

MICROPSECTRA ALYSSAE SP. N. AND M. EKREMI SP. N., TWO NEW SPECIES INHABITING GLACIAL SPRINGS AND PEAT BOGS IN THE EASTERN PYRENEES, FRANCE (DIPTERA: CHIRONOMIDAE, TANYTARSINI)

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Abstract

Micropsectra alyssae sp. n. and *M. ekremi* sp. n. are diagnosed and described based on associated material of adults, paratype male and female adults and pupal exuviae collected in glacial springs and acid peat bogs (altitude 2000-2300m) in the upper basin of the River Mantet (Mantet Nature Reserve, Eastern Pyrenees, south-western France). The descriptions include the male and female adults and pupal exuviae for *M. alyssae* sp. n. and *M. ekremi* sp. n., with taxonomic notes on some related *Micropsectra* species. The geographical distribution of *M. alyssae* sp. n. and *M. ekremi* sp. n. is currently restricted to their type locality. Remarks on the taxonomic position and ecology of the two new species are given.

Key words: Chironomidae, *Micropsectra alyssae* sp. n., *M. ekremi* sp. n., glacial springs, peat bogs, Eastern Pyrenees (south-western France), conservation.

Introduction

Data on the taxonomy, geographical distribution and ecology of the genus *Micropsectra* Kieffer, 1909 from the Palaearctic Region (Shilova, 1976; Reiss, 1969a, 1969b, 1971, 1982, 1983; Cranston *et al.*, 1989; Stur and Ekrem, 2006; Ekrem *et al.*, 2010; Gilka, 2009, 2011; Gilka and Jazdzewska, 2010; Sæther and Spies, 2013; Moubayed-Breil and Ashe, 2018b) show that about 45 valid species are currently known from Europe and neighbouring regions.

In continental France, the genus *Micropsectra* is represented by about 32 taxa including 25 valid species and 6-7 undescribed species: *M. alyssae* sp. n.; *M. andalusiaca* Marcuzzi, 1950; *M. appendica* Stur and Ekrem, 2006; *M. apposita* (Walker, 1856); *M. cf. aristata* Pinder, 1976; *M. atrofasciata* (Kieffer, 1911); *M. attenuata* Reiss, 1969; *M. auvergnensis* Reiss, 1969; *M. chionophila* (Edwards, 1933); *M. ekremi* sp. n.; *M. junci* (Meigen, 1818); *M. lacustris* Säwedä, 1975; *M. lindrothi* Goegeheuer, 1931; *M. mendli* (Reiss, 1983); *M. nohedensis* (Moubayed and Langton, 1996); *M. notescens* (Walker, 1856); *M. oksanae* Moubayed-Breil and Ashe, 2018 (previously cited as *M. sp. 6* in Moubayed-Breil and Ashe, 2016); *M. pallidula* (Meigen, 1830);

M. radialis Goetghebuer, 1939; *M. recurvata* Goetghebuer, 1928; *M. roseiventris* (Kieffer, 1909); *M. shrankelae* Stur and Ekrem, 2006; *M. sofiae* Stur and Ekrem, 2006; *M. styriaca* Reiss, 1969 and *M. uliginosa* (Reiss, 1969).

In this paper *Micropsectra alyssae* sp. n. and *M. ekremi* sp. n. are described as male and female adults and pupal exuviae based on associated material recently collected in pristine glacial springs and acid peat bogs located in the protected area of the Mantet Nature Reserve (upper basin of the River Mantet, Eastern Pyrenees, altitude 2000-2300m). In both diagnoses and descriptions of the two new species, the male and female adults and pupal exuviae are compared with some known or recently recorded *Micropsectra* species from the Eastern Pyrenees: *M. cf. aristata*, *M. attenuata*, *M. atrofasciata*, *M. auvergnensis*, *M. nohedensis*, *M. shrankelae*, *M. sofiae* and two undescribed species: *M. sp. 1* and *M. sp. 2*.

The recent updated list of **807** taxa previously reported from continental France in Moubayed-Breil (2017), was updated to **820** including **781** valid known chironomid species in Moubayed-Breil *et al.* (2018) and Moubayed-Breil and Ashe (2018a, b). Consequently, the descriptions of *M. alyssae* sp. n. and *M. ekremi* sp. n. increases the total number of known *Micropsectra* species from continental France to **25** and to **822** taxa including **783** valid known species and **40** undescribed taxa. Remarks and discussion on closely related *Micropsectra* species, as well as comments on the ecology and geographical distribution of the two new species, are given.

Materials and methods

Morphological terminology and measurements follow Sæther (1980), Pinder and Reiss (1986) and Spies (1998) for the imagines and Sæther (1980), Anderson *et al.* (2013) and Langton (1991, 1994) for the pupal exuviae. For the male hypopygium feature “*Micropsectra*-seta” see Gilka and Jazdzewska (2010, Figs 8, 10).

Type material was preserved in 80-85% alcohol, and later mounted in polyvinyl lactophenol. For each adult, the head, thorax and abdomen were cleared in 90% lactic acid then washed in about 60% ethanol before mounting on slides. Part of the abdomen and the haltere of the male adult are preserved in 85% ethanol for an eventual DNA analysis.

Description

Micropsectra alyssae Moubayed-Breil and Ashe, sp. n.

Material examined

Holotype. France, Mantet Nature Reserve (Eastern Pyrenees), Callau acid springs and peat bogs, upper basin of Ressec stream, altitude 2000-2300 m, 42° 28' 38" North, 02° 18' 26" East, 05 August 2010, 1 male pharate adult, leg. J. Moubayed-Breil. Environmental data of aquatic habitat: crystalline water, conductivity 15-20µS/cm, pH 5-5.3; temperature 4-8°C.

Paratypes (all leg. J. Moubayed-Breil). 4 pharate adults (2 males and 2 females), 3 pupal exuviae (2 males and 1 female); same locality and data as for holotype.

The Holotype (on 2 slides including the male adult and its pupal exuviae) is deposited in the collections of National Museum of Ireland – Natural History, Merrion Street, Dublin 2, Ireland. Remaining paratypes are deposited in the senior author's collection.

Diagnostic characters

The European *Micropsectra* species nearest to *M. alyssae* sp. n. is *M. aristata* based, in particular, on the shape of the median volsella. The pupal exuviae of the new species likely belongs to the *atrofasciata*-group on the basis of the distribution pattern of armament on tergites III-V. However, *M. alyssae* sp. n. can be separated from other related members of the genus by the following combination of distinguishing characters.

Male adult. Anal lobe of wing not projecting, squamal area densely covered with dark to blackish proclinate microtrichia (directed forwards). The shape of tergite IX including crest and anal point is atypical; tergite IX broadly rectangular, posterior margin tapering distally; anal point long, drop-like in shape, with rounded apex; superior volsella oblong to tubercle-like with longitudinal extension, antero-dorsal inner surface covered with dense macrotrichia, digitus long, thumb-like, and markedly projecting upwards medially; median volsella moderately short (90-95µm long), stem linear with both simple and lanceolate setae; sternapodeme typically sub-rectangular at base which is distinctly swollen latero-medially.

Pupal exuviae. Frontal tubercle well developed and typically conical; thoracic horn distinctly swollen medially, rows of long setae starting near the distal half; thoracic mound typically large with thumb-like apical projection; granulation on thoracic suture located anteriorly and medially; specific distribution pattern of armament on tergites III-V.

Etymology

The new species is named '*alyssae*' after our colleague Dr Alyssa Anderson (Northern State University, South Dakota, U.S.A.), who is actively working on the taxonomy and DNA barcoding of Tanytarsini species.

Male adult

(n = 7: 2 male pharate adults + 5 adults; Figs 1-6, 8-13)

A large sized *Micropsectra* species. Total length 5.60-6.40mm. Wing length 3.65-3.75mm. TL/WL 1.53-1.71. Colouration brown to dark brown, thorax contrasting light brown to blackish scutal thoracic strips. Head, legs and abdominal segments dark brown, anal segment contrasting brown to dark brown.

