

IMMATURE STAGES OF *NEMAPALPUS NEARCTICUS*
(DIPTERA: PSYCHODIDAE)

FARIDA MAHMOOD¹ AND J. BRUCE ALEXANDER²

¹11500 Summit West Boulevard, 45 D

Temple Terrace, FL 33617 USA

²Fundacion Centro Internacionale de Entrenamiento

e Investigaciones Medicas

Apartado Aereo 5390

Cali - Columbia

ABSTRACT

The external morphology and biology of the immature stages of *Nemapalpus nearcticus*, a Psychodid fly from Florida, USA, are described for the first time. Morphological similarities and differences from its near relatives are also discussed.

RESUMEN

La morfología externa de los estados inmaduros de *Nemapalpus nearcticus* y su biología se describen inicialmente. También son descritas y comparadas las diferencias y similitudes morfológicas de estas especies y otras relacionadas.

Nemapalpus nearcticus Young is the only known Nearctic representative of Bruchomyiinae, a subfamily thought to contain the most primitive members of the Psychodidae. This species was originally collected at Sugarfoot Hammock, a small forest 7 km SW of Gainesville, Florida (Young 1974) and has been recorded only from the type locality and from Gulf Hammock in Levy County, Florida.

The genus *Nemapalpus* shows a disjunct geographical distribution, probably indicative of its antiquity (Fairchild 1952). To date a total of 26 species have been described (Alexander 1987). No published descriptions exist of the immature stages of *Nemapalpus* species other than that of Hanson (1968) who illustrated the first and fourth instars of an unnamed member of the genus in his treatise on immature Panamanian Psychodidae. Satchell (1953) described the early stages of *Bruchomyia argentina* Alexander, a species morphologically comparable to *Nemapalpus* and belonging to the same subfamily.

Little is known about the biology of the adults or immature stages of *Nemapalpus* species, although they often occur in the same habitats as their phlebotomine sand fly relatives. Unlike sand flies, the females are not hematophagous and it is unclear whether either sex feeds in the adult stage.

In this paper we describe the immature stages of *Nemapalpus nearcticus* for the first time and compare it with other closely related species.

MATERIALS AND METHODS

Specimens were collected from the bases of tree trunks during daylight in Gulf Hammock, Levy County, Florida in June 1986. Adult females were introduced into 120 ml plaster-lined plastic containers (Endris et al. 1982); the plaster bases of which had been moistened with water prior to use. Drops of Karo[®] syrup placed on the gauze lids of the containers provided a carbohydrate source.

Females were allowed to oviposit, after which several eggs were removed for descriptive purposes. The remaining eggs were allowed to develop and when the larvae hatched, they were provided with rearing diet consisting of an aged 1:1 mixture of dried rabbit feces and Purina rabbit chow complete diet 5315^R (Young et al. 1981).

Before examination larvae were killed and boiled in a 10% NaOH solution for 5 minutes, then transferred to liquid phenol in depression microslides for study.

DESCRIPTION OF IMMATURE STAGES

THE EGG

The egg of *Nemapalpus nearcticus* is oval and measures 0.57 mm by 0.24 mm (mean of 4 eggs). The chorion is yellowish and does not darken with age, unlike that of sand fly eggs. It is covered with irregularly-shaped protuberances arranged in ridges (Fig. 1). These may act as a plastron, allowing oxygen exchange across the egg surface and the moist habitat in which they are presumably laid in nature. The larva emerges through a slit made at one end of the chorion that extends for about two-fifth of its length.

