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First detailed description of morphology of larva of *Paranovelsis pantherinus* (Ahrens, 1814) (Dermestidae: Attageninae: Attagenini) with remarks on biology

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ABSTRACT

The description of the last larval instar (based on the exuvium) of *Paranovelsis pantherinus* (Ahrens, 1814) (Coleoptera: Dermestidae) is presented. Morphological characters of *Paranovelsis* larvae such as general morphology of antenna, epipharynx, mandibula, maxilla, ligula with labial palpi, setae, legs, terga, condition of antecostal suture, and spiracle are documented, and discussed. Structural differences of mature larvae of four *Paranovelsis* species are compared and summarized.

Introduction

The genus *Paranovelsis* Casey, 1900 was originally described as a subgenus of the genus *Novelsis* by Casey (1900). In 1954, Beal amalgamated this subgenus with the genus *Novelsis*. Although Mroczkowski (1968) still treated *Paranovelsis* as a subgenus of *Novelsis* in his catalogue. Currently, *Paranovelsis* is considered to be a separate genus (Zahradník and Háva, 2014) and consists of 17 species distributed throughout the Neotropic, Nearctic and Palaearctic ecozone (Háva, 2015). Described herein *Paranovelsis pantherinus* (Ahrens, 1814) formerly has been classified as the genus *Attagenus* (Mroczkowski, 1968, 1975; Zhantiev, 1976; Háva, 2013). Zahradník and Háva (2014) in their catalogue moved it to the genus *Paranovelsis* (as a stat. Nov.; comb. Nov.). Abovementioned authors have not given any detailed explanation for these taxonomic decisions, except by providing the statement: "*Subgenus Paranovelsis is removed from synonymy with Novelsis and reelevated to the generic level. Status nov. based on recent study of type material and recently collected fresh material of all constituent species*". This statement lacks the detailed diagnosis for the newly established genus that would allow distinguishing related genera to each other.

Morphologically *Paranovelsis* is related to the genus *Attagenus* Latreille, 1802 and *Novelsis* Casey, 1900. The genus *Novelsis* groups species have the following set of characteristics: segments of antennal club loosely jointed; length of ultimate segment in male shorter than combined length of 2 preceding segments or all 3 segments greatly elongated with penultimate segment 2× as long as wide (Beal, 1954, 1959, 2003), whilst the genus *Attagenus* contains the species that represent the following set of characteristics: segments of antennal club compact; length of ultimate segment in male exceeding combined length of 2 preceding segments (Beal, 1959, 2003). Interestingly, there have been no major differences found between *Attagenus* and *Novelsis* in the larval stages. There are joint characteristic for both aforementioned genera larvae, that can be defined by following set of features: 4 or 5 stemmata on each side of the head; caudal brush of long spicisetae present; some lanceolate setae or scale-like setae present on terga; body elongate, cylindrical, strongly sclerotized and somewhat tapering posteriorly (Beal, 1991; Peacock, 1993). The genus *Paranovelsis* has been established recently by Zahradník and Háva (2014) on the basis of adults morphology, thus there is not any clear definition of larval characteristics.

The primary purpose of this paper therefore is to describe the detailed morphology of *Paranovelsis pantherinus* (Ahrens, 1814) and present the biological data available for this species. The second purpose is to gather all available larval data for other *Paranovelsis* species. As we have not had an access to the mature larva of the rest of known *Paranovelsis* (Table 1) including larva of type species for the genus

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Table 1
List of *Paranovelsis* species with references related to larval morphological characters.

Taxon	References	Available data
Paranovelsis aequalis (Sharp, 1902)	Beal (1970)	Short description in a key (p. 162) and detailed description of larval morphology (p. 207)
Paranovelsis varicolor (Jayne, 1882)	Beal (1970)	Illustration of spiracles and spiracular sclerites (p. 158), short description in a key (p. 162) and detailed description of larval morphology (p. 204)
	Kiselyova and McHugh (2006)	Data matrix with larval characters (p. 498)
Paranovelsis pantherinus Ahrens, 1814	Kadej & Guziak (current paper)	Detailed description of larval morphology with illustration of antenna, epipharynx and labro-epipharyengal margin, ligula, labial palp, maxilla, phrotoracic leg, mandible, spiracle and spiracular sclerit of I abdominal tergum
Paranovelsis punctatus (Scopoli, 1772)	Rey (1887)	Description of larval morphology (p. 189–191) [in French] (it has been made for *Attagenus vigintiguttatus* Fabricius, 1775 which currently is synonym of *P. punctatus* (Scopoli, 1772))
	Klausnitzer (2001)	Short description in key (p. 27) (it has been made for *Attagenus punctatus* Reitter, 1906 which currently is synonym of *P. punctatus* (Scopoli, 1772))

(*Attagenus varicolor* Jayne, 1882) we were not able to provide key for identification of larval forms to facilitate identification, thus, we propose only simple distinctions by presenting some of the features in the Table 2.

