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MORPHOLOGY AND BIOLOGY OF LARVAL  
*GIBBOBRUCHUS MIMUS* (SAY)  
(COLEOPTERA: BRUCHIDAE)

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ABSTRACT

First and final larval instars of *Gibbobruchus mimus* (Say) are described using illustrations and scanning electron micrographs. Characters described include habitus, antenna, clypeolabrum, epipharynx, mandible, maxilla, labium, prothoracic plate, spiracle, leg, anal aperture, and chaetotaxy. A brief description of the egg is provided, as is a discussion on larval biology. Included in the latter are probable co-evolutionary strategies employed by bruchid and host which directly affect survival of the first instar.

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Webster (1894), published one of the earliest accounts of *Gibbobruchus mimus* (Say) (as *Bruchus mimus*) being reared from seeds of *Cercis canadensis* L. Although cursory, Cushman (1911) subsequently published the first account of the biology of this species, which included the only discussion of parasites reared from this host. It wasn't until 1975, when Whitehead and Kingsolver published their work on the genus *Gibbobruchus*, that a more indepth account of the probable origin, biology, and geographical distribution of this species became available. Shortly thereafter, Center and Johnson (1976) reported additional information on this species from Arizona.

To date, nothing has been reported on the larval biology of a member of this genus. Therefore, the purpose of this paper is to provide the first description of a larva of this genus and to supply additional information on the behavior of *Gibbobruchus mimus*. Moreover, this is the first report of this species in New Mexico.

*Gibbobruchus mimus* (Say)

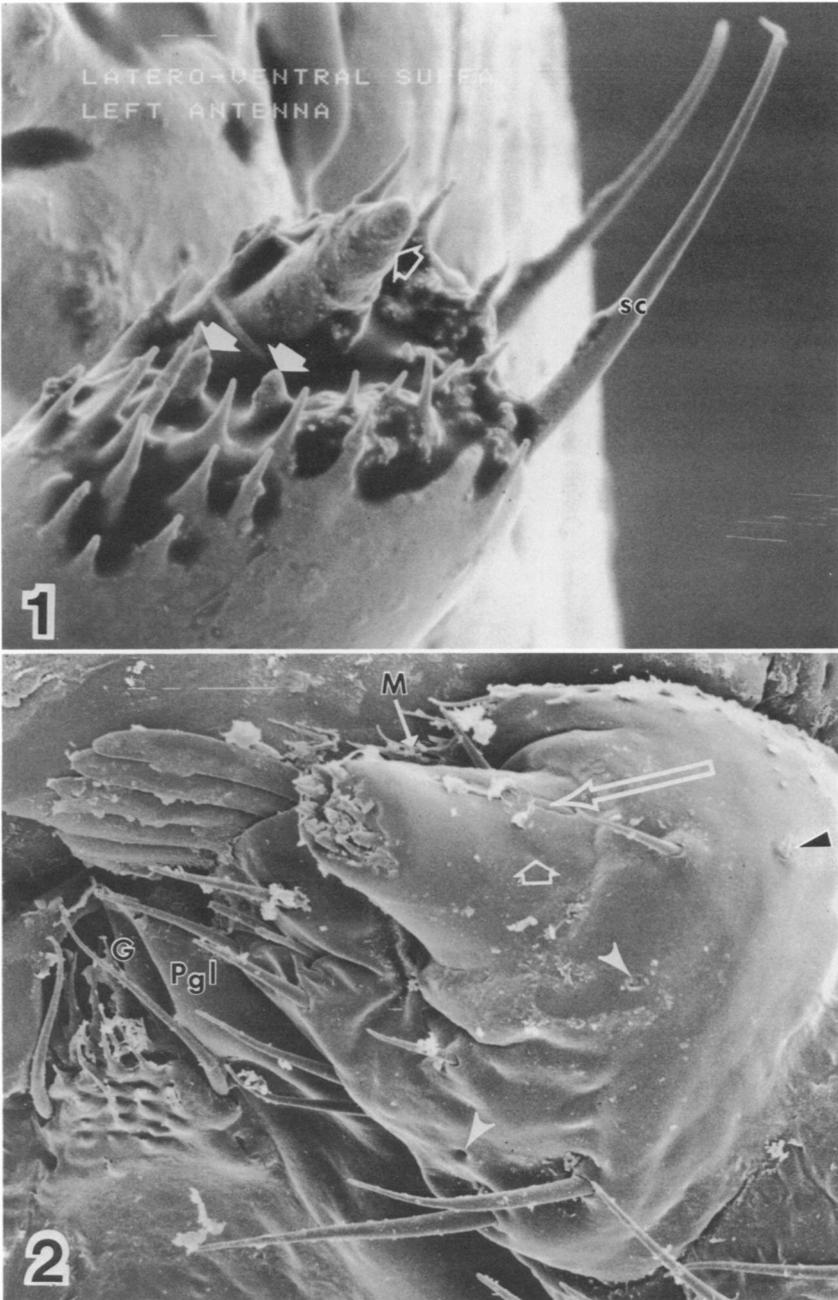
FINAL INSTAR (Figs. 1-8).

