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REDESCRIPTION OF THE LARVAE OF
BRUCHIDIUS ATROLINEATUS (PIC)
(COLEOPTERA: BRUCHIDAE: BRUCHINAE)

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ABSTRACT

The morphology of final and first instars of the larvae of *Bruchidius atrolineatus* (Pic) is illustrated and described. Structures described for final instar include enface view, antenna, clypeolabrum, epipharynx, mandible, maxilla, labium, spiracle, and leg. First instar structures described include head capsule, frons, gena, clypeolabrum, mandible, antenna, prothoracic plate, prothoracic chaetotaxy, spiracles, legs, and abdominal chaetotaxy. The clypeolabrum, antenna, and leg of the final instar, as well as the leg and prothoracic plate of the first instar are redescribed. Significant characters are indicated for final and first instar larvae. Relationships between this species and others within the subfamily Bruchinae based on larval characteristics are discussed.

Approximately 20 years ago Preveit (1971) described the first and final larval instars of *Bruchidius atrolineatus* (Pic) (Pfaffenberger 1985a). However, Preveit (1971) did not describe the larval forms in their entirety, but only provided illustrations (no descriptions) of the clypeolabrum, antenna, and leg of the final instar and the leg and prothoracic plate of the first instar.

Preveit (1971) was not the first to examine larvae of this species. Luca (1968) initially described the first instar larva and was also the first to partially illustrate it. Unfortunately, because of errors and brevity of the description and accompanying illustrations, his contributions are of minimal value.

To obtain lasting baseline data for ongoing studies in larval taxonomy of the Bruchidae, it is essential that as many structures as possible be illustrated and that these illustrations be accompanied by detailed descriptions. This is the first complete description of *B. atrolineatus* larvae and is also the first complete description of a larval form from the genus *Bruchidius*.

As indicated in previous works (Pfaffenberger 1990a), contributions from larval taxonomy will lend considerable insight into the development of an accurate system of classification within the subfamily Bruchinae and the family Bruchidae.

The egg has been electron micrographed and described (Biemont *et al.* 1982) and the biology and host plants have been reported (Kingsolver 1991).

FINAL INSTAR OF *BRUCHIDIUS ATROLINEATUS*

DESCRIPTION. *Habitus:* As in figures 1 and 2 in Pfaffenberger (1977). Size 2.1–3.4 mm long by 1.5–1.2 mm wide; C-shaped; robust; thorax increasing in width from pro- through metathoracic segments; meso- and metathoracic segments with single, dorsal plica; diameter of abdominal segments 1–5 subequal, but narrower than metathorax and wider than abdominal segment 6; abdominal segments 6–10 progressively tapering to minute ultimate segment; color white to yellowish-white; integument barbed with minute, short, pointed, posteriorly directed projections with occasional elongate sensilla trichodea (see fig. 2C in Pfaffenberger 1974).

Head (cf. Figs. 1, 9 with figs. 3, 4 in Pfaffenberger 1977): Oval-shaped with noticeable posterior taper; mostly white except for heavily pigmented areas of mouthparts (Fig. 1); retractable head capsule with lyre-shaped epicranial suture; epicranium with medial, elongate pair of sensilla trichodea; medial pair flanked laterally by triad of shorter sensilla trichodea; pair of short sensilla trichodea located ventrolaterally to antenna on gena.

Ocellus (O, Fig. 9): Single, anterior on gena near junction of antenna and mandible.

Antenna (cf. Fig. 2 with fig. 23C in Prevett 1971): Single, telescopic segment located anteriorly between epicranium and gena; periphery of distal margin supporting one or more rows of pointed microtrichia; single, enlarged sensillum basiconicum bordered dorsomedially by elongate sensillum chaeticum; small, single sensillum basiconicum mediolateral to large sensillum basiconicum and sensillum chaeticum; single sensillum ampullaceum located dorsally at base of segment. [The additional sensilla basiconicum and ampullaceum reported by Prevett (1971, fig. 23C) were not observed in this study.]

