

**A NEW SPECIES GROUP WITHIN *TETHINA* HALIDAY
(DIPTERA: TETHINIDAE) WITH DESCRIPTIONS OF
SIX NEW MEDITERRANEAN SPECIES**

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ABSTRACT

Six new species of Tethinidae (*Tethina acrostichalis*, *guttata*, *pictipennis*, *quadricephala*, *shalom*, and *yaromi*) are described from Mediterranean countries. These species, together with *T. alboguttata* (Strobl) and *T. karatasensis* Munari, constitute a (new) monophyletic group (the *alboguttata* group) based on three apomorphies: scutellum darkly maculated; crossveins r-m and dm-cu pale and surrounded by pale areas; and female cerci with spines ("pseudacanthophorites"). The relevance of these species to the need to preserve sand dune habitats in Israel and elsewhere is discussed.

KEY WORDS: Diptera, Tethinidae, *Tethina*, *Tethina alboguttata* group, taxonomy, new species, morphology, sand dune conservation, Mediterranean.

INTRODUCTION

This is a second contribution in a series of articles on Mediterranean and Near East Tethinidae, based primarily on material collected in Israel and the Sinai. The first contribution (Freidberg, 1995) dealt with the description of a new genus and species, *Suffomyia scutellaris* Freidberg, from the Sinai coast of the Gulf of Elat. In the present paper we describe six new species, four of them from Israel and the Sinai and two from western Mediterranean coasts. These descriptions are especially significant, as the new species are mostly confined to coastal sand dunes, which comprise a seriously threatened habitat in Israel (Perry and Dmi'el, 1995) and elsewhere (van der Meulen et al., 1989). One purpose of this paper is thus to draw the attention of the scientific community and general public to the fact that sand dunes and their habitats are still insufficiently explored and harbor an as yet undescribed fauna that is in immediate danger of destruction. A third paper, now in preparation by V.B., covers the remaining tethinid species of Israel and the Sinai.

Sand areas in Israel occupy a total of 920 km² and are confined to four main regions (Yom-Tov and Mendelssohn, 1988; numbers in parenthesis indicate the percentage of the total

area covered by sands): the Mediterranean coast (38%); the western Negev (52%); Arava (2%); and other parts of the Negev, especially in the north (8%). All these areas have suffered from ecological damage primarily due to development, with the western Negev subjected to the least damage, and the Arava to the most. In the latter region almost all the sand patches have been converted to intensive agriculture fields. These changes, which have mostly taken place in this century, particularly during its second half, have already resulted in the reduction and disappearance of many organisms from these areas (Yom-Tov and Mendelsohn, 1988). Although the western Negev and coastal sand dunes form an extension of Saharan dunes, their specific location and remarkably swift and late evolution appear to have resulted in a rather unique biota, different from the adjacent biota of the northern Sinai. Once these habitats are destroyed, the species that inhabit them will disappear, thus contributing to the alarming global biodiversity crisis. To illustrate by example, we use the northern Tel Aviv coast, the type locality of *T. acrostichalis* n. sp., which, until recently, was a pristine sandy habitat. It now suffers from many modern ecological maladies. It is being intensively developed, with high-rise buildings replacing natural dunes. Most of the remaining sandy areas in the site are abused by recreational beach buggies, which both plough up and compact the sand except where large bushes grow. Finally, garbage, such as bricks and cement, is dumped freely, without any control. These types of destruction are visible in the photograph taken at this locality (Fig. 1).

Unlike most known tethinid species that are confined to the immediate vicinity of seas and oceans, including the moist intertidal zone and nearby, the Israeli and Spanish species described

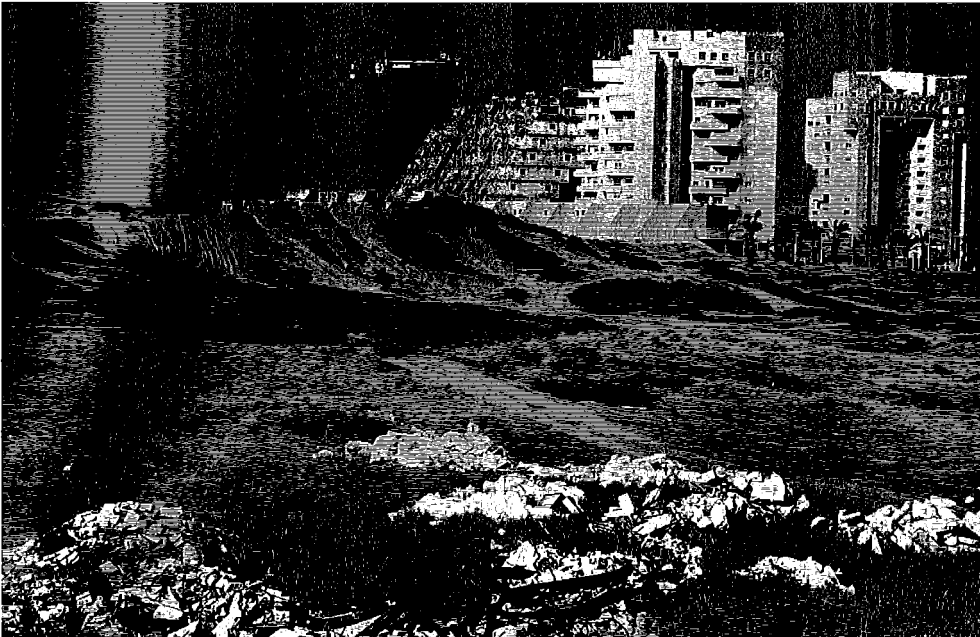


Fig. 1. Type locality and habitat of *Tethina acrostichalis* n. sp. Note marks of "development," such as urbanization, garbage and tracks of recreation vehicles.

in this paper were collected between about 100 m from the water line and about 50 km inland. These species were mostly found on clean dry sand within 100–2000 m from the shore line, never in the vicinity of water. We suspect that the other species treated in this paper also show this ecological preference.

In most tethinids the female cerci are rather elongate and covered by fine setae and setulae (Vockeroth, 1987). This generalized structure is used in tethinids to place eggs on the larval food (rotten vegetable material) or insert eggs into crevices in moist situations (Freidberg, unpublished observations). Collin (1966, in key) mentioned the occurrence of short, spinose cerci in *Tethina alboguttata* (Strobl) (recorded by him under *Rhinoessa*), and Vockeroth (1987) mentioned similar cerci in at least one species, which he did not name. However, none of these authors described these organs in detail or used specific terms for them. The females of the species group described in this paper are equipped with short cerci that bear stout spines (Figs. 29–34). These cerci, which are newly termed here “pseudacanthophorites”, are described below in detail and illustrated for six species. True acanthophorites occur in several families of orthorrhaphous Diptera (e.g. Therevidae, Mydidae) and are a pair of spine-bearing hemitergites 10, used for digging during oviposition. A similar function is assumed for the “pseudacanthophorites”. As with acanthophorites, pseudacanthophorites appear to be associated with oviposition into dry sand and possibly other light soils.

In this paper, six new species of *Tethina* are described, four of them from Israel and the Sinai (Egypt), and one each from Spain and Morocco, all apparently comprising a monophyletic group within the genus. Two additional Mediterranean species are included in this group, and a key to all eight species is given.

Terminology follows McAlpine (1981), with the exception of “pseudacanthophorites,” a term proposed in this paper. In addition, we suggest the terms “lateral vertical” and “median vertical” for the setae known as “outer vertical” and “inner vertical,” respectively, conforming better with body axes and orientation as suggested by McAlpine (1981). The species account is presented alphabetically, beginning with *acrostichalis* n. sp. This species is described in detail, and most other species are compared to it, rather than a full description being given for each one of the species.

Most of the material on which this study is based is deposited at the entomological collection, Zoological Museum, Tel Aviv University (TAU). We are grateful to the following curators (listed after their institutions) for the opportunity to study material under their care: ETH = Swiss Federal Institute of Technology, Zurich, Switzerland (Dr. B. Merz); HNHM = Hungarian Natural History Museum, Budapest, Hungary (Dr. L. Papp); MSNV = Museo Civico di Storia Naturale, Venezia, Italy (Mr. L. Munari and Dr. E. Ratti); and ZMUC = Zoologisk Museum, Copenhagen, Denmark (Dr. Verner Michelsen). We are also grateful to Dr. M. Carles-Tolrà, Barcelona, Spain, for the loan of specimens from his private collection.

Paratypes of *acrostichalis*, *guttata* and *yaromi* were also distributed among the following institutions: AMS = Australian Museum, Sydney, Australia (Dr. David K. McAlpine); BAS = Bulgarian Academy of Sciences, Sofia, Bulgaria (Dr. V. Beschovski); BMNH = The Natural History Museum (formerly British Museum of Natural History), London, UK (Dr. Brian R. Pitkin); INHS = Illinois Natural History Survey, Champaign, Illinois, USA (Dr. D.W. Webb); and USNM = Smithsonian Institution, Washington, D.C., USA (Dr. Wayne N. Mathis).

TAXONOMY

Tethina Haliday

The genus is diagnosed here primarily by extracting the characters used to key it out in Mathis and Munari (1996), although Beschovski (1993) used other characters for the most part. Comments about these characters are given in parentheses.