*Body*: 2.0 mm wide, 4.0-4.5 mm long; C-shaped, fleshy; greatest width at metathoracic and abdominal segments 1-4, tapering to minute button-like 10th abdominal segment (Pfaffenberger 1985); integument white, with yellowish-white pronotum, vestiture longest and most dense on sternites (similar to *Carbruchus buscki* Bridwell, Pfaffenberger 1974); distance between appendages of segment increasing with succeeding segments (Pfaffenberger 1985).

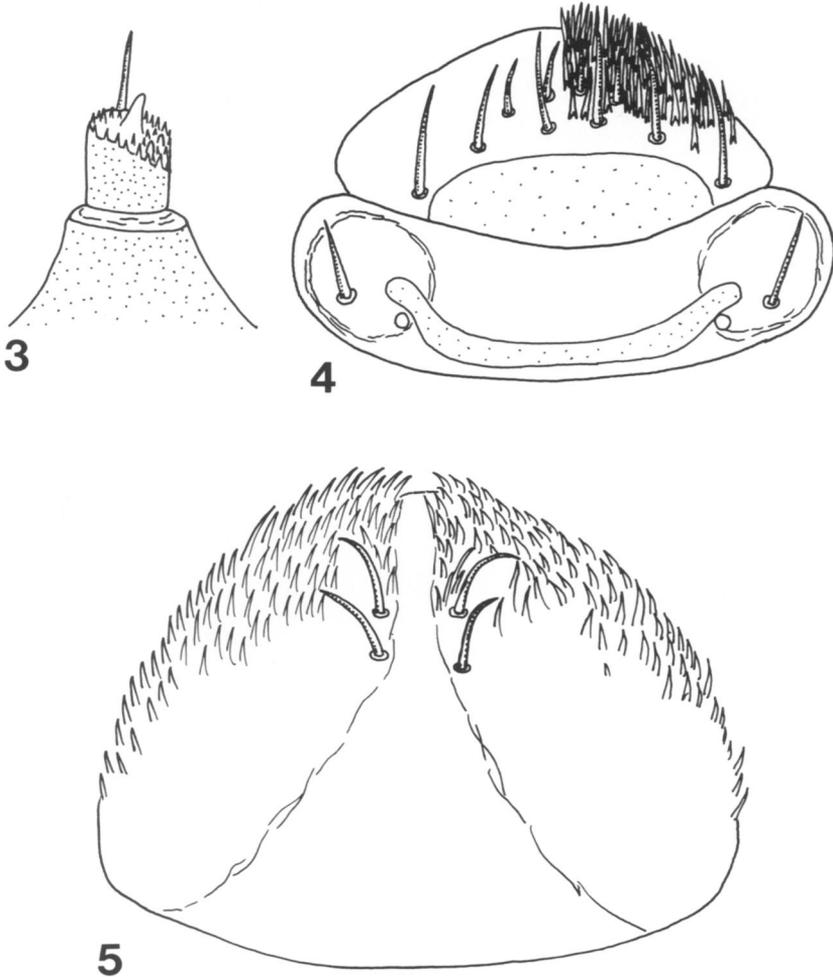
*Head* (Pfaffenberger 1977): Retractable, mostly asetiferous, triplicate of primary and 2 secondary sensilla trichodea in anterolateral margin of frons; lightly pigmented, mouthparts hypognathous-prognathous, deeply pigmented.

*Ocelli*: Absent.

*Antenna* (Figs. 1, 3): One-segmented, telescopic; sensillae include 1 enlarged s. basiconicum (hollow arrow, Fig. 1) subtended by 2 smaller s. basiconica (solid arrows, Fig. 1); elongate s. chaeticum (sc, Fig. 1) emerging from dorso-



Figs. 1, 2. *Gibbobruchus mimus*, final instar. 1, distal end of antenna showing *s. chaeticum* (sc), *s. basiconica* (arrows). 2, maxilla and part of labium showing microtrichia



