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LARVAE OF THE EUROPEAN SPECIES OF THE GENUS TEMNOSTOMA (DIPTERA, SYRPHIDAE)

N. P. KRIVOSHEINA and B. M. MAMAYEV

Temnostoma larvae were first described in detail 30 years ago. Stammer (1933) found a larva of the European species of T. vespiforme L. in the semidecayed wood of a birch tree and described it in detail. In the same year Metcalf in the USA (1933) reared larvae of two other species of the genus to the imago stage and described them. One of these was identified as T. balyras Walk. (Nearctic species) and the other as T. bombylans F. Whether the European T. bombylans F. was identical with the species discovered in America remained an open question, but it was stipulated that if the two were shown not to be identical the American species should be known as T. obscura Loew.

Heiss, working on material received from Metcalf, gave a detailed description of a larva called T. bombylans F.; but the very next year Curran (1939) demonstrated that T. bombylans F. did not occur in America. It thus appeared that the larva described from America under this name belonged, in reality, to another species; the genuine T. bombylans F. larva remaining unknown.

The larva of a third European species, T. apiforme F., was described only comparatively recently, by Heqvist (1957), on the basis of a small series of specimens collected from the stump of a birch tree.

The present authors have collected insect larvae from decaying wood for a number of years. The material that has accumulated in our collection contains fairly large series of Temnostoma larvae in association with the imagos; after examining these we can describe the T. bombylans F. larva on the basis of European material, record the existence of a new species, T. meridionale, sp. n., and also systematize data on the variability of the larval characters of all the European species of this genus.

The following material was used for describing the larvae.

1. T. bombylans F. Tula, from maple and linden stumps, 11 May and 13 June 1958 – 12 adult larvae and 4 young-instar larvae, 1 puparium. Krasnodar territory, beech log, 27 April 1959 – 1 adult larva, 1 puparium, 1 imago. Tellerman forestry, Voronezh province, oak log, 12 September 1959 – 6 adult larvae.

2. T. vespiforme L. Tula, from maple and linden stumps, 11 May and 13 June 1958 – 11 adult larvae and 6 younger-instar larvae, 1 puparium, 1 imago. Tellerman forestry, oak log, 12 September 1959 – 3 adult larvae. Krasnodar, beech log, 27 April 1959 – 3 adult larvae.

3. T. apiforme F. Tula, from linden stumps, 13 June 1958 – 1 puparium, 1 imago. Four adult larvae of this species were kindly sent to us by Dr. Heqvist from the Stockholm Natural History Museum.

4. T. meridionale, sp. n. Krasnodar, beech log, 27 April 1959 – 13 adult larvae, 3 puparia, 2 imagos.

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The Temnostoma larvae develop in extremely peculiar ecological circumstances. They occur in the wet, but comparatively hard wood of various trees, in which they are able to use their characteristic teeth and strongly sclerotized plates (rakes) to gnaw out branched passages ideally circular in cross-section. The main larval passage is hollowed out of the rotten wood, which is either ejected through the outer opening or raked up and forced into the side passages. The larva moves along the passage in both directions, using small spinules situated on the 1st body segment as a support, and the teeth of the posterior stigmal plate. Stumps and logs infested with the larvae are very rarely found, but the number of larvae present in each case is considerable, indicating high selectivity of the Temnostoma species in regard to their habitat conditions. Larvae of the various Temnostoma species under consideration are often found together in the same stumps and logs.

DESCRIPTION

Generic characters. Adult larvae large, reaching 14–17 mm in length and 5–7 mm in diameter. Body cylindrical (Fig. 8), milky white, consisting of 10 visible segments with a large number of folds. Dorsally from mouth opening, which is low, short single-segmented antennae and palps, barely emerging above the body surface, are set on an elongate, papillose projection. On the anterior extremity of the body, above the mouth opening, are readily visible the anterior spiracles, the stigmal plates of which bear oval or round respiratory apertures (Fig. 2, a). Stigmal plate as a rule surrounded by a well-developed peritreme, stigmal disc at the margin of plate. Laterally from spiracles are large, strongly sclerotized platelets, the rakes, each bearing 3 rows of strong teeth. From the base of the rake extend two processes, one dorsal and one median (Fig. 2 c, d). First body segment also with cuticular spines of various sizes, set near the mouth opening, around the anterior spiracles and rakes and on the dorsal side of the segment. Near the mouth opening, between the anterior spiracles on the 1st segment and on the different parts of the last segment, are small, downy papillae.

