

# Immature stages of two European species of the subgenus *Meloehalea* (Diptera: Ceratopogonidae), with keys to the European subgenera of *Atrichopogon*

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Larvae and pupae of *Atrichopogon winnertzi* Goetgebuer and *A. oedemerarum* Storå are described and illustrated. Larvae of both species are terrestrial and associated with rotting pine wood. Diagnoses are given for all stages. Immature stages of *A. oedemerarum* are described for the first time. *A. meloesugans* Kieffer, 1922 is recognized as a junior synonym of *A. winnertzi* Goetgebuer, 1922. Keys are provided to European subgenera of *Atrichopogon* based on all stages.

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## Introduction

Immature stages of Culicomorpha are primarily aquatic with only a few taxa within the families Chironomidae and Ceratopogonidae which secondarily became terrestrial. Within the Ceratopogonidae the subfamily Forcipomyiinae, with two genera *Forcipomyia* and *Atrichopogon*, as a group is terrestrial. This is evidenced by the larval exuvium which covers the caudal portion of the pupa and in this way protects it against dehydration in dry terrestrial habitats. Similar adaptations are known in many other terrestrial midges, for example in the Scatopsidae (Hennig 1968) or some Cecidomyiidae (Wyatt 1963). Hinton's (1955) explanation that the larval exuviae of some *Forcipomyia* (subg. *Forcipomyia*) are retained by pupae in order to keep the defensive larval secretion against ants is less likely (Szadziewski 1990). This character state is preserved almost uniformly within the subfamily, even in those species which again became aquatic or semiaquatic. We agree with Nielsen's (1951: 92) statement 'The [aquatic] *Atrichopogon* species treated here probably descend from forms the larvae of which lead a terrestrial life, beneath loose bark on trees'.

Larvae of *Atrichopogon* are terrestrial, semi-

aquatic or aquatic. They occur in shaded moist, semiaquatic or aquatic habitats where plant debris, fungi, and algae are present as food. Larvae of the genus inhabit rotting wood where they live under bark or on its moist shaded surface in forests, on/in algae covering moist soil along edges of streams, totally or partly submerged wood, stones or aquatic plants, and among mosses growing on wood or soil, (Nielsen 1951; Ewen & Saunders 1958; Chan & Linley 1988).

Adults of *Atrichopogon* can easily be separated from *Forcipomyia* by the thoracic paratergite bearing at least 1 seta. In *Forcipomyia* and all other biting midges the paratergite is bare. That character state found in *Atrichopogon* seems to be unique within the family Ceratopogonidae and whole infraorder Culicomorpha. As proposed by Wirth (1952), *Atrichopogon* differs also from *Forcipomyia* by the fringe of posterior wing margin which is composed of a single row of alternating long and short hairs, and by the size and distribution of wing macrotrichia and microtrichia.

All known European larvae of *Atrichopogon* differ from *Forcipomyia* by their flattened body and elongated lateral processes. These character states are not universal for the genus as larvae

of some non-European species, for example *Atrichopogon (A.) wirthi* Chan & Linley (1988) from Florida, are cylindrical and void of lateral processes, looking similar to those of *Forcipomyia*. Larvae of *Forcipomyia (Phytohelea)* are flattened but lack lateral processes. The pupae have a short posterior median prolongation of the mesothorax which never overlaps the first abdominal segment as in all *Forcipomyia* other than the subgenus *Phytohelea* Remm (Ewen & Saunders 1958). However the latter subgenus does not occur in Europe. In Saunderson's (1924) drawing of the pupa of the Holarctic *Forcipomyia (F.) brevipennis* (Macquart) the prolongation appears to be short, as in *Atrichopogon*. We examined some pupae from our collection and found that actually it is long and covers half the length of the first abdominal tergite.

Immature stages of European *Atrichopogon* are relatively poorly known. Müller (1905) gave the first description of the larva and pupa of this genus from Germany, while Speiser (1910) was the first to describe larvae of the subgenus *Melohelea* from Poland (as *Atrichopogon lucorum* Meigen; see *A. winnertzi* described below). Subsequently, the number of original descriptions of immature stages of European species of *Atrichopogon* has been moderate: Goetghebuer (1923) from Belgium, Bangerter (1933) from Switzerland, Lenz (*in* Goetghebuer & Lenz 1934) from Germany, Nielsen (1951) from Denmark, and Ewen & Saunders (1958) from England, Belgium and Canada.