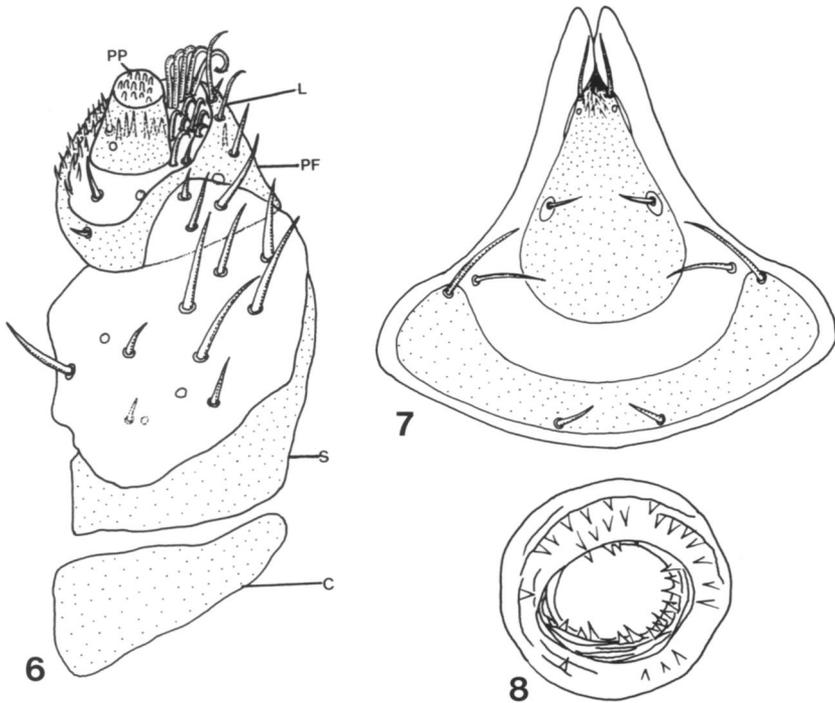
Figs. 3-5. *Gibbobruchus mimus*, final instar. 3, antenna. 4, clypeolabrum. 5, epipharynx.

medial surface, length equivalent to that of segment; numerous small microtrichia present on distal and lateral surfaces.

*Clypeolabrum* (Fig. 4): Labral portion with 10 pointed s. trichodea, 6 form arc across middle of plate, arc of remaining 4 centered and distal to latter arc, distal arc nearly concealed by dense mat of microtrichia; sclerite transversely oval and lightly pigmented; clypeal portion with lateral s. trichodeum and subtending s. ampullaceum (dart, Fig. 11), both sensilla situated on concentric, slightly domed areas; sclerite bow-shaped connecting domed areas with sensilla.

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(M), s. ampullacea (white darts and small, hollow arrow), s. trichodeum (black dart), s. placodeum (large arrow), glossae (G), and paraglossae (Pgl).



Figs. 6–8. *Gibbobruchus mimus*, final instar. 6, maxilla showing cardo (C), stipes (S), palpifer (PF), lacinia (L), and palpus (PP). 7, labium. 8, abdominal spiracle.

*Epipharynx* (Fig. 5): Epipharyngeal groove bordered laterally by oval area, area covered anterolaterally by mat of short microtrichia, each oval area with pair of pointed s. trichodea located anteromedially.

*Mandible*: Monocondylic; with awl-shaped cutting surface; pair of s. trichodea located medially on external surface (as in Fig. 12).

*Maxilla* (Figs. 2, 6): Cardo (c, Fig. 6) wedge shaped, weakly sclerotized; stipes (s, Fig. 6) with asetiferous sclerite; membranous stipes with 11–13 s. trichodea and 2 s. ampullacea; lacinial surface (L, Fig. 6) of palpifer (PF, Fig. 6) with numerous, short to elongate microtrichia (Fig. 2), sclerite of palpifer with 1 lateral (black dart, Fig. 2), 4 medioventral s. trichodea, 1 s. ampullaceum (lower white dart, Fig. 2) present ventrally; membrane of palpifer with 1 s. trichodeum, 1 s. ampullaceum located lateroventrally (upper white dart, Fig. 2), cluster of 8, sometimes decurved s. trichodea located medially near base of 5 spatulate setae (Fig. 2) (latter often appearing strongly decurved in slide mounts, Fig. 6); palpus with dorsal s. trichodeum, elongate s. placodeum (long arrow, Fig. 2) located dorsolaterally, lateral s. ampullaceum; terminal end with 13 s. basiconica.

*Labium* (Figs. 2, 7): Sclerite of submentum lightly sclerotized, canoe-shaped with mid-proximal bow, lateral end with elongate, pointed s. trichodeum, 1 pair of medial s. trichodea located along proximal border; 1 elongate s. trichodeum located laterad in membranous labium between submentum and mentum; mentum more deeply pigmented than submentum, pear-shaped with pair of mediolateral membranous islets each bearing decurved s. trichodeum,

distal end with pair of s. trichodea, each subtended by proximal s. ampullaceum and separated by cluster of microtrichia; prementum with paired glossae and paraglossae (G and Pgl, respectively; Fig. 2).

*Spiracle* (Fig. 8): Atrium lined with numerous, short rows of pointed, sclerotized projections.

*Leg:* Four-segmented, basal through penultimate segments tapering fleshy lobe, ultimate segment finger-like, subequal in length to penultimate segment; penultimate segment with pair of s. trichodea, 1 anterolateral, 1 posterolateral; thoracic sternal vestiture of numerous elongate, coiled s. trichodea.

*Anal aperature:* Transverse.

Specimens examined: 15.

