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THE PUPAL STAGE OF *CULICOIDES FURENSOIDES* WILLIAMS (DIPTERA: CERATOPOGONIDAE); A FIRST DESCRIPTION

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ABSTRACT. The pupal stage of *Culicoides furensoides* Williams is described from a single specimen collected at the Malloryville Bog, Tompkins County, New York. The affinities of the pupal stage of this species with other species of the *furens* group in which it is placed are discussed.

Adult *C. furensoides* were first recovered by Williams (1955) with an emergence cage placed over a *Sphagnum* mat at the edge of a pond at Bryant's Bog, Cheboygan County, Michigan, July 22, 1954. The first New York State record is credited to W. W. Wirth who collected a male of this species at Braddock Bay, Monroe County, New York, June 12, 1963.

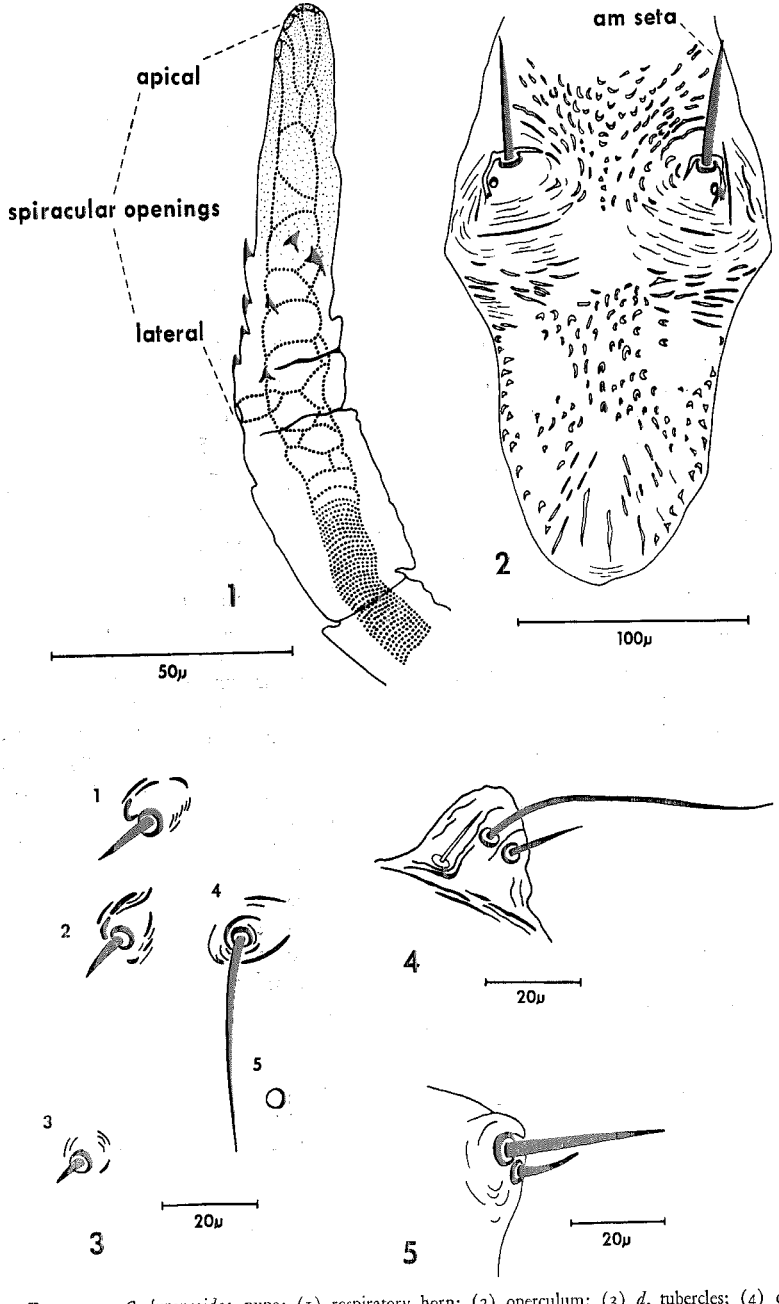
During the period of July 8, 1970, to July 23, 1970, the author collected 18 females using a light trap placed at the Malloryville Bog, Tompkins County, New York. The following summer one pupa was isolated from the *Sphagnum* mat at this bog. This paper provides the first description of the pupal stage of *C. furensoides.*