## Descriptions

Larvae of the two studied species were collected under and over the bark of logs and small branches of rotting pine wood *Pinus silvestris* L. In the laboratory they were placed in small glass vials together with some substrate. Appropriate humidity in the vials was kept by sprinkling the substrate with water.

The terminology used in the descriptions follows that of Nielsen (1951), Ewen & Saunders (1958) and Wirth (1980).

### *Atrichopogon (Melohelea) winnertzi*

Goetghebuer, 1922

(Figs 1-4, 5A, 6A, 7A, 8, 10A, 11A, 12A, 13A, 14A)

*Ceratopogon lucorum* auctt. nec Meigen, 1818: Winnertzi 1852: 30 (♂, ♀, reared from larvae collected under bark of rotting tree, Krefeld in Germany); Speiser 1910: 738 (larva, pupa, under rotting log, Poland). Goet-

ghebuer & Lenz 1934: 23, 110 (♂, ♀, larva, pupa); Remm 1988: 86 (distribution in catalogue).

*Atrichopogon winnertzi* Goetghebuer, 1922: 51 (new name for *Ceratopogon lucorum* auctt., nec Meigen).

*Atrichopogon meloesugans* Kieffer, 1922b (31 Dec.): 495 (♀, Algeria, Massive de Mouzaïa, on *Meloe* beetle); Wirth 1956: 17 (♂, ♀, England); Ewen & Saunders 1958: 701 (larva, pupa, ♂, ♀, England); Wirth 1980: 135 (♂, ♀, England, Slovenia); Remm 1988: 86 (distribution in catalogue); Szadziewski 1991: 106 (records from Poland). **Syn. n.**

**Diagnosis.** – Larva with flat dorsal surface of head; almost whole head capsule covered with sparse large nodules including antennal tubercles (Fig. 5A); a proximal pair of tubercles of anal segment long, with pointed bare apex directed caudally, dorsal surface of base with long spine-like nodules (Fig. 7A). Pupae with relatively large respiratory horn bearing 8-9 openings, mesothoracic processes m5 long and sinuous, 5th abdominal segment with only very short mediodorsal setae placed on very short processes (Fig. 8). Adults have long, slender 3rd palpal segment (Figs 11A, 14A). Female proximal flagellomeres flattened (Fig. 13A) and median teeth of mandible larger than proximal and distal ones (Fig. 12A). Male genitalia, as in many species of the subgenus, with the aedeagus with broad, blunt, caudomedian process.

**Larva (4th instar)** (Figs 1, 3, 5-7). – Total length 2.4 – 2.6 mm. Blackish brown, head capsule darker than body (Fig. 1).

Head (Fig. 5A): Antenna long, placed on prominent slender antennal tubercle; tubercle slightly shorter than antenna, uniformly covered with sparse large nodules. Seta p on smooth long tubercle, directed anteriorly, somewhat shorter than antenna, covered with short serrations. Seta t bristle-like, on distinct smooth tubercle; longer than antenna. Setae u, v of almost same length, similar, on small, smooth tubercles. Seta s smooth, distinctly shorter than seta p; expanded towards midlength, then tapering to tip, becoming sharply slender subapically. Dorsal portion of head flat. All nodules large, relatively sparse, of similar size. Laterodorsal tubercle slender.

Thoracic and abdominal segments: each segment 1-11 with pair of mediodorsal setae d placed on long slender process or tubercle (Figs 3, 6A); each seta more or less as long as its tubercle, one side serrated; tubercle covered with long cuticular spine-like nodules. Lateral processes, anterolateral and posterolateral (Fig. 3), armed with seta or bare. Anterolateral seta al placed on tubercle of similar

shape as above; seta less serrated, longer than seta d. Body segments 1-11 with seta al on tubercle. Body segments 1-2 with posterolateral processes bearing apical strong seta, segments 3-11 only with club-like tubercles lacking apical seta. Tubercles pl heavily sclerotized, covered with sparse slender nodules (Fig. 6A). Lateroventral setae e, f smooth, short.