Head. Eyes bare; antero-median and distal part of the inner margin of eyes densely covered with hairs; frontal margin with a distinct triangular tubercle located medially on the coronal triangle; frontal tubercles absent. Temporal setae 18-19 including 13-14 inner and 5 outer verticals. Clypeus sub-rectangular with about 33-35 setae in 7 rows. Palp 5-segmented; length (in μm) of segments: 90-95, 100-105, 360, 200, 220; palpomere 3 markedly longer than fourth; palpomere 3 (Figs 1-2) with 5-6 sensilla clavata and several pin shaped sensilla coeloconica (about 5). Antenna 13-segmented, 1440-1450 μm long; ultimate flagellomere 940-950 μm long, well developed, clubbed and bearing 1 distinct apical seta; antennal groove reaching segment 2; AR 1.88-1.90.

Thorax. Lobes of anteprenotum widely separated (Fig. 3), lateral anteprenotals 4-5, median anteprenotals absent; acrostichals 14 in 1-2 rows; dorsocentrals 20-21 including 11-12 located proximally in 1-2 rows and 8-9 grouped distally; prealars 4. Scutellum with about 16 setae placed in 2 groups of on each side of the median area, which is bare. *Wing.* Brachiolium with 3 setae, all veins and cells heavily covered with setae, anal lobe not projecting; squamal area (Figs 4-5) densely covered with blackish proclinate microtrichia (directed forwards); squama bare; veins R_1 , R_{2+3} with numerous setae, remaining veins bare. *Legs.* Tarsomere ta_1 of PI longer than tibia; length (in μm) of tibial spurs: PI, 20; PII, 30 and 20; PIII, 50 and 40. Length (μm) and proportions of legs PI-PIII as in Table 1.

TABLE 1. *Micropsectra alyssae* sp. n.: length (μm) and proportions of prothoracic (PI), mesothoracic (PII) and metathoracic (PIII) legs.

P	Fe	Ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
PI	1510	1250	1750	940	720	535	245	1.40	1.85	1.58	3.20
PII	1750	1780	835	560	445	310	220	0.47	2.85	4.23	2.67
PIII	1450	1310	725	485	365	225	170	0.55	2.80	3.80	2.30

Hypopygium (Figs 8-9) as illustrated in dorsal (Fig. 8), and ventral view (Fig. 9, without anal point and tergite IX). Tergite IX (Fig. 8, dorsal) about 200 μm maximum width at median part (between the lateral teeth), broadly sub-rectangular to sub-square, with a nearly straight posterior margin which is narrowed distally and turned over inwards at apex and with 2 distinct rounded expansions located laterally below the lateral teeth; anal tergite bands (ATB) about 200 μm long, 17-20 μm maximum width, widely open basally and converging but not joined posteriorly and abruptly terminated well before base of anal point, not reaching crests of anal point; projecting elevated hump (dorsal tubercle) on median area present (clearly visible in lateral view, Fig. 6), with 4 dorsal setae located below its apical part; teeth on median part of

lateral margin present. Anal point in dorsal, lateral and ventral view (Figs 6, 8, 12) 75µm long, 50-55µm maximum width at base, nearly parallel sided to drop-like in shape, larger at base and apex than medially, with 16-18 setae including 6 placed laterally (3 on each side of base of anal point) and 10-12 on ventral side (in 2 rows). Sternapodeme broad rectangle-like, slightly swollen latero-medially, 120-125µm long and 50-55µm maximum width, lateral horn-like basal projections present; coxapodeme linearly elongated, outer part turns over distally to join the basal part of sternaopodeme; phallapodeme linearly elongated, nearly S-like in shape and bifurcate in its median part, outer smaller branch projecting upwards to join the distal part of coxapodeme. Superior volsella (Figs 8, 10) about 105-115µm long, 70-75µm maximum width, elongated lobe-like and vertically projecting, wider at base and constricted in its third distal part; setiger area (SA) with 9-10 short setae located antero-medially and distally, inner margin with 2 long setae, inner antero-dorsal surface with field of macrotrichia; digitus 40-45µm long, about 12-15µm maximum width, thumb-like and bent upwards medially at a right angle, apex rounded; *Micropsectra*-seta on basal inner margin absent. Median volsella (Figs 9, 11, 13) 90-95µm long, 20-25µm maximum width, stem uniformly linear, bent downwards medially, reaching distal half of inferior volsella, lamellar setae subulate (Fig. 13) and typically ending with long curved tail-like apices. Inferior volsella (Figs 8, dorsal; 9, ventral) 250-255µm long, 50-55µm maximum width, wider in its distal part, reaching beyond half length of gonostylus, longitudinal dorsal setiferous groove present; setiferous ventral lobe weakly developed, with 4 long setae inwardly directed. Gonocoxite 190-200µm long, 75-80µm maximum width, with 11-13 setae. Gonostylus 250µm long and 60-65µm maximum width, broadly shaped, moderately swollen basally and distally; median and distal inner margin bearing 2-3 row of numerous fine long setae. HR 0.80.

Female adult

(n = 2 female pharate adults; Figs 15, 17-21)

Colouration as in the male adult except for the antennae, which are brownish. TL 5.70-6.80mm. WL 3.70-3.80µm. TL/WL = 1.54-1.79.

Head. Temporal setae 11 including 8 inner and 3 outer verticals. Clypeus sub-rectangular with up to 30 setae in 6-7 rows. Palp 5-segmented; length (in µm) of segments: 35 (1 and 2 fused), 75, 85, 160; palpomere 3 with 3-4 sensilla clavata and 2-3 pin shaped sensilla coeloconica. Antenna 5-segmented, 625µm long; ultimate flagellomere (Fig. 15) 125µm long, clubbed and bearing 1 distinct apical seta; antennal groove reaching segment 1; AR 0.25.

Thorax. Lobes of anteprenotum gaping, lateral anteprenotals 5-6, median anteprenotals absent; acrostichals consist of 14-15 long setae (75-80µm long) mostly inserted in 2 rows; dorsocentrals 21-22 including 4 grouped proximally and 17-18 in 1 row; prealars 3-4 in 1 row.

Scutellum with about 16 setae. *Wing*. Brachiolum with 3 setae; veins R_1 , R_{2+3} densely covered with setae, remaining veins bare. Squamal area of wing as in the male; squama entirely bare.

Genitalia. Genitalia in dorsal and ventral view as illustrated in Fig. 17. Notum about 135µm long, rami distinct. Sternite VIII with 32-34 setae (16-17 on each side of the notum). Gonapophysis VIII (Figs 17-19). Dorsomesal lobe nearly linear in its proximal half, rounded in its distal half; ventro-lateral lobe sub-triangular, broad basally and narrowed apically; apodeme lobe (Figs 17, 19) base sinuous, forking medially into two branches apically. Seminal capsules (Fig. 17) 110µm long, 90µm maximum width, typically spherical and slightly sclerotized at base; spermathecal ducts with loops and separate openings. Tergite IX nearly semi-circular, not divided, with more than 50 long setae. Gonocoxite (Fig. 20) broadly sub-triangular, bare and covered with dense macrotrichia. Cercus (Fig. 21) normally developed with rounded apex, outer margin undulating.

Pupal exuviae

(n = 4: 2 males, 2 females; Figs 23, 25-29)

Total length 5.65-6.85mm. General colouration yellowish to brownish; frontal apotome and thorax brownish; abdominal segments brownish, anal segment dark brown with wrinkles, genital sac brownish. Cephalothorax including frontal apotome moderately wrinkled, scutal hump well developed; thorax with granulations restricted to 2 small areas located on antero-median and median areas close to the thoracic suture.