Head: Roundish or strongly prognathous (by “prognathous” these authors probably mean that the anteroventral corner of head is strongly protuberant) (quadrate in some of the species described here), but with antenna always porrect (in our opinion, the antenna is short and normal in orientation, neither porrect, nor pendulant); clypeus small, if exposed not protuberant anteriad beyond oral margin; palpus and proboscis usually normally developed, proboscis often long and geniculate; labellum shorter than head; gena either homogeneously pale, microtomentose or with a longitudinal golden patch, usually lacking setulae (setulose in *pictipennis* n. sp.). Paraverticral setae more or less convergent; fronto-orbital setae usually with similar orientation, mostly reclinate or laterocline; frons with 2 rows of interfrontal setulae, often seta-like; true vibrissae absent, but foremost peristomal setae inclinate and simulating vibrissae (“vibrissa-like” seta in further text); peristome bearing row of strong, anaclinate setae (lacking in *pictipennis* n. sp.); eyes bare or sparsely setulose.

Thorax: Postpronotum with 3 or more setae, ventral seta anaclinate; both proepisternal and proepimeral setae present, or proepimeral seta absent; prescutellar acrostichal setae present or lacking; mesonotum with more or less numerous rows of coarse setae arising from punctures.

Wing: Costa not spinose; vein R₁ bare above; cells bm and dm distinct, separated by crossvein bm.

Abdomen: Tergites wider than long; tergite 6 well differentiated from short sytergosternite 7 + 8, the latter forming the true dorsal pregenital sclerite; abdominal setae and setulae pale (whitish) to dark; epandrium with 1 pair of surstyli partially fused with epandrium; aedeagus usually very long and sinuous, ventrally micropubescent.

DIAGNOSIS OF THE *ALBOGUTTATA* GROUP

Within *Tethina*, species of the *alboguttata* group are characterized by the following three apomorphies: 1) scutellum darkly maculate (Figs. 11–18); 2) crossveins r–m and dm–cu white or whitish, each surrounded by pale area that is rather clearly contrasted with remaining, darker, background of wing membrane and veins (Figs. 19–22); 3) female cercus relatively short, about 2.5–3 times as long as wide, with 5–12 spines mostly on distal half and several additional fine setae mostly mesodistally (Figs. 29–34).

Species currently placed in the *alboguttata* group are *acrostichalis* n. sp., *alboguttata* Strobl, *guttata* n. sp., *karatasensis* Munari, *pictipennis* n. sp., *quadricephala* n. sp., *shalom* n. sp., and *yaromi* n. sp., although the female terminalia of *karatasensis* have not been studied and are only assumed to conform with the above characterization. Vockeroth (1987) mentioned a Nearctic species without giving its name, that allegedly shares apomorphy 3 and may also belong here.

Within the *alboguttata* group there are two, more or less well-defined and possibly monophyletic, subgroups. The *acrostichalis* subgroup, which contains *acrostichalis*, *shalom*, *karatasensis* and *quadricephala*, is characterized by the head in lateral view quadrate or

subquadrate; proboscis relatively short; a paler coloration (e.g. femora yellowish); mostly yellowish setae and setulae (but setae and setulae brown in *karatasensis*); thorax entirely covered by thick, pale microtomentum; and dark scutellar spot usually shorter than scutellum, velvety brown or black, strongly contrasted with general pale coloration of thorax. The *alboguttata* subgroup contains *alboguttata* and *guttata*, which are characterized by the head triangular in lateral view, with anteroventral corner strongly protuberant; proboscis very long and geniculate; darker coloration (e.g. femora blackish), setae and setulae blackish; microtomentum less pale; and scutellar spot not strongly contrasted with general color of thorax. Furthermore, scutellar spot is an extension of a dark scutal stripe and crosses the entire length of the scutellum. *T. pictipennis* is generally more similar to species of the *acrostichalis* subgroup, despite the blackish setae and setulae. *T. yaromi* occupies an intermediate position between the two subgroups. The exact relationships between these taxa have not been determined. This would better be done within a more comprehensive phylogenetic analysis of *Tethina* and related genera.

The three synapomorphies mentioned above appear to be highly reliable (although the scutellar spot and the crossvein characters are occasionally subject to minor intraspecific variation). They had been proposed in an earlier version of the manuscript before the new species, *yaromi* and *pictipennis*, were brought to our knowledge. Hence, these two species constituted a test case for these synapomorphies, and indeed they were found to conform well with them. Consequently, although empirical, these apomorphies can be accorded a high degree of predictability. Furthermore, these three synapomorphies may be sufficient to warrant generic status for the group of species studied here. However, this can be determined with confidence only following a cladistic study of *Tethina* and related genera, which is beyond the scope of this paper.

DISTRIBUTION

With minor exceptions, the group treated in this paper is limited to the Mediterranean basin. Two species were recorded from this subregion prior to this study but were not recognized as constituting a monophyletic group or even as being closely related. The recent discovery of six additional species helped in the recognition of this monophyletic group. Five species are known from eastern Mediterranean countries, and four from western Mediterranean countries (Fig. 2; *Tethina guttata* n. sp. is recorded from both eastern and western Mediterranean countries). No records are available from central Mediterranean countries, from either the European or African coasts. The gaps between Spain and Turkey in the north and between Tunisia and eastern Sinai (Egypt) in the south are probably collecting artifacts, as suitable habitats probably occur throughout these distributional gaps (e.g. Klijn, 1990).

The exceptions to a strictly Mediterranean distribution are *T. alboguttata* (recorded from the Canary Islands and St. Helena, in addition to several Mediterranean countries), *T. pictipennis* n. sp. (recorded from the Atlantic coast, some 100 km south of Gibraltar), and *T. shalom* n. sp. (recorded from the coast of the northern tip of the Gulf of Elat (Red Sea). Although most of these places are officially considered a part of the Mediterranean subregion, they may also be considered as indications of a larger distributional area for the *alboguttata* group that may at least include long stretches of the Atlantic and Red Sea coasts. Vockeroth's (1987) record of a (Nearctic?) species, with what seem to be pseudacanthophorites, may indicate a still wider distribution of this group, but he did not state the distribution of that species.

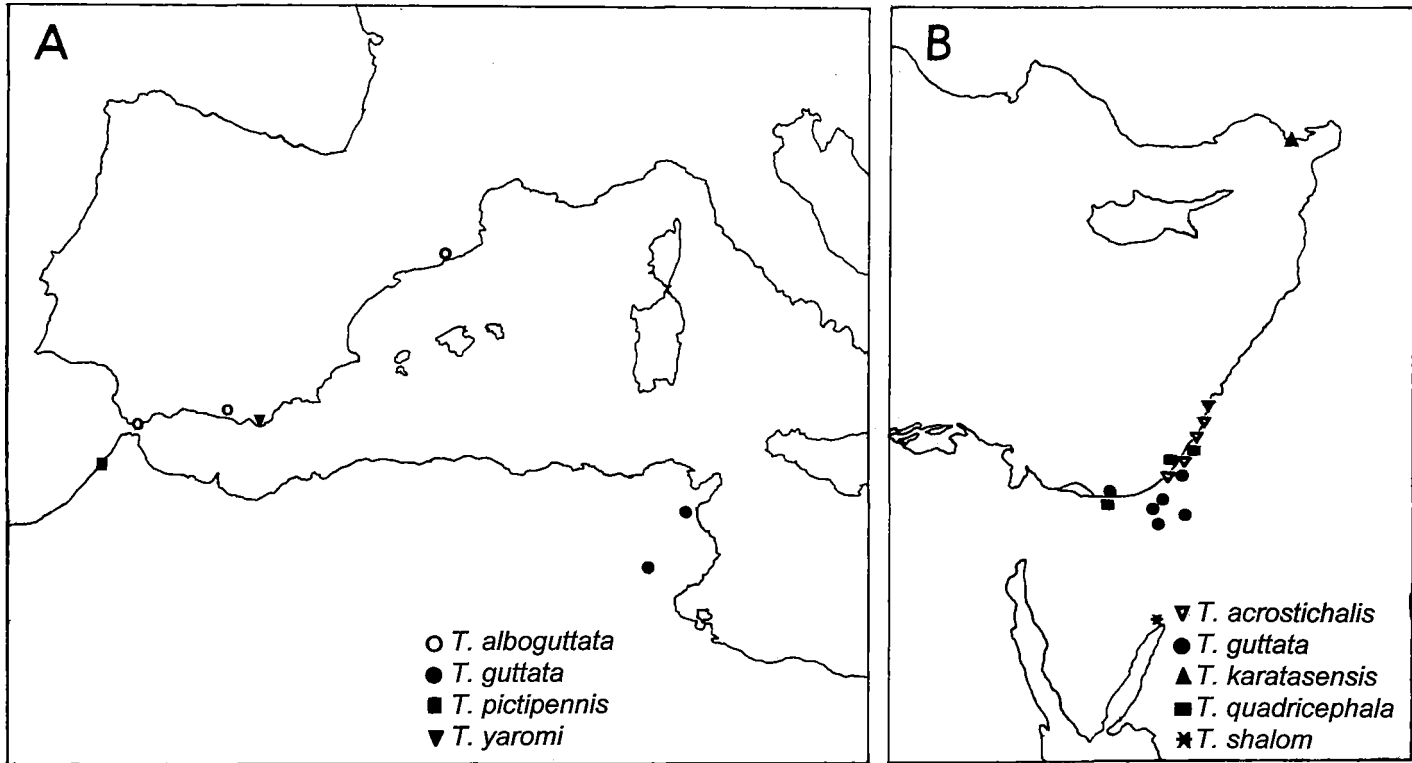


Fig. 2. Distribution maps of species of the *Tethina alboguttata* group. A. Western Mediterranean. B. Eastern Mediterranean (only confirmed locality records are marked).