Clypeolabrum (cf. Figs. 1, 3 with figs. 5C, 23E, 28A in Prevett 1971): Vaguely sclerotized except near clypeolabral border (Fig. 1). Clypeal portion transversely rectangular elongate with concave distal and proximal borders; single sensillum trichodeum near lateral margin, subtended by medial sensillum ampullaceum. Small, narrow, transversely elongate sclerite overlying border of clypeolabrum; sclerite with single sensillum ampullaceum located laterally. Oval labral portion rounded distally, with peripheral arc of dense microtrichia; four elongate sensilla trichodea located distomedially in mat of microtrichia; arc of six elongate sensilla trichodea located along proximal border of microtrichia.

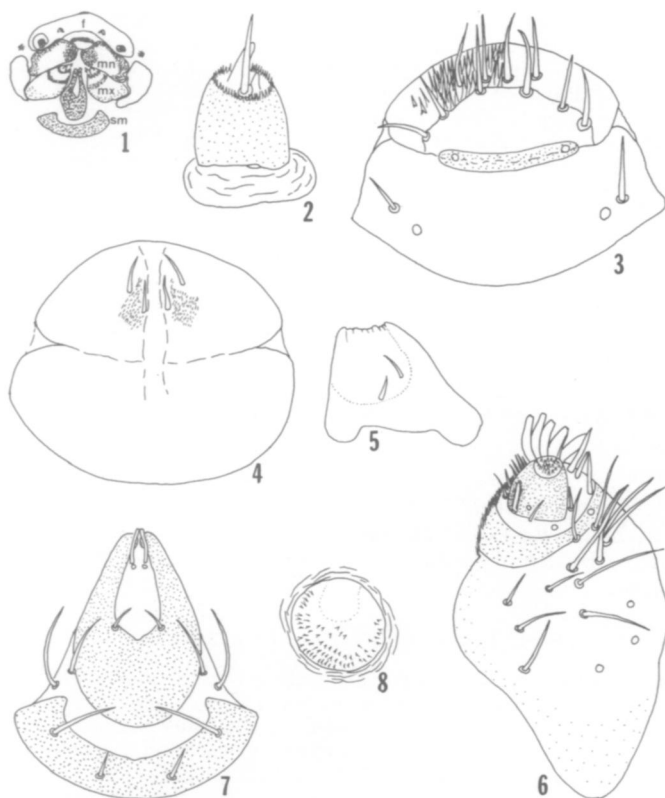
Epipharynx (Fig. 4): Epipharyngeal groove bordered laterally by two pairs of sensilla trichodea; proximal pair of sensilla adjacent to epipharyngeal groove and surrounded by small mat of fine, pointed projections; distal pair of sensilla more widely separated and not enclosed in mat of pointed projections.

Mandible (Figs. 1, mn; 5): Heavily sclerotized; transversely elongate; monocondylic, with awl-shaped chewing surface; pair of sensilla trichodea located on medioventral surface.

Maxilla (cf. Figs. 1, mx, 6 with fig. 45 in Pfaffenberger 1985b): Cardo absent; membranous stipes with 11 or 12 sensilla trichodea, three sensilla ampullacea located ventrolaterally; sclerite of palpifer with one ventrolateral sensillum ampullaceum; membranous palpifer with single ventral sensillum ampullaceum, seven sharp, distomedial sensilla trichodea, two sensilla trichodea located ventrally flanking opposite sides of palpus, medial surface with dense mat of microtrichia; lacinia with five enlarged, spatula-like setae, four additional sensilla trichodea located slightly lateroventral to spatula-like setae; palpus with ventrolateral, elongate sensillum placodeum (cf. figs. 12, 13 in Pfaffenberger 1990b), sensillum ampullaceum lateral to latter sensillum, apical end with 20 sensilla basiconica.

Labium (Figs. 1, 7): Submentum canoe-shaped, bowing anteriorly toward lateral margins, sclerotized, with medial and lateral pairs of sensilla trichodea; paired, elongate sensilla trichodea flanking mentum and between mentum and submentum; oval-shaped mentum rounded proximally with tapered, elongate arms converging distally at glossa, converging arms enclosing membranous area; membranous area flanked proximally by pair of sensilla trichodea, paired sensilla trichodea subtended by sensilla ampullacea in distal membranous mentum; unsclerotized paraglossa present.