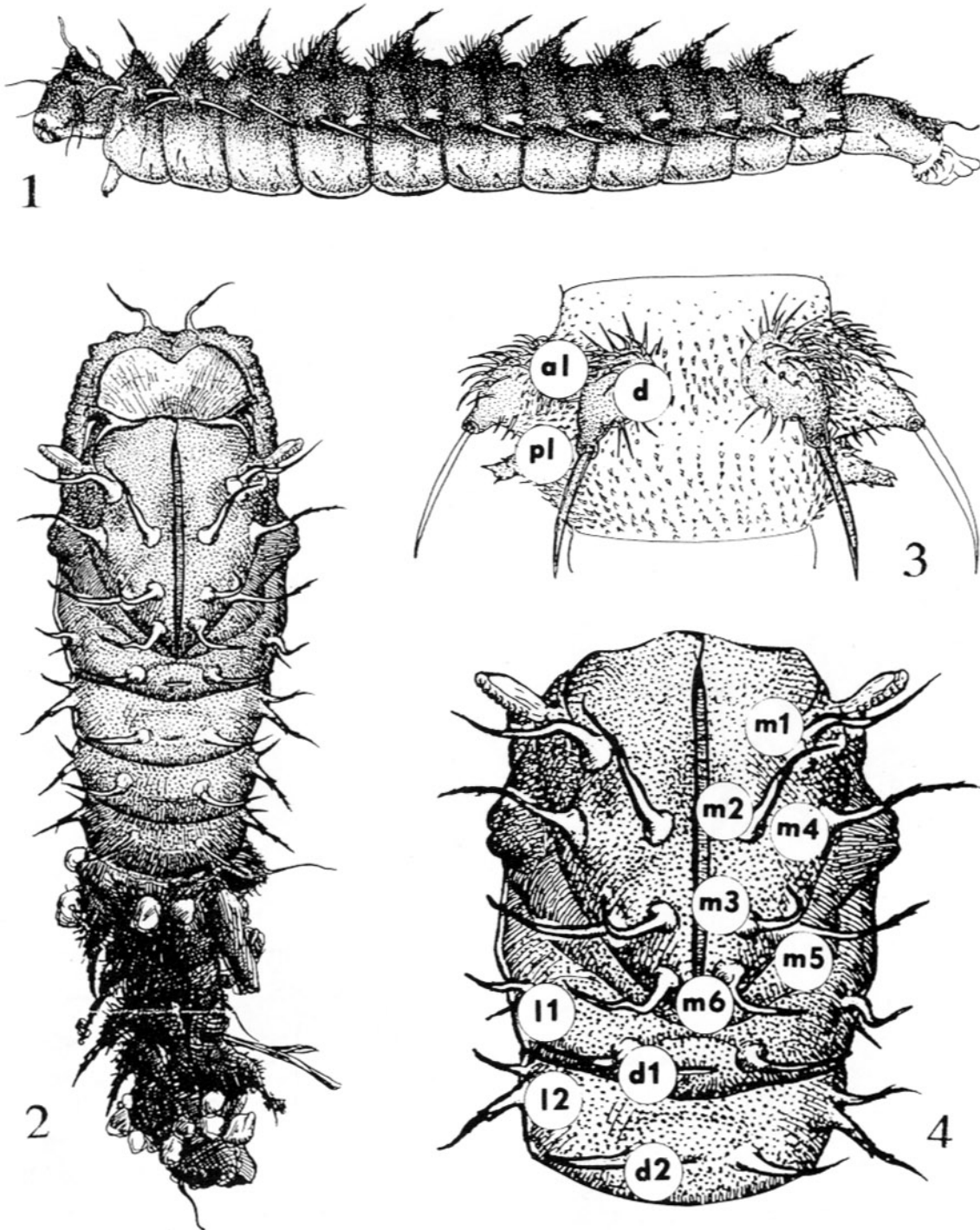
Anal segment 12 (Fig. 7A): bearing 2 pairs of mediodorsal tubercles; first pair lacking apical seta, with apices pointed, directed caudally. Dorsal,

lateral and lateroventral surfaces covered with long spine-like nodules. Second pair of tubercles short, broad, bearing long, slightly serrated, curved seta.

*Pupa* (Figs 2, 4, 8). - Total length 1.6 - 1.8 mm. Dark brown. Total habitus as in Fig. 2.