MATERIALS AND METHODS

On July 21, 1971, a sample of *Sphagnum* taken at the Malloryville Bog yielded one *C. furensoides* pupa after being washed, using a set of three nested brass gauze sieves, 10, 40, and 80 mesh, and then being subjected to magnesium sulphate flotation (Kettle and Lawson, 1962). The specimen was transferred to moist absorbent cotton in a clear plastic box measuring 2 cm. x 2 cm. x 1½ cm. for rearing. The adult, a female, emerged July 22, 1971.

The adult and pupal exuvia were mounted on the same slide under separate coverslips. The specimens were first cleared in a saturated solution of phenol in absolute alcohol, passed through a graded series of phenol-balsam, and then mounted in pure, paper-filtered, Canada balsam. The respiratory horns and operculum were dissected from the intact pupal pelt for close examination.

A 10 x 10-square grid micrometer disc was used to make the drawings. Terminology for the body tubercles is that of Carter *et al.* (1920), with the exception of the dorsomedian (*d.m.*) tubercle which was first used taxonomically by Lawson (1951). Many of the body tubercles, including the *d., v.m.,* and *v.l., d.a.s.m., d.p.m.,* and *v.p.m.* tubercles, were drawn in correct relationship to one another.



FIGS. 1–5.—*C. furensoides*, pupa: (1) respiratory horn; (2) operculum; (3) *d.* tubercles; (4) d.l. tubercle; (5) *a.d.* tubercle.

Measurements given for the associated setae are averages for corresponding pairs of setae.

THE PUPA

PIGMENTATION. In balsam, the abdomen and posterior half of the cephalothorax a pale yellow brown, the anterior half of the cephalothorax a dark brown.

LENGTH. In 70 percent alcohol, 1.1 mm.

RESPIRATORY HORN (fig. 1). In balsam, with apical third a slightly darker brown; a few well-defined darkened teeth on central third; two weak convolutions close to lateral spiracular opening; tracheal taenidial rings extending into basal one-fifth of horn; one lateral and four apical spiracular openings; tapered distally; average length 119 μ and average maximum width 28 μ; L/W ratio 4.2.

OPERCULUM (fig. 2). In balsam, a uniform light brown; *a.m.* tubercles prominent; associated setae stout, 45 μ; a small pore on each tubercle; teeth in distinct pattern, the most prominent and most pointed teeth on the disc along the lateral margins, teeth in central portion and posterior to the tubercles more rounded than sharp; maximum width 139 μ.