Cephalothorax as in Figs 23, 25-26 including frontal apotome (Fig. 23), thorax (Fig. 25) and thoracic horn (Fig. 26). Frontal apotome (Fig. 23), frontal tubercles 80-85µm high, 150-155µm wide at base, typically conical, frontal setae 120-125µm long. Thorax (Fig. 25) with 1 median anteprenotal seta 130µm long and 1 lateral anteprenotal 110µm long; precorneal setae respectively 160, 90 and 100µm long; dorsocentrals Dc_1 - Dc_2 and Dc_3 - Dc_4 subequal (about 100-110 µ long), distance between Dc_2 and Dc_3 190-200µm; thoracic horn 310-320µm long, distinctly swollen in its proximal part, narrowed distally with pointed apex, numerous long setae mostly present along the outer margin and located almost on distal half; thoracic mound (Fig. 27) large and well developed, broad longitudinally with a thumb-like to lobe-like outer projection, which is bent downwards.

Abdomen (tergites II-VI, Fig. 28). All pleurae bare. Tergite I bare. Armament present on tergites II-VI as in Fig. 28. Tergite II covered with dense field of points (anterio-median area) and small spines (postero-median area); oval longitudinal bare area present postero-medially; transverse row of hooks occupying about 55% of tergite width, composed of about 140 hooklets in 1 row; Pedes spurii B distinct but weak. Tergites III-V, each with a pair of elongated long spine bands on either side of mid-line: continuous on tergites III-IV, becoming shorter and less

spinulated on tergites V-VI. Pairs of long spines on tergites III-VI becoming gradually shorter and less extensive: 22-24 long spines (tergite III), 37-40 (IV), 5-7 (V), 3-4 (VI). Tergites VII-VIII bare. Lateral setae on segments I-IV: 1, 2, 2, 1; lateral taeniae on segments IV-VIII: IV (2), V-VII (4), VIII (5). Posterio-lateral comb of segment VIII (Fig. 29) consists of 4-5 unequal teeth including 1 much larger (37-40µm long) located medially. Anal lobe 220-230µm long, 330-340µm maximum width, 2 dorsal setae about 180µm long present on postero-median part; taeniae on fringe with 22-25 (in male), 26-28 (in female) in 1 row. Male genital sac about 270-275µm long, 130 µm maximum width, overreaching tip of anal lobe by 100-110µm.

Larva

Known but not described.

Taxonomic remarks

Male adult. Only the basal part of the squamal area is densely covered with blackish microtrichia (Fig. 4), while both basal and distal parts are blackish in *Micropsectra atrofasciata*, *M. recurvata* and *M. roseiventris* (Moubayed-Breil and Ashe, 2018b, Fig. 3). Tergite IX with a distinct dorsal hump, differently figured in *M. atrofasciata*, *M. sofiae*, *M. schrankelae* of the *atrofasciata*-group (Figs 46-48), and absent in the *attenuata*-group (*M. attenuata*, Reiss 1969, Fig. 4; *M. nohedensis* and *M. auvergnensis*, Moubayed and Langton, 1996, Figs 3, 11). Superior volsella sub-oval, occasionally bi-lobed in its distal half, with digitus atypically projecting upwards medially (Figs 8, 10). Lamellar setae of median volsella subulate with long tail-like apices (Figs 9, 11, 13), while they are aristate and abruptly tapered distally in *M. aristata* (Pinder, 1976, Fig. 3; Langton and Pinder, 2007, Fig. 103B).

Female adult. Last flagellomere of *M. alyssae* n. sp. with 1 single pre-apical seta (Fig. 15), while it bears 2 pre-apical setae (Fig. 16) in *M. sp. 1* (a closely related East Pyrenean species). Dorsomesal lobe (Fig. 17) swollen medially, while it is linearly elongated in *M. aristata* (Fig. 22).

Pupal exuviae. Frontal tubercles (Fig. 23) well developed and markedly conical, which are domed in *M. atrofasciata* (Fig. 24; Langton, 1991, Fig. 147n) and *M. aristata* (Stur and Ekrem, 2006, Figs 6B, 7E); rows of long setae on thoracic horn located up to the median part, which are inserted near the base in other related species of the *atrofasciata*-group; thoracic mound nose-like to thumb-like (Fig. 27), is much broader in the Pyrenean *Micropsectra sp. 1* (Fig. 30); posterio-lateral comb of segment VIII (Fig. 29), is differently figured in *M. sp. 1* (Fig. 31), while a nearly similar shape is observed in *M. atrofasciata* (Stur and Ekrem, 2006, Fig. 7H).

***Micropsectra ekremi* Moubayed-Breil and Ashe, sp. n.**

Material examined

Holotype. France, Mantet Nature Reserve (Eastern Pyrenees), Callau acid peat bogs and springs, upper basin of Ressec stream, altitude 2000-2300m, 42° 28' 38" North, 02° 18' 26" East, 05 August 2010, 1 male pharate adult, leg. J. Moubayed-Breil. Environmental data of aquatic habitat: crystalline water, conductivity 15-20µS/cm, pH 5-5.3; temperature 4-8°C.

Paratypes (all leg. J. Moubayed-Breil). 4 pharate adults (2 males and 2 females), 3 pupal exuviae (2 males and 1 female); same locality and data as for holotype.

Holotype (on 2 slides including the male adult and its pupal exuviae) is deposited in the collections of National Museum of Ireland – Natural History, Merrion Street, Dublin 2, Ireland. Remaining paratypes are deposited in the senior author's collection.

Diagnostic characters

Although the general shape of the pupal exuviae resembles species belonging to the *attenuata*-group (*sensu lato*), some characters found in the male adult are similar to those observed in the *atrofasciata*-group. However, *Micropsectra ekremi* n. sp. can be easily separated from other related *Micropsectra* species by the following combination of characters.

Male adult. Squamal area of wing yellowish and densely covered with pale proclinate microtrichia (directed forwards), squama bare; tergite IX with a distinct triangular hump (clearly visible in lateral view); anal point broadly triangular; superior volsella spherical but lacking digitus; lamellar setae of median volsella subulate and ending with long curved tail-like apices; inner ventral margin of gonocoxite with two distinct lobes (posterior one larger).

Pupal exuviae. Frontal apotome weakly domed, frontal tubercles quite indistinct; thoracic horn markedly swollen medially; thoracic mound broadly triangular, armament on tergites III-VI consists of a very specific and unusual distribution pattern of spines located on either side of the mid-line.

Etymology

The new species is named '*ekremi*' after our colleague Professor Torbjørn Ekrem (Museum of Natural History and Archaeology, NTNU, Trondheim, Norway), who is actively working on the taxonomy and DNA barcoding of Tanytarsini species.

Male adult

(n = 2: 2 male pharate adults; Figs 32, 35, 37-39, 44-45)

A relatively small sized *Micropsectra* species (especially wing, palp segments and legs). Total length 3.60-3.70mm. Wing length 1.65-1.70mm. TL/WL 2.17-2.18. Colouration brown to dark brown, thorax mostly light brown, scutal stripes dark brown. Head, legs and abdominal segments brownish; squamal area of wing yellowish to pale; abdomen and anal segment contrasting brown to dark brown.

Head. Eyes bare; hairs on inner margin of eyes indistinct; frontal margin nearly straight with a distinct triangular tubercle located medially on the coronal triangle; frontal tubercles weak. Temporal setae 10-12 including 7-8 inner and 3-4 outer verticals. Clypeus sub-rectangular with 12-13 setae in 3-4 rows. Palp 5-segmented with short segments; length (in μm) of segments: 25, 35, 45, 45, 75; palpomere 3 with 2-3 sensilla clavata and a few pin-like sensilla coeloconica. Antenna 13-segmented, about 950 μm long; ultimate flagellomere 590 μm long, weakly clubbed and lacking apical seta; antennal groove reaching segment 3; AR 1.64.