FIRST INSTAR (Figs. 10–17; Table 1).

*Body* (cf. Pfaffenberger and Johnson 1976): 0.2–0.3 mm wide, 0.5 mm long; width greatest in mesothorax-third abdominal segments, remainder of abdomen rapidly tapering to minute 10th segment; integument white except for yellowish-brown prothoracic plate; head capsule yellowish-brown with deeply pigmented mouthparts.

*Ocelli:* Absent.

*Antenna* (Fig. 10): Single segmented, telescopic; distal end occupied by elongate s. chaeticum (sc, Fig. 10) arising from pillar-like base; enlarged s. basiconicum with smaller, subtending, peg-like (Pg, fig. 269 A; Snodgrass 1935) s. basiconicum (latter with articulating base).

*Clypeolabrum* (Fig. 11): Labral portion with distal arc of 4 and proximal arc of 6 s. trichodea; small microtrichia present or absent on proximolateral margins; clypeal portion with single lateral s. trichodeum, latter bordered medially by single s. ampullaceum (dart, Fig. 11).

*Mandible* (Fig. 12): Monocondylic; 2 s. trichodea on anterolateral surface.

*Maxilla* (Fig. 12): Cardo (C) present; stipes (S) with 2 s. trichodea; palpifer (PF) with 4 ventral s. trichodea, few microtrichia located between ventral border and palpus; palpus (PP) with 12 apical s. basiconica, elongate s. placodeum (PL) located laterally; lacinia (L) with distal spatulate-like setae, mandibular surface with numerous small microtrichia, 5 s. trichodea located near base of spatulate setae.

*Labium* (Fig. 13): Submentum with pair of lateral s. trichodea (one 4 × longer than other); mentum with small s. trichodeum located midlaterally; paraglossae (Pgl) well developed, numerous small microtrichia between paraglossae; glossae small.

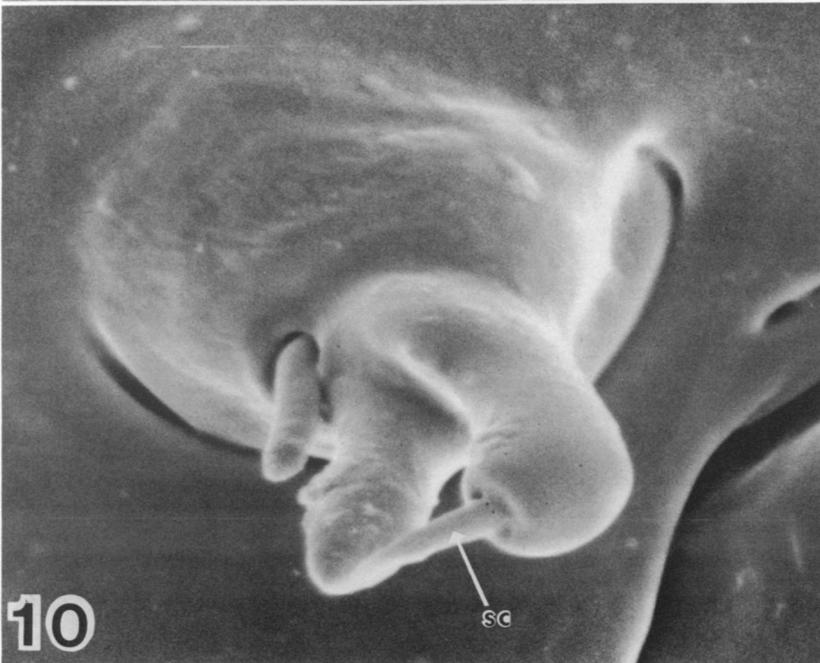
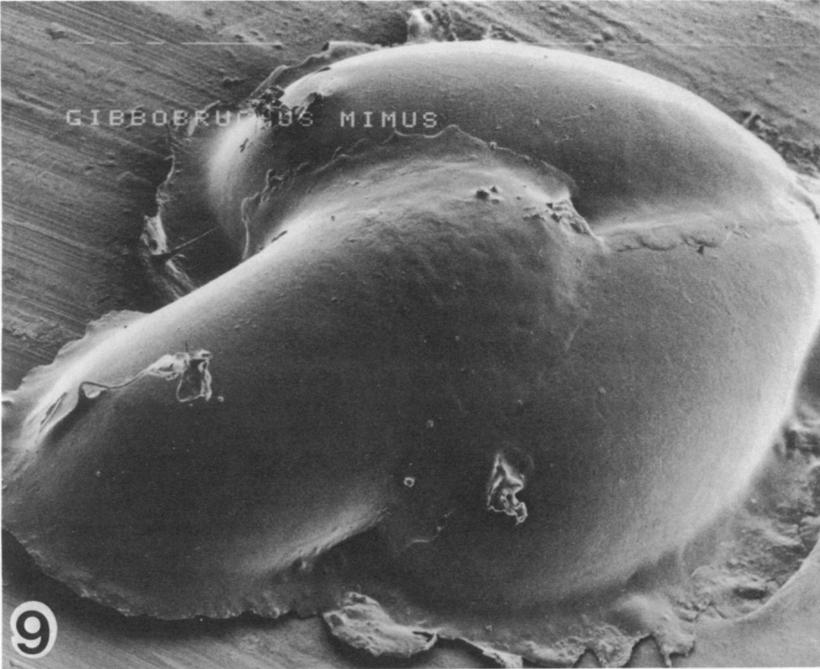
*Prothoracic plate* (Fig. 15): H-shaped; zygomorphic; teeth arranged in 3 + 0 + 5 (cf. 15 A in Prevett 1971); plate with 5 pairs of s. trichodea, pairs 1–2 and 4–5 half as long as 3rd pair, 5th pair subtended by median s. ampullaceum.