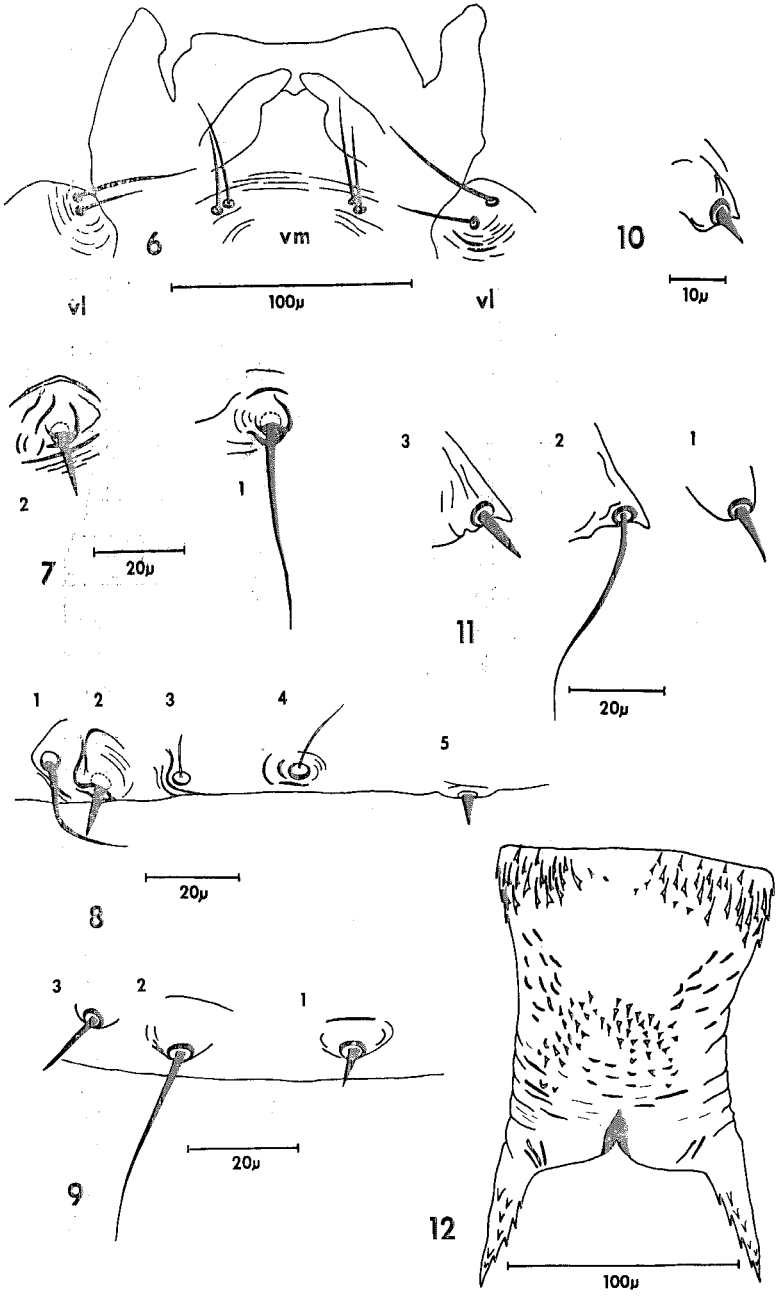
CEPHALOTHORACIC CHAETOTAXY. *d.* tubercles 1, 2, and 4 prominent; tubercles 3 and 5 inconspicuous (fig. 3); tubercles 1, 2, and 3 in a straight line with distance of separation between associated setal bases 18 and 39 μ respectively; setal bases of tubercles 4 and 5 separated by 27 μ; seta 1 stout, 12 μ; seta 2 stout, 10 μ; seta 3 very short, 4 μ; seta 4 filamentous, 41 μ; seta 5 represented only as setal base; thoracic surface between and immediately adjacent to *d.* tubercles smooth. *d.l.* tubercle (fig. 4) very prominent; 3 associated setae measuring 10, 12, and 50 μ; short seta originating at base of a cleft in the tubercle and difficult to see (Jamnback, 1965). *a.d.* tubercle (fig. 5) prominent; two associated setae, one stout and 38 μ long, the other 12 μ. *d.m.* tubercle inconspicuous, only the setal base apparent. *v.l.* tubercles (fig. 6) inconspicuous, each with 2 associated filamentous setae measuring 30 and 50 μ; *v.m.* tubercles (fig. 6) inconspicuous, each with two long filamentous setae measuring 31 and 37 μ.