Thorax. Lobes of anteprenotum separated; anteprenotals absent; acrostichals consisting of 8 long setae (70 μm long); dorsocentrals 15-16 in 1-2 rows; prealars 3-4 grouped together. Scutellum with about 20 setae. *Wing.* Brachiolum with 2 setae; all veins and cells heavily covered with setae; squamal area (Fig. 32) yellowish and densely covered with pale proclinate microtrichia (directed forwards); squama bare. *Legs.* Tarsomere ta_1 of PI and PII longer than tibia. Length (in μm) of tibial spurs: PI, about 50; PII, 40 and 20; PIII, 35 and 20. Length (μm) and proportions of legs PI-PIII as in Table 2.

TABLE 2. *Micropsectra ekremi* sp. n.: length (μm) and proportions of prothoracic (PI), mesothoracic (PII) and metathoracic (PIII) legs.

P	Fe	Ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
PI	835	560	720	430	310	245	155	1.29	1.86	1.94	3.20
PII	895	650	740	520	370	295	170	1.14	0.83	2.09	2.30
PIII	825	710	590	225	180	145	120	0.82	3.17	2.60	2.40

Hypopygium (Figs 37-38) as illustrated in dorsal (Fig. 37) and ventral view (Fig. 38, without anal point and tergite IX). Tergite IX 165 μm maximum width, 125 μm wide between the lateral teeth, semi-circular, slightly narrowed distally; anal tergite bands (ATB) widely open basally, converging posteriorly and abruptly terminated well before base of anal point, not reaching crests of anal point; a projecting elevated hump (tubercle) on median area (clearly visible in lateral view, Fig. 35), 6 dorsal setae located between the posterior part of the ATB (3 on each

side, Fig. 37); teeth on median part of lateral margin present. Anal point in lateral, dorsal and ventral view (Figs 35, 37, 44) 55µm long, 40µm maximum width at base, broadly triangular, with 18-20 setae including 6 placed laterally (3 on each side of base of anal point) and 12-14 on ventral side (in 1-2 rows). Sternapodeme rectangular, about 15-20µm long and 30-35µm wide, bearing two small lateral projections; coxapodeme composed of a linear elongate inner part which turns over at base to join the upper outer part; phallapodeme weakly S-like in shape, bifurcate in distal part, outer branch projecting upwards to join the distal part of coxapodeme. Superior volsella (Figs 37, 45) about 45-50µm long, 40µm maximum width, spherical and slightly narrowed in distal part; setiger area (SA) with 6-7 dorsal setae, inner margin with 2 longer setae located medially; digitus absent; *Micropsectra*-seta placed on a weak rounded tubercle. Median volsella (Figs 38) about 200µm long and 15µm maximum width, stem nearly S-like, uniformly linear except on its distal part which is tapering apically and reaching terminal part of inferior volsella; 9-11 typical long subulate setae (Fig. 39) present on distal third (Fig. 38). Inferior volsella (Figs 37, dorsal; 38, ventral) about 190µm long, 25µm maximum width, wider at base and distal part, reaching beyond half length of gonostylus, slightly bent inwards distally, presence of a distinct transversal protrusion medially, setiferous ventral lobe well developed and bearing 5 long setae. Gonocoxite 150µm long, with 10-11 setae. Gonostylus (Figs 37) about 165µm long and about 50µm maximum width, broadly shaped, moderately swollen medially, slightly tapering distally and truncate apically; median and distal inner margin bearing 1-2 row of 8-10 fine setae. HR 0.91.

Female adult

(n = 2: 2 female pharate adults; Figs 49, 50-54).

A small sized female *Micropsectra* species. Colouration as in the male adult except for the antennae and abdomen, which are yellow brownish. TL 3.80-3.90mm. WL 1.70-1.80µm. TL/WL = 2.17-2.24.

Head. Frontal tubercles weakly developed; temporal setae 10-11 including 7-8 inner (in 1 row) and 3-4 outer verticals. Clypeus sub-rectangular with 13-15 setae in 3-4 rows. Palp 5-segmented with short segments; length (in µm) of segments: 25, 35, 45, 45, 75; palpomere 3 with 1-2 sensilla clavata, thin and setae-like in shape. Antenna 5-segmented, 480-485µm long; ultimate flagellomere (Fig. 49) 145µm long, linearly elongated to weakly clubbed with 1 distinct pre-apical seta; antennal groove reaching segment 1; AR 0.42.

Thorax. Lobes of anteprenotum gaping, anteprenotals absent; acrostichals consist of 8-9 long setae 70µm long, inserted in 1-2 rows; dorsocentrals 15-16 in 1-2 rows; prealars 3-4 grouped together; scutellum with about 20 setae. *Wing.* Brachiolium with 2 setae; veins R₁, R₂₊₃ densely covered with setae, remaining veins bare; anal lobe as in the male adult; squama bare.

Genitalia. Genitalia with gonapophysis VIII in dorsal and ventral view as illustrated in Fig. 50. Notum 155-160µm long, rami distinct. Sternite VIII with 30-32 setae (15-16 on each side of the notum). Dorsomesal lobe distinctly rounded proximally and swollen in distal part; ventrolateral lobe (Figs 50, 52) bulbous to sub-circular, rounded basally and narrowed apically; apodeme lobe (Figs 50-51) basal part curving upwards, forking medially into two branches. Seminal capsules (Fig. 50) 110µm long, 90µm maximum width, sub-spherical and sclerotized medially and laterally; spermathecal ducts with loops and separate openings. Tergite IX (Fig. 53) semi-circular, not divided, with more than 40 long setae located in 5-6 rows; gonocoxite semi-circular, with 3-4 setae. Cercus (Fig. 54) normally developed, inner margin swollen, outer margin undulating.

Pupal exuviae

(n = 5: 3 males + 2 females; Figs 55, 57-63)

Total length 3.90-4.00mm. General colouration brown to dark brown; frontal apotome and thorax brownish; abdominal segments brownish except for segment VIII and anal segment which are dark brown, muscles marks blackish and distinctly represented on segments I-VIII, genital sac brownish. Cephalothorax including frontal apotome weakly wrinkled, scutal hump weak; thorax with granulations restricted to the antero-median area extending close to the thoracic suture and above dorsocentrals Dc_1 - Dc_2 .

Cephalothorax. Cephalothorax as in Figs 55, 57-59 including frontal apotome (Fig. 55), thorax (Fig. 57) and thoracic horn (Figs 58-59). Frontal tubercles (Fig. 55) present but weakly developed, frontal setae about 55µm long. Thorax (Fig. 57) with subequal median and lateral anteprenotals (each about 90µm long); precorneal setae respectively 90, 95, and 105µm long; dorsocentrals Dc_1 - Dc_2 (40-45µm long) about 2.5 times shorter than Dc_3 - Dc_4 (about 105-110µm long), distance between Dc_2 and Dc_3 175-180µm; thoracic horn 250-260µm long, distinctly swollen in its postero-median part, narrowed distally with pointed apex, numerous long setae mostly present along the outer margin and inserted a short distance from its base; thoracic mound (Figs 60-61) 140µm long, 140µm maximum width at base, broadly triangular to sac-like in shape, narrowed distally and strongly bent downwards.

