EXTERNAL FEATURES OF THE LARVA OF HYDROMYZA CONFLUENS

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This paper deals with the external anatomy of the larva of *Hydromyza confluens* Loew, a dipterous insect associated in some localities with yellow water-lily beds. This insect deposits its eggs on the surface of the floating leaf petioles of the yellow water-lily (*Nymphaea americana*). So far as is known oviposition is restricted entirely to this particular plant, as other aquatic plants, such as the white water-lily, which is often found in the same locality, are unmolested. Two other workers have given some attention to the morphology of this larva. Needham (1908, pp. 270-271) described a few of the more obvious external characters of the larva. Later Welch (1917, pp. 39-40) confirmed the results of Needham and presented new data on the features of size, segmentation, and cuticular spines of the larva's external features. The present study re-checks the work of these two workers and adds some new observations made in the course of the investigation.

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Materials and Methods. The specimens used were collected by Dr. Welch from the petioles of the yellow water-lily at Douglass Lake, Michigan. They were killed by being dropped into hot water and then preserved in 85% alcohol. As many of the external organs are heavily chitinized, it was necessary to use clearing agents to make out their structures. The best method for clearing was found to be a bath of 20-24 hours in a 10% solution of potassium hydroxide. A gentle boiling in a 2% solution of sodium hydroxide followed by a long bath in xylol also gave excellent results. The former of these two methods showed the spiracles of the stigmal plates well. The skins were first mounted in glycerin and later in balsam.

General Somatic Features

Alcoholic specimens, uncleared material, are pale yellowish or dull whitish in color, except the chitinous parts which are brownish black. Specimens just removed from preserved petioles are almost pure white. Shed skins are dark brown.

The body is cylindrical and consists of a head followed by eleven segments. The thoracic segments are the thickest, and from this blunt anterior region the body tapers gradually to the posterior end. Full-grown larvae (preserved specimens) are about 8.9 mm. in length. The greatest diameter, occurring in the region of third and fourth somites,

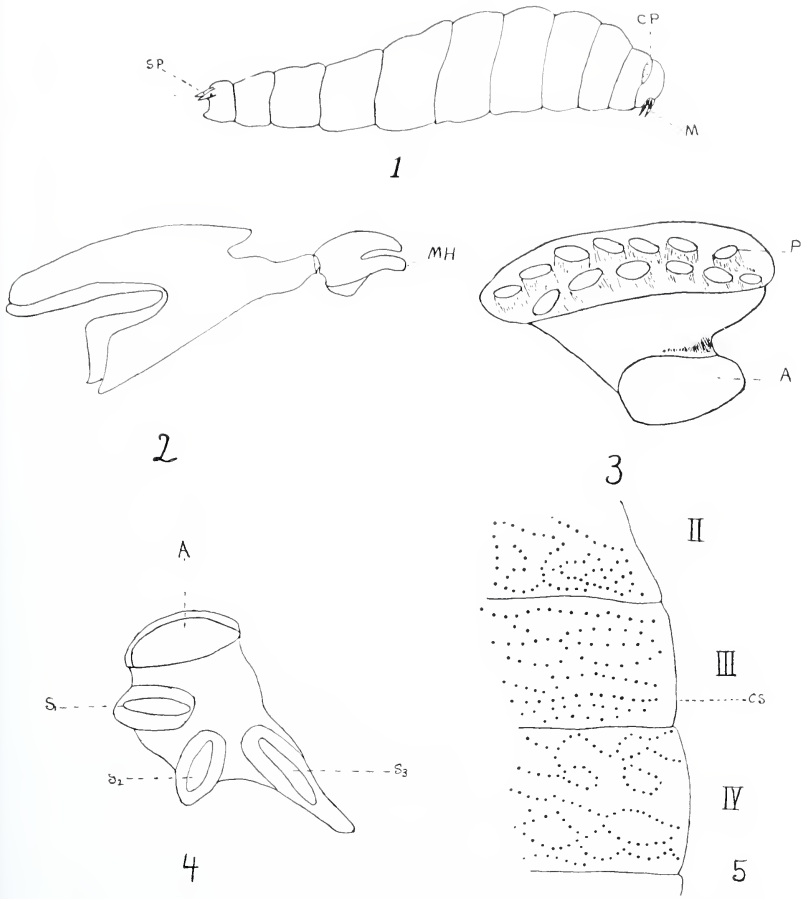

Fig. 1. Lateral view of mature larva: M, mouth, with mouth-hooks protruding; CP, cribriform plate. SP, stigmal plate.

Fig. 2. Lateral view of mouth-hooks dissected out: MH, hooks that protrude from the mouth.

Fig. 3. Dorso-lateral view of cribriform plate dissected out: P, perforations in dorsal part of plate; A, place of attachment to tracheal system.

Fig. 4. Lateral view of stigmal plate: A, place of attachment to trunk tracheal system: S_1, S_2, S_3, Spiracles.

Fig. 5. Dorsal view of segments 2, 3, and 4, showing arrangement of cuticular spines: CS, cuticular spine.

is 2.4 mm. The diameter of the last segment is 1.25 mm. None of the segments differ from each other, except in size and chitinous parts.

Distinct shallow grooves separate the segments from each other, and the segments in turn are subdivided by irregular transverse constrictions, which seem most pronounced on the posterior segments. Longitudinal furrows on the various segments are not uncommon.

