

A STUDY ON THE MAXILLAE OF THIRD INSTAR LARVAE OF THE SIX ITALIAN
GASTEROPHILUS SPECIES (DIPTERA : GASTEROPHILIDAE) : OBSERVATIONS
ON THEIR TAXONOMIC SIGNIFICANCE IN THE IDENTIFICATION TO THE SPECIES

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ABSTRACT

The taxonomic importance of Gasterophilus maxillae and the possibility of using them for the larval identification are considered.

A new key for identification of third instar larvae of the six Italian Gasterophilus species, based exclusively on the maxillae, is, therefore, herein proposed.

KEY-WORDS : Gasterophilus - Third instar larvae - Maxillae morphology - Specific diagnosis - Italy.

ETUDE DES MAXILLES DES LARVES AU 3ème STADE DES SIX ESPECES
ITALIENNES DE GASTEROPHILUS (DIPTERA : GASTEROPHILIDAE).
OBSERVATIONS SUR LEUR IMPORTANCE TAXONOMIQUE DANS
L'IDENTIFICATION DES ESPECES

RESUME

L'importance taxonomique des maxilles chez les Gasterophilus larvaires et la possibilité d'utiliser leur morphologie pour leur identification est envisagée.

Une nouvelle clef pour l'identification des larves au 3ème stade des six espèces italiennes de Gasterophilus, basée exclusivement sur la morphologie des maxilles, est donc ici proposée.

MOTS-CLES : Gasterophilus - Larves au 3ème stade - Morphologie des maxilles - Détermination spécifique - Italie.

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INTRODUCTION

The identification of Gasterophilus larvae is usually based on more or less regular morphological aspects, such as the size and shape of larvae, the shape of mouth hooks, the shape of posterior peritremes, the location, size and shape of spines (Zumpt, 1965; Grunin, 1969; Draber-Monko, 1978).

In our investigations on the mouth apparatus of third instar Gasterophilus larvae, it has been noted that the maxillae, chitinous structures located vertically between the mouth hooks, though variable they appear, present some peculiar characteristics in every species.

As far it is known to us, the maxillae have never been studied previously and they have not been taken in consideration by any author to identify Gasterophilus larvae either.

The present investigation has been undertaken, therefore, with the main purpose of studying comparatively maxillae of third instar larvae of the six Italian Gasterophilus spp., summing up the results in a key for the identification of the maxillae, that can be usefully considered together with the presently used characters, in the identification to the species.

MATERIALS AND METHODS

In the present investigation n° 100 third instar larvae of Gasterophilus intestinalis, Gasterophilus nasalis, Gasterophilus inermis, n° 50 third instar larvae of Gasterophilus pecorum and Gasterophilus haemorrhoidalis and n° 30 third instar larvae of Gasterophilus meridionalis were examined, identified according to the present larval keys.

The mouth apparatus kept in lactophenol were dissected and the maxillae were removed by a microbistoury and the tip of a pin. To facilitate the removal, every pharynx was cut ventrally and medially lengthwise, so as to separate the right maxilla from the left one and to study them singularly.

Finally, all the maxillae, thus removed, were definitively mounted on slides, using, as a mounting medium, either Canada balsam or Berlese solution and then they were observed at the optical microscope.

RESULTS

The maxillae are chitinous structures located one opposite the other one with an inner concave part, to form a channel through which fluids flow, and an outer convex part in front of the mouth hooks (Fig. 1).

The maxillae are triangle-shaped and it is possible to distinguish a base which extends with the larval exocuticle, a flexure, an apex, a dorsal side, a ventral side, lateral teeth and apical teeth (Fig. 2).