Abdomen. Abdominal tergites II-VI as in Fig. 62. Field of shagreen present on pleurae of segments II-VI, dense on II-IV, becoming gradually less extensive on V-VI. Tergite I bare. Armament on tergites II-VI as in Fig. 62. Tergite II covered with dense field of points in antero-median area and small spines in postero-median part; bare oval area present postero-medially; transverse row of hooks occupying about 60% of tergite width, composed of about 120 hooklets in 1 row; Pedes spurii B distinct but weak. Tergites III-VI, each densely covered with a pair of spine bands extending posteriorly on either side of mid-line; patches of short and

stout spines on anterio-median area with anterio-lateral extension only present on tergites IV-VI, pair of patches occasionally interrupted only on tergite V; postero-median bands of long vertically directed spines present on tergites III-V; remaining area of tergites III-V densely covered with various sizes of spines, shorter in anterior and becoming gradually longer in posterior area. Length (in μm) of longest spines (posterior bands) on tergites III-VI: 40-50 (III); 35-40 (IV-V); 25-30 (VI). Tergites VI-VIII bare. Lateral setae on segments I-IV: 1, 3, 3, 1; lateral taeniae on segments IV-VIII: IV (2), V (3), VI-VII (4), VIII (5). Postero-lateral comb of segment VIII (Fig. 63) consists of 4-5 teeth including 2 large sized (30-35 μm long) and 2-3 smaller teeth. Anal lobe of male (175 μm long, 270 μm maximum width) and female (185 μm long, 330 μm maximum width); 2 dorsal setae about 190 μm long present on postero-median part; fringe with 18-19 taeniae (in male), 20-21 (in female). Genital sac of male about 265-270 μm long, overreaching tip of anal lobe by 120-125 μm .

Larva

Known but not described.

Taxonomic remarks

The morphological affinities of both male adult and pupal exuviae of *Micropsectra ekremi* sp. n. are difficult to deduce or associate with one of the known groups of the genus *Micropsectra*, except for some species which key in both the *attenuata*-group and the *atrofasciata* group. Moreover, while there is ample taxonomic data in the literature on the *atrofasciata*-group our knowledge of the *attenuata*-group is still very limited and less well known. Therefore, compared to other members of the genus, *M. ekremi* sp. n. can be tentatively keyed to the *attenuata*-group (sensu lato) rather than the *atrofasciata*-group based on resemblance of some common features highlighted in the following combination of characters: a relatively small sized *Micropsectra* species; lamellar setae of the median volsella subulate (Figs 38-39) and resemble those of the *attenuata*-group (spoon to lanceolate shaped, Figs 40-43); weakly developed frontal tubercles; distribution pattern of armament on tergites III-V. However, some distinguishing characters found in the male and female adult and pupal exuviae of *M. ekremi* sp. n. will easily separate the new species from all other members of the genus. A separate group may be required to accommodate *M. ekremi* sp. n.

Male adult. Squamal area of wing (Fig. 32) yellowish and densely covered with pale microtrichia in *M. ekremi* which is quite similar to that of *M. auvergnensis* and *M. nohedensis* (Figs 33-34), while it is blackish in: *M. atrofasciata*, *M. recurvata*, *M. oksanae* and *M. roseiventris* (Moubayed-Breil and Ashe, 2018b, Figs 2-3); tergite IX and anal point of *M. ekremi* sp. n. with a distinct triangular hump (Fig. 35, clearly visible in lateral view), differently figured in the *atrofasciata*-group (*M. atrofasciata*, *M. schrankelae*, *M. sofiae*, Figs 46-48) or

absent in the *attenuata*-group (*M. attenuata*, Reiss, 1969, Fig. 4; *M. nohedensis* and *M. auvergnensis*, Moubayed and Langton, 1996, Figs 3, 11); superior volsella spherical in *M. ekremi* sp. n. (Fig. 45) but similarly spherical in the *atrofasciata*-group while it is foot-like in the *attenuata*-group; lamellar setae of median volsella lanceolate in *M. ekremi* sp. n. (Figs 38-39) which are foliate in the *attenuata*-group (Figs 40-43, for *M. auvergnensis*, *M. attenuata*, *M. nohedensis* and *M. sp. 1*).

Female adult. Last flagellomere of *M. ekremi* sp. n. (Fig. 49) not clubbed and nearly linear, while it is distinctly clubbed and straight in *M. nohedensis* (Moubayed and Langton, 1996, Fig. 5); dorsomesal lobe distinctly swollen in distal part in *M. ekremi* sp. n. (Fig. 50) but is markedly linear in *M. nohedensis* (Moubayed and Langton, 1996, Fig. 10).

Pupal exuviae. Armament on tergites III-VI (Fig. 62) composed of very distinct and unusual fields of long vertically directed spines located posteriorly, which is completely different to what is figured in all of the known members of the *attenuata*-group (e.g.: *M. attenuata*, Reiss, 1969, Fig. 7; *M. nohedensis* and *M. auvergnensis*, Moubayed and Langton, 1996, respectively Figs 12-13 and Figs 16-17).

Ecology and geographical distribution

Material of male adults, male and female pharate adults, pupal exuviae and larvae of both *Micropsectra alyssae* sp. n. and *M. ekremi* sp. n. was collected in two glacial springs and acid peat bogs (Plate 1) located in the upper basin of the River Mantet (altitude 2000-2300m). Emergence was mainly recorded from late spring to summer (June to September).

Despite extensive investigations throughout various high mountain springs and peat bogs located in the Eastern Pyrenees the geographical distribution of both *M. alyssae* sp. n. and *M. ekremi* sp. n. remains restricted to their type localities in the Mantet Nature Reserve.