THE LARVA

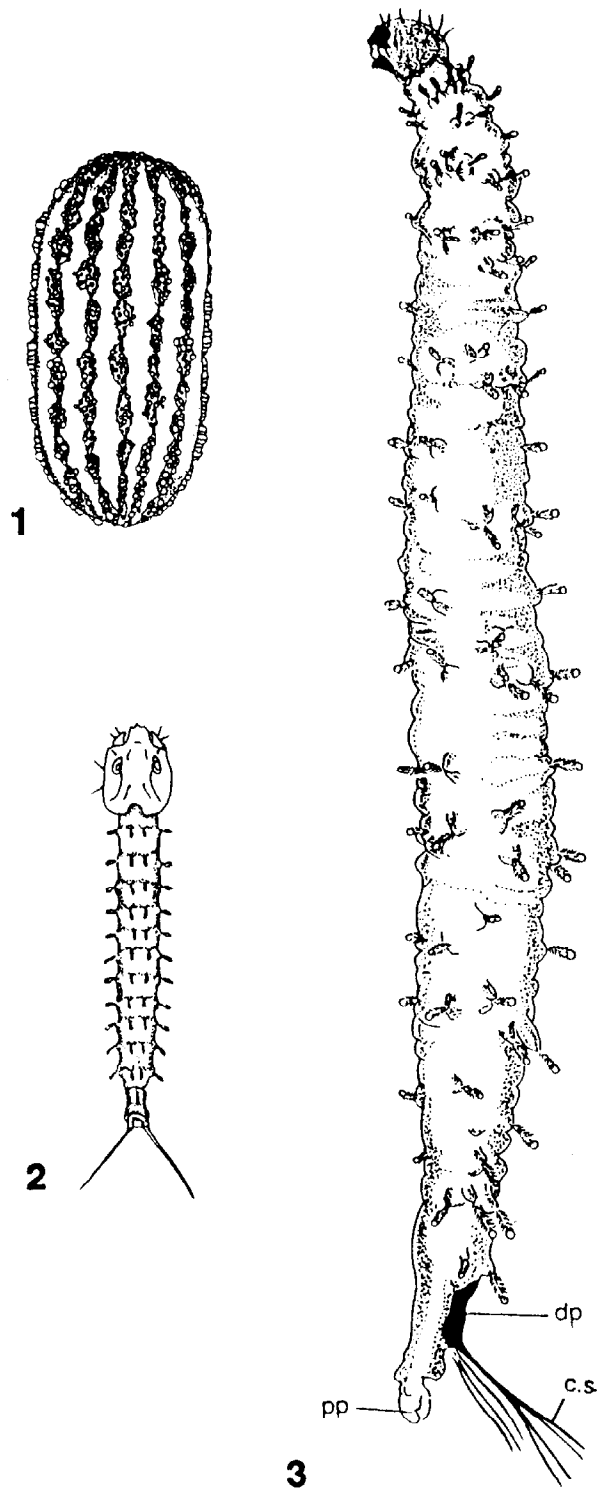
There are 4 larval instars, of which the first and fourth instars are illustrated (Fig. 2 & 3). Total length of the single first instar larva examined was 1.93 mm, excluding the simple paired caudal setae which measured 0.31 mm. The pale brown head capsule was approximately 0.25 mm long by 0.25 mm wide. The whitish thorax and abdomen were markedly narrower.

The mature larva is 7.20 mm long, excluding the paired caudal setae, which measure 0.65 mm (Fig. 3). The well-developed, sclerotized head capsule is dark brown and measures approximately 0.55 mm by 0.45 mm. The pinkish-brown body consists of a 3-segmented thorax and a 9-segmented abdomen. The latter bears a dark brown sclerotized peritreme on the eighth segment.