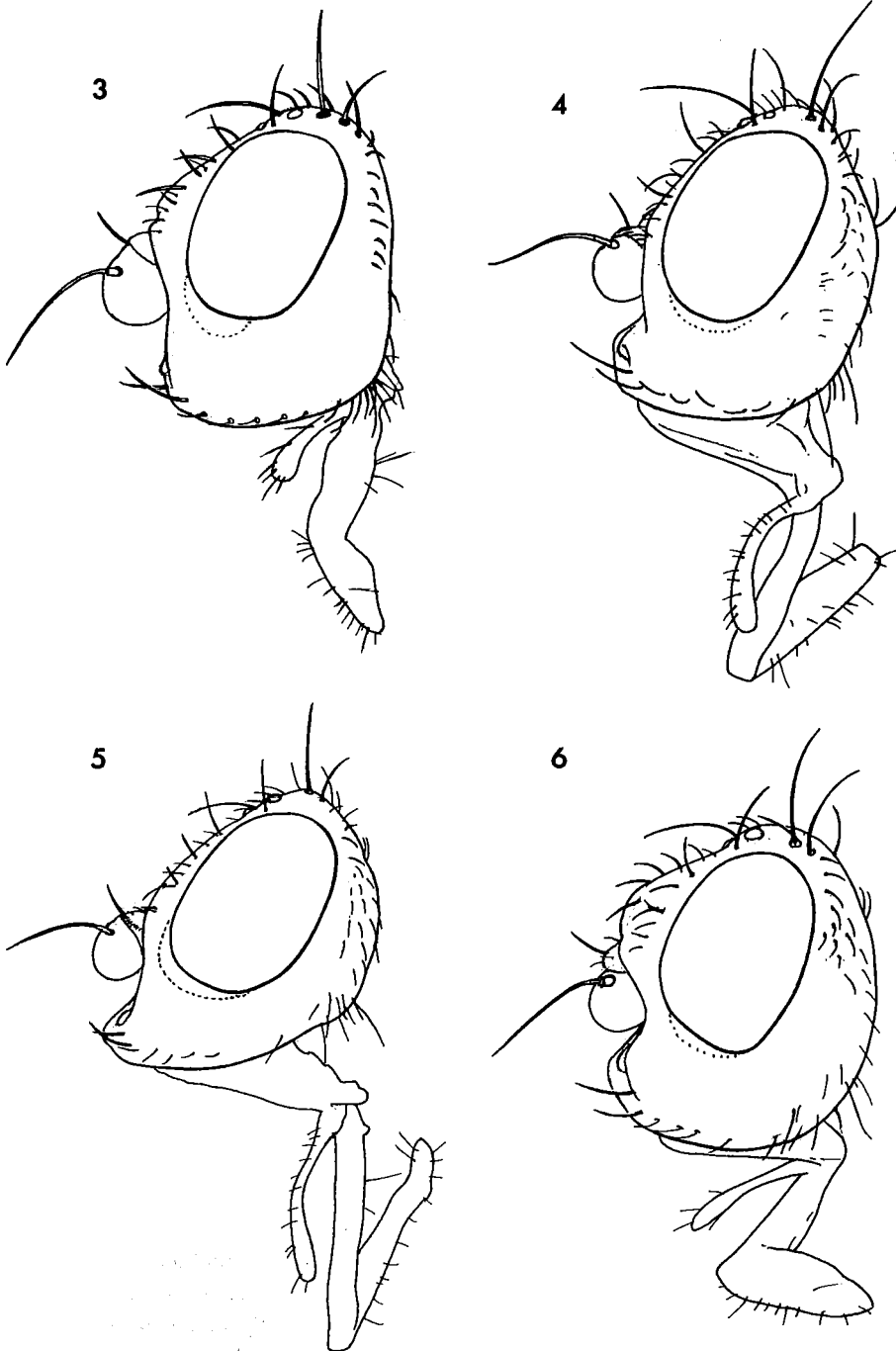
KEY TO THE SPECIES OF THE *ALBOGUTTATA* GROUP

1. Coxae and femora predominantly blackish; prementum and labella, each, about as long as ventral margin of head (Figs. 4–5, 10) 2
 — Coxae and femora yellowish; prementum and labella, each, distinctly shorter than ventral margin of head (Figs. 3, 6–9) 4
2. Scutellum predominantly blackish (Fig. 18), strongly contrasted with the more or less uniformly silver-gray scutum (Spain) *yaromi* n. sp.
 — Scutellum not strongly contrasted with scutum, at most slightly darker medially (Figs. 12–13); scutum brownish gray, with distinct darker spots at base of setae 3
3. Head longer than high, with ventral margin strongly produced; two distalmost tarsomeres brown (Israel, Egypt–Sinai, Tunisia) *guttata* n. sp.
 — Head higher than long, with ventral margin not strongly produced; only distalmost tarsomere brown (Spain, Algeria, Tunisia, Morocco, Canary Islands, St. Helena) *alboguttata* Strobl
4. Wing with dark pattern comprised of blackish spots and bands posterior of vein R_{4+5} (Fig. 21); setae and setulae black (Morocco) *picipennis* n. sp.
 — Wing without such pattern, at most generally infusate with whitish crossveins (Figs. 19, 22); setae and setulae yellowish or brown 5
5. Head in profile quadrate or subquadrate (Fig. 8); gena about as high as eye; long axis of eye nearly horizontal; larger species (wing length 2–2.5 mm) (Israel, Egypt–Sinai) *quadricephala* n. sp.
 — Head in profile more triangular (Figs. 3, 6, 9); gena distinctly lower than eye; long axis of eye nearly perpendicular; body size and wing length variable 6
6. Scutellar spot large, reaching or nearly reaching base of scutellum (Figs. 11, 14); eastern Mediterranean coasts 7
 — Scutellar spot small, about half as long as scutellum (Fig. 17); Red Sea coast (Israel) *shalom* n. sp.
7. Thoracic setae brown; acrostichal setae well developed, long and erect; larger species (wing length 2.6 mm) (Turkey) *karatasensis* Munari
 — Thoracic setae yellowish; acrostichal setae reduced in size and number, often entirely missing; smaller species (wing length 1.4–2 mm) (Israel) *acrostichalis* n. sp.

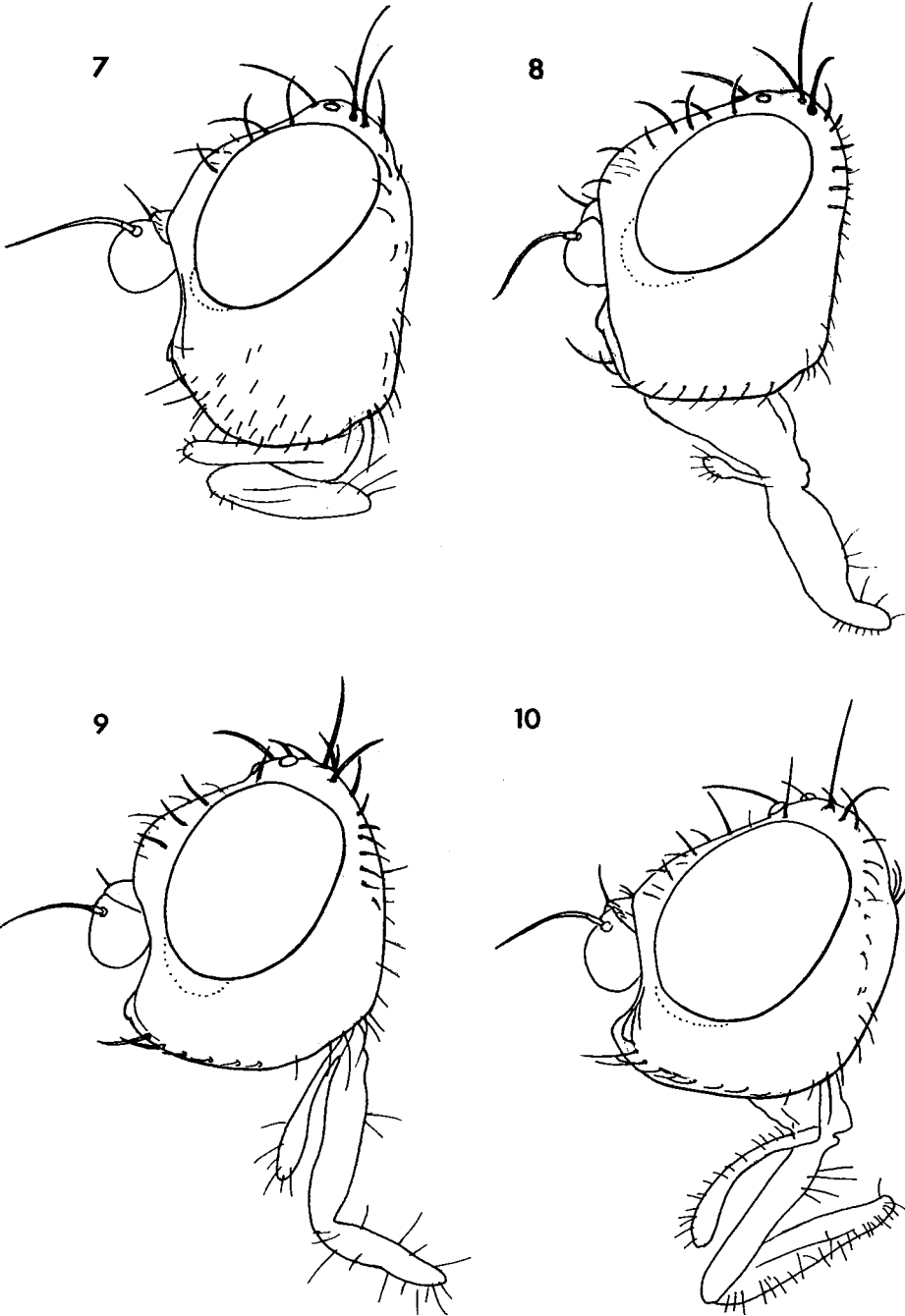
***Tethina acrostichalis* n. sp.**

(Figs. 3, 11, 19, 23, 29)

