe Photoshop software. The photographic illumination follows Kawada & Buffington (2016).

Morphological terms used here follow Sousa *et al.* (2018). The identification key to known Rutelini pupae is modified from Bento *et al.* (2018), and uses additional information from Morón (1990), Morelli (1996), Calisto & Morelli (2011), Lugo-García *et al.* (2019), Carvalho *et al.* (2019), and new data.

RESULTS

Pupa of *Pelidnota granulata* (Gory, 1834) (Figs. 1-2)

Specimens examined: One reared male adult and one female pupa are deposited in the LASEC collection with the following data: Brazil: Amazonas, Manaus, Museu da Amazônia (MUSA), collected in decaying wood, 21.II.2020, M. Bento, W. Lima, and L. Zeballos (legs.).

Description of female pupa (Fig. 1A-G): Length 21.9 mm, greater width 11.9 mm. Body shape elongated, oval. Surface yellowish white, covered by minute, dense pubescence visible in high magnification (56x). **Head (Fig. 1A-B):** vertex visible dorsally, convex. Eyes small, partially covered by anterior angles of pronotum and antennal lobes. Ocular canthus small, rounded and elevated. Frons slightly convex, with two median, parallel striations, and an anteromedial, rounded tubercle. Frontoclypeal suture evident laterally, sinuous and poorly defined at middle. Clypeus subrectangular, sides rounded; dorsal surface with three rounded depressions. Labrum subtrapezoidal, with medial furrow; lateral margins sinuous, apex slightly rounded (Fig. 1A-A1). Mandibles with two lobes: outer lobe tubercle-like, rounded, and inner lobe acuminate. Maxillae subquadrate; palps tubercle-like, distally narrowed. Labium rounded, slightly convex; palps subquadrate. Antennae triangular in lateral view, with three lobes: scape-pedicel, funicle, and club. **Thorax (Fig. 1B-D):** Pronotum hexagonal: anterior angles acute, posterior angles obtuse; anterior and posterior margins slightly sinuous; lateral margins medially angulated; disc medially flat. Mesonotum as long as the half of pronotum length, notum (area between the elytral thecae) as long as wide. Metanotum longer than mesonotum, with a posteromedial lobe. Posterior process of prosternum flat, triangular, positioned between prolegs (Fig. 1A). Mesometaventral process positioned between meso- and between posterior area of prolegs, apex narrow (Fig. 1A), process convex in lateral view. Wing thecae hiding partially metalegs in ventral view. Elytral thecae

with about six well-defined, longitudinal striae. **Legs (Fig. 1B, D):** with femur-tibia articulations exposed in dorsal view. Meso- and metafemurs with a narrow, apical posteromedial process. Tibial spurs barely visible, tubercle-like. **Abdomen (Fig. 1B-F):** with contact areas of segments I-II, II-III, III-IV, IV-V, V-VI, and VI-VII deeply constricted, and of VII-VIII and VIII-IX shallowly constricted. Dorsal middle area with five pairs of dioneiform organs between segments I-II, II-III, III-IV, IV-V and V-VI (Fig. 1C). Tergite IX posterolaterally folded, posterior area of fold densely setose, with setae reddish brown (Fig. 1F). **Spiracles:** Mesothoracic spiracle present between pronotum and elytral thecae, large and with peritreme (Fig. 1D); I exposed, not hidden by wing thecae (Fig. 1E); I-IV slightly prominent, with peritreme; V-VIII as cuticular invagination, with no peritreme (Fig. 1D-F); VI-VIII prominent. Abdominal sternites VII and VIII longer than twice of sternite VI length. **Female terminalia (Fig. 1G):** Sternite IX with bilobed genital ampulla, lobes longitudinally separated from each other, broadly rounded and strongly convex, somewhat inserted in a depression.