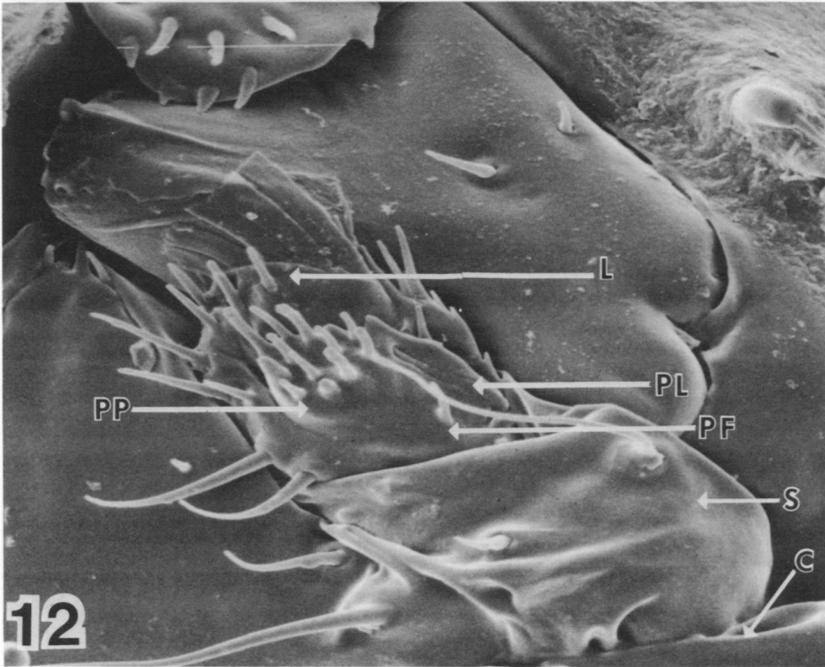
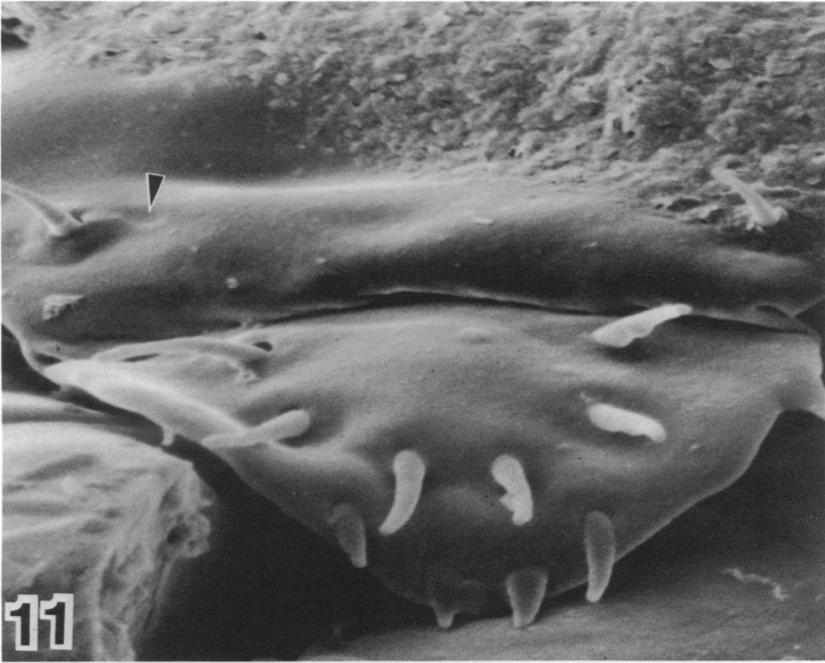
*Prothorax* (Figs. 14, 16; Table 1): With 13 pairs of s. trichodea (for numbers refer to Pfaffenberger and Johnson 1976) exclusive of those associated with plate; sternite with numerous, posteriorly directed, sclerotized projections.