DIAGNOSIS. Differing from the other species of this group by the combination of a relatively large dark scutellar spot that occupies more than half of the dorsal surface of the scutellum, reduced number of acrostichal setulae that are often lacking entirely, and by the terminalia. The male epandrium and surstylus are triangular in lateral view, with the latter pointed ventrally. The female cercus bears 7–8 spines, arranged in one transverse, preapical row, although one of the small spines may be off the row.



Figs. 3–6. *Tethina* spp., head, lateral view. 3. *T. acrostichalis* n. sp. 4. *T. alboguttata* (Strobl). 5. *T. guttata* n. sp. 6. *T. karatasensis* Munari.



Figs. 7-10. *Tethina* spp., head, lateral view. 7. *T. pictipennis* n. sp. 8. *T. quadricephala* n. sp. 9. *T. shalom* n. sp. 10. *T. yaromi* n. sp.

DESCRIPTION. *Head* (Fig. 3): Coloration: Predominantly yellow, but dorsal 3/5 of postcranium, vertex and posterior part of frons, including ocellar triangle, blackish, mostly covered by silvery gray microtomentum, but mesofrons and posterior corner of postgena without microtomentum; gena anterodorsally, just ventral to eye, with crescentic area that appears microtomentose only in anterior view; antenna yellow; arista yellow proximally, brownish at distal half; proboscis and palp yellow; setae and setulae usually whitish or yellow, occasionally brownish (as they also are on other body parts). Structure and chaetotaxy: Head subquadrate; frontofacial angle about 100–120°; eye small, oval, oblique; gena slightly higher than half height of eye; face low, more or less vertical, slightly concave, with indistinct and narrow carina; supervibrissal callus (= facial knob) distinct; proboscis geniculate, labella about half as long as ventral head margin. Palpus elongate. Frons profusely and evenly setulose; subvibrissal (= peristomal) setae about 1/2 as long as vibrissa-like seta, except anterior seta equal to vibrissa-like seta; gena otherwise without setulae.

Thorax: Ground color dark but, except for large shiny oval area anteromesally that is usually hidden by head, entirely obscured by heavy grayish yellow microtomentum, which is more golden on most of scutum, more silvery on pleura and posterior part of scutum; scutellar spot (Fig. 11) large and dark, extended to or nearly to anterior margin of scutellum, velvety blackish; setulae usually almost entirely restricted to presutural area; acrostichal setulae often entirely lacking; if present, mostly restricted to a few pairs on anterior half of scutum, rarely present on posterior half of scutum; discrete prescutellar acrostichal seta lacking; dorsocentral setae 1 + 3, but slightly enlarged setula usually present anterior to presutural seta; intra-alar row comprising 1 presutural seta and 2 widely gapped postsutural setae, all, especially middle seta, short, often barely distinguished from scutal setulae; supraalar row comprising of similar but much longer three setae; proepimeral seta present, shorter than proepisternal seta.

Legs: Entirely yellow, except distalmost tarsomere blackish and penultimate tarsomere brownish at least distally; setae and setulae yellow, except midtibial spur and setulae at apex of midtibia, along mid metatarsus ventrally and at apex of mid and hind tarsomeres brown; hind femur rather strongly turgid in male.

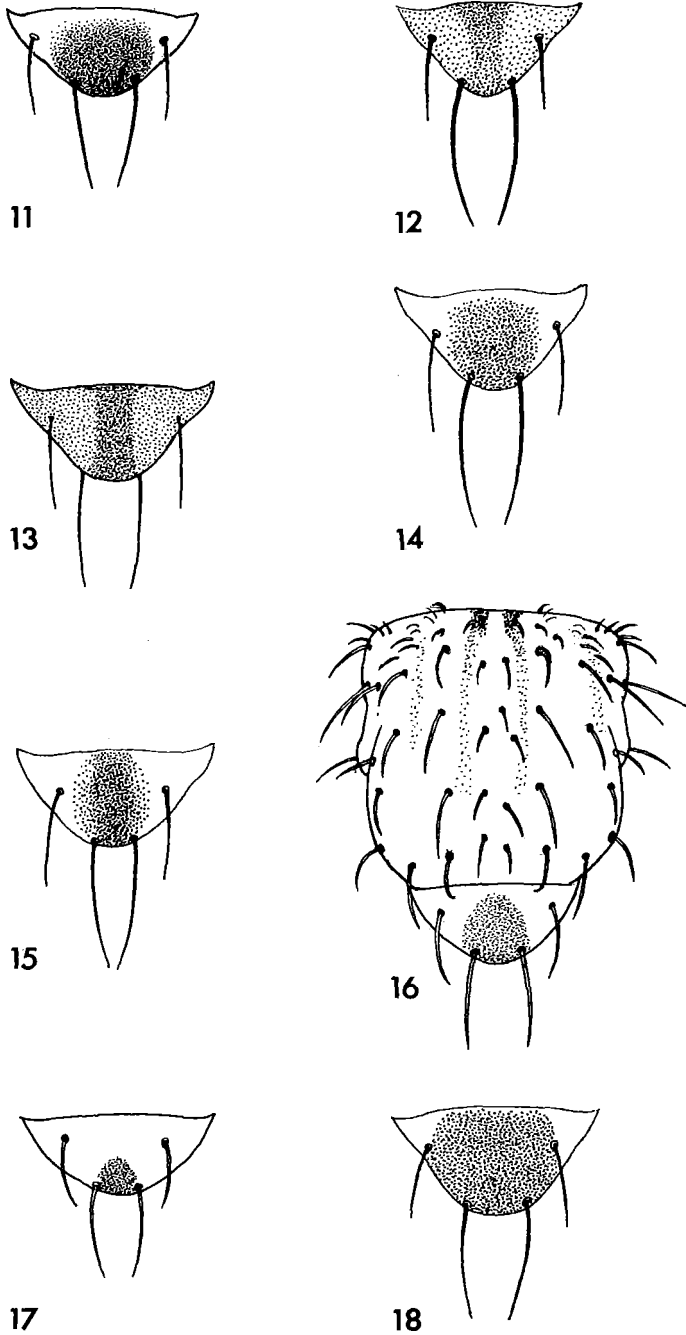
Wing (Fig. 19): Opaque, milky to yellowish, with longitudinal veins brownish, but crossveins r-m and dm-cu and immediate surroundings colorless or whitish, contrasted with general background; crossvein r-m opposite proximal 0.3–0.4 of section of vein M bordering cell dm. Halter whitish, with yellowish stem. Wing length 1.4–2 mm.

Abdomen: Rather conspicuously striated, with T2 through T6 having more or less extensive (1/6–3/5 of length of tergite) whitish posterior margin contrasted with usually brown anterior part, although anterior part of T6 usually hidden under T5; T1 often almost entirely brown, except laterally yellow; T1 and T2 sometimes predominantly yellow, but even then whitish margin still obvious; terminalia yellow; microtomentum gray, not obscuring striation.

Male terminalia (Fig. 23): Epandrium and surstylus almost entirely fused, in lateral view forming a narrow triangular structure, with the surstylus pointed ventrally.

Female terminalia (Fig. 29): Cercus spatulate, essentially with single transverse row of 7–8 spines subapically; 3–4 mesal spines distinctly smaller; epiproct with a pair of fine setae.

MATERIAL EXAMINED. Holotype ♂, ISRAEL: Tel Aviv Dunes [Tel Baruh], 14.iv.1994, A. FREIDBERG. Paratypes: same locality data as holotype (27 ♂, 46 ♀); additional paratypes: Tel Aviv Dunes [Tel Baruh], 8.iv.1981, A. Freidberg (1 ♂, 4 ♀); Tel Aviv Beach, Country Club, 14.iii.[19]95, B. Merz (3 ♂, 11 ♀), 24.iv.1996, A. Freidberg (10 ♂, 30 ♀); Holon, 5.iii.1996,



Figs. 11–18. *Tethina* spp., scutellum, dorsal view. 11. *T. acrostichalis* n. sp. 12. *T. alboguttata* (Strobl). 13. *T. guttata* n. sp. 14. *T. karatasensis* Munari. 15. *T. pictipennis* n. sp. 16. *T. quadricephala* n. sp. (including scutum). 17. *T. shalom* n. sp. 18. *T. yaromi* n. sp.