Posterior spiracles, the stigmal plates of which together form a full circle, are situated on a small, slightly sclerotized projection of the last body segment. On the surface of each stigmal plate are 20–35 spiracular slits near the stigmal discs. Outer margin of plates with a variable number of teeth; inner margins often fused.

The peculiar shape of the body, the presence of rakes with sturdy teeth on the anterior extremity and the specific structure of the posterior spiracles are distinctive characters by which the larvae of Temnostoma can be readily distinguished from larvae of other genera of syrphids.

Larva of T. bombylans F. Length of adult larva 16–17 mm. Rakes strongly sclerotized, almost black, each bearing 16–22 teeth (Fig. 2). Number of teeth variable on the right and left rakes in the same larva. On the inside the oval anterior spiracle, with a well-developed peritreme (Fig. 2, 3), abuts on the rake. Stigmal plate with 10–16 oval apertures in the form of a letter V (Fig. 2). The spiracle occurs within a sclerotized area at base of the rake itself and not remote from it as for example in T. vespiforme L. Ventrally from the rakes is a large area covered with sharp spines of unequal size (Fig. 1). Near the mouth-opening such spines are lacking. Within the area are 6 papillae situated symmetrically in relation to the median line of the body.

Posterior stigmal plates divided, each with 22–40 oval spiracular apertures on its surface. On the outer margin of each stigmal plate are 4 pairs of teeth approximately equal in size, and between the teeth are 4 branched hairs (Fig. 4, 5). Apart from these larger teeth there are also a few small, weakly developed teeth.

The projection bearing the posterior spiracles is heavily sclerotized and consists of 2 rings. The cuticle near the projection is covered with small pigmented plates of irregular shape (Fig. 4, c), forming a continuous ring.

In the younger (probably second) instar larva each rake bears 10 teeth arranged in two rows (Fig. 6). The anterior stigmal plates each have 4 oval apertures; the posterior ones are like those of the adult larva but more widely separated. The projection bearing the posterior spiracles (Fig. 7) consists of two distinctly visible rings, the first at the base and less heavily sclerotized. The cuticle near the projection is pigmented, as in the adult larvae.

The area covered with spines and situated ventrally of the rakes is wider than the distance between the bases of the rakes and is not divided along the median line. The spines covering it are roughly equal in size (Fig. 12). Near the mouth aperture is an area also covered with spines. The projection on the posterior body segment bearing the spiracles is surrounded by a light cuticle; the continuous pigmented area characteristic of mature T. bombylans F. larvae is lacking. The stigmal plates, as a rule, are fused at several points. Each plate has one well-developed lateral denticle and 4 branched hairs, of which the one at the apex of the tooth is the largest. The spiracular slits are arranged in the form of an irregular curved line near the stigmal disc.

It is noteworthy that the Temnostoma larva which Peterson (1953) mentions as related to T. bombylans F. is in fact distinguished from the latter by a whole series of important characters. There can be no doubt that these larvae belong to unrelated species. The T. bombylans F. larva, by a combination of characters, is found to resemble that of the American species, T. balyras Walk., from which it differs in the structure of the rakes and the anterior stigmal plate.

The larvae of T. vespiforme L., T. apiforme F. and T. meridionale, sp. n. The larvae of these three species differ sharply from the T. bombylans F. larva, but are so similar to one another that they have a whole series of common characters, enumerated below.

Larva of T. vespiforme L. The adult larva attains a length of 16--17 mm. Rakes with well developed, strongly sclerotized processes (Figs. 10, 11) of the same color as the bases of rakes, varying from dark brown to black. The processes meet at their bases to form almost a right angle (Fig. 9). The number of teeth varies from 17 to 22, usually from 18—20. Anterior spiracle distinctly set off from the base of the rake, with the peritreme strongly sclerotized only along the margin directed toward the rake. Stigmal plate of spiracle with tongue-like projection in the direction of the rake. Number of spiracular apertures on anterior stigmal plate varies from 13 to 16.

Posterior stigmal plates completely separated or joined at the middle by a bridge which is sometimes fairly wide and is divided by depressions into separate segments (Figs. 13, 15, a, b, c, d). Stigmal plates each with 19—36 spiracular slits. Lateral tooth of each plate comparatively large, blunt, broad basally (Fig. 14). The projection bearing the posterior spiracles consists of two strongly sclerotized rings. Short lateral lines formed by a series of punctate sclerotized depressions (Fig. 13) run downward from this projection.