The regular structural details of maxillae pointed out through the present investigation, were elaborated in the following key for identification of third instar larvae of Italian Gasterophilus species:

- Width at the flexure generally not over 166 micron and however never more than 190 micron.....1
- Width at the flexure more than 190 micron, not over 300 micron..2 (8)
- 1. Very slender shape, sometimes the flexure has only a showy long sharp tooth, but, more often, it is without teeth and sometimes it forms some steps (Figs. 3, 4).....G.inermis Br.
- 2. Wide and squat shape having both sides inclined; the dorsal side is sometimes nearly perpendicular to the base. Width at the apex not less than 83 micron and not over 116 micron.....3 (7)
- 3. Mixed apical teeth, more often long and mainly sharp at the apex but sometimes, some of them are rounded or cut. Lateral teeth sometimes long and mainly sharp, some other times short, cut or sharp.....4
- Short apical teeth, mainly rounded or cut; sometimes one of them is sharp and it is longer than the others. Lateral teeth mainly short and rounded; less frequently some of them are long and sharp. Width at the flexure usually more than 265 micron.....5 (6)
- 4. Some teeth, sometimes only one or two, are serrulate, both on their tops and sides; sometimes instead, only a short tract of the maxilla side appears serrulate (Figs. 5, 6 and Fig. 16).....G.nasalis (L.)
- 5. Very intense dark brown sides. The flexure is most times very marked full of short rounded teeth (Figs. 7, 8).....G.pecorum (Fabr.)

6. Apical teeth more often long and mainly cut on their tops. Lateral teeth sometimes long and mainly cut as well, never cleanly sharp. Some of the teeth have serrulate tops. Width at the flexure usually not more than 265 micron (Figs. 9, 10).....G.intestinalis (De Geer)
7. A little slender shape with a strong apical narrowing. Apex always less than 83 micron wide; often finger-like and generally from 33 micron to 66 micron wide. The flexure can show more or less long and often very sharp teeth.
Height not less than 400 micron (Figs. 11, 12)..G.haemorrhoidalis (L.)
8. Width at the flexure cleanly over 300 micron. Long and sharp apical teeth, appearing little or not at all prominent over the apical edge. Flexure very near the base. Sides and apex are always very serrulate. Height not less than 400 micron (Figs. 13-15).G.meridionalis(Pill.& Ev)

The measures of the maxillae of each Gasterophilus species and, between parenthesis, the most occurring sizes are reported below:

- G.intestinalis: -Apex: from 83 to 116,2 micron (83-99,6 micron)
 -Flexure: from 215,8 to 265,6 micron (215,8-249 micron)
 -Base: from 398,4 to 448,2 micron (448,2 micron)
 -Height: from 282 to 448 micron (332-298,8 micron)
- G.nasalis: -Apex: from 83 to 116,2 micron (99,6 micron)
 -Flexure: from 199,2 to 298 micron (199,2-215,8 micron)
 -Base: from 348,6 to 415 micron (381,8-415 micron)
 -Height: from 315 to 498 micron (365,2 micron)
- G.pecorum: -Apex: from 83 to 116,2 micron (99,6 micron)
 -Flexure: from 265,6 to 298 micron (265,6-282,2 micron)
 -Base: from 415 to 464,8 micron (415 micron)
 -Height: from 298,8 to 381 micron (332 micron)
- G.haemorrhoidalis: -Apex: from 33,2 to 83 micron (33,2-41,5 micron)
 -Flexure: from 232,4 to 265,6 micron (232,4 micron)
 -Base: from 464,8 to 498 micron (464,8 micron)
 -Height: from 415 to 448,2 micron (415 micron)

G.inermis: -Apex: from 49,8 to 83 micron (49,8-66,4 micron)
-Flexure: from 132,8 to 166 micron (149,4 micron)
-Base: from 332 to 415 micron (348,6 micron)
-Height: from 315 to 381 micron (332-381,8 micron)

G.meridionalis: -Apex: from 132,8 to 166 micron (149,4 micron)
-Flexure: from 348 to 381,8 micron (381,8 micron)
-Base: from 408 to 451,5 micron (408-430 micron)
-Height: from 415 to 498 micron (448-498 micron)

DISCUSSION

The maxillae of Gasterophilus spp., though extremely variable they are, have some morphological characteristics, typical for each species, which are constantly enough maintained from one individual to the other. The most important of these characteristics is the shape of maxillae, varying from species to species.

On the contrary, the teeth of maxillae seem to be a character difficult to be classified, as it is variable in relation to several factors, such as the maturity of larvae, the length of time of their attachment to the mucosa, the point of the mucosa, where they have penetrated and so on. All that determines, in our opinion, a different length of teeth and also, sometimes, the complete loss of them in some points. Nevertheless, some characters, such as the cut top of the teeth in Gasterophilus intestinalis and the serrulate sides of the teeth in Gasterophilus meridionalis and in Gasterophilus nasal, are constantly maintained.