A. Freidberg (2♂), 6.iv.1981, A. Freidberg (1♂, 4♀), 14.iv.1981, A. Freidberg (1♂; 1♀), 15.iv.1994, A. Freidberg & Fini Kaplan (1♂, 5♀); Shifdan [near Holon], 7.iii.1995, A. Freidberg (2♂, 5♀); Nizzanim, 23.iii.1995, A. Freidberg (12♂, 33♀), 7.ii.1996, A. Freidberg & I. Yarom (23♂, 18♀), 5.iii.1996, A. Freidberg (12♂, 13♀); Ziqim, 7.ii.1996, A. Freidberg & I. Yarom (1♂, 6♀); Sedot Yam, 17.iv.1995, M. Irwin (1♀); 'Atlit, 28.iv.1996, A. Freidberg (1♀); 'Atlit, 4 km N, 28.iv.1996, A. Freidberg (4♂, 5♀). The holotype is in excellent condition, is double mounted on a minuten nadel and plastic block and is deposited together with most paratypes in TAU. Some paratypes were returned to ETH. Other paratypes were distributed among the following institutions: AMS, BAS, BMNH, INHS, MSNV, USNM, ZMUC.

ETYMOLOGY. This species is named after the weak representation of acrostichal setulae.

COMMENTS. This species was found in large and dense populations, especially when compared to other Israeli species that belong to the same group. In Israel, it was collected from Sedot Yam in the north to Nizzanim in the south, within 100–2000 m from the Mediterranean coast. Munari (in litt.) informed us about specimens he studied from Tunisia, which compared well with specimens he saw from the type series of *acrostichalis*, although in his specimens the whitish halo around the crossveins was not conspicuous. The species, therefore, can be expected to have a circummediterranean distribution and to occur along the Mediterranean shore wherever there are sand dunes. It was found to live sympatrically with *T. quadricephalo* between Nizzanim and Tel Aviv. Specimens were collected between the beginning of February to the end of April. However, the sex ratio of the samples collected in Tel Aviv in late April (3:1 in favor of females) is probably an indication to the proximity of the end of the flight season. The flies apparently spend all or most of their time on sand. Specimens were observed walking, mating or resting on clean sand, hopping or flying short distance when disturbed, mostly to land again on the sand. Their body and wing coloration afford them good camouflage. About 30 males and females were transferred to a laboratory cage furnished with sand and plants from the collecting site. Some of these lived in the cage for a few weeks and were repeatedly observed mating, but oviposition was not observed, nor were immature stages found in the cage.

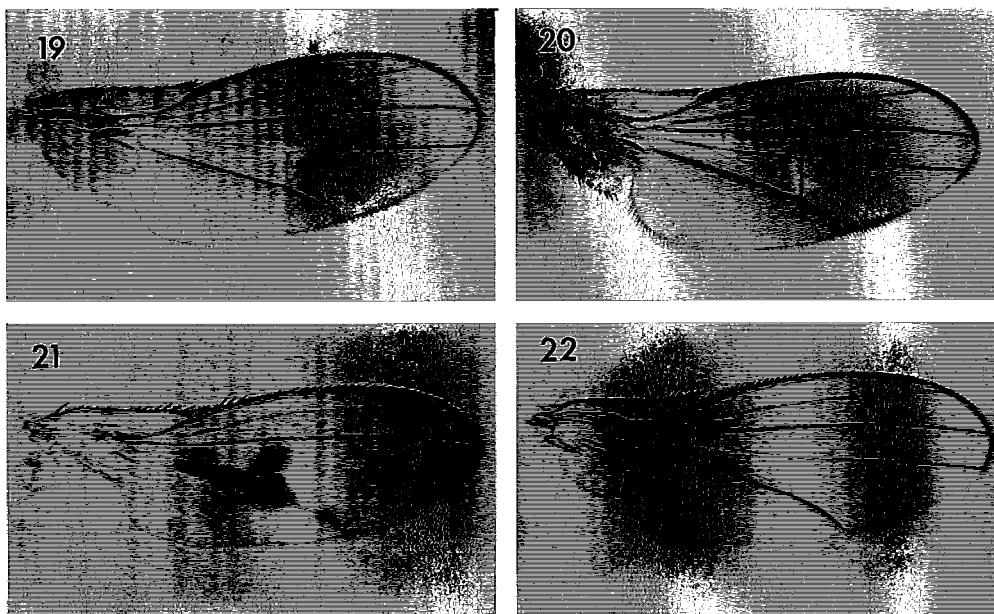
Tethina alboguttata (Strobl)

(Figs. 4, 12, 24, 30, 36)

Rhinoessa alboguttata Strobl, 1900:6.

Full synonymy in Soós (1984) and Mathis and Munari (in press).

This species was adequately redescribed by Czerny (1928), hence only critical characters are illustrated here. It is similar to *T. guttata* n. sp., its proposed sister species. They are readily distinguished from each other by the shape of the head, which is higher than long in *alboguttata* (Fig. 4), less triangular and with the ventral margin less protuberant (longer than high, more triangular, and with the ventral margin more protuberant in *guttata*); the shape of the surstylus (Fig. 24), which is aligned with the longitudinal axis of the epandrium (not so aligned in *guttata*, Fig. 25); and the female terminalia (Fig. 30), which include 2–3 short spines on the basal half of the cercus (without spines on the basal half in *guttata*). Wing length 1.8–2.7 mm. Ten mature eggs were found inside the abdomen of a female. The egg is about 0.5 mm long, about 3 times as long as wide with the micropilar end slightly more pointed (Fig. 36).



Figs. 19–22. *Tethina* spp., wing. 19. *T. acrostichalis* n. sp. 20. *T. guttata* n. sp. 21. *T. pictipennis* n. sp. 22. *T. quadricephala* n. sp.

MATERIAL EXAMINED. SPAIN: “Tarifa, Rhicnoessa alboguttata Strobl, coll. Thalham” (1 ♂; HNHM); “Algeciras, Andalusien, Pr. G. Strobl, coll. Thalham.” (1 ♀; HNHM); Granada, Torrenueva E Motril, 12–17.iv.1966, Lyneborg, Martin & Langemark (3 ♂, 6 ♀; ZMUC); Barcelona, Castelldefels, 10.xii.1983, Carles Tolrá (4 ♂, 3 ♀; in Carles Tolrá private collection). MOROCCO: Ain Diab, 3.i.1951, P. Kinch (1 ♀; ZMUC). The holotype male from Algeciras (in Strobl collection, Admont, Austria) was not studied.

COMMENTS. Originally described from Spain, this species was also recorded from Algeria and Tunisia (Soós, 1984), Sicily and Sardinia (with query; Munari, 1995), and is recorded here from Morocco. Mathis and Munari (1996) mention it from the Canary Islands and St. Helena. They also give a full list of references for this species. Collin (1966) noticed variation in size and coloration, which is also noticed in the material studied by us. It is noteworthy that the dark median thoracic stripe (Fig. 12) is sometimes missing, a variation also apparent in *guttata* n. sp.

***Tethina guttata* n. sp.**
(Figs. 5, 13, 20, 25, 31)

DIAGNOSIS. This species is closely related to *T. alboguttata* (Strobl), with which it shares the generally dark body coloration and the triangular head. However, the head and proboscis are even more prolonged in *guttata*. Because *guttata* differs from the species of the *acrostichalis* subgroup in so many characters, a full description is given to it.

DESCRIPTION. *Head* (Fig. 5): Coloration and chaetotaxy: Predominantly whitish to yellow, postcranium, postgena, vertex and extension including ocellar triangle blackish, mostly covered by silvery gray microtomentum, but mesofrons only lightly microtomentose; gena anterodorsally, just ventral to eye, with crescentic area that appears microtomentose only in anterior view; antenna yellow or brownish yellow, generally darker in female than in male; arista and 1st flagellomere brown proximally; prementum partly brown; clypeus brown; setae and setulae predominantly dark brown or blackish (as they also are on other body parts); bases of lateral vertical, median vertical and two posterior fronto-orbital setae surrounded by black spots; vibrissa-like seta, several posterior subvibrissal (= peristomal) and postgenal setae whitish or yellow; subvibrissal (= peristomal) setae about as long as vibrissa-like seta, except anterior seta which is longer. Structure: Head triangular; frontofacial angle about 135°; eye moderately small, oval, oblique; gena 0.3–0.4 times as high as eye; face very oblique, strongly protuberant ventrally, slightly concave, with rather distinct carina; proboscis strongly geniculate, labella about as long as ventral head margin; palpus about 2/3 as long as labella.