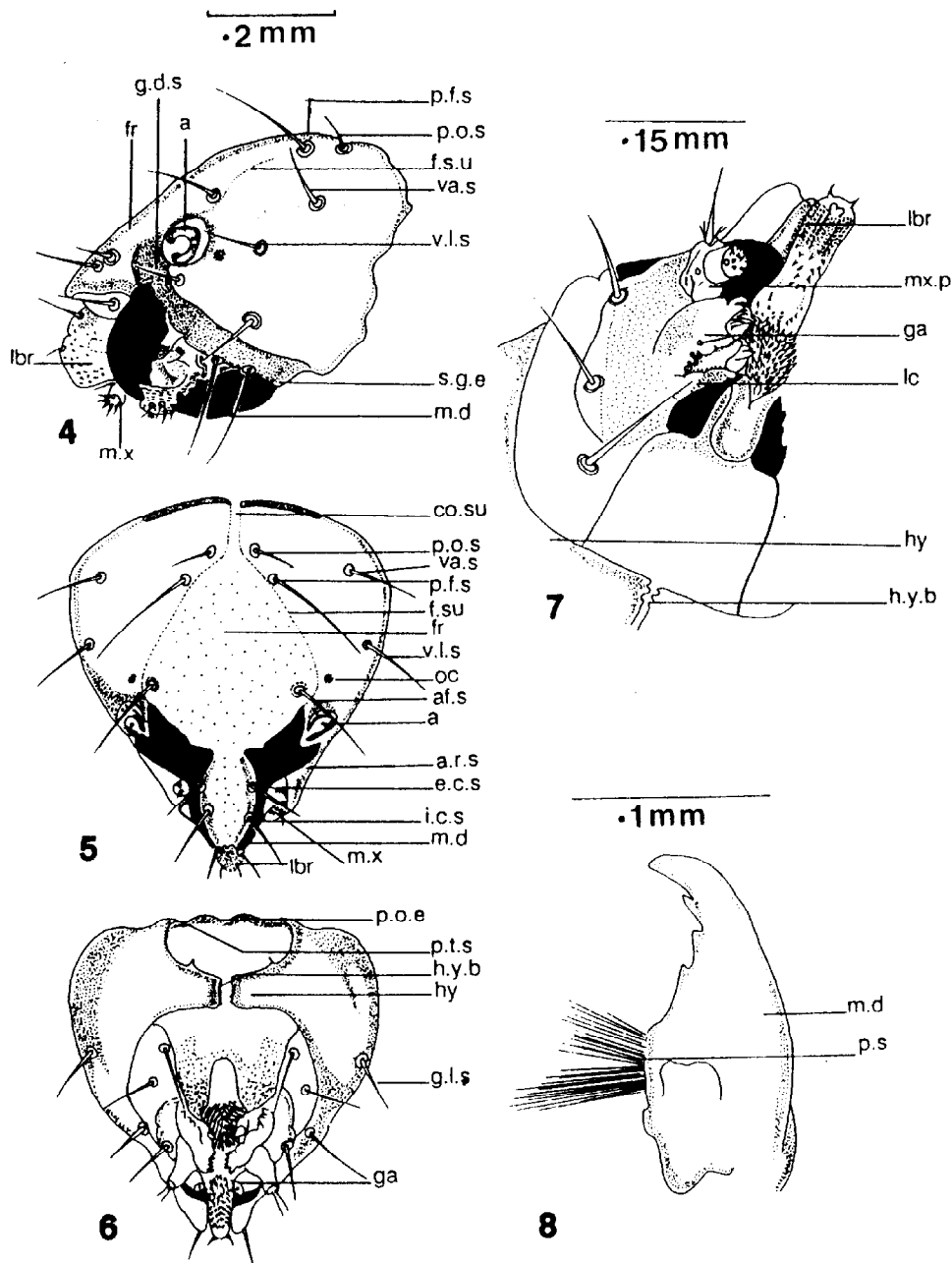
The head is eucephalous, hypognathous, with a short coronal suture (co.su) and an indistinct frontal suture (f.su) enclosing a contiguous frons (fr) and clypeus (Fig. 4 & 5). On the ventral side of the frons, lateral parietals form a narrow hypostomal bridge (h.y.b) which is split in its center (Figs. 6 & 7). The foramen magnum is bounded by a heavily-sclerotized post-occipital edge (p.o.e), which also shows posterior tentorial scar (p.t.s) (Fig. 6). The subgenal edge (s.g.e) is also heavily sclerotized and bounds the preoral cavity; its two ends meet posteriorly and form the hypostoma (hy) (Figs. 4 & 6). The short, club-shaped, unsegmented antennae (a) project from the posterior end of the antennal rings. Each bears 4 small, vertically projecting sensilla (Figs. 4 & 5). A very small ocellus (oc) is located behind each of the antennae (Fig. 5).