Furthermore, by observing and comparing the maxillae of the various species, no correspondence has been noted between the larval size and the size of the maxillae. Gasterophilus meridionalis larvae, for instance, though they are smaller sizes, when compared with Gasterophilus intestinalis and Gasterophilus pecorum larvae, have much bigger maxillae. By measuring the width of the maxillae at their flexures, a distinction can be made among larvae having maxillae of medium width, those having very narrow maxillae (Gasterophilus inermis) and those having very wide maxillae (Gasterophilus meridionalis).

Also another important distinctive characteristic has been observed, that is to say, the morphological resemblance of maxillae of the various species in relation to the host's anatomic sites, where larvae are found.

In fact, there is a clear resemblance between the maxillae of Gasterophilus intestinalis and Gasterophilus pecorum larvae, being found in stomachs, and between those of Gasterophilus nasalis and Gasterophilus meridionalis larvae, being found in the duodenum. The maxillae of Gasterophilus inermis larvae, localizing in the rectum, have a typical narrow and slender shape, which is different from that of the other species; the maxillae of Gasterophilus haemorroidalis larvae, instead, which are found mainly in the duodenum and in the rectum, present a mixture of characters, having a strongly narrow apex, typical of Gasterophilus inermis and the rest of the maxillae wider and similar to those of the other species. In our opinion, this resemblance among the maxillae of species living in the same sites, shows the adaptation of larvae to their host's specific anatomic site. The extreme variability of the maxillae is due to the continuous adaptation of larvae to adverse conditions of life in the animal's digestive apparatus. A small percentage of larvae has so very different maxillae from each other in their morphology, as to be at the limits with malformation. A great part of them has, on the contrary, some very typical characteristics like those described in the present paper, more or less maintained also in those specimens having inter-medial characteristics. Anyhow, the maxillae of Gasterophilus larvae are undoubtedly of a taxonomic importance and the exam of them makes it possible to identify the greater number of larvae. The exam of the maxillae can be a complement to the exam of other distinctive elements or, rather, the only possible one, when the larva to be identified is damaged, broken or, above all, when only the cephalic part of it is left, infixed in the lesion.

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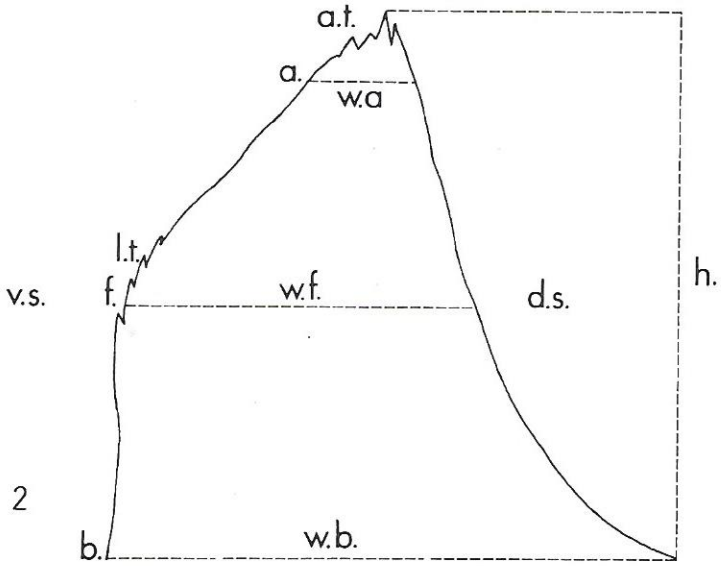
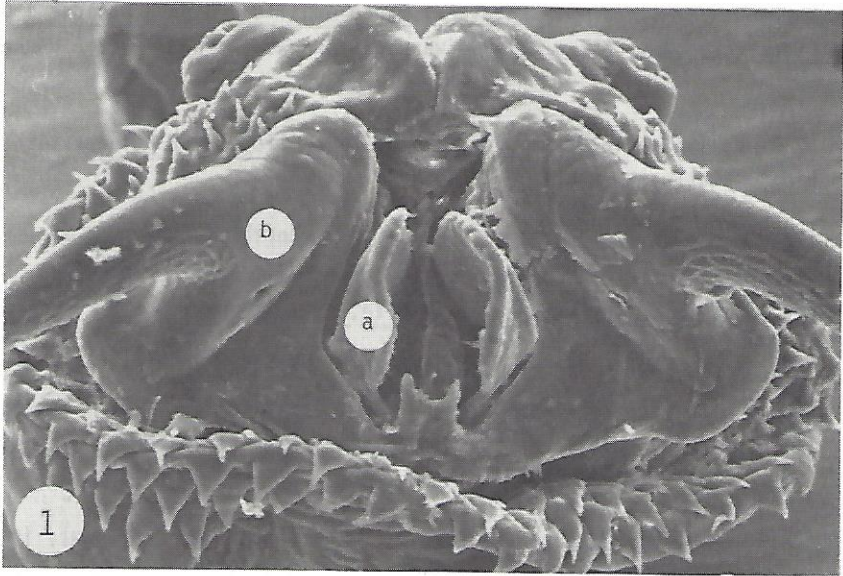
LITERATURE CITED