Thorax: Ground color dark but, except for large shiny oval area anteromesally that is usually hidden by head and small shiny area anterior of postpronotum, entirely invested by heavy grayish yellow microtomentum, appearing lighter on pleura in most angles and having a more or less clear brownish sheen medially on scutum, along acrostichal and intra-alar lines and at dorsal margin of anepisternum; brown acrostichal stripe extends across scutellum and widened to fill gap between apical scutellar setae; these brown stripes variously developed, often interrupted, sometimes indistinct; scutellar spot most often visible (Fig. 13), although weakly contrasted with lighter gray background; base of setae and most setulae surrounded by blackish spot; setulae more or less evenly distributed over scutum; acrostichal setulae in 2–4 (usually 2) irregular rows, usually with undifferentiated prescutellar pair; dorsocentral setae 1 + 3, with few setulae in between, and usually slightly enlarged setula anterior to presutural seta; intraalar row comprised of 1 presutural seta and 2 widely gapped postsutural setae, all, especially middle seta, short, often barely distinguished from intraalar setulae; supraalar row comprises of 1 + 3, much longer, setae; proepimeral seta much shorter than proepisternal seta, usually tiny, lacking in about 25% of the specimens.

Legs: predominantly yellow, but coxae and trochanters, especially mid and hind coxae and trochanters, all femora except apices, and occasionally hind tibia dark brown to black, with light gray microtomentum, although posterior surface of hind femur, except apex, strongly shiny, devoid of microtomentum; distalmost tarsomere, especially of mid and hind legs, blackish; setae and setulae mostly brown on dark parts, mostly yellow on yellow parts; midtibial spur and setulae at apex of midtibia, along mid metatarsus ventrally and at apex of mid and hind tarsomeres brown to black; hind femur strongly turgid in male, although this character appears to be allometric (proportionately more turgid in larger males).

Wing (Fig. 20): Opaque, distinctly grayish to brownish, with longitudinal veins brownish, but crossveins r–m and dm–cu and immediate surroundings colorless or whitish, contrasted with general background; crossvein bm–cu, small area distal to vein CuA₂ and cell a also lighter than general background; crossvein r–m opposite middle of section of vein M bordering cell dm. Halter whitish, with some infuscation and with yellow to brownish stem. Wing length 2–2.5 mm.

Abdomen: Predominantly dark brown, with narrow whitish posterior margins of tergites not sharply delimited from dark parts, subshiny, with light gray microtomentum; setae and setulae predominantly brown.

Male terminalia (Fig. 25): Epandrium quadrate in lateral view; surstylus triangular or axelike.

Female terminalia (Fig. 31): Cercus relatively narrow and widened apically, with 6–8 relatively long and straight spines arranged in two partial or full rows restricted to apicodistal quarter of cercus.

MATERIAL EXAMINED. Holotype ♂, ISRAEL: Bor Meshash, 28.ii.1996, A. FREIDBERG & N. DORCHIN. Paratypes: Same locality data as holotype (30♂, 21♀), 16.iii.1995, A. Freidberg & B. Merz (1♂, 1♀), 29.iii.1996, A. Freidberg (1♂, 1♀), 21.iv.1987, A. Freidberg (1♀); Sede Halamish (near Nizzana), 29.iii.1996, A. Freidberg & Y. Malichi (4♀); Kerem Shalom, 10 km S, 30.iv.1996, A. Freidberg (1♀); Deqel, 30.iv.1996, A. Freidberg (1♀); Nizzanim, 5.iii.1996, A. Freidberg (2♀). EGYPT: near Mizpaq, west of El Arish [label reads: Israel, Nahal Yam], 3.ii.1973, A. Freidberg (3♂, 2♀). Additional material: TUNISIA: Gafsa, Biro, 23.iii.1923 (1♂; HNHM). The holotype is in excellent condition, is double mounted on a minuten nadel and plastic block and is deposited together with most paratypes in TAU. Some paratypes were returned to ETH. Other paratypes were distributed among the following institutions: AMS, BAS, BMNH, INHS, MSNV, USNM, ZMUC.

COMMENTS. This is the eastern sister species of *T. alboguttata*. It is the only species in this group that was found at a considerable distance from the sea coast (in Bor Meshash, about 50 km from the nearest coast), indicating the ecological affinity of the entire group to dry sand habitats.

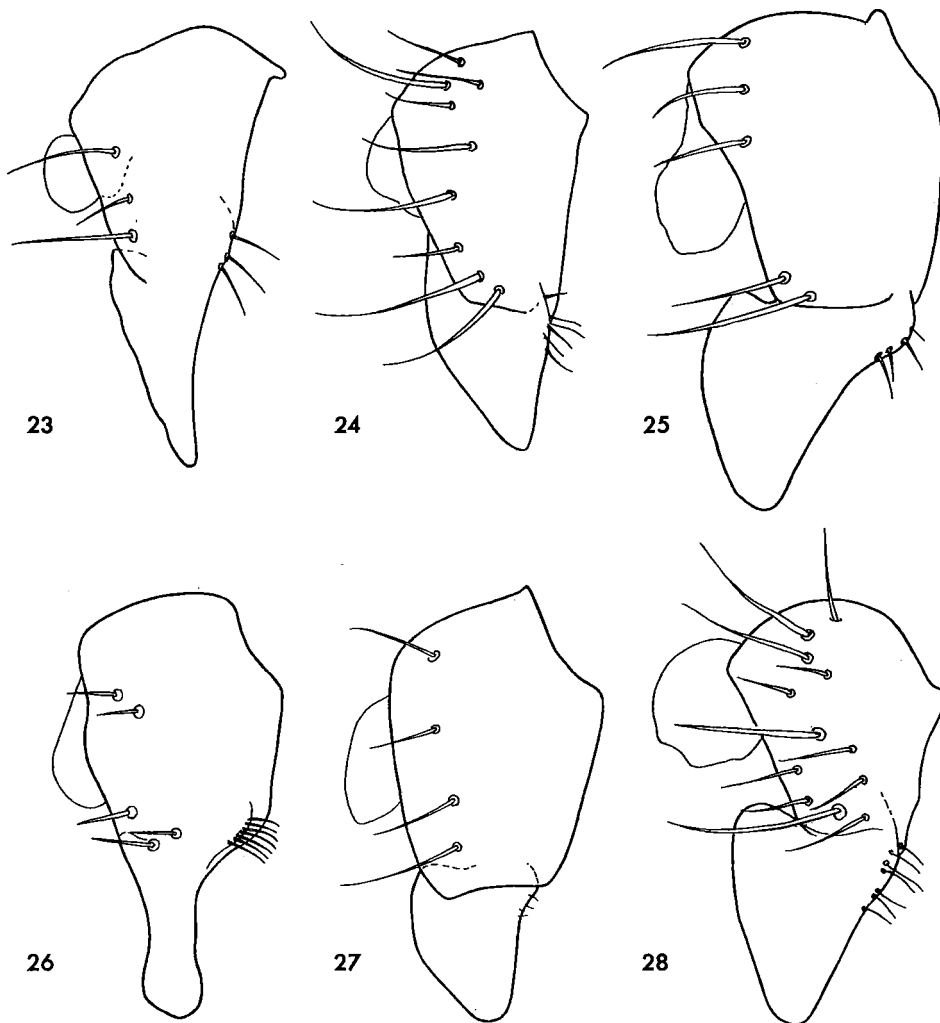
Tethina karatasensis Munari

(Figs. 6, 14)

Tethina karatasensis Munari, 1981:139 (Fig. 1).

This species was described from the beach of Karatàs (located at the Gulf of Alexandreta), Turkey, based on a single female, which is still the only known specimen. Thanks to Mr. Munari and Dr. Ratti, Venezia, we were able to study the holotype. The species was adequately described and illustrated, and a detailed redescription is not necessary. It is similar to *acrostichalis*, differing from it primarily by the characters mentioned in the key. A more detailed comparison follows: it is larger and generally darker than *acrostichalis*. Gena (Fig. 6) lower than half height of eye (higher in *acrostichalis*), but this might be due to the fact that the head is slightly sunken in; cephalic and thoracic setae darker, generally brown and longer than the yellow to brownish setae of *acrostichalis*; acrostichal setulae conspicuous, arranged in two (×2) irregular rows on anterior half of scutum and in one (×2) row on posterior half of scutum; scutal microtomentum predominantly gray, with only small yellowish area centrally, whereas in *acrostichalis* it is mostly yellowish to golden; scutellar spot (Fig. 14) essentially as in *acrostichalis*; wing as in *acrostichalis*, with crossvein r–m opposite proximal 0.35 of section of vein M bordering cell dm; abdomen almost entirely blackish, with large, dark lateral spots of microtomentum on the tergites and only irregular, small, yellow spots posteriorly on some tergites, not conspicuously or predominantly yellow, with distinct yellow posterior margins, as in *acrostichalis*. Wing length 2.6 mm.

MATERIAL EXAMINED. Holotype ♀, [TURKEY:] Asia Minore, Karatàs, 22.v.61, A. Giordani-Soika / Spiaggia bagnata (Talitreum) / HOLOTYPUS *Tethina karatasensis* n. sp. / det. L.



Figs. 23–28. *Tethina* spp., male, epandrium and surstylus, lateral view. 23. *T. acrostichalis* n. sp. 24. *T. alboguttata* (Strobl). 25. *T. guttata* n. sp. 26. *T. quadricephala* n. sp. 27. *T. shalom* n. sp. 28. *T. yaromi* n. sp.

Munari 1979. The specimen is glued sidewise to a cardboard triangle, is in good condition, except the tip of the abdomen slightly damaged (by *Anthrenus*) (MSNV).