There is no demarcation between frons (fr) and clypeus. The clypeus bears a pair of external clypeal setae (e.c.s) and a pair of internal clypeal setae (i.c.s) that are present in front and internal to the former (Fig. 5). Whereas, anterior frontal setae (af.s), post-frontal setae (p.f.s), post-occipital setae (p.o.s), and ventro-lateral setae are visible in both lateral and dorsal views (Figs. 4 & 5).

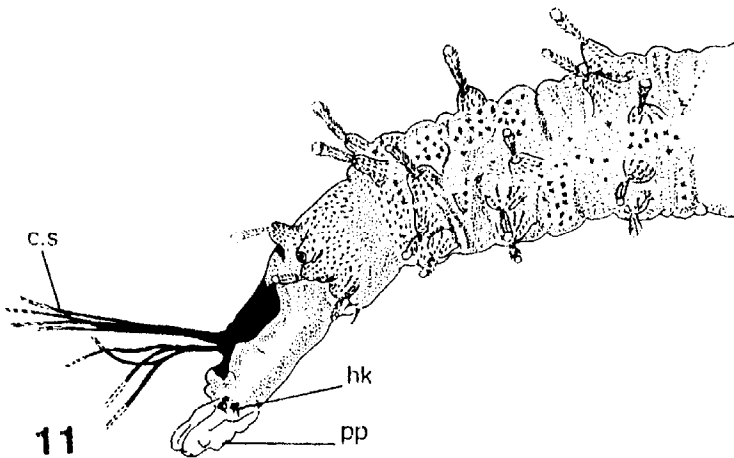
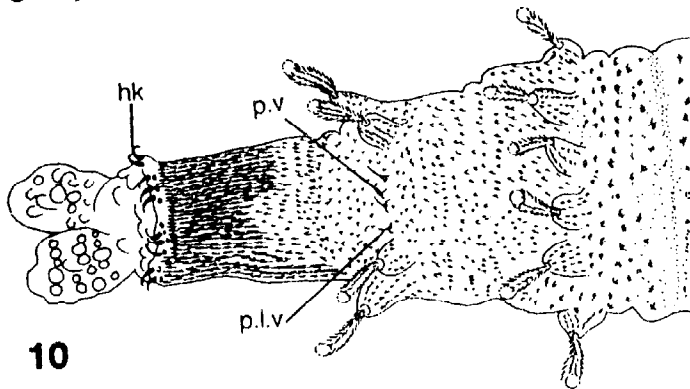
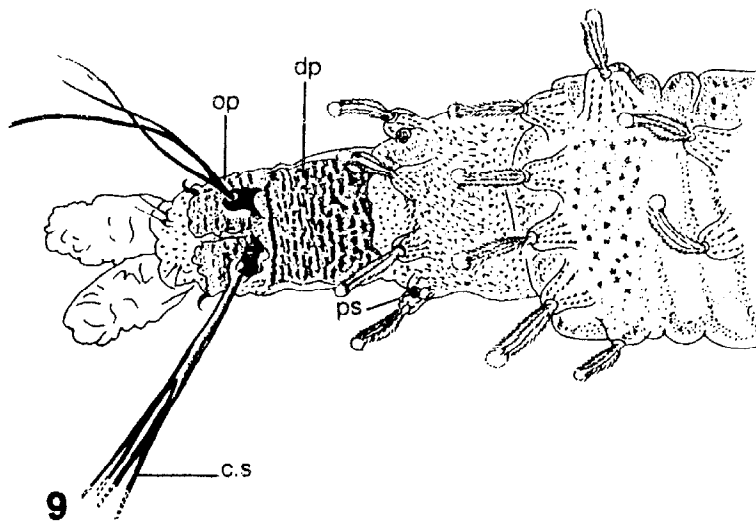
The transparent labrum (lbr) has several setae on its dorsal and ventral sides and overhangs the preoral cavity (Figs. 4, 5 & 7). A large toothed plate can be seen underneath, which Satchell (1953) considered to be part of the hypostome in *Bruchomyia*. The mandible (m.d) is sclerotized and bears 4 stout apical teeth and a prosthema (Fig. 8). There is also a penicillus (p.s) and a pair of ventral setae. The penicilli of the two mandibles project inwardly and touch each other (Fig. 6). The maxilla (m.x) is a flattened plate at the side of the preoral cavity. It bears a short 1-segmented maxillary palpus (mx.p), galea (ga), and a lacinia (lc) with 5 small sensory rods at its apex, unfused with