Remarks: Of the 21 species of Rutelini with known pupae, *Pelidnota granulata* pupae are similar to the pupa of *Homonyx chalceus* Blanchard, 1850 and its congener *Pelidnota lugubris* LeConte, 1874. Those species have a similar general body shape, femur-tibia articulations exposed in dorsal view, five pairs of dioneiform organs, abdominal spiracle I exposed, and abdominal tergite IX fold densely setose. Pupae of *P. granulata* are distinguished from them by (characters of 1 = *H. chalceus* and 2 = *P. lugubris* pupae given in brackets): 1) pronotum with ecdysial longitudinal line distinct (1 = ecdysial longitudinal line indistinct; 2 = as *P. granulata*); 2) medial area of mesonotum as long as wide, with posteromedial margin narrowly rounded and not extending to anterior margin of abdominal tergite I (1 = as *P. granulata*, but posteromedial margin broadly rounded; 2 = medial area longer than wide, posteromedial margin truncated and extending to anterior margin of abdominal tergite I); 3) posterior margin of metanotum almost straight and with a medial lobe (1 = posterior margin of metanotum multisinuuous and without median lobe; 2 = posterior margin of metanotum trapezoidal and without median lobe); 4) dioneiform organs between abdominal tergites I-II well defined (1 = as *P. granulata*; 2 = barely defined).

As pointed out by Morón (1993), ethologic characters such as ecdysis, pupation location of the third instar larvae are important sources of taxonomic and phylogenetic information. The observed pupal chambers of *P. granulata* is oblong and about 1.3 times wider than pupae, internally covered with compressed sawdust (Fig. 2) and locate in the sapwood section of the decaying trunk, where the decomposition class was between CD2 and CD3 according to the classification scheme used in Alencar *et al.* (2020). The dorsal ecdysial opening of the last instar larva is almost equal to the larval body length and the pupa stays partially covered by last larval cast skin (Fig. 2). Similar habits are also observed in *Lagochile emarginata* (Gyllenhal, 1817) (*cf.*, Albertoni



Figure 1. Female pupa of *Pelidnota granulata* (Gory, 1834): head and prothorax in ventral view (A); head in frontal view showing the medial furrow of labrum (A1); ventral habitus (B); dorsal habitus (C); lateral habitus (D); lateral view showing the first abdominal spiracle (E); lateral view of last abdominal segments showing the invaginated, without peritreme abdominal spiracle VIII (F); and genital ampulla (G). Scales: A, A1, F = 1 mm; B, C, D = 5 mm; G = 0.2 mm.

et al., 2014: fig. 81) and were supposed by Morón (1993) to be diagnostics for Rutelinae (Anomalini and Rutelini). In opposition, in Melolonthinae the larval exuvia is positioned at the posterior region of the abdomen of the pupa, and in third instar larvae of Dynastinae (Dynastini and Oryctini) the ecdysial opening occupies only half of the body length (*cf.*, Morón 1993: figs. 8-11).

Gory (1834) described *P. granulata* from Cayenne, French Guiana, and was reported in Demerara, Guiana by Ohaus (1912). Moore *et al.* (2017) reviewed the distribution of the pelidnotine species based on literature and recorded *P. granulata* to Brazil.

The distributional data presented here update the occurrence register of the species. This species is known to occur in Brazil, French Guiana, and Guiana.

Material examined: 82 specimens of *Pelidnota granulata* Gory. BRAZIL. Amazonas: Itapiranga, 08.x.2010, D. Ochoa, A. Agudelo & P. Dias (legs.) (1 ♂, INPA); Manaus, AM-10 km 28, P. Buhrnheim, N.O. Aguiar, J. Vicente Silva, F.J. Bendahan & C.M. Buhrnheim (legs.) (1 ♂, CZPB); Manaus, Fazenda Porto Alegre, viii.1996, R.W.H. Hutchings & R.S.G. Hutchings (legs.) (1 ♂, 2 ♀, INPA); Manaus, campus UFAM, 25.iii.1982, A.T.S. Jatahy (leg.) (1 ♀, INPA); *idem*,