COMMENTS. Two of the three synapomorphies of the *alboguttata* group are clearly seen on the single specimen available for study: the darkly maculated scutellum and the whitish spotted crossveins. The third synapomorphy, the pseudacanthophorites, cannot be seen and was not mentioned in the original description because of damage to the tip of the abdomen. Examining additional specimens from the type locality would undoubtedly validate the third synapomorphy as well as the specific status for this species and *acrostichalis*.

Tethina pictipennis n. sp.

(Figs. 7, 15, 21)

DIAGNOSIS AND DESCRIPTION. This species is related to *T. acrostichalis* from which it can be distinguished by the quadrate head shape, setulose gena and heavily patterned wing. A fuller list of differences follows:

Head (Fig. 7): Postgena entirely microtomentose; setae and setulae blackish; head quadrate; frontofacial angle about 100°; gena about 0.8 times as high as eye; labella about 2/3 as long as ventral head margin; frons with 2 (pairs) of long interfrontal setulae (developed as setae) and 3–4 tiny setulae laterally; gena with scattered, yellowish, short, erect setulae, from which subvibrissal setulae cannot be easily distinguished.

Thorax: Coloration more striking: most of scutum with golden microtomentum, except postpronotal, notopleural and prescutellar areas (latter about the size of scutellum, with silver microtomentum; scutellar spot (Fig. 15) occupying about central 1/3 of scutellum, nearly reaching anterior margin and not clearly delimited laterally; pleura with silvery microtomentum; proepimeral seta lacking.

Legs: predominantly yellow, but at least 2 distalmost tarsomeres almost always blackish; female fore tarsus in addition with preceding 2 tarsomeres distally brown; hind femur on distal half slightly darkened; setae and setulae predominantly blackish.

Wing (Fig. 21): With unique pattern, which comprises three quadrate blackish spots more or less at the middle of each section of vein M, respectively, extending across the cells anterior and posterior of this vein, not quite reaching vein R_{4+5} , reaching the longitudinal fold in cells dm and m; proximal spot more elongate than other two; cell dm, posterior of fold, with blackish longitudinal band, filling distal 3/5 of space, except near crossvein dm–cu, more or less connected with the two proximal spots and partly extended across vein CuA₁ into cell cua₁; similar but smaller spot present over distalmost section of vein CuA₁; isolated blackish spot present near center of cell cua₁, reaching or nearly reaching hind margin of wing; more or less clear infuscation present in cell r₁, posterior of pterostigma, and along hind margin in cell m; veins mostly yellow but blackish where pattern present; pattern highlights white crossveins r–m and dm–cu and surrounding areas; crossvein r–m opposite middle of section of vein M bordering cell dm; costal setulae long and spaced out, spine-like. Wing length 2–2.6 mm.

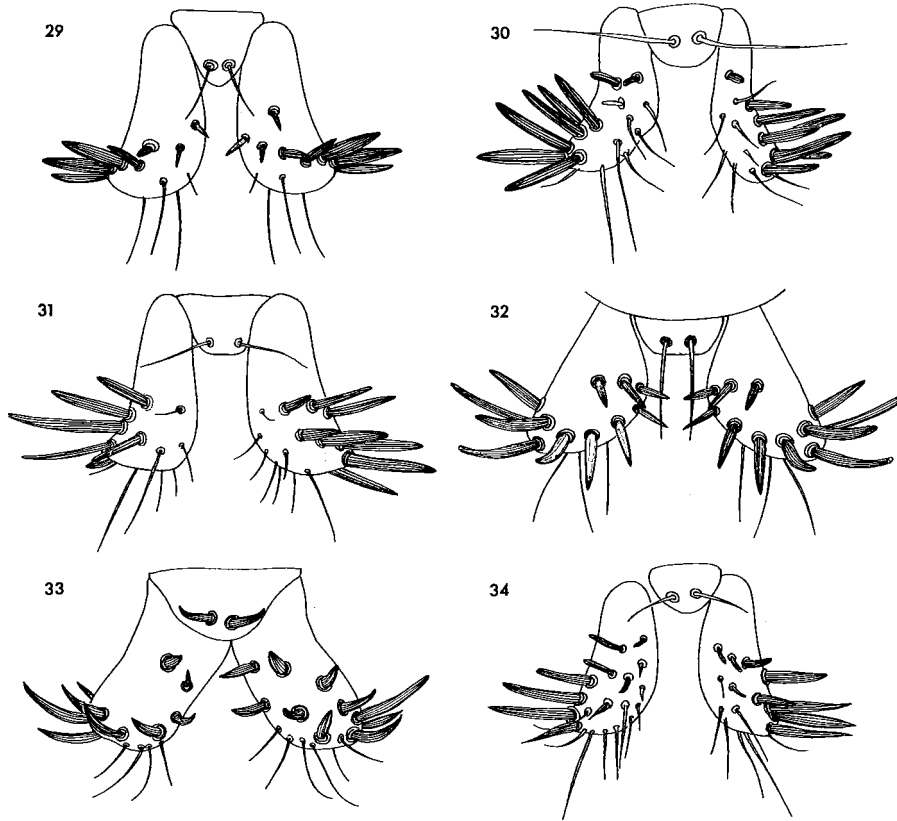
Abdomen: Of holotype: Predominantly yellow, with irregular blackish areas and spots on anterior tergites, blackish transverse bands anteriorly on T5 and T6, where whitish posterior margins more conspicuous; microtomentum gray, more conspicuous on blackish areas; terminalia blackish and yellow; setae and setulae blackish.

Male and female terminalia: Not dissected, although female cerci exposed, clearly showing presence of pseudacanthophorites.

MATERIAL EXAMINED. Holotype ♂: MOROCCO: 0–20 m, 40 km S Larache, 23–24.iv.1989, Zool. Mus. Copenh. Exp. Paratypes: same locality data as holotype (1♂, 1♀). The holotype is in good condition, is double mounted on a minuten nadel and polyporus block and is deposited together with the paratypes in ZMUC.

ETYMOLOGY. Named after the beautifully patterned wing.

COMMENTS. This species is known only from the holotype and two other, badly damaged specimens. The holotype is one of the largest specimens checked in this study, but the paratypes



Figs. 29–34. *Tethina* spp., female, cerci and spines (“pseudacanthophorites”). 29. *T. acrostichalis* n. sp. 30. *T. alboguttata* (Strobl). 31. *T. guttata* n. sp. 32. *T. quadricephala* n. sp. 33. *T. shalom* n. sp. 34. *T. yaromi* n. sp.

are considerably smaller. This species is unique among all congeners, as well as within the entire family, in having a discrete wing pattern. Like all members of the *alboguttata* group, crossveins r–m and dm–cu are whitish and embedded in whitish areas. Unlike the other members, these whitish spots are highlighted by three dark spots proximal, between and distal to them. More posteriorly, these dark spots partially unite to form a more complex pattern.

***Tethina quadricephala* n. sp.**

(Figs. 8, 16, 22, 26, 32)

DIAGNOSIS AND DESCRIPTION. This species is closely related to *T. acrostichalis* from which it can be distinguished by the quadrate head shape, shorter labella, coarser acrostichal setulae and male and female terminalia. A fuller list of differences follows:

Head (Fig. 8): Only dorsal half of postcranium blackish; only mesofrons devoid of microtomentum; arista almost entirely brownish; anterior subvibrissal (= peristomal) seta also

only half as long as vibrissa-like seta; head more quadrate; frontofacial angle about 90–100°; eye smaller, horizontal or nearly so; gena slightly higher than eye; face barely protuberant ventrally, more distinctly concave, without carina; proboscis, including labella, slightly shorter.

Thorax (Fig. 16): Anterior dark scutal area with pair of narrow acrostichal extensions that fade out and disappear toward middle of scutum; scutellar spot generally narrower and lighter, usually brownish; more setulae on postsutural area, especially acrostichal setulae which are long, extend along scutum and contain discrete prescutellar pair; proepimeral seta lacking.

Wing (Fig. 22): Crossvein r–m opposite middle of section of vein M bordering cell dm. Wing length 2–2.6 mm.

Abdomen: With similar pattern, but white posterior margin of tergites often less contrasted with dark parts, sometimes extremely narrow.

Male terminalia (Fig. 26): Epandrium and surstylus united, but former much wider than latter, which is narrowed distally, but slightly widened and rounded at apex.

Female terminalia (Fig. 32): Cercus widest around middle, with row of 11 spines decreasing in size mesad, extending recurrently to middle of cercus.

MATERIAL EXAMINED. Holotype ♂, EGYPT: near Mizpaq, west of El Arish [label reads: Israel, Nahal Yam], 3.ii.1973, A. Freidberg. Paratypes: Same locality data as holotype (5♂, 8♀). Additional paratypes: Holon, 6.iv.1981, A. Freidberg (1♀); Nizzanim, 23.iii.1995, A. Freidberg (1♂). The holotype is in excellent condition, is double mounted on a minuten nadel and polyporus block and is deposited together with the paratypes in TAU.

ETYMOLOGY. This species is named after the quadrate shape of the head in profile.

COMMENTS. This species was only found along the southeast Mediterranean coast where it is partly sympatric with *acrostichalis* and *guttata*.