ABDOMINAL CHAETOTAXY (Drawings from segment 4). Each abdominal segment, exclusive of the caudal segment, covered with a band of very minute teeth on the anterior margin; teeth absent elsewhere on the segments. *d.a.s.m.* tubercles (fig. 7) prominent, each with a single seta; seta 1 filamentous, 37 μ; seta 2 stout, 13 μ. *d.p.m.* tubercles 1 and 2 prominent; tubercles 3, 4, and 5 reduced (fig. 8); seta 1 filamentous, 24 μ; seta 2 stout, 10 μ; seta 3 and 4 hyaline and difficult to see, very slender and measuring 7 and 15 μ respectively; seta 5 short, 4 μ. *v.p.m.* tubercles (fig. 9) prominent; seta 1 stout, 7 μ; seta 2 filamentous, 35 μ; seta 3 stout, 12 μ. *l.a.s.m.* tubercle (fig. 10) very prominent and pointed at tip; associated seta stout, 7 μ. *l.p.m.* tubercles (fig. 11) very prominent; tubercle 1 rounded, tubercles 2 and 3 sharply pointed; seta 1 stout, 9 μ; seta 2 filamentous, 39 μ; seta 3 stout, 10 μ.

CAUDAL SEGMENT (fig. 12). Teeth on the dorsal surface confined to three distinct areas, a patch on either side at the anterior end, and a patch centrally on the disc; teeth of the anterior patches exceptionally long and continuing laterally on the segment forming a band across the anterior margin on the ventral surface; apicolateral processes sharply pointed, well-armed with teeth, directed at an angle of about 30 degrees to the longitudinal axis of the body; cleft area darkly pigmented.

DISCUSSION

Williams (1955) notes that the male genitalia of *furensoides* are more similar to those of *furens* (Poey) than to any other described species in the eastern United States, hence the name *furensoides*. In many of its pupal characters, *furensoides* is closely allied to other species of the *furens* group (subgenus *Oecacta*) in which it is placed. Included species of this grouping are *baueri, dickei* (pupal stage un-



FIGS. 6–12.—*C. furensoides*, pupa: (6) *v.l.* and *v.m.* tubercles; (7) *d.a.s.m.* tubercles; (8) *d.p.m.* tubercles; (9) *v.p.m.* tubercles; (10) *l.a.s.m.* tubercle; (11) *l.p.m.* tubercles; (12) dorsal view of caudal segment.

known), *furens, furensoides, haematopotus,* and *stellifer* (Jamnback, 1965). The opercular teeth are short, the *a.d.* setae are very unequal, the caudal segment has a patch of spines on its dorsum, and the respiratory horn is transversely convoluted, although weakly, near its midlength. Two characters of the respiratory horns are, however, notably divergent. There is but a single lateral spiracular opening and there is the absence of a pronounced dorsally directed protuberance for this opening. Undoubtedly, with the examination of additional pupal pelts, variation will be found in some of the characters described in this paper.

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EVALUATION OF AERIAL APPLICATIONS OF FLIT® MLO FOR THE CONTROL OF ORGANOPHOSPHORUS-RESISTANT *AEDES NIGROMACULIS* AND *CULEX TARSALIS*

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INTRODUCTION

Two major species of California mosquitoes have become resistant to all the available organophosphorus ond organochlorine larvicides. The irrigated pasture mosquito, *Aedes nigromaculis* (Ludlow), is extremely resistant in two areas of the San Joaquin Valley and in one part of the Sacramento Valley, and is developing resistance in the rest of the Central Valley, (Womeldorf *et al.,* 1971). *Culex tarsalis* Coquillett, the primary vector of St. Louis and Western equine encephalitis in California, has become highly resistant in the southern and central San Joaquin Valley and possibly in other locations in the State as well, (Georghiou *et al.,* 1969; Womeldorf *et al.,* 1971). This critical situation has renewed interest in the petroleum-derived control agents.

FLIT® MLO has been extensively studied in the laboratory against *C. pipiens quinquefasciatus* Say and *A. aegypti* (L.). The effects of the material, expressed as mortality, developmental retardation, and physiological manifestations, have been

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