Leg (cf. Fig. 11 in Pfaffenberger 1977 with figs. 8E, 23J in Prevett 1971): Four fleshy



Figs. 1–8. *Bruchidius atrolineatus*, final instar larva. 1, enface view showing frons (f), mandible (mn), maxilla (mx), and labium (sm = submentum). 2, single-segment antenna. 3, clypeolabrum showing dense mat of microtrichia [illustrated only on left side (microtrichia tend to obscure presence of sensilla trichodea)]. 4, epipharynx showing paired sensilla trichodea and neighboring patches of microtrichia. 5, monocondylic mandible with paired sensilla trichodea. 6, maxilla. 7, labium. 8, abdominal spiracle.

segments, ultimate segment nipple-like; two sensilla trichodea and ampullacea on penultimate segment.

Spiracle (Fig. 8): Uniformous, spherical with enlarged, oval-shaped atrium projecting posteriorly; atrium lined with numerous sclerotized projections; peritreme absent.

Anal sulcus: Transverse.

SPECIMENS EXAMINED. Nine final instar larvae from Department of Biology, Université de Niamey, Niamey, Niger, West Africa, 1988, from cultures of black-eyed peas [*Vigna unguiculata* (L.) Walp.].

SIGNIFICANT CHARACTERS. Lyre-shaped epicranial suture. Single pair of ocelli. Narrow, transversely elongated sclerite overlapping junction of clypeolabrum. Presence of sensillum ampullaceum at opposite ends of latter sclerite. Proximal arc of six sensilla trichodea and distal, transverse row of four sensilla trichodea on labium. Epipharyngeal mat of minute, fine projections, and the

Table 1. Distribution of setae on *Bruchidius atrolineatus*, first instar.

Segment	Pro-dor-sum	Post-dorsum	Spi-rac-ular area	Epi-pleuron	Hypo-pleu-ron	Sternum	Pro-thorax
Mesothorax		Aa'a''		Ee'		R	2 16
Metathorax		Aa'a''		e'	h	R	3 17
Abdomen							5
1	d'	A	s'	E	h	uv	7
2	d'	A a''		Ee'	h	uv	8
3-4	d'	A a''		e'	h	uv	11
5-8	d'	A a''		Ee'	h	uvx	20
9	d'	A a''		E	h	u	14
10 g and h*							15

* Present on dorsolateral area of 10th segment.

more widely spaced, distal, epipharyngeal sensilla trichodea. Two mandibular sensilla trichodea. Row of seven sharp, sensilla trichodea on distomedial surface of palpifer. Absence of cardo. Presence of two pairs of sensilla trichodea on submentum.