Figs. 1-3. Immature stages of *Nemapalpus nearcticus*: 1, Egg of *Nemapalpus nearcticus*; 2, Dorsal view of the first instar larva; 3, Lateral view of the fourth instar larva.



Figs. 4-8. Different parts of the head of *Nemopalpus nearcticus*: 4, Lateral view of the head; 5, Dorsal view of the head; 6, Ventral view of the head; 7, Part of the ventral view of the head showing the different parts of the maxilla; 8, An enlarged view of the mandible.



Figs. 9-11. Enlarged view of the caudal segment of *Nemopalpus nearcticus*: 9, Dorsal view; 10, Ventral view; 11, Lateral view.

the reduced galea (ga) (Fig. 7). The labium is reduced to a cushion-shaped hairy lobe above the hypostome.

The thoracic segments each have two annuli, with the anterior spiracles (sp) on the posterior annulus of the prothorax. There are no legs or prolegs present on the thorax.

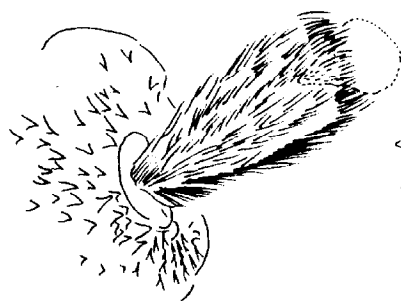
The abdomen has 8 segments and a cylindrical caudal region. Each of the first 7 abdominal segments has three annuli (Figs. 3, 14 & 15). The eighth segment bears a posterior spiracle (ps) on a tubercle which is surrounded by a dark peritreme (Fig. 9). The anus lies terminally on the elongated caudal region, from which a pair of delicate retractable pseudopods (pp) protrude (Figs. 3, 9, 10 & 11). These pseudopods have ventral unsclerotized swellings (Fig. 10) and a sclerotized, brown dorsal plate (dp) with minute posteriorly directed spines (Fig. 9). The dorsal plate is bifurcated posteriorly and carries two vertical processes which themselves each divide to form paired caudal setae (c.s) (Figs. 9 & 11). These setae are dark brown proximally shading to light brown and finally to white at their tips. Two slightly sclerotized oval plates (op), that are devoid of spines, are present behind the setae bearing processes (Fig. 9). Numerous ventrally directed microspines are present on the ventral surface of the caudal region (Fig. 10). The base of each pseudopod bears five ventrally directed hooks (hk) (Figs. 10 & 11). The surface of the larval body is covered by two types of microspines, one type occurring singly and the other in groups (Figs. 2, 3, 12 & 13).

The nomenclature used here for chaetotaxy of the setae follows that of Satchell (1953). Both simple and brush-like setae are present on larvae of *Nemapalpus nearcticus* (Figs. 2, 3 & 9-15). Each brush-like seta consists of a hollow cylinder covered with imbricated scales, mounted on a distinct plaque. Each seta has a spherical ampulla at its top (Fig. 12).