Head: Both pairs of setae straight, placed on long process of almost the same length; slightly serrated, with blunt apex (Fig. 8).

Thorax: Respiratory horn relatively large, with



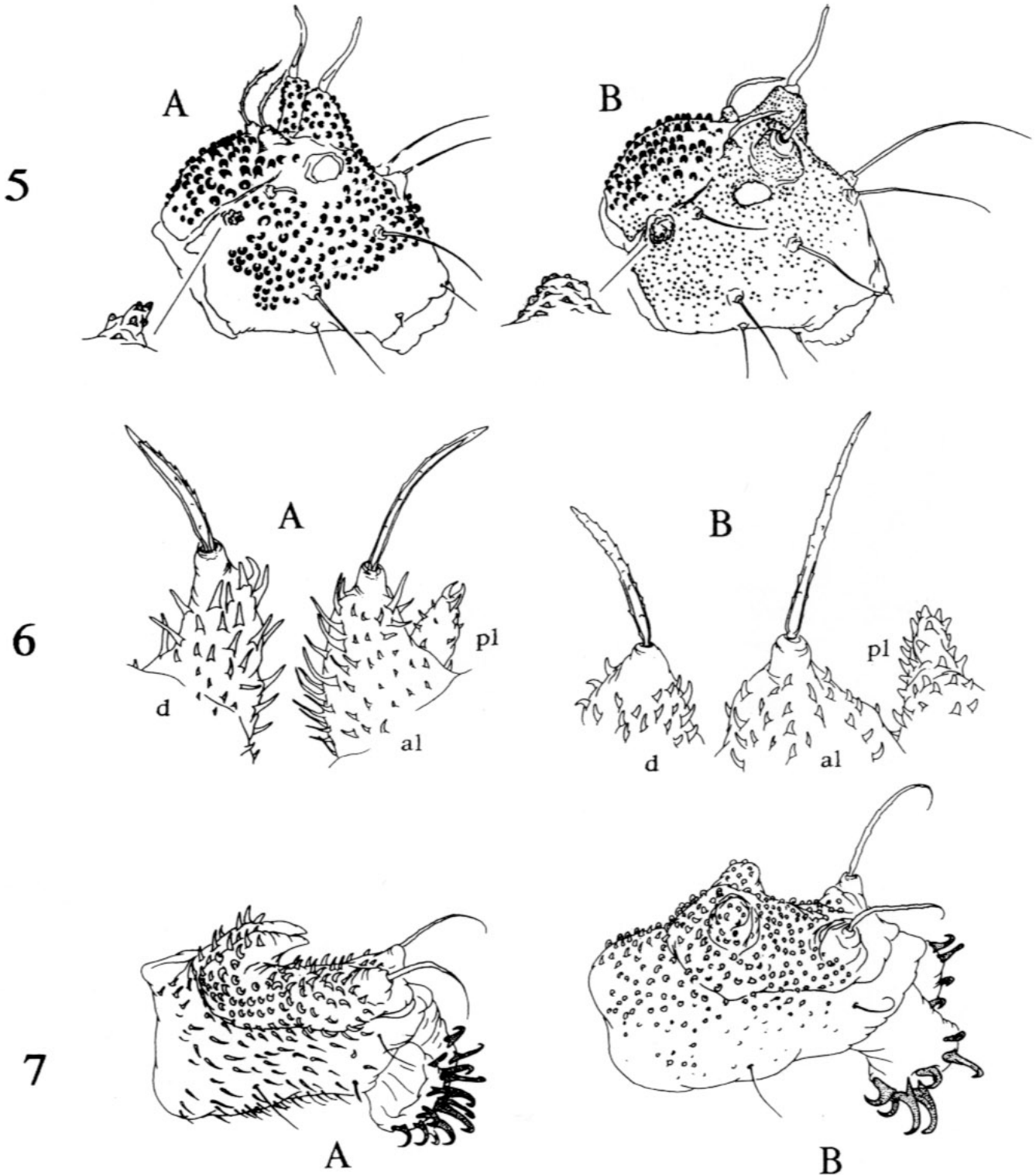
Figs 1-4. Immature stages of *Atrichopogon winnertzi* Goetghebuer: (1) lateral aspect of larva; (2) dorsal aspect of pupa; (3) body segment 11 of larva; (4) mesothorax of pupa. Abbreviations: al - anterolateral process of larva, d - mediodorsal process of larva and pupa, l - lateral process of pupa, m1-6 - mesothoracic processes 1 to 6 of pupa, pl - posterolateral process of larva.