The younger-instar larva has 10 teeth in two rows on the rake (Fig. 16). Anterior stigmal plates segmented from the base of the rake and bearing 2--3 spiracular apertures. Posterior stigmal plates separated by a broad band (Fig. 17); projection formed of only one sclerotized ring; punctate lines on sides of projection lacking. Anterior stigmal plates, rakes, bases of rake teeth and projection at end of body less heavily sclerotized than in adult larvae.

T. apiforme F. larva. Adult larva attains a length of 12—13 mm. Rakes with well developed but slightly sclerotized processes. Color of rakes varies in different parts: the base is light brown, the processes are yellowish, the teeth dark brown. Processes of rakes converge basally in an obtuse angle (Fig. 19). Median process with several dark sclerotized patches. Number of teeth, 17 to 20.

Anterior spiracle surrounded by slightly sclertozied cuticle and conspicuously separated from the base of the rake. Stigmal plate with a very conspicuous tongue-shaped projection surrounded by a peritreme, which is strongly sclerotized only along the outer margin, the rest being light brown. Each plate bears 14—15 spiracular apertures.

Posterior stigmal plates joined over a fairly considerable distance (Figs. 23, a, b, c). Each plate bears 22—26 spiracular slits. Lateral tooth of stigmal plate comparatively small (Fig. 20, a). Dorsal halves of posterior stigmal plates elevated and at an angle to each other, as can be seen more clearly if the plates are viewed from the ventral side (Fig. 22 a, b). Near the projection bearing the posterior spiracles is a circle of 6 broken lines, each

formed by punctate sclerotized striae (Fig. 21).

Of the larva collected in the Dakhava forestry of the Krasnodarsk territory, two were males, originally identified as T. vespiforme L. Study of the characters both of the larvae and of the adult individuals, however, showed that here we were dealing with a new species, distinct from T. vespiforme L. in a number of characters. A comparative description of the adult stage of this species and of T. vespiforme L. will be found below.

T. meridionale, sp. n. larva. Adult larvae attain a length of 15–16 mm. Rakes with well developed processes, sclerotized less than the bases of the rakes. Color of processes varies from yellowish to light brown, the median process being lighter than the dorsal. Teeth and bases of rakes dark brown. Processes of rakes not joined to one another, their bases being set widely apart (Fig. 24). Number of teeth on rake varying from 15 to 19 (Fig. 25). The whole peritreme strongly sclerotized, dark brown or black, forming a broad ring around stigmal plate, which is

oval, with 16—22 spiracular apertures (Fig. 24).

The posterior stigmal plates in the larvae we examined were not separated, and each bore 27—37 slit-like apertures (Figs. 26, 28). Lateral tooth of each plate comparatively large, acuminate, broad basally (Fig. 27). Projection consisting of two well developed sclerotized rings. Near projection well defined pigmented area with punctate striae similar to those in T. apiforme F. (Fig. 26).

But what characters should be used for identifying Temnostoma larvae? Heqvist (1957) adduces the following for distinguishing between T. vespiforme L. and T. apiforme F.:

Character	T. vespiforme L.	T. apiforme F.
Teeth on rake	18—20	16—19
Base of rake	sclerotized	not sclerotized
Posterior stigmal plates	completely or almost completely separated	not separated
Lateral teeth of stigmal plates	very prominent	not prominent

T. vespiforme L.	T. apiforme F.	T. meridionale, sp. n.
Processes of rake strongly sclerotized	Processes of rake slightly sclerotized	Processes of rake slightly sclerotized
Anterior stigmal plate with tongue-shaped projection directed towards rake	Anterior stigmal plate with tongue-shaped projection directed towards rake	Plate oval, without projection
Peritreme strongly sclerotized only on the margin facing the rake	Peritreme strongly sclerotized only on the margin adjoining the stigmal plate	Whole peritreme strongly sclerotized and forming a broad dark ring
Two short lateral punctate striae run from projection bearing posterior spiracles	Near projection, there is a circle formed by 6 disconnected punctate striae	Near projection, there is a circle formed by 6 disconnected punctate striae

On the basis of these characters we propose the following key for Temnostoma larvae:

Variability of characters in Temnostoma larvae

Species	Number of specimens examined	Character, number of	Arithmetic mean ($M \pm m$)	Mean quadratic deviation
T. vespiforme L.	17	Rake teeth (ST)	19±0.34	1.4
		Respiratory apertures on anterior stigmal plate (RA)	15±0.23	0.95
		Respiratory apertures on posterior stigmal plate (RP)	23.5±0.5	2.0
T. meridionale, sp. n.	13	Rake teeth (ST)	18±0.39	1.4
		Respiratory apertures on anterior stigmal plate (RA)	18.5±0.53	1.9
		Respiratory apertures on posterior stigmal plate (RP)	32.8±0.53	1.9
T. apiforme F.	4	Rake teeth (ST)	18±0.71	1.42
		Respiratory apertures on anterior stigmal plate (RA)	14.5±0.5	1.0
		Respiratory apertures on posterior stigmal plate (RP)	23.5±0.87	1.74
T. bombylans F.	17	Rake teeth (ST)	17.4±0.34	1.4
		Respiratory apertures on anterior stigmal plate (RA)	13.4±1.6	1.6

If the data in the Table are compared with the larval descriptions, it becomes clear that the characters used by Heqvist are not very precise, and overlap one another. Moreover, after counting the number of teeth and respiratory openings on the anterior and posterior spiracles in the larvae of all four species at our disposal, and statistically processing the results (see Table), we found that the number of teeth on the rakes could not serve as a diagnostic character, since the average number was the same or nearly the same in different species, while the possible variation within each species was fairly wide. Significant differences are observed only in a few cases in the number of respiratory openings on the anterior and posterior stigmal plate.

In compiling the key, therefore, we have paid attention mainly to the more clear-cut and stable characters, not mentioned in earlier published work.

These can be summarized as follows:

T. vespiforme L.	T. apiforme F.	T. meridionale, sp. n.
Processes of rake converge basally	Processes of rake converge basally	Processes of rake set wide apart

1 (2). Each of posterior stigmal plates with four pairs of small identical teeth on the margin..... ..... T. bombylans F.

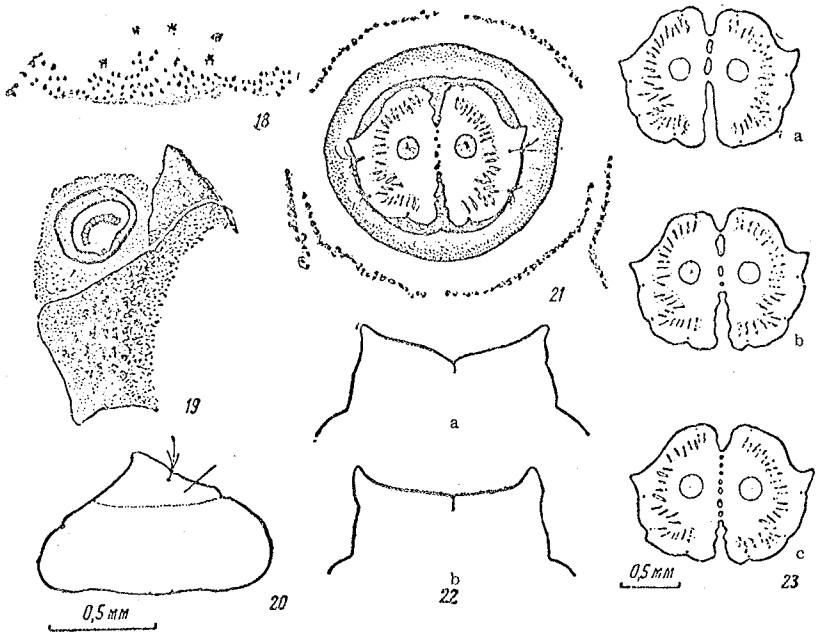
2 (1). Each of posterior stigmal plates with one large lateral tooth.

3 (4). Only two short lateral lines, formed by punctate sclerotized striae, run from projection bearing posterior spiracles..... ..... T. vespiforme L.

4 (3). Round projection bearing posterior spiracles is a circle formed by six punctate sclerotized striae.

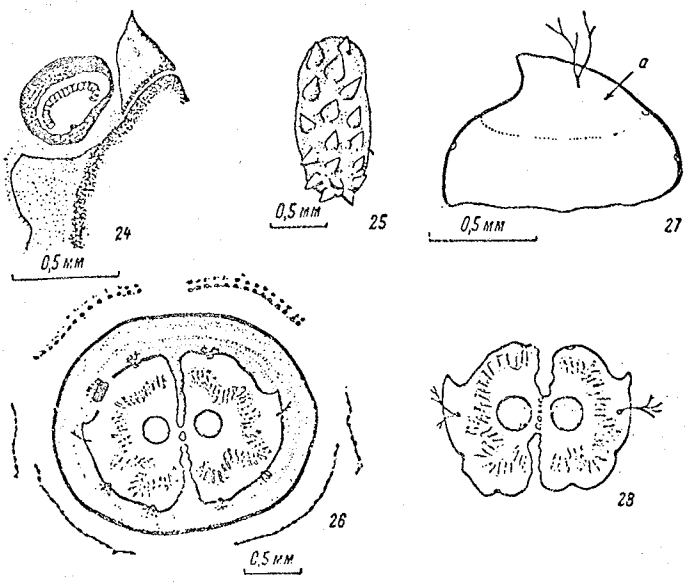
5 (6). Processes of rake converge to form an obtuse angle. Anterior stigmal plate with a tongue-shaped projection facing rake. Peritreme sclerotized only on the margin joining the stigmal plate..... ..... T. apiforme F.