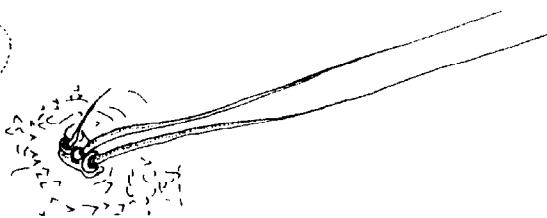
The chaetotaxy of the prothorax differs from that of the remaining thoracic and abdominal segments. The dorsum of the anterior annulus of the prothorax bears a total of five pairs of brush-like setae, consisting of anterior internal dorsals (a.i.d), anterior median dorsals (a.m.d), anterior lateral dorsals (a.l.d), anterior external dorsals (a.e.d) and accessory dorsals (ac.d) (Fig. 14). The posterior annulus of the prothorax bears three pairs of brush-like setae on its dorsum consisting of posterior internal dorsals (p.i.d), posterior external dorsals (p.e.d) and posterior lateral dorsals (p.l.d) (Fig. 14). Two pairs of simple setae are present on the ventral surface of the anterior prothoracic annulus, together with a pair of accessory ventrals (ac.v) and a pair of anterior internal ventrals (a.i.v) (Fig. 15). In the middle of the posterior annulus are situated a pair of posterior internal ventrals (p.i.v), median ventrals (mv) and external ventrals (ev) as well as a group of pedichaetan setae (pd) (Fig. 15). The posterior internal ventrals (p.i.v) and pedichaetae (pd) are simple setae, the latter consisting of three separate setae of different lengths, each with its own separate base. The bases of these setae are clustered in a small group (Fig. 15). On the sides of the posterior annulus of the prothorax, paired posterior lateral ventrals (p.l.v) and anterior lateral ventrals (a.l.v) setae are present (Figs. 14 & 15).

The chaetotaxy of the mesothoracic and metathoracic segments is similar. The anterior annuli have paired accessory dorsals (ac.d) and anterior lateral dorsals (a.l.d) (Fig. 14). The posterior annulus of each segment bears brush-like posterior internal dorsals (p.i.d) and posterior lateral dorsals (p.l.d) setae (Fig. 14). The ventral surface of the meso- and meta-thorax each have a pair of pedichaetae (pd), as well as paired external ventrals (ev), median ventrals (mv), anterior internal ventrals (a.i.v) and anterior lateral ventrals (a.l.v) (Fig. 15).

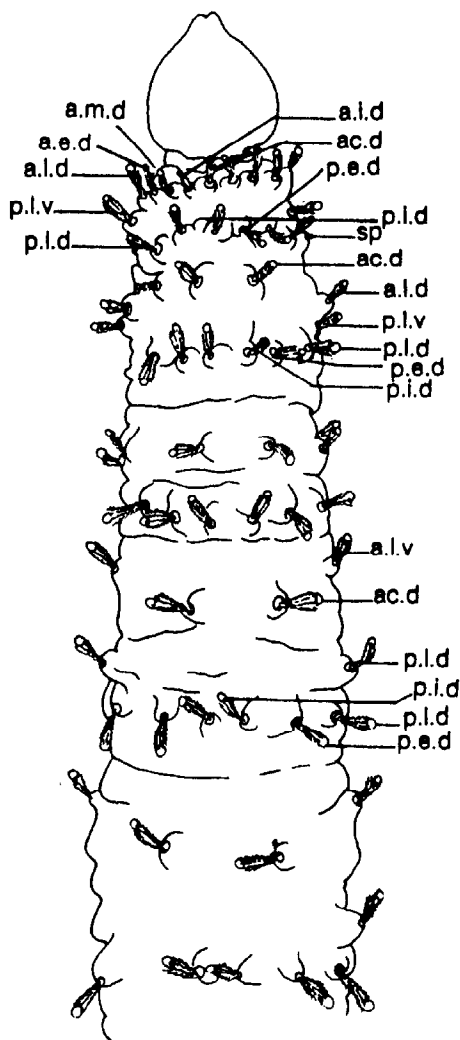
Abdominal segments 1-7 have identical chaetotaxy. The anterior annulus of each segment bears a pair of accessory dorsal setae (ac.d); the middle annulus has paired posterior lateral dorsals (p.l.d) and the posterior annulus has paired external dorsals (p.e.d) (Fig. 14). The ventral surface of anterior annuli has anterior lateral ventrals