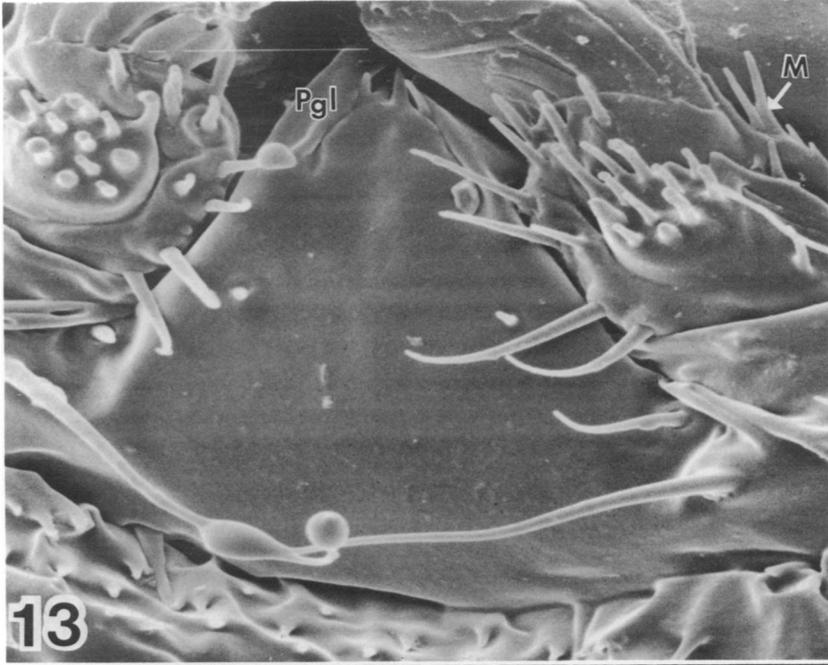
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Figs. 9–10. *Gibbobruchus mimus*. 9, egg cluster. 10, first instar antenna showing s. chaeticum (sc).

Figs. 11, 12. *Gibbobruchus mimus*, first instar. 11, clypeolabrum showing s. ampullaceum (black dart). 12, mandible, maxilla, and part of labium. Labelling on maxilla includes cardo (C), stipes (S), palpifer (PF), s. placodeum (PL), palpus (PP), and lacinia (L).







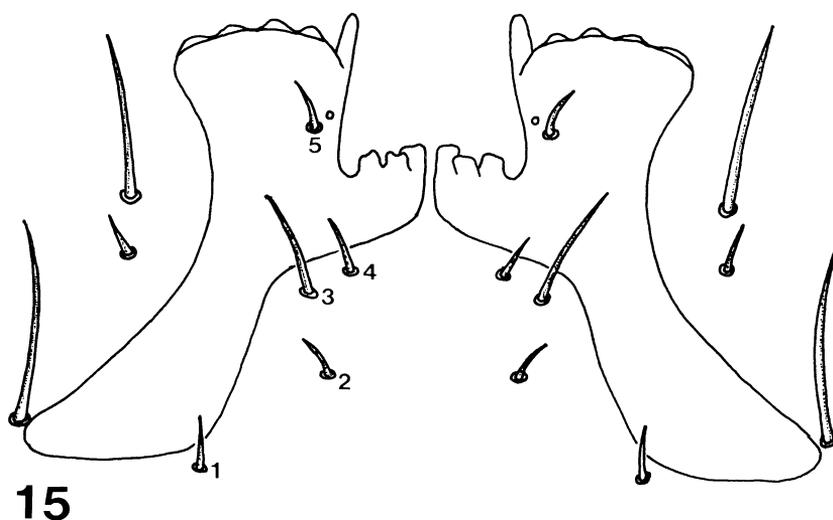


Fig. 15. *Gibbobruchus mimus*, first instar, prothoracic plate.

*Mesothorax and metathorax* (Figs. 14 and 16; Table 1): Prodorsum with primary (D) and 2 secondary (d'd'') s. trichodea; epipleuron with primary (E) and secondary (e') s. trichodea; sternites with posteriorly directed, sclerotized projections and pair of elongate s. trichodea (R).

*Leg* (Fig. 14): Two-segmented; basal segment with pair of short s. trichodea on distolateral surface; terminal segment with spoon-shaped distal end.

Table 1. Distribution of setae on *Gibbobruchus mimus*, first instar.

Segment	Pro-dorsum	Post-dorsum	Spiracular area	Epi-pleuron	Hypo-pleuron	Sternum	Pro-thorax
Mesothorax	Dd'd''			Ee'		R	2 14
Metathorax	Dd'd''			e'		R	3 15
Abdomen							5 16
1	d''		s'	E	h	u	6
2		A a''		e'ee	h		7
3-4		A a''		e'	h		8
5-7		A a''		Ee'	h	u	9
8		A a''		Ee'	h	u	10
9		A a''		Ee'	h	u	11
10 g*					h		12

\* Present on dorsolateral area of 10th segment.