but 10.v.1984, Herbert Lima (leg.) (1 ♂, CZPB); *idem*, but iv.2019, Ana Paula Rodrigues Pinheiro (leg.) (1 ♂, INPA); Manaus, Fazenda Experimental UFAM, ii.2020, Alencar J. (leg.) (1 ♂, INPA); Manaus, Esmeraldina Bonfim (leg.) (1 ♀, INPA); Manaus, Fazenda Dimona, 11-12.vi.1990, C.S. Motta, R.S.G. Hutchings & A. Faustino Neto (legs.) (1 ♂, INPA); *idem*, but 28-31.vii.2000, R. Andreazze (leg.) (1 ♂, 1 ♀, INPA); Manaus, ZF-2 km 14, 21-24.i.2004, C.S. Mota, S.F. Trovisco, F.F.F. Xavier & A.S. Filho (legs.) (1 ♂, INPA); *idem*, but 18-21.ii.2004, J.A. Rafael, C.S. Motta, F.F. Xavier, A. Silva & S. Trovisco (legs.) (5 ♂, 1 ♀, INPA); *idem*, but 19-22.iii.2004, J.A. Rafael, C.S. Motta, F.F. Xavier, A. Silva & J.T. Câmara (legs.) (6 ♂, 1 ♀, INPA); *idem*, but 16-19.iv.2004, J.A. Rafael, C. Motta, A. Silva & J.M.F. Ribeiro (legs.) (2 ♂, INPA); *idem*, but 13-16.viii.2004, J.A. Rafael, F.F. Xavier, A.R. Uruhay, A. Silva & S. Trovisco (legs.) (11 ♂, 4 ♀, INPA); *idem*, but 12-15.x.2004, J.A. Rafael, C.S. Motta, F.F. Xavier, A. Silva & S. Trovisco (legs.) (1 ♂, 2 ♀, INPA); *idem*, but 09-12.xi.2004, C.S. Motta, A.S. Filho, A.S. Trovisco & L. Aquino (legs.) (3 ♂, 2 ♀, INPA); *idem*, but 10-13.xii.2004, C.S. Motta, A.S. Filho, S. Trovisco & M. Cutrin (legs.) (3 ♂, INPA); *idem*, but 04.iii.2011, R.A. Rafael & R.F. Silva (legs.) (1 ♂, INPA); *idem*, but 05.iii.2011, P. Dias & R. Freitas (legs.) (1 ♂, 1 ♀, INPA); AM 240 km 14, viii.2005, Xavier-Filho (leg.) (1 ♂, INPA); Novo Airão,



Figure 2. Male pupa of *Pelidnota granulata* (Gory, 1834) within the pupal chamber resting over the larval third instar skin.

Parque Nacional do Jaú, 10-11.iv.1994, C. Motta (leg.) (1 ♂, INPA); Presidente Figueiredo, Rio Urubu, 08-09.v.1983, P. Buhrnheim, N. Otaviano & F. Peralta (legs.) (1 ♀, CZPB); Presidente Figueiredo, 24-25.x.2003, J.A. Rafael, F.F. Xavier & A.S. Filho (legs.) (1 ♂, 3 ♀, INPA); *idem*, but 11-12.xii.2004, F.F. Xavier & G.M. Lourido (legs.) (1 ♂, 1 ♀, INPA); *idem*, but 26.vii-03.viii.2005, F.F. Xavier, G.M. Lourido & F. Machado

(legs.) (7 ♂, 4 ♀, INPA); *idem*, but 25-26.i.2006, J.A. Rafael, F.F. Xavier, A. Silva, J.S. Duarte & D.M. Mendes (legs.) (1 ♀, INPA); *idem*, but 17-21.ix.2006, C.S. Motta & R.S. Hutchings (legs.) (1 ♀, INPA); *idem*, but 29-31.x.2008, J.A. Rafael, F.F. Xavier, G. Lourido, R.J.P. Machado & E. Amat (legs.) (1 ♀, INPA); *idem*, but 28.vii-06.viii.2015, Henriques, Xavier & Daniel Carmo (legs.) (1 ♂, INPA).

Key to genera and species of Rutelini based on known pupae (modified from Bento *et al.* (2018))

Pupae of *Macraspis morio* Burmeister, 1844 were measured and figured by Oliveira *et al.* (2016), those of *Pelidnota punctata* (Linnaeus, 1758) were figured by Isaac (1907), and those of *Rutelisca durangoana* Ohaus, 1905 were described by Morón & Deloya (1991) bearing 5 pairs of dioneiform organs. More morphological studies are needed to differentiate the pupae of these species from others. The pupae of *Macraspis* (step 14 and subsequent steps) included here need more studies to clarify and check some diagnoses.