8-9 openings (Fig. 8 th). Processes m1 and m2 bearing apical, long seta; processes m3-6 lacking apical seta (Fig. 8); process m5 relatively long and sinuous.

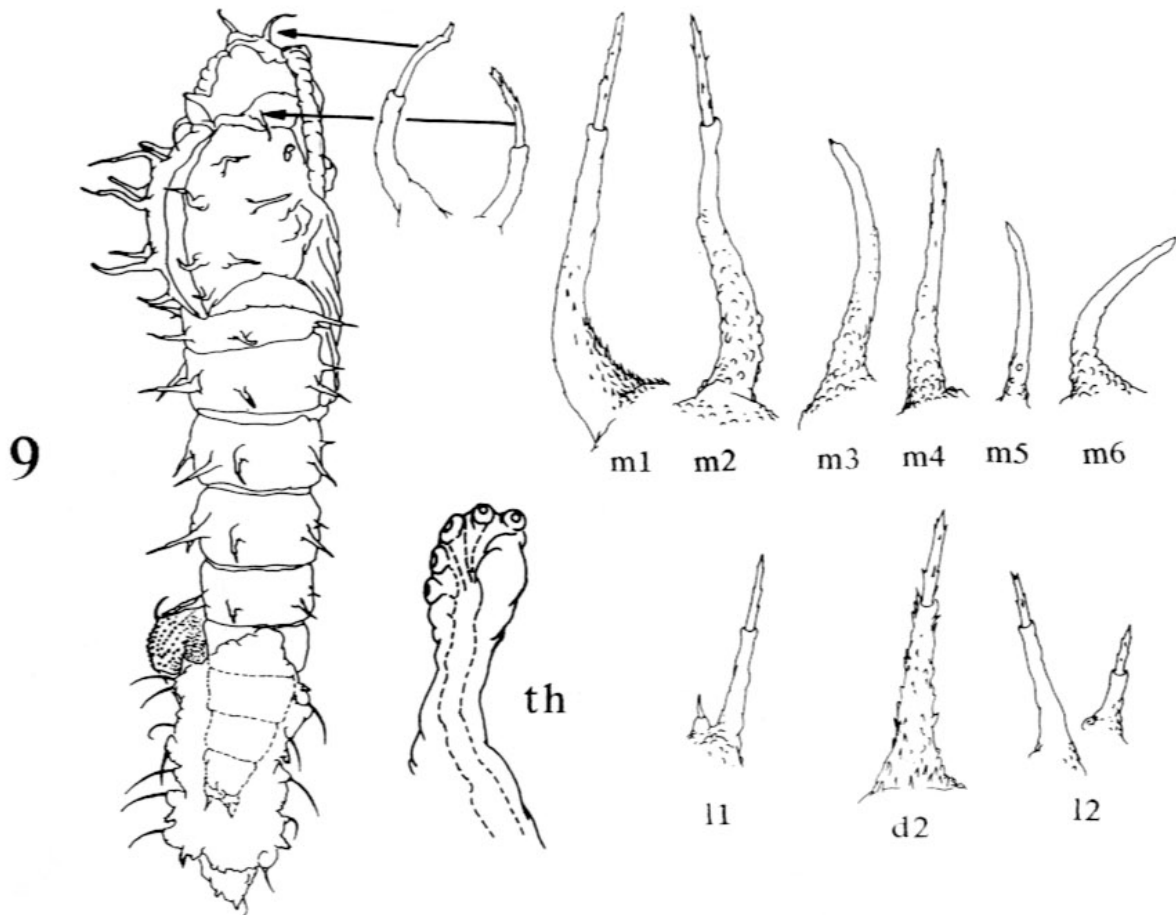
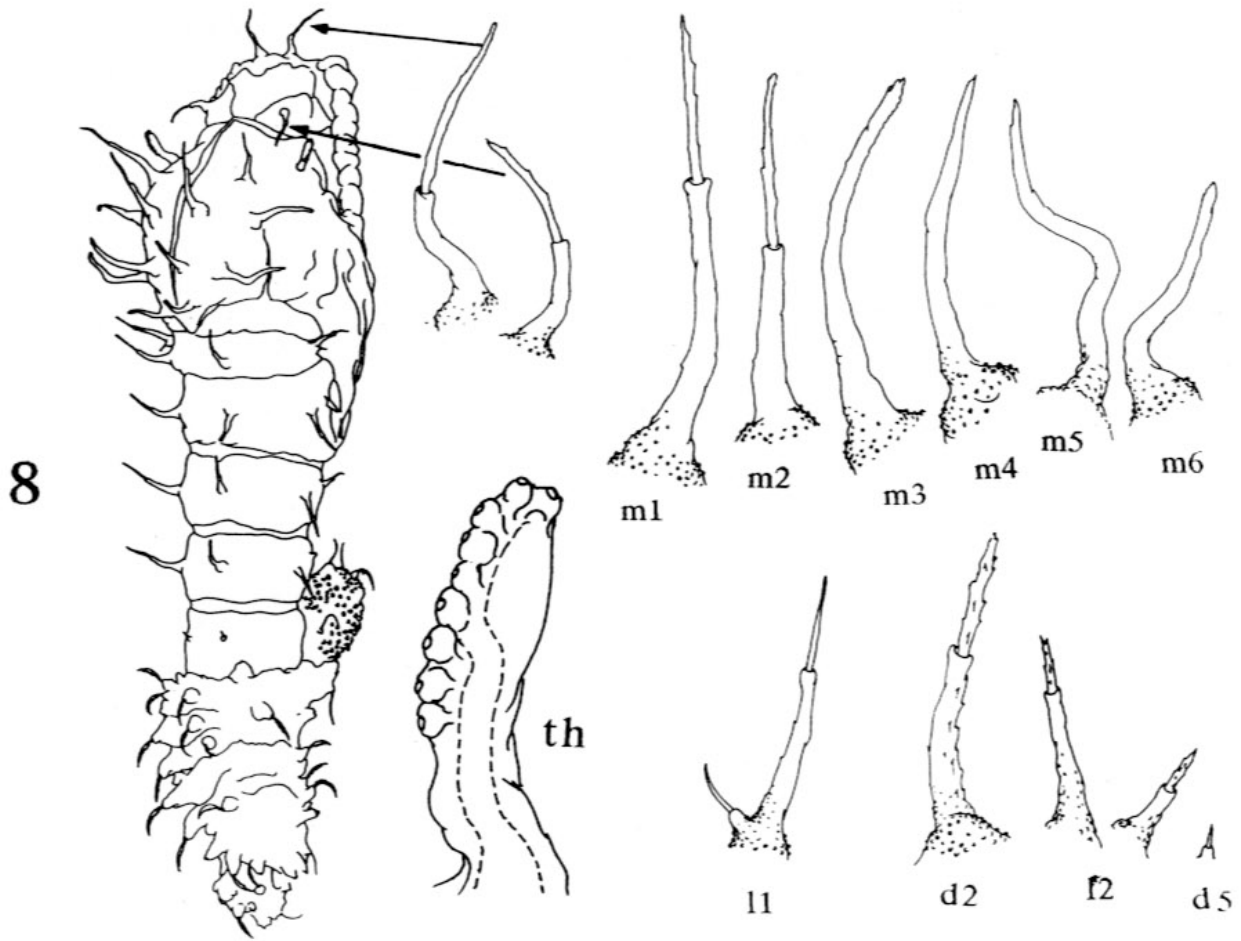
Abdomen: Mediodorsal processes of segments 1-4 long, slender, with distinctly serrated apical seta (Fig. 8 d2). Two lateral processes on segment 2-4 smooth, apical seta serrated (Fig. 8 l2). On first abdominal segment bases of lateral tubercles fused; smaller one armed with apical, curved seta three times longer than its tubercle (Fig. 8 ll). Abdominal

segment 5 bearing only pair of very small, difficult to discern mediodorsal processes with very short apical seta (Fig. 8 d5).