The body is covered with numerous cuticular spines which are so small that they are not perceptible to the unaided eye. The cuticle is smooth, and when dissected out is very thin. Other chitinized parts are the broad ring-like head with the inconspicuous mouth-parts, the two oval, brownish cribriform plates on the first segment, and the two very darkly colored stigmal plates set close together at the extreme tip of the last segment. On the ventral side of the ultimate segment, at the margin of the groove between the ultimate and penultimate segments, the anus is found. It is a longitudinal slit with a narrow crescent-shaped chitinous plate on each side.

Integument

Head and Mouth-parts. The head is imperfectly developed and capable of considerable retraction into the first body segment. It is really a broad chitinous ring, of an oval, irregular shape. The length of this ring is 0.060 mm., while the width is nearly 0.040 mm. Eye-spots seem to be entirely lacking.

A pair of prong-like processes, the mouth-hooks, extend out of the body almost parallel to a transverse section of the body and project well into the body of the larva. When dissected out these hooks are found to converge posteriorly and form a joint with a single rod-like process which terminates in four irregular prongs. The total length of the mouth-hooks, including connecting processes, is nearly 1 mm.; the length of the hooks that protrude from the mouth is 0.14 mm. These hooks are the most chitinized parts of the body and are attached to the head and body walls by strong muscles.

Thoracic Segments. The thoracic segments differ chiefly from the other segments of the body in being larger and more blunt. The furrows on them, however, are not quite so prominent as those on the abdominal segments, nor are there as many secondary annulations as on some of the posterior segments.

The entire integument, with the exception of the chitinous parts and the grooves between the segments, is covered with small cuticular spines. One of these appears under the microscope as a rounded projection terminating in a sharp point which is somewhat more heavily chitinized than the rest of the spine. The spines are most numerous on the third and fourth segments, and become less numerous and more irregular in distribution toward the posterior segment. On the third segment there were 44 spines on .0025 sq. mm. of surface; on the fourth, 51 spines; and on the fifth, 35 spines. In the grooves between the segments, spines are almost entirely lacking. There is also a marked tendency for the spines to be more numerous toward the median dorsal line of the body. The spines on most segments occur in transverse loop-like rows, with

the exception of those on the third segment, where they are arranged in series of long-curved or, in many instances, straight rows.

Abdominal Segments. The abdominal segments are considerably smaller than those of the thorax, and differ from the latter in minor constrictions and annulations. Furrows are more prominent toward the posterior end. From the thorax to the ultimate segment there is a gradual tapering off in size of the larva. The diameter of the first abdominal segment is nearly 2 mm., of the last segment, 1.25 mm. A few of the intersegmental grooves are indistinct, the last one being especially so in most specimens. Cuticular spines become less numerous caudally, although the decrease is, as a rule, quite gradual. On the last two segments, the spines are comparatively few on the ventral side. In addition to the spines, the ultimate segment bears the anus and the two stigmal plates.

Respiratory Organs. Just back of the mouth, at the intersegmental groove between the first and second segments are situated two brownish-colored bodies, the cribriform plates. These plates are on opposite sides of the body about 1 mm. apart. When viewed from the dorsal side a plate appears oval-shaped, with many small perforations. The lower portion of the plate tapers gradually and near the lower end makes a sharp curve toward the median line of the body terminating in a ring which serves as an attachment. This end is attached to one of the trunk tracheal systems.

At the extreme tip of the terminal or ultimate segment is located the posterior respiratory system which is made up of two chitinous stigmal plates arranged side by side on the dorsal portion of the segment. Their general shape is that of a triangle with two of the angles rounded off and the third terminating in a sharp spine, which Needham (1908, p. 271) suggests may be used to break open the walls of air spaces in the tissue of the petiole where it is confined. These spines project downward at an angle of about 45 degrees and are about the only parts of the plates visible, as the remainder extend well back into the last segment. The plates are approximately of the same size and shape, each being nearly 0.067 mm. wide and 0.117 mm. long. A chitinous, ring-shaped mass is found on the blunt side of the plate. It serves as a connection with the body and with the trunk tracheal system.

Each stigmal plate has three slit-like openings, the spiracles, arranged radially, so that a line connecting the outer ends of the spiracles would be of a crescent-shape. The spiracles are of the same size and form. They are oblong and oval, being about three times as long as wide. The average length of a spiracle is 0.044 mm., and the average width, 0.015 mm. One of the spiracles extends well into that part of the plate that is prolonged into a spine. When viewed under a microscope it is not nearly as conspicuous as the others and some difficulty was experienced in finding it. The outer ends of the other two spiracles extend slightly out into rounded projections of the margin of the plate.

Conclusions

This investigation on the external morphology of the larva of *Hydromyza confluens* may be summarized as follows:

1. The general external features of the larva are head and mouth parts, integument, cribriform plates, and the posterior respiratory organs.

2. The most striking feature of the integument is the cuticular spines in the form of small rounded projections which occur on every segment of the body.

3. The head is undeveloped, but the mouth parts consist of large hooks which extend back into the body.

4. On the first segment are the cribriform plates which are the external openings of the anterior tracheal system.

5. At the posterior end of the larva two stigmal plates, each bearing three spiracles, make up the posterior termination of the tracheal system.

Literature Cited

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