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Figs. 13, 14. *Gibbobruchus mimus*, first instar. 13, labium [showing paraglossae (Pgl) and part of maxilla (showing microtrichia (M))]. 14, thoracic sternites showing appendages and chaetotaxy.

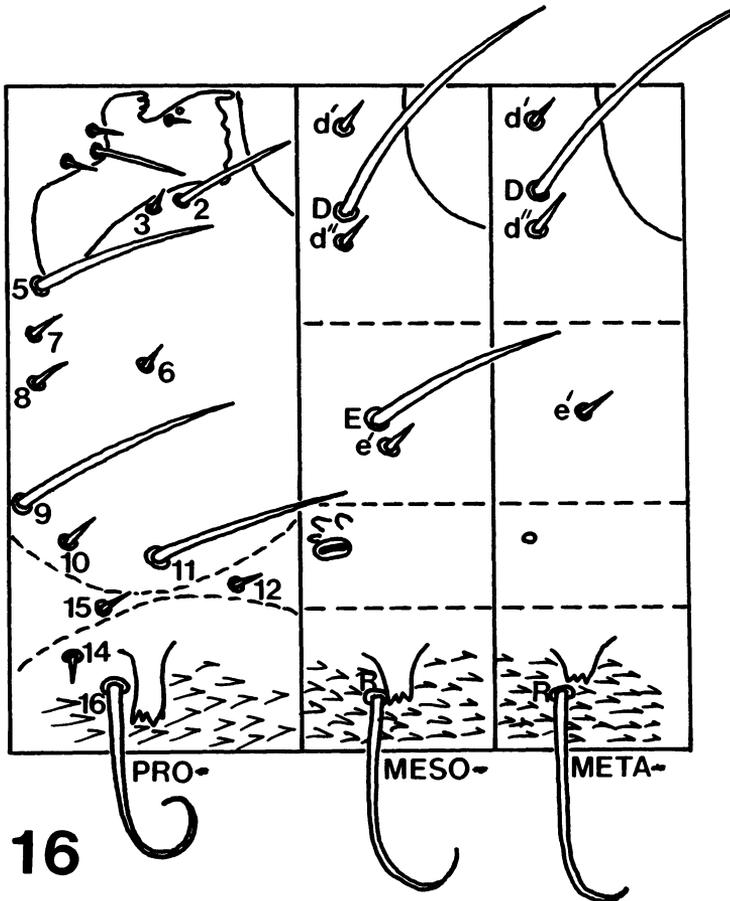


Fig. 16. *Gibbobruchus mimus*, first instar, thoracic setal map.

*Spiracle* (Fig. 40; Pfaffenberger and Janzen 1984): Slit-opening of atrium paralleling longitudinal axis of body.

*Abdomen* (Fig. 17; Table 1): First segment with primary s. trichodeum (E) on epipleuron, prodorsum (d''), spiracular area (s'), hypopleuron (h), and sternum (u) with secondary s. trichodeum, sternum with sclerotized, pointed projections (Fig. 14); second segment with primary s. trichodeum (A) on postdorsum, secondary s. trichodea present on postdorsum (a''), epipleuron (e'/ee), and hypopleuron (h), spiracular area with 2 small projections near atrium, sternum with sclerotized projections; segments 3-4 same as 2nd segment except epipleuron with single s. trichodeum; segments 5-7 with primary s. trichodeum on postdorsum (A) and epipleuron (E), single, secondary s. trichodea on postdorsum (a''), epipleuron (e'), hypopleuron (h), and sternum (u); segment 8 same as 5-7 except 2 sharp, sclerotized projections appear on hypopleuron; segment 9 same as segments 5-7 excepting fewer sclerotized projections present on sternum; segment 10 with 2 secondary (g, h) s. trichodea.

Specimens examined: 19.

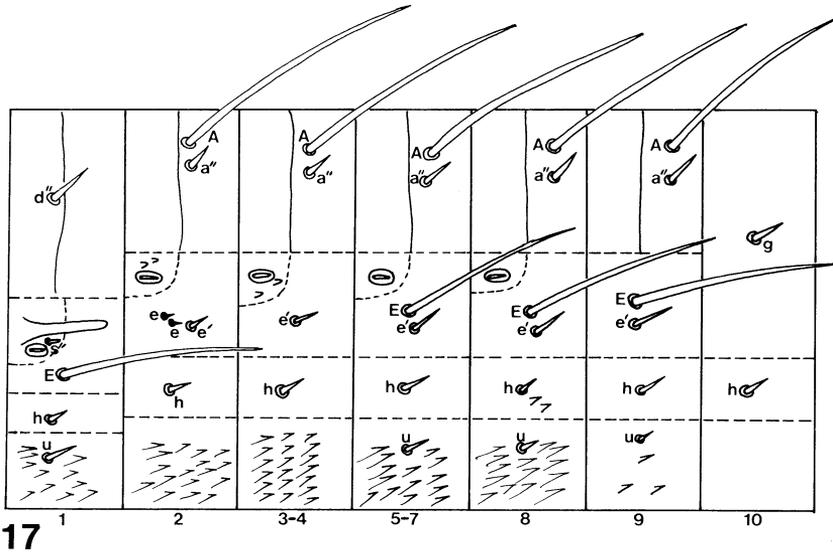


Fig. 17. *Gibbobruchus mimus*, first instar, abdominal setal map.