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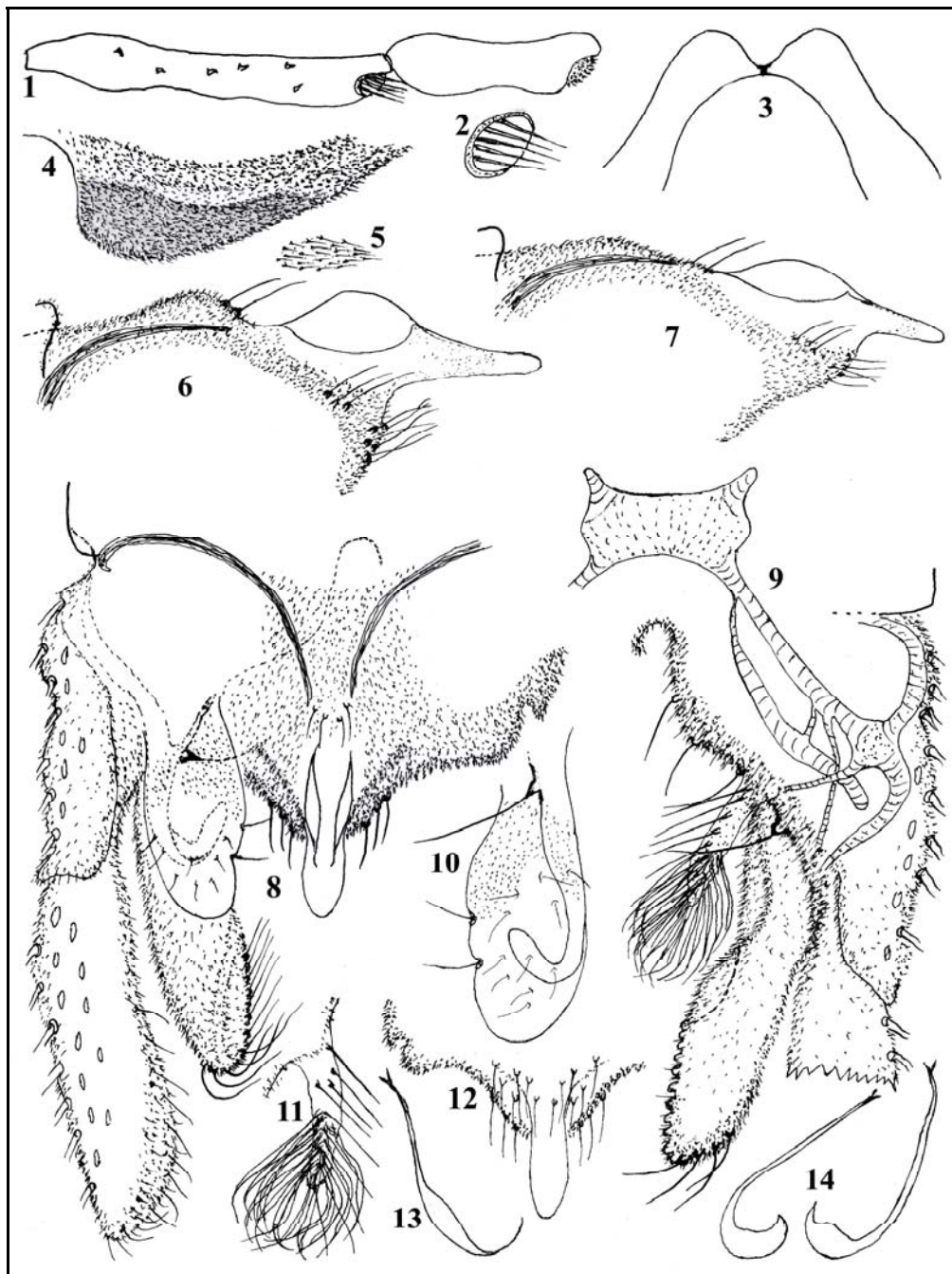
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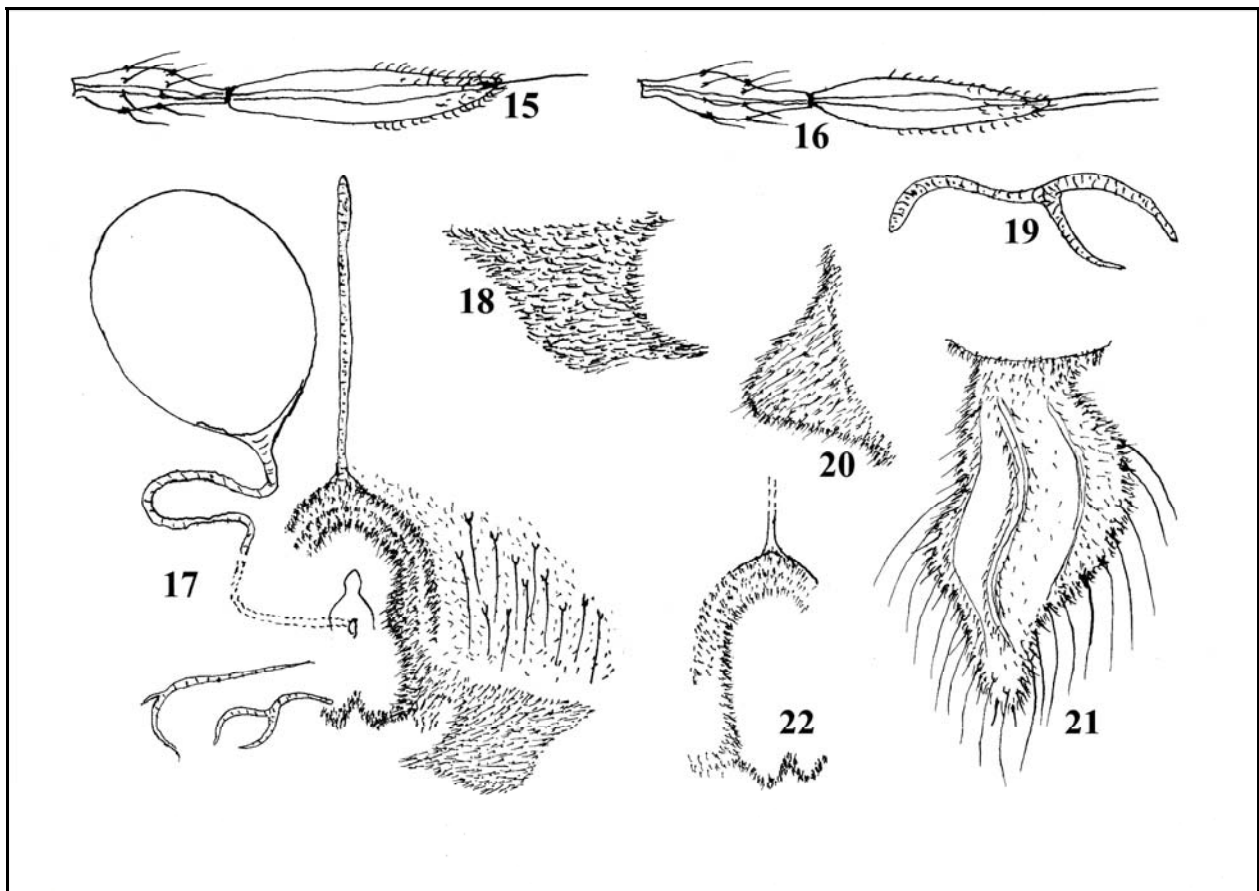
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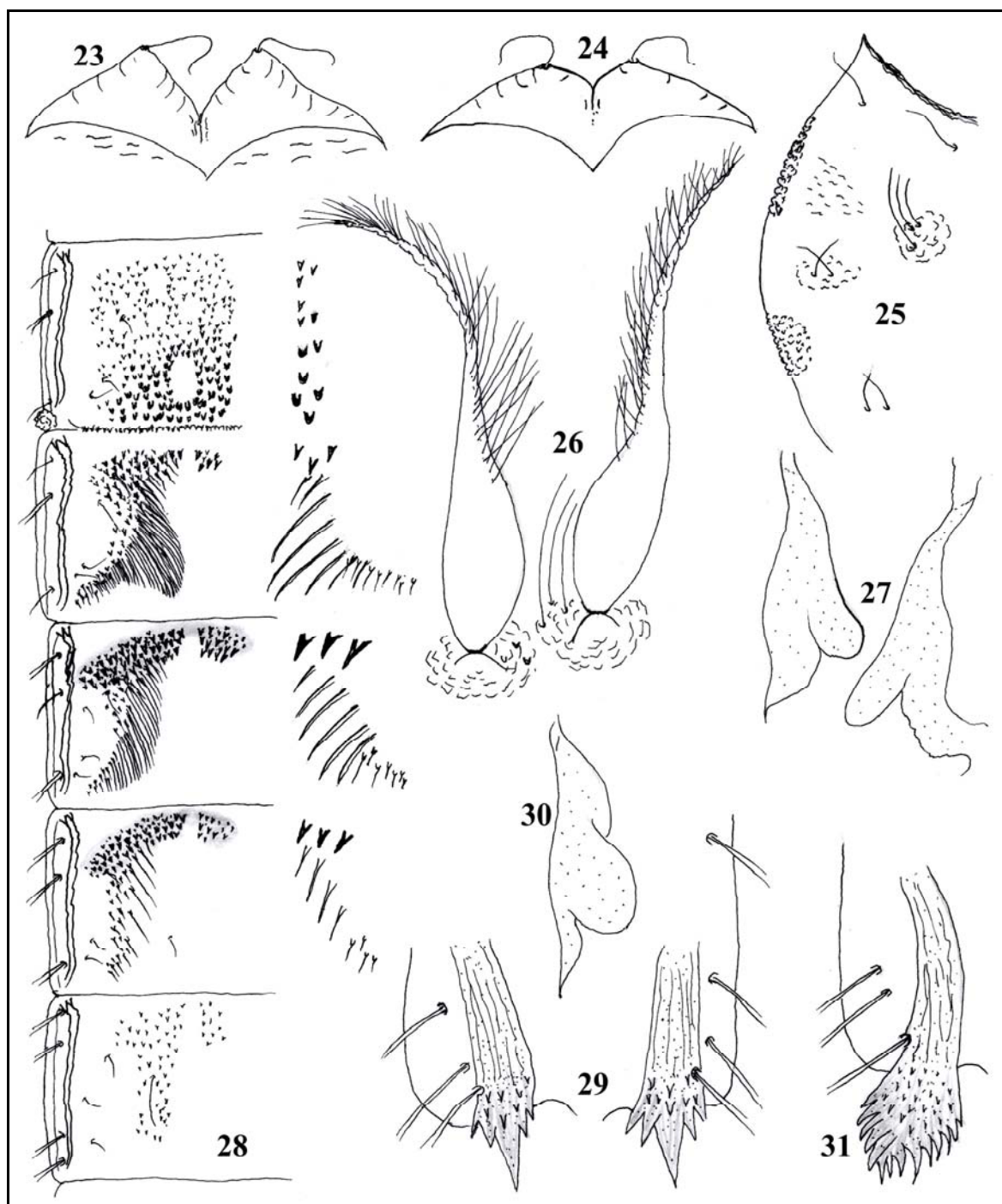
PLATE 1. Glacial springs and acid peat bogs at the Mantet Nature Reserve (altitude 2000-2300m), France: type locality of both *Micropsectra alyssae* sp. n. and *M. ekremi* sp. n. Photograph © J. Moubayed-Breil, 5 August 2008.