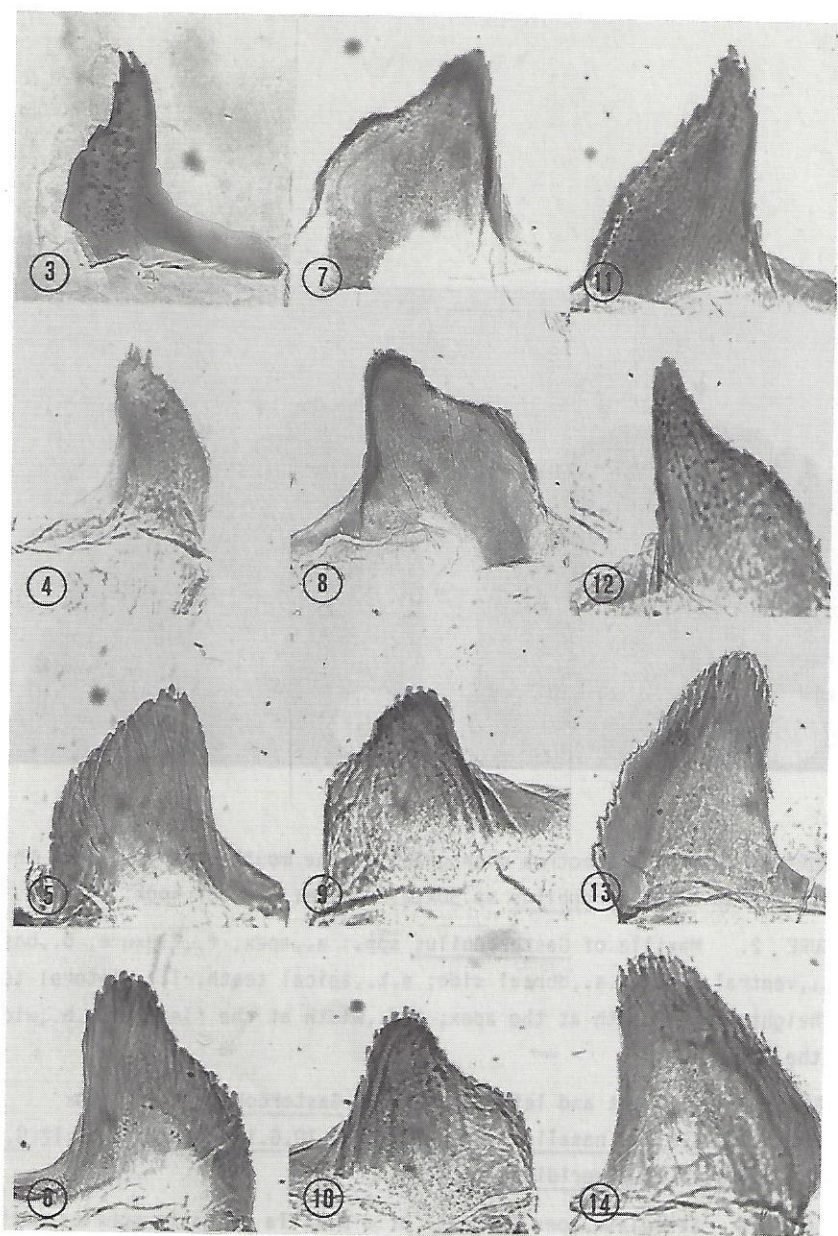
- DRABER-MONKÓ, A. 1978. Gzy (Diptera: Gasterophilidae, Hypodermatidae i Oestridae) Pasozyty Sskow Polski. Warszawa: Panstwowe Wydawnictwo Naukowe p. 32-55.
- GRUNIN, K. J. 1969. 64a Gasterophilidae W: "Die Fliegen der Palaearktischen Region", Stuttgart. 8, 1-61.
- PRINCIPATO, M., D. PIERGILI FIORETTI AND A. MORETTI. 1984. Diffusione ed incidenza di Gasterophilus spp. negli equini dell'Umbria. Atti della Società Italiana delle Scienze Veterinarie, 38, 744-748.
- PRINCIPATO, M., D. PIERGILI FIORETTI AND L. GALEOTE. 1985. Gasterophilus pecorum FABRICIUS, 1794 e Gasterophilus inermis (BRAUER, 1858) (Diptera: Gasterophilidae) negli equini dell'Umbria. Atti della Società Italiana delle Scienze Veterinarie, 39, in press .
- PRINCIPATO, M., D. PIERGILI FIORETTI, A. MORETTI AND G. A. POLIDORI. 1986. Osservazioni sullo sviluppo biologico di larve al III stadio di Gasterophilus spp. in condizioni di laboratorio. Annali dell'Istituto Superiore di Sanità, 22, 521-524.
- ZUMPT, F. 1965. Myiasis in Man and Animals of the Old World. Butterworths, London.