EGG (Fig. 9). Length 0.8 mm; width 0.5 mm; chorion transparent; oval base with greatest depth near anterior end; secured by broad band of musilage. Most frequently eggs appear singly or in clusters of three.

SIGNIFICANT CHARACTERS. *Final instar*: Ocelli absent; antenna with numerous, short microtrichia on distal end and comparative sizes of large vs. smaller s. basiconica; clypeolabrum with double arc of 6 and 4 s. trichodea; maxillary palp with s. placodeum and 13 terminal s. basiconica; clypeal sclerite bow-shaped; labial glossae and paraglossae well-developed; anal aperture transverse. *First instar*: Ocelli absent; antenna with small peg-like s. basiconicum, with articulating base; clypeolabrum with double arc of 6 and 4 s. trichodea; maxillary palp with 12 s. basiconica on tip; legs 2-segmented with spoon-shaped distal end; spiracular atrium with slit-like opening; 2nd abdominal epipleuron with 3 secondary s. trichodea; spiracular areas of abdominal segments 2-4 with 2 sclerotized projections; abdominal segment 10 bisetiferous. *Egg*: Oviposited singly or in clusters of three.

MATERIAL EXAMINED. 15 final instar and 19 first instar larvae. Collected from seeds of Redbud (*Cercis canadensis* L.), 23-III-82, Portales, Roosevelt Co., New Mexico. Determined by association with reared adults.

BIOLOGICAL NOTES. Contrary to reports by Cushman (1911), oviposition was seemingly restricted to green pods. Eggs, oviposited mostly individually or in clusters of three, were most frequently observed along the pod rib. Those eggs oviposited upon the broad surface of the pod appeared to be subject to significant negative selection pressure; most were covered by a thick layer of gummy fluid, which successfully suffocated the developing larvae. With others the pod surface immediately beneath the eggs turned a conspicuous brown. I suspect that parasitic wasps (Cushman 1911) may use these color changes as visual cues in locating their host's eggs. As an additional countermeasure by *G. mimus*, the eggs are oviposited in clusters and although no 'decoys' (Pfaf-

fenberger 1979) were observed, clustering of eggs seems to offer survival of a limited number of offspring through the 'grouping effect.'

Emergence nearly always occurred through the ventral surface of the egg. Advantages of this form of emergence were discussed by Pfaffenberger and Johnson (1976). On occasion a larva would emerge through the dorsal surface of the egg and would wander in search of a place to gain leverage. As I observed this behavior, I intentionally tried to dislodge the larva from the surface of the pod by shaking the pod or even tapping it lightly. In all instances, the larva remained attached. I subsequently appressed several objects against it and in all instances the larva successfully clung. From this I surmise the existence of a lifesaving sticky coat (possibly amniotic in origin) upon the surface of the first instar larva.

It appears as though one larva develops in each seed. The remainder of larval biology departs little from the generalities discussed by Pfaffenberger and Janzen (1984).

#### DISCUSSION

Inasmuch as this is the first description of a larva of this genus a discussion on its phylogenetic affinity with other members of the subfamily Bruchinae is in order. Its placement in this subfamily, as determined by adult characters, appears to be well founded when characters of the first and final instars are compared to other known larval forms.

The presence of two-segmented legs and absence of median teeth or arms on the prothoracic plate of the first instar, as well as the presence of two pairs of s. trichodea bordering the epipharyngeal groove and a tapering four-segmented fleshy leg on the final instar are sufficient to confirm its placement in the subfamily Bruchinae. The presence of a transverse anal aperture and high probability of ventral emergence from egg also lend support to its subfamilial placement.

Since no other larvae of this genus have been described, it is not possible to delineate a larval generic character cluster. Whether or not the following characters are of generic or specific significance awaits additional larval descriptions within this genus. However, *G. mimus* is easily differentiated by the presence of a peg-like s. basiconicum, with articulating base, on the first instar antenna, the presence of well-developed glossae and paraglossae on both instars, the presence of three secondary s. trichodea on the second abdominal epipleuron, and a bow-shaped clypeal sclerite on the final instar. Finally, according to my host plant records *G. mimus* and *Caryedon serratus* (Ol.) are the only bruchid species to feed on the seeds of *Cercis* spp. This being the case it should not be difficult to distinguish larvae described herein from the vastly different instars of *C. serratus* (Prevett 1967). Therefore, the host plant offers an additional criterion for distinction.

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