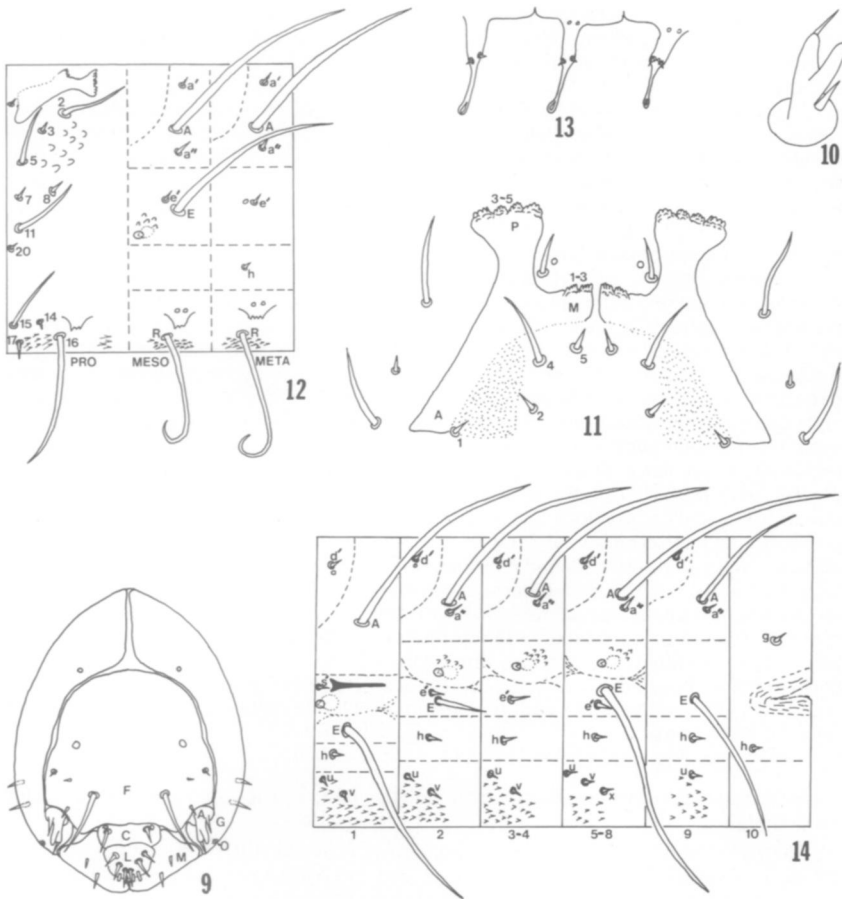
FIRST INSTAR OF *BRUCHIDIUS ATROLINEATUS*

DESCRIPTION. *Habitus:* See fig. 1 in Pfaffenberger and Johnson 1976. Size 0.5 mm long \times 0.25 mm wide; cyphosomatic; greatest width in meso- and metathoracic segments tapering to minute 10th abdominal segment; cuticle white except prothoracic plate, adorned with symmetrical pattern of long (primary) and short (secondary) sensilla trichodea, and sensilla ampullacea (Figs. 7, 21 in Pfaffenberger 1985b).

Head (Fig. 9): Ovate with lyre-shaped epicranial suture. Frons (F, Fig. 9) bowl-shaped base, with pair of anteromedial, elongate sensilla trichodea, triad of shorter sensilla trichodea located laterad to each elongate sensillum trichodeum in distolateral corner, pair of sensilla ampullacea located lateromedially midway toward apex; single pair of sensilla trichodea dorsal to ocellus on gena. Ocelli (O, Fig. 9) single, deeply pigmented, located anteriorly on gena across arm of epicranial suture near base of antenna. Antenna (A, Figs. 9, 10) located laterally at frons-mandibular interface; single telescopic segment consisting of one enlarged lateral and one medial sensillum basiconicum; elongate sensillum chaeticum arising from tip of smaller sensillum basiconicum; shorter sensillum trichodeum located at basolateral margin of large sensillum basiconicum. Clypeolabrum (C, L, Fig. 9; see figs 25, 27 in Pfaffenberger and Janzen 1984) with clypeal portion (C) rectangular, transversely elongate; short, lateral sensillum trichodeum with medial, subtending sensillum ampullaceum located near each proximolateral margin; labral portion (L) transversely oval with arc of eight short sensilla trichodea along anterolateral margins, pair of medial sensilla trichodea located distomedially. Mandible (M, Fig. 9) monocondylic, with two sensilla trichodea on anterior surface.

Prothoracic plate (cf. Figs. 11, 12 with fig. 26F in Prevett 1971): X- or H-shaped; tooth formula 1-3 + 0 + 3-5 (enface view, right side most variable), anterior arms (A) faintly sclerotized, medial surface covered with triangular patch of numerous, minute projections; medial (M) and posterior (P) arms sclerotized, supporting 1-3 and 3-5 teeth, respectively; sensilla trichodea 1 and 2 located anteromedially of each roughened triangular patch; fourth sensillum trichodeum 4 \times longer than fifth, both located anteromedially of median arms; short sensillum trichodeum and subtending sensillum ampullaceum located along medial border between median and posterior arms.