*Female* (Figs 10-13 A). – Body brown, legs paler, brownish. Eyes bare. Proximal flagellomeres slightly flattened, transverse (Fig. 13A), distal flagellomeres elongate. Antennal ratio (AR) 2.10 - 2.35. Palpus relatively long, slender (Fig. 11 A); third palpal segment slender, 4.7 - 5.0 as long as its greatest



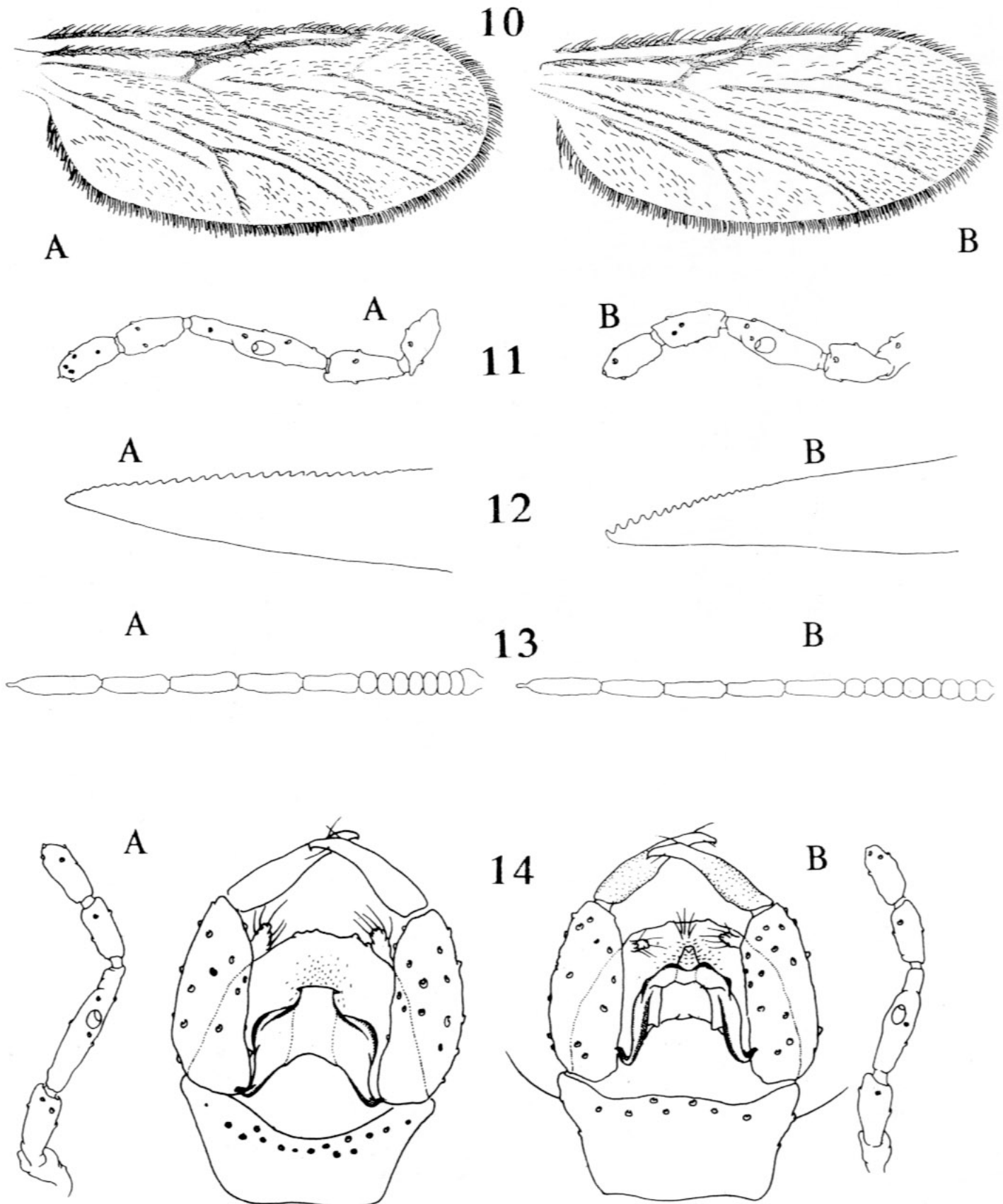
Figs 5-7. Larvae of *Atrichopogon winnertzi* Goetghebuer (A) and *A. oedemerarum* Storå (B): (5) head; (6) mediodorsal (d), anterolateral (al) and posterolateral processes (pl) of 6th body segment; (7) anal segment.