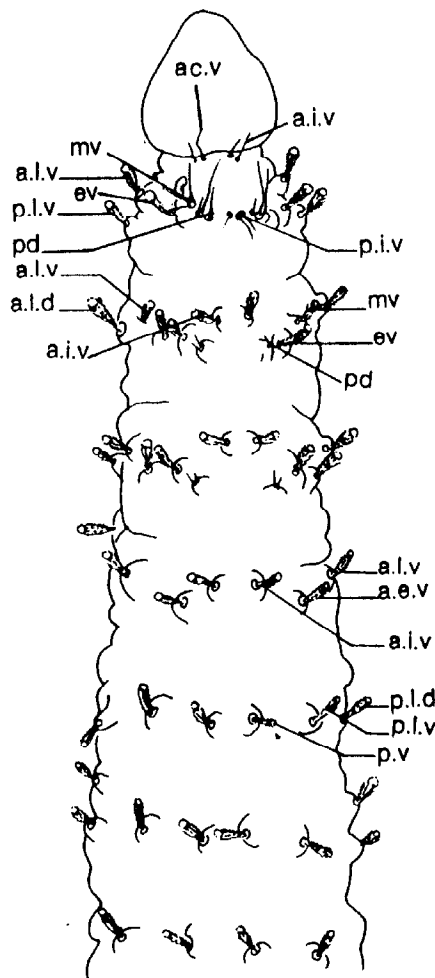
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14



15

Figs. 12-15. Chaetotaxy of thoracic and abdominal segments of *Nemapalpus nearcticus*: 12, Brush like seta; 13, Spine like setae; 14, Dorsal view of the thoracic and abdominal segments; 15, Ventral view of the thoracic and abdominal segments.

(a.l.v) and the posterior annuli has posterior ventrals (p.v) and posterior lateral ventrals (p.l.v) (Fig. 15). All the setae on abdominal segments 1-7 are brush-like (Figs. 3, 14 & 15).

The eighth abdominal segment differs from the others in having setae only on the posterior annulus. Both the posterior ventrals (p.v) and posterior lateral ventrals (p.l.v) of this segment are simple setae (Fig. 10).

THE PUPAE

The pupae is exarate and adectious. The presumptive antennae, mouth parts, thoracic legs, and wings can be seen clearly as well as the paired pseudopods on the underside of the eighth segment. The pupal abdomen terminates in a pair of stout pointed processes.

DISCUSSION

The number of eggs produced by females of *Nemopalpus nearcticus* is apparently less than that laid by *Bruchomyia argentina* or the phlebotomine sand flies. Eleven laboratory-reared females laid between 6 and 24 eggs (average 14.36). The larva of *Nemopalpus nearcticus* closely resembles Hanson's (1968) description of the unnamed Panamanian species. Hanson reported that this species had 4 caudal setae, although these were so closely appressed at the base that they seemed to arise from a single seta. It may be that in this species there is a single seta which is quadrifurcate distally.

The larva of *Nemopalpus nearcticus* appears to resemble that of *Bruchomyia argentina* in most respects. Differences include the presence of simple accessory ventrals on the ventral surface of the prothorax of *N. nearcticus*, absent in *B. argentina*. The anterior and posterior internal ventrals are simple in *N. nearcticus* but branched in *B. argentina*. The ventrally directed sensillum present on the antennae of *N. nearcticus* is absent in *B. argentina*. Finally, Satchell (1953) recorded the presence of 3 small sensory setae at the bases of the cylindrical processes on the caudal dorsum of *B. argentina*, absent in *N. nearcticus* which however, possesses nodules at the base of the pseudopods of the caudal region, not found in the former species.

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