Thorax (Fig. 12, Table 1): Prothorax with 11 pairs of sensilla trichodea (exclusive of



Figs. 9–14. *Bruchidius atrolineatus*, first instar larva. 9, head capsule, showing frons (F), clypeus (C), labrum (L), mandible (M), antenna (A), ocellus (O), and gena (G). 10, antenna, showing basal and terminal sensilla trichodea arising from base and distal end of sensilla basiconica, respectively. 11, prothoracic plate, showing anterior (A), medial (M), and posterior (P) arms and associated sensilla. 12, thoracic chaetotaxy; note tuberosities near lateral surface of prothoracic plate and spiracular area of mesothorax. 13, legs, the anterior appendage appears to the left. 14, abdominal chaetotaxy; Note unusual folds in spiracular and epipleural regions, very elongate abdominal spine on first segment, and transverse anal aperture indicated on tenth segment.

those associated with prothoracic plate); patch of tuberosities immediately laterad of prothoracic plate and numerous short, pointed, sclerotized projections on sternum (see fig. 37 in Pfaffenberger and Janzen 1984). Mesothorax with asetiferous prodorsum, postdorsum with primary (A) and two secondary (a', a'') sensilla trichodea; epipleuron with primary (E) and secondary (e') sensilla trichodea; oval, uniforous spiracle anteroventrally on epipleuron immediately inferior to small cluster of tuberosities, oval peritreme enlarged posteriorly and 3 × larger than spiracle; hypopleuron asetiferous; sternum with paired, elongate, coiled sensilla trichodea (R) between legs, also with numerous transverse

rows of sclerotized, posteriorly pointed projections. Metathorax with epipleuron with single sensillum trichodeum (e') and subtending sensillum ampullaceum; hypopleuron with single secondary (h) sensillum trichodeum; remainder of segment similar to mesothorax.

Legs (cf. Figs. 12, 13 with fig. 25D in Prevett 1971): Leg length and distance between legs of a segment increasing slightly with each succeeding segment; two-segmented; ultimate segment with stalk-like base, terminating in awl-shaped, foot-like structure; basal segment with distally located, paired, short sensilla trichodea on anterolateral and posterolateral surfaces; paired sensilla ampullacea located basolaterally on meso- and metathoracic legs; single sensillum ampullaceum located between paired sensilla trichodea at distal end of metathoracic basal segment.

Abdomen (Fig. 14, Table 1): First prodorsum with secondary (d') sensillum trichodeum subtending sensillum ampullaceum; postdorsum with single primary (A) sensillum trichodeum; spiracular area with secondary sensillum trichodeum (s') posteriorly directed, sclerotized spine, and uniferous spiracle with posteriorly enlarged, oval-shaped peritreme; epipleuron with primary (E) sensillum trichodeum; hypopleuron with secondary (h) sensillum trichodeum; sternum with two secondary (u,v) sensilla trichodea, and numerous sclerotized, posteriorly directed projections; prodorsum of second segment same as first prodorsum; second postdorsum with primary (A) and secondary (a'') sensilla trichodea; spiracular area asetiferous with several tuberosities dorsal to spiracle; epipleuron with primary (E) and secondary (e') sensilla trichodea; hypopleuron with secondary (h) sensillum trichodeum; second sternite same as first sternite; 3-8 pro- and postdorsa, and spiracular areas same as those on second segment; epipleuron with secondary (e') sensillum trichodeum; hypopleura 3-10 each same as that of second segment; sternites 3 and 4 same as second sternite; epipleurites 5-8 with primary (E) and secondary (e') sensillum trichodeum; sternites 5-8 with three secondary (u,v,x) sensilla trichodea; ninth prodorsum with secondary (d') sensillum trichodeum; ninth epipleuron with single primary (E) sensillum trichodeum; ninth sternite with single secondary (u) sensillum trichodeum and posteriorly directed projections; remainder of ninth segment similar to segments 3-5; tenth segment with two secondary (g,h) sensilla trichodea; remainder of segment asetiferous.

Anal sulcus (Fig. 14): Transverse.

SPECIMENS EXAMINED. First instar larvae, 135. For locality see above under final instar.

SIGNIFICANT CHARACTERS. Lyre-shaped epicranial suture. Presence of a single pair of sensilla ampullacea on frons and the occurrence of a pair of sensilla trichodea dorsal to ocellus on gena. Single pair of ocelli. Presence of two elongate sensilla basiconica (one appearing as a branch of the other) on antenna. Presence of basal sensillum trichodeum on antenna. Peripheral arc of eight sensilla trichodea on labrum surrounding an additional pair. Presence of two sensilla trichodea on anterior surface of each mandible. Existence of asymmetrical tooth distribution on prothoracic plate, with right side showing more variation than left side (from enface view). Presence of an enlarged, oval-shaped atrium on all spiracles. Secondary (h) seta on metathoracic hypopleuron. Very elongated, narrow spine on first abdominal segment. Presence of u,v, and x sensilla trichodea on abdominal sternites 5-8.