Figs 8, 9. Pupae of *Atrichopogon*: (8) *A. winnertzi* Goetghebuer; (9) *A. oedemerarum* Storå. Abbreviations: d - medio-dorsal process, l - lateral process, m - mesothoracic process, th - respiratory horn.

width; sensory pit small, at midlength. Proboscis long, bent forward. Mandible armed with 28 - 30 teeth, their size gradually decreasing from middle in two, distal and proximal, directions (Fig. 12 A).

Wing length 1.40 - 1.45 mm; costal ratio (CR) 0.69 - 0.72; macrotrichia below basal radial cell numerous, in 2-3 rows (Fig. 10A). Seminal capsules 2, oval, with short neck.



Figs 10-14. Adults of *Atrichopogon winnertzi* Goetghebuer (A) and *A. oedemerarum* Storå (B): (10) female wing; (11) female palpus; (12) female mandible; (13) female flagellum; (14) male palpus and genitalia.

**Male** (Fig. 14 A). – Similar to female with usual sexual differences. Third palpal segment 4.4 - 4.8 times as long as greatest width (Fig. 14 A). Wing length 1.40 - 1.58, costal ratio (CR) 0.63 - 0.65. Macrotrichia present at wing apex. Male genitalia as in Fig. 14 A. Aedeagus with blunt, broad, rooflet-like apicomedian process.

**Material examined.** – Poland: Raciąż, Wysocki Młyn and Kosowa Niwa nr. Tuchola, under rotting logs, branches and bark of *Pinus silvestris* L., 5 Dec. 1992 - 20 larvae; 30 Oct. 1993 - 42 larvae; 16 Oct. 1993 - 79 larvae, reared - 3♂, 9♀; W. Gilka. Wyskok nr. Kętrzyn, 14 May 1992, on beetle *Meloe violacea* L. - 39♀, W. Gilka & R. Szadziewski. Denmark: NE Zealand, Jægersborg Hegn, April 1939 - larvae, pupae and adults, H. Anthon (coll. Zoological Museum, Copenhagen).

**Distribution and biology.** – *Atrichopogon winnertzi* is a West Palaearctic species known from Algeria, Italy, Slovenia, Bulgaria (in our collection), England, Belgium, France, Austria, Hungary, Germany, Poland, Slovakia, Denmark, Finland, Estonia, Lithuania, Ukraine, Armenia, Kirghizia, Russia - West Siberia.

Females attack meloid beetles and suck their haemolymph (Kieffer 1922b; pers. obs.). Some previous records on the feeding habit of females of this species were actually based on specimens of *A. lucorum* and *A. oedemerarum* (Wirth 1980). In experiments in German northern Bavaria where meloid beetles are absent, the species was not attracted by cantharidin analogues (Frenzel et al. 1992). Larvae live under rotting wood (Winnertz 1852; Speiser 1910; Ewen & Saunders 1958; present records).

**Discussion.** – Kieffer (1922b) described a female of *Atrichopogon meloesugans* from Algeria which sucked haemolymph from a *Meloe* beetle. That name was in common use since Wirth's (1956) redescription of the species. Present examination of all stages of the species and older literature leads us to the conclusion that the species named *winnertzi* and *meloesugans* are identical. Both names were published in 1922, but that of Kieffer appeared in a paper published on December 31. The holotype of *A. meloesugans* from Algeria is lost and the occurrence of the species in that area has not subsequently been confirmed. However, the occurrence in southern Europe makes it biogeographically plausible that it also lives in North Africa.

***Atrichopogon (Meloehalea) oedemerarum***  
Storå, 1939

(Figs 5B, 6B, 7B, 9, 10B, 11B, 12B, 13B, 14B)

*Atrichopogon oedemerarum* Storå, 1939: 16 (♀, Finland - N.Lojo, Kaikuma); Wirth 1980: 137 (♂, ♀, illustr., England, Estonia, Germany, North America); Remm 1988: 86 (Soviet Union); Szadziewski 1991: 106 (Poland).

**Diagnosis.** – Larva with convex dorsal surface of head; almost whole head capsule covered with fine and dense nodules, dorsal surface additionally with large sparse nodules; proximal pair of tubercles of anal segment short, broad, covered with small nodules. Pupa differs from that of *A. winnertzi* in having smaller