***Tethina shalom* n. sp.**
(Figs. 9, 17, 27, 33, 35)

DIAGNOSIS AND DESCRIPTION. This species is closely related to *T. acrostichalis*, from which it can be distinguished by the relatively longer head, with more protuberant ventral facial margin and longer labella, smaller scutellar spot and male and female terminalia. A fuller list of differences follows:

Head (Fig. 9): Eye slightly larger; gena about 0.4 as high as eye; ventral facial margin slightly more protrudent; proboscis, including labella, slightly longer.

Thorax: Scutellar spot (Fig. 17) triangular, smaller, about half as long as scutellum, base as wide as gap between apical scutellar setae; setulae less restricted to presutural area, and acrostichal setulae in 3 irregular pairs along anterior half of scutum.

Wing: Crossvein r–m opposite middle of section of vein M bordering cell dm. Wing length 1.7–1.8 mm.

Legs: Apical tarsomere of all legs lighter, brownish, sometimes barely darker than other, yellow, tarsomeres.

Abdomen (observed intact only on the holotype (♂)): As in *acrostichalis*.

Male terminalia (Fig. 27): Epandrium and surstylus separate; surstylus in lateral view a more or less rounded flap.

Female terminalia (Fig. 33): Cercus quadrate, with 9–10 thicker spines, extending in 1 or 2

rows toward base; epiproct with pair of spines. Spermatheca rounded, borne on wide tube; ventral receptacle a membranous extension of the bursa copulatrix, with cluster of 4–5 sclerotized “domes” subapically on either side (Fig. 35).

MATERIAL EXAMINED. Holotype ♂, ISRAEL: Elat, 28.iv.1974, A. FREIDBERG. Paratype: same locality data as holotype (1 ♂); additional paratype, ISRAEL: Taba, 27.iv.1974, A. Freidberg (1 ♀). The holotype is in good condition, is double mounted on a minuten nadel and polyporus block and is deposited together with the paratypes in TAU.

ETYMOLOGY. This species is named after the developing peace process between Israel and Arabic countries (peace = *shalom* in Hebrew). It is especially appropriate to bear this name because the specimens were collected in the Elat–Taba area, where in a small area, two passes actively connect now Israel to Jordan and Egypt, countries that were still hostile to Israel at the time the type specimens were collected.

COMMENTS. This species is known only from the holotype and two other, badly damaged specimens. Both morphological and distributional characters indicate that it is distinct from *T. acrostichalis*, its closer congener. However, to keep the holotype in good condition it was not dissected. The male terminalia were illustrated from the male paratype, which had the terminalia somewhat distorted. Hence the accuracy of this drawing is questionable.

***Tethina yaromi* n. sp.**

(Figs. 10, 18, 28, 34)

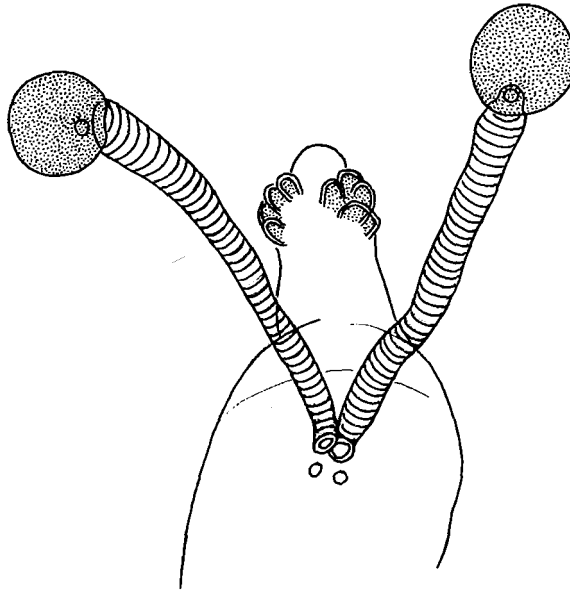
DIAGNOSIS AND DESCRIPTION. This species is closely related to *T. acrostichalis* from which it can be distinguished by the predominantly blackish coxae and femora. A fuller list of differences follows:

Head (Fig. 10): Microtomentum gray; postgena entirely microtomentose; antennal coloration sexually dimorphic: male antenna predominantly yellow, 1st flagellomere laterobasally and sometimes also mesally slightly blackish; female antenna varies between the condition described for male (in few females) to entirely or nearly entirely blackish, but usually 1st flagellomere entirely blackish laterally; arista brownish, darker on distal half; proboscis largely yellow, but sclerotized parts of prementum blackish; setae and setulae mostly blackish (as also on thorax), on postgena yellowish; head triangular; fronto-facial angle about 120–135°; eye larger; gena slightly lower than half height of eye; face distinctly protuberant; proboscis strongly geniculate; labella about as long as ventral head margin.

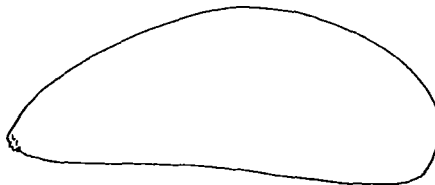
Thorax: Microtomentum gray, occasionally brownish at mid scutum; scutellar spot (Fig. 18) lighter, less velvety and less contrasted with background, larger, extending to or nearly to anterior margin of scutellum, leaving only small lateral corner of scutellum paler; setulae more or less evenly distributed on scutum; acrostichal setulae in one (×2) complete and more or less regular row; prescutellar acrostichals occasionally differentiated as setae.

Legs: Coxae blackish; femora predominantly blackish except basally yellow and distally narrowly yellow; tibiae more or less brownish except yellow base, although fore tibia often entirely yellow and hind tibia usually predominantly blackish; tarsi yellow, except distalmost 1–2 tarsomeres blackish; setae and setulae generally darker (blackish) on dark parts, lighter (yellowish) on light parts.

Wing: As in *quadricephala* (compare with Fig. 22); also similar to *acrostichalis* (compare



35



36

Figs. 35–36. 35. *Tethina shalom* n. sp., female, spermathecae and ?ventral receptacle. 36. *Tethina alboguttata* (Strobl), egg.

with Fig. 19), except crossvein r–m usually opposite middle of section of vein M bordering cell dm. Wing length 1.5–2.5 mm.

Abdomen: Anterior margin of tergites blackish; white posterior margin of tergites usually less than 1/3 as long as tergite and usually more conspicuous on T3–T5, sometimes barely distinct; terminalia predominantly blackish, although surstylus yellow.

Male terminalia (Fig. 28): Shape intermediate between that of *alboguttata* and that of *guttata*: surstylus with a “shoulder” strongly protruding posteriorly beyond ventral margin of epandrium (as in *guttata*), but surstylus nearly aligned with longitudinal axis of epandrium (nearly as in *alboguttata*).

Female terminalia (Fig. 34): Cercus with 4–5 long spines laterodistally and 4–5 short spines medioidistally.

MATERIAL EXAMINED. Holotype ♂, SPAIN: Almería, Cabo de Gata, 28.iii.1996, I. YAROM. Paratypes: same locality data as holotype (73♂, 110♀). Additional paratypes: SPAIN: Almería, Cabo de Gata, 24.iii.1966, Leif Lyneborg (1♂, 4♀); same locality data, but 26.iii.1966 (2♀), 31.iii.1966 (2♂, 6♀). The holotype is in excellent condition, is double mounted on a minuten nadel and plastic block and is deposited together with most paratypes in TAU. Paratypes were returned to ZMUC and also distributed among the following institutions: AMS, BAS, BMNH, ETH, INHS, MSNV, USNM.

ETYMOLOGY. Named after Ilan Yarom, a friend and dipterist, who collected most of the type series.

COMMENTS. This species occupies an intermediate position between the two main subgroups of the *acrostichalis* group. On the one hand, it resembles the *alboguttata* subgroup in the generally dark coloration, including the coxae, femora and most setae and setulae, and in the relatively long proboscis, the labella of which is about as long as the ventral head margin. On the other hand, the thoracic coloration is more similar to that of the *acrostichalis* subgroup, with the thorax generally heavily and uniformly gray microtomentose, having a dark, isolated and contrasted scutellar spot, which is not an extension of a median scutal vitta.

The species was first collected by the renowned Danish dipterist, Leif Lyneborg. Exactly 30 years later, equipped with the necessary knowledge, another enthusiastic dipterist, the Israeli Ilan Yarom, rediscovered this species in the same place. Dr. Yarom collected a large series by sweeping over the sand about 50–500 m from the shore (mostly 500 m), at the westernmost reserve of the “Parque Natural Marítimo Terrestre de Cabo de Gata — Nijar” (about 15 km east of the city of Almería) in southeastern Spain. According to Dr. Yarom, the habitat mostly comprised semi-stabilized sand dunes with low vegetation, which covered about 10–20% of the area. The dunes comprise quartz sand grains rich with volcanic ash rendering a somewhat greenish appearance.

ACKNOWLEDGMENTS

We are grateful to Ilan Yarom for his special effort in collecting tethinids while on vacation in Spain; to the authorities of the Parque Natural Cabo de Gata — Nijar and especially to the rangers, Jose-Angel Rodriguez Fenoy and Antonio Garcia Coello, who generously helped Ilan while in the park; to L. Munari for critically reviewing the manuscript; to L. Munari and Wayne N. Mathis for permission to use data from their unpublished catalog of Tethinidae; to Michael E. Irwin and Ilan Yarom, for reviewing the manuscript; to W. Ferguson for the drawings; and A. Shoob for the photography. Nomi Paz checked the style of the manuscript.

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