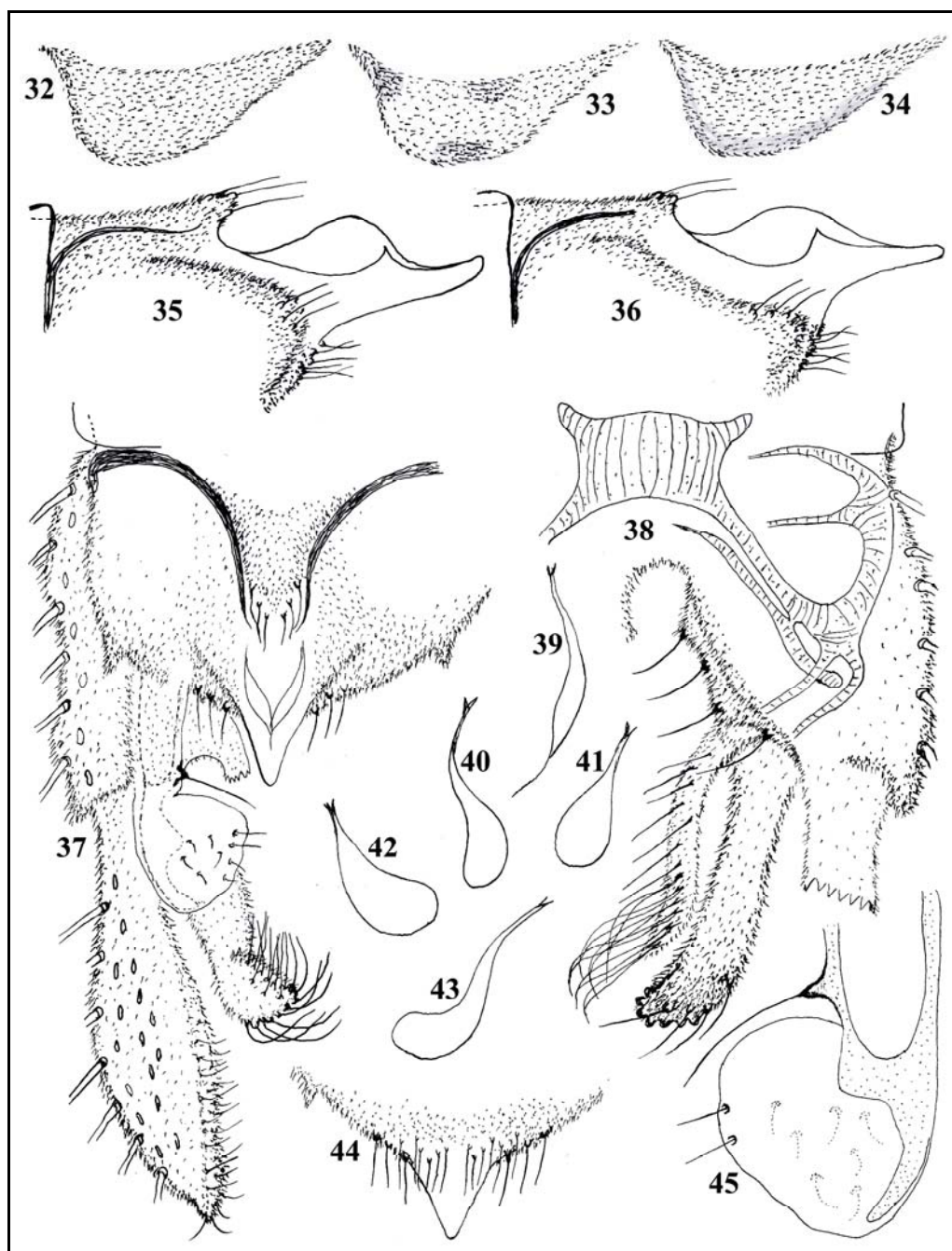
FIGURES 1-14. Male adult of *Micropsectra* spp. *M. alyssae* sp. n.: (1-2) palpomeres 2-and details of sensilla coeloconica; (3) lobes of antepronotum; (4-5) squamal area and details of microtrichia. Tergite IX and anal point (lateral) of: (6) *M. alyssae* sp. n.; (7) *M. sp. 1*. *Micropsectra alyssae* sp. n.: (8-9) hypopygium in dorsal (8) and ventral view (9, without tergite IX and anal point); (10) superior volsella; (11) median volsella; (12) anal point, ventral. Differentiated setae of median volsella of: (13) *M. alyssae* sp. n., (14) *M. sp. 1*.



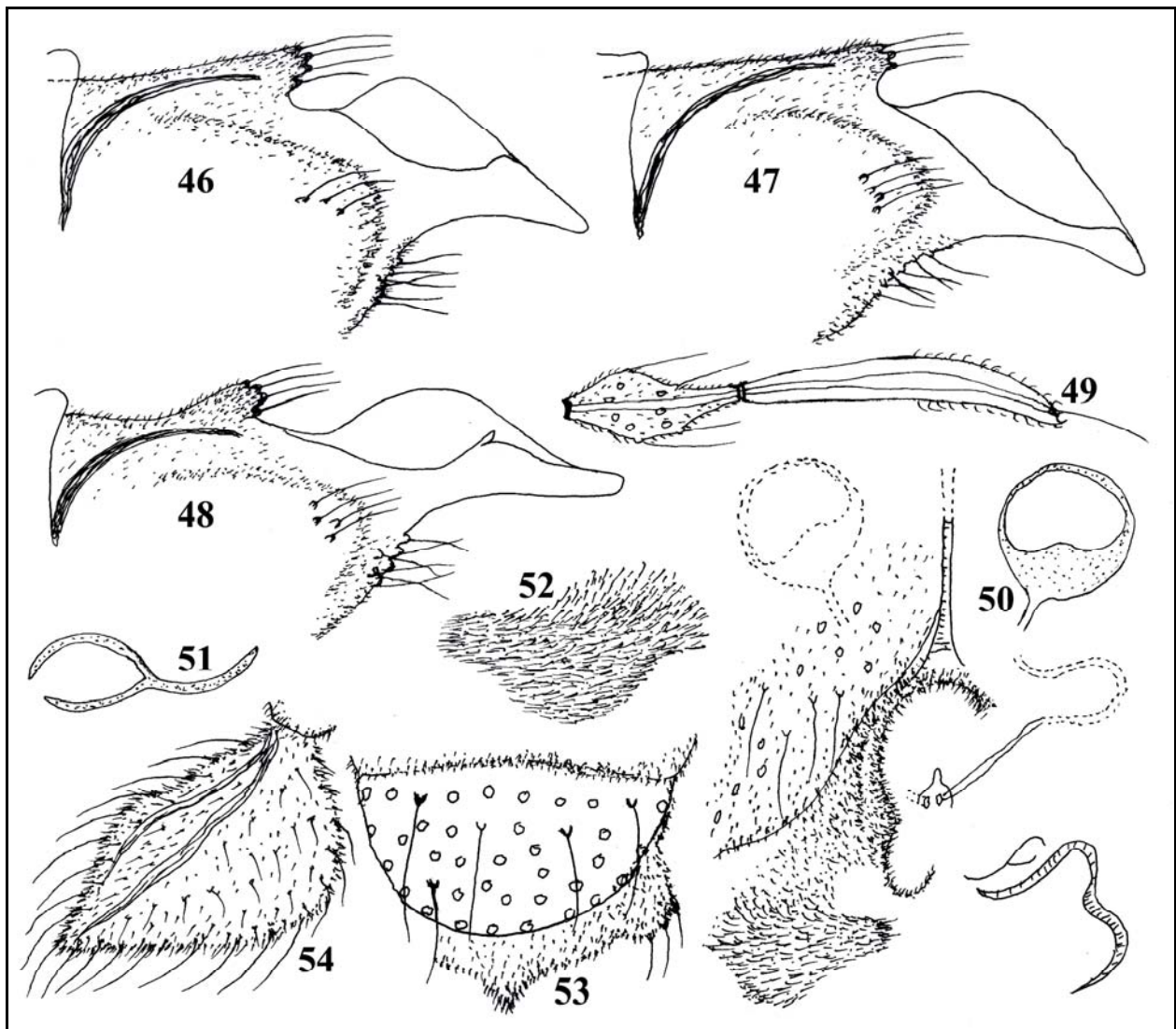
FIGURES 15-22. Female adult of *Micropsectra* spp. Fourth and last flagellomeres of antenna of: (15) *M. alyssae* sp. n., (16) *M. sp. 1*. *Micropsectra alyssae* sp. n.: (17) genitalia, ventral and dorsal view; (18) ventrolateral lobe; (19) apodeme lobe; (20) gonocoxite, dorsal; (21) cercus. *Micropsectra* sp. 1: (22) dorsomesal lobe.