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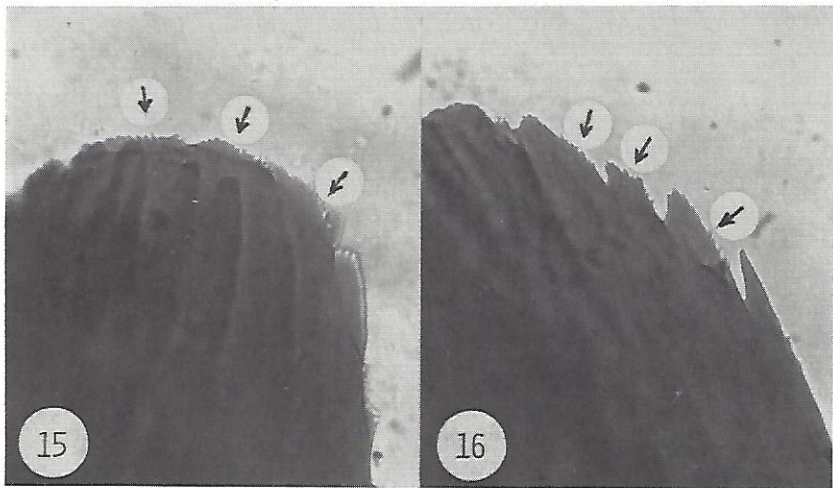


FIGURE 1. Scanning electron micrograph of the mouth apparatus of a third instar larva of Gasterophilus sp.50x.a,maxilla; b,mouth hook.

FIGURE 2. Maxilla of Gasterophilus spp.: a.,apex; f.,flexure; b.,base; v.s.,ventral side; d.s.,dorsal side; a.t.,apical teeth; l.t.,lateral teeth; h.,height; w.a.,width at the apex; w.f.,width at the flexure; w.b.,width at the base.

FIGURES 3-14. Right and left maxillae of Gasterophilus spp. 100x
 3,4.G.inermis.5,6.G.nasalis.7,8.G.pecorum.9,10.G.intestinalis.11,12.G.hae-
morroidalis.13,14.G.meridionalis.

FIGURE 15. Serrulate apex (arrows) of a maxilla of Gasterophilus meridionalis.400x.

FIGURE 16. Serrulate lateral teeth (arrows) of Gasterophilus nasalis maxilla.400x.