Material and methods

For morphological examination, larva of the last-stage were stored in alcohol. The material came from the collection of Prof. Maciej Mroczkowski (1927–2007), who cultured larvae "*ex ovo*" in the Museum and Institute of Zoology, Polish Academy of Science, Warszawa, Poland (MIZ). The details of rearing (source and type of food) are unknown. Larva were boiled for 3–10 min in 10% solution of KOH, and then rinsed with distilled water. Then were placed in distilled water for ~1 h for cleaning and softening the material and all of structures were put into glycerin on slides. The morphological structures were examined under a Nikon Eclipse E600 (Tokyo, Japan) phase contrast microscope with a drawing tube attached, and a Nikon SMZ-800 (Tokyo, Japan) binocular microscope; the samples were mounted in glycerin and exposed to transmitted light. Photographs were taken with a Canon 500D (Taiwan) camera under a Nikon SMZ–800 (Tokyo, Japan). Image stacks were processed using Combine ZM (Hadley, 2010). The terminology used in this paper follows Beal (1970) and Kiselyova and McHugh (2006).

Figure abbreviations: ac – acrotergite ; as – antecostal suture (ridge); br – transverse row of placoid sensillae on epipharynx; c – claw; cs – camapniform sensilla(e); dst – distal epipharyengal sensillae; er – epipharyengal rods; f – femur; gl – galea; l – lacinia; lp – labial palp(i); mp – mesal pair of labor-epipharyengal setae ; msr – mesal row of setae on lacinia; mxp – maxillary palp(i); p2 – second pair of labor-epipharyengal setae; pr – pretarsus; prst – prostheca; s – sensorium (accessory sensory papillae); sbp – subproximal epipharyngeal sensillae; sp. – spiracle; st – stipes; t – tibia; tr – trochanter.

Results

Systematics

Family Dermestidae Latreille, 1807.
Subfamily Attageninae Laporte, 1840.
Tribe Attagenini Laporte, 1840.
Genus *Paranovelsis* Casey, 1900.
Paranovelsis pantherinus (Ahrens, 1814).
Figs. 1–16

Material examined

7 exx. of larva: „Polonia, Kazimierz Dolny, distr. Puławy, 25.VIII.1959, leg A. Mońko z gniazd [from the nests of] *Colletes inoxpectatus* Nosk / *Attagenus pantherinus* Ahr. Det. M. Mroczkowski 1959 [both labels had written]". Deposited in Department of Invertebrate Biology, Evolution and Conservation, Department of Evolutionary Biology and Ecology, University of Wrocław, Przybyszewskiego 65, PL–51–148 Wrocław, Poland.

Description

Body elongated and cylindrical (Figs. 1–2); length 9.0–11.0 mm, body width 1.0–1.5 mm; abdominal segment IX terminal with a caudal brush of long setae (usually longer than half body length); segment X reduced; urogomphi absent. Dorsal cuticle of head, thorax and abdomen brown and strongly sclerotized (except for acrotergites, Fig. 1); ventral surface yellowish-brown and rather membranous than sclerotized (Fig. 2). Body setae brown to dark brown (almost black), setae on legs brown. Head protracted and hypognathous. Probably two stemmata present on each side of head. Frons triangular; epicranial stem present. Gula separate from postmentum. Antennae orientated anterolaterally

Table 2
Comparison of some larval characters between *Paranovelsis* species (after Beal, 1970 and current paper).

Taxon	Antenna	Maxillary palp	Spiracle and spiracular sclerite	Antecostal suture on 8th abdominal terga
Paranovelsis aequalis (Sharp, 1902)	Terminal seta subequal in length to length of terminal segment; one or no seta present on 2nd segment	2 setae on 3rd segment	Spiracle closed behind by tergum; spiracle sclerite rhomboidal to ovate and encircled by rim-like extension of sclerotized part of tergum	Present
Paranovelsis varicolor (Jayne, 1882)	Terminal seta five-ninths as long as length of terminal segment; no seta present on 2nd segment	9–14 setae on 3rd segment	Spiracle enclosed by tergum; spiracle sclerite nearly round and enclosed by tergum	Absent
Paranovelsis pantherinus Ahrens, 1814	Terminal seta six-tenth as long as length of terminal segment; no seta present on 2nd segment	0–2 setae on 3rd segment	Spiracle enclosed by tergum; spiracle sclerite oval and not enclosed by tergum	Present
Paranovelsis punctatus (Scopoli, 1772)	No data	No data	No data	No data