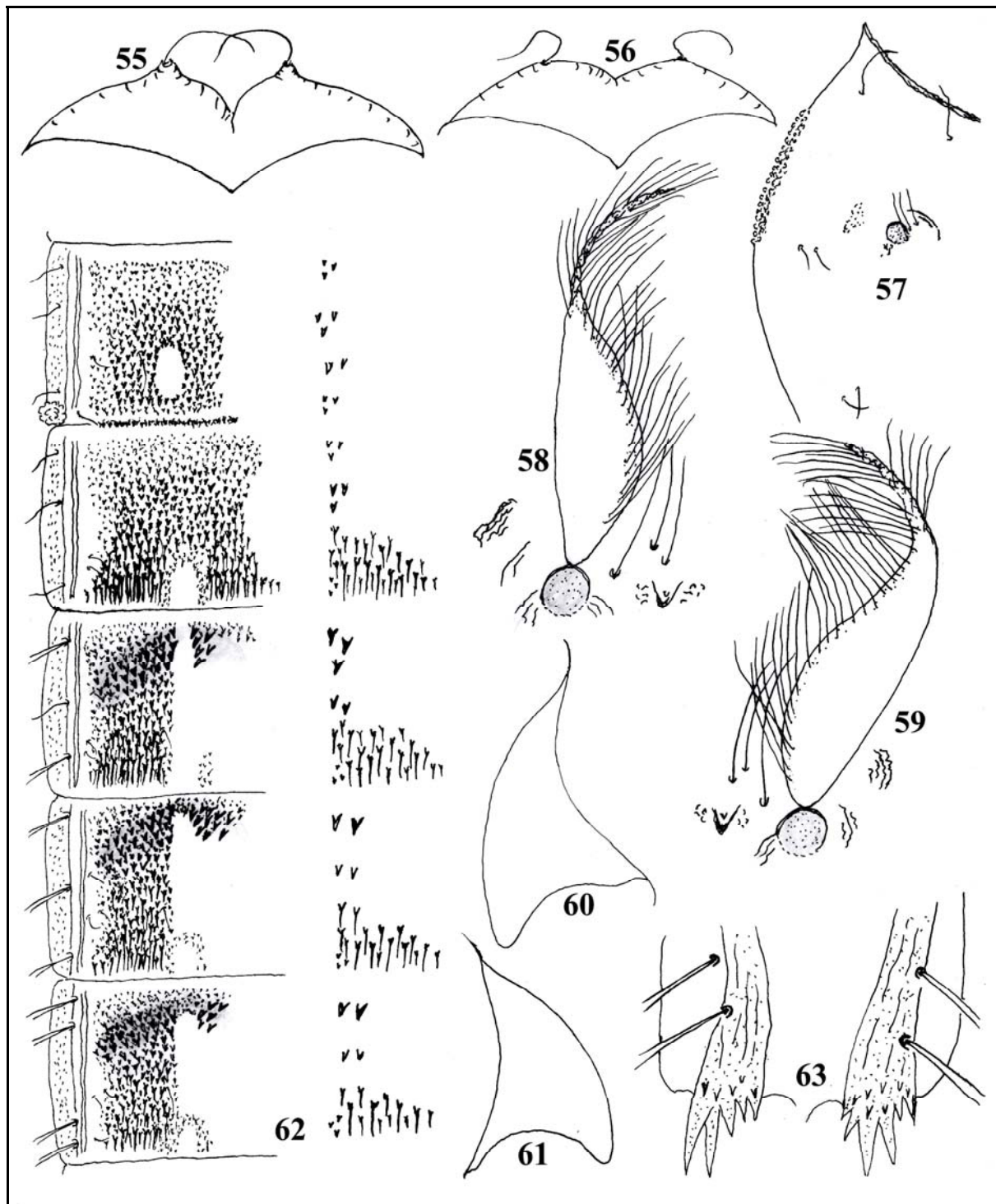
FIGURES 23-31. Pupal exuviae of *Micropsectra* spp. Frontal apotome of: (23) *M. alyssae* sp. n., (24) *M. atrofasciata*. *Micropsectra. alyssae* sp. n.: (25) thorax; (26) thoracic horn, two aspects; (27) thoracic mound, two aspects; (28) abdominal segments II-VI (dorsal), with details of armament on tergites; (29) postero-lateral comb of segment VIII, two aspects. *Micropsectra* sp. 1: (30) thoracic mound; (31) postero-lateral comb of segment VIII.



FIGURES 32-45. Male adult of *Micropsectra* spp. Squamal area with microtrichia of: (32) *M. ekremi* sp. n.; (33) *M. nohedensis*; (34) *M. auvergnensis*. Tergite IX and anal point (lateral) of: (35) *M. ekremi* sp. n., (36) *M. sp. 2.* *M. ekremi* sp. n.: (37-38) hypopygium in dorsal (37) and ventral view (38, tergite IX and anal point removed). Differentiated seta of median volsella of: (39) *M. ekremi* sp. n.; (40) *M. auvergnensis*; (41) *M. attenuata*; (42) *M. nohedensis*; (43) *M. sp. 2.* *Micropsectra ekremi* sp. n.: (44) anal point, ventral; (45) superior volsella.



Figures 46-54. Male and female adult of *Micropsectra* spp. Male tergite IX and anal point (lateral) of: (46) *M. atrofasciata*; (47) *M. sofiae*; (48) *M. schrankelae*. *Micropsectra ekremi* sp. n., adult female: (49) fourth and last flagellomere of antenna; (50) genitalia, ventral and dorsal view; (51) apodeme lobe; (52) ventrolateral lobe; (53) tergite IX and gonocoxite, dorsal; (54) cercus.



FIGURES 55-63. Pupal exuviae of *Micropsectra* spp. Frontal apotome of: (55) *M. ekremi* sp. n., (56) *M. sp. 1.* *Micropsectra ekremi* sp. n.: (57) thorax; (58-59) thoracic horn, two aspects; (60-61) thoracic mound, two aspects; (62) abdominal segments II-VI (dorsal), with details of armament on tergites; (63) postero-lateral comb of segment VIII, two aspects.