6 (5). Processes of rake set wide apart. Anterior stigmal plate round, without a tongue-shaped projection. Entire peritreme sclerotized, forming a broad ring ..... T. meridionale, sp. n.



Figs. 18—23. — Temnostoma apiforme F. Larva.

18 — area covered with spines on anterior extremity of larva; 19 — dorsal and median processes of rake and anterior spiracles; 20 — posterior stigmal plate with lateral tooth (a); 21 — projection, posterior spiracles and punctation around projection; 22 — projection bearing stigmal plates (ventral view), a — T. apiforme F., b — T. meridionale, sp. n.; 23 (a, b, c) various types of separation of posterior stigmal plates.

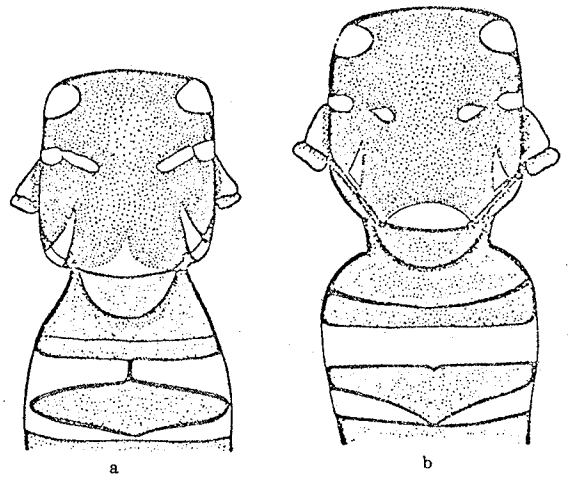


Figs. 24—28. — Temnostoma meridionale, sp. n. Larva.

24 — dorsal and median processes of rake and anterior spiracles; 25 — rake with teeth (viewed from above); 26 — projection, posterior spiracles and punctation around projection; 27 — posterior stigmal plate with lateral tooth (a); 28 — posterior stigmal plates.

Comparative Description of T. Vespiformе L. and T. Meridionale Kriv. et Mam., sp. n. Imagos

T. vespiformе L., ♂ (Fig. 29, a)	T. meridionale, sp. n., ♂ (Fig. 29, b)
Triangular black spot on frons.	Frons completely yellow.
1st and 2nd antennal segments with yellow setae, more rarely 1st segment also with several black setae.	1st and 2nd antennal segments with black setae, no yellow setae.
Two yellow spots on transverse suture of mesonotum touching.	Spots on transverse suture of mesonotum separated by a distance equal to the diameter of each spot.
Yellow spots on sides of mesonotum in front of scutellum extend beyond postalar tubercles and are covered with yellow hairs.	Yellow spots in front of scutellum do not extend beyond postalar tubercles and are covered with black hairs.
Unpaired yellow spot in front of scutellum triangular.	Unpaired yellow spot in front of scutellum semicircular.
First yellow band on 2nd abdominal tergite perceptibly thinner at median line than at margins and interruped by a narrow black stripe.	First yellow band of abdomen continuous of the same width throughout.
Hind femora have yellow setae below.	Hind femora have black setae below.



a b

Fig. 29. a — Temnostoma vespiformе L.; b — Temnostoma meridionale, sp. n. Adult insect. Thorax and base of abdomen from above.

Apart from T. meridionale, sp. n. material reared by us from larvae (Krasnodar territory 27 April 1959, 2 males, including holotype; Krivosheina and Mamayev), the Zin collection contains material from the following places: Sv. Gory, Khar'kov province, 2 May 1882 (1 male; Yaroshevskiy); Spassk, Orenburg province (1 male; Eversman); Teberda, Krasnodar territory 14 July 1939 (1 female -- allotype; Stepanov); Borzhomi, Georgia, 10 July 1898 (1 female; Zakharov).

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Laboratory of Soil Zoology,
Severtsov Institute of Animal Morphology,
USSR Academy of Sciences, Moscow