DISCUSSION

Morphological features of *B. atrolineatus* and other species within the subfamily Bruchinae indicate this species is to be appropriately included. Within the Bruchinae, if the first instar chaetotaxy and prothoracic plates are compared, *B. atrolineatus* appears to be most closely related to *Sennius morosus*. However, the latter species has no sensilla trichodea on the abdominal sternites, possesses

a differing number of teeth on the prothoracic plate, and has one less sensillum trichodeum associated with the plate.

According to Pfaffenberger and Johnson (1976) the antenna of the first instar is identical to that of *Algarobius prosopis*, while the legs of the first instar are more like those of *Neltumius arizonensis*. When comparing other characteristics of the latter two species, the prothoracic plate of *B. atrolineatus* is most like that of *A. prosopis*. Despite the fact that the final instars of these species have not been described, there is sufficient evidence from first instars to indicate that *B. atrolineatus* would fit nicely within the *Sennius*, *Algarobius*, and *Acanthoscelides* complex shown in figure 44 of Pfaffenberger and Johnson (1976).

Among the final instar Bruchinae which have been described *B. atrolineatus* most closely resembles *Acanthoscelides obtectus* (figs. 43–46 in Pfaffenberger 1985b). The two species share similarities in their antenna, numbers and distribution of sensilla on the clypeolabrum, arrangement and spacing of epipharyngeal sensilla trichodea, general maxillary characteristics (e.g., number and arrangement of sensilla trichodea on lacinia, approximate numbers of stipial sensilla trichodea), and shape of mentum and distribution of sensilla associated with it.

Basic differences between these two species include, among others: Differences in clypeolabral sclerites, absence of a cardo, shape of submentum, and presence of two pairs of sensilla trichodea on the submentum. These differences, and the similarities indicated above, between final instars of *A. obtectus* and *B. atrolineatus* indicate a strong phylogenetic relationship. But sufficient primitive differences between them also indicate that final instars of *Neltumius*, *Sennius*, and *Algarobius* need to be examined before conclusions can be made regarding the phylogeny of *B. atrolineatus*.

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SCIENTIFIC NOTE

THE WILLARD HOLMES NUTTING, JR. COLLECTION
DONATED TO THE CALIFORNIA ACADEMY OF SCIENCES

The purpose of this note is to advise the community of coleopterists that the Willard H. Nutting, Jr. collection has been donated to and now is deposited in the entomological collection of the California Academy of Sciences.

A long time associate of the Academy, Bill Nutting was a mechanical engineer by profession and coleopterist by avocation. He died on April 19, 1990, at the age of 73, in Oakland, California. Two brief biographies have already appeared that describe his extraordinary life and accomplishments (Arnaud 1990; Dozier 1990). Bill's collection, along with his entomological library and his correspondence relating to his entomological activities, was given to the Academy by his son, Mr. Willard H. Nutting, III.

As received, the Nutting collection contains a total of 19,426 specimens, including 352 paratypes. North American specimens comprise about 60% of the material; the remainder is exotic. Almost 10,600 specimens are coccinellids, the group in which Bill was most interested and with which he chose to work. The collection also includes more than 3,200 scarabaeids and almost 1,500 buprestids, as well as representatives of many other coleopterous families. Specimens provided through this donation join the more than 6,500 specimens that Bill donated to the Academy during his lifetime, including nine holotypes and 156 paratypes of coccinellid species, the J. E. Blum collection (which itself contained the W. F. Leng collection of Mordellidae and Bruchidae), and assorted other materials.

Specimens from the Nutting collection have been integrated with the general holdings at the Academy, and each specimen received a label identifying it as part of the "Willard H. Nutting, Jr. Collection" before its incorporation. Materials from the Nutting library have also been incorporated into the Academy's entomological library, and the Nutting correspondence is now housed in the archives of the Academy.

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