1. Abdomen with 5-6 pairs of dioneiform organs	2
1'. Abdomen with 4 pairs of dioneiform organs.....	12
2. Fold of abdominal tergite IX with small spines and without dense group of setae.....	<i>Cnemida retusa</i>
2'. Fold of abdominal tergite IX fold without spines and with dense group of short setae.....	3
3. Abdomen with 6 pairs of dioneiform organs.....	<i>Chrysophora chrysochlora</i>
3'. Abdomen with 5 pairs of dioneiform organs.....	4
4. Metatibia long, arcuate, distinctly longer than metafemur.....	5
4'. Metatibia short, straight or slightly arcuate, as long as or shorter than metafemur.....	6
5. Posterior margin of metacoxa with short process; posterior margin of metafemur with short preapical process; inner margin of metatibia with short medial process.....	<i>Paraheterosternus lueddeckei</i>
5'. Metacoxa, metafemur and metatibia without process.....	<i>Heterosternus buprestoides</i>
6. Abdominal sternites VII-VIII combined slightly longer than II-VI combined.....	<i>Rutela dorcyi</i>
6'. Abdominal sternites VII-VIII combined shorter than II-VI combined	7
7. Posterior process of prosternum not flat and barely evident between procoxae; femur-tibia articulations hidden in dorsal view	<i>Chlorota</i> . . 8
7'. Posterior process of prosternum flat and evident between procoxae, femur-tibia articulations exposed in dorsal view	9
8. Pubescence of posterolateral fold of abdominal tergite IX restrict to posterior half; abdominal sternite VIII and IX coalesced.....	<i>C. cincticollis</i>
8'. Pubescence of posterolateral fold of abdominal tergite IX present in all lateral margin; abdominal sternite VIII and IX well defined	<i>C. paulistana</i>
9. Metatibia almost straight in both sexes; metafemur-tibia articulation not reaching the level of spiracles; abdominal spiracle I exposed, not hidden by wing thecae	10
9'. Metatibia with inner margin slightly arcuate in males; metafemur-tibia articulation reaching the level of spiracles; abdominal spiracle I hidden by wing thecae <i>Chrysina macropus</i> (cf., Morón, 1990: plate C)	
10. Pronotum with ecdysial line indistinct.....	<i>Homonyx chalceus</i>
10'. Pronotum with ecdysial line distinct.....	<i>Pelidnota</i> . . 11
11. Middle area of mesonotum as long as wide, with posteromedial margin rounded and not extended to abdominal tergite I; posterior margin of metanotum almost straight and with a median lobe; dioneiform organs between tergites I-II explicitly defined.....	<i>P. granulata</i>
11'. Middle area of mesonotum longer than wide, with posteromedial margin truncated and extending to abdominal tergite I; posterior margin of metanotum trapezoidal and without a median lobe; dioneiform organs between tergites I-II barely defined	<i>P. lugubris</i>
12. Mesonotum as long as the pronotum or almost so, and not extended to abdominal tergite I.....	<i>Lagochile emarginata</i>
12'. Mesonotum longer than pronotum and extended to abdominal tergite I.....	13
13. Head in dorsal view wider than half the pronotum at middle; profemur-tibia articulation exposed in dorsal view; abdominal spiracle I exposed, not hidden by wing thecae	<i>Rutela lineola</i>
13'. Head in dorsal view narrower than half the pronotum at middle; profemur-tibia articulation hidden in dorsal view; abdominal spiracle I hidden by wing thecae	<i>Macraspis</i> . . 14
14. Fold of abdominal tergite IX with reddish-brown short setae	15
14'. Fold of abdominal tergite IX with light yellow short setae.....	16
15. Frontoclypeal suture somewhat straight and medially indistinct.....	<i>M. cincta</i>
15'. Frontoclypeal suture weakly sinuate and medially distinct (suture complete).....	<i>M. chrysis</i>
16. Frontoclypeal suture somewhat straight and medially indistinct.....	<i>M. festiva</i>
16'. Frontoclypeal suture weakly or strongly sinuate and medially distinct (suture complete)	17
17. Abdominal sternites VIII-IX combined slightly longer than VII	<i>M. pseudochrysis</i>
17'. Abdominal sternites VIII-IX combined as long as VI-VII combined or almost so	18
18. Frontoclypeal suture weakly sinuate; pronotum semicircular shaped in dorsal view (cf., Morón & Paucar-Cabrera, 2003: fig. 27).....	<i>M. rufonitida</i>
18'. Frontoclypeal suture evidently sinuate; pronotum somewhat transversal	<i>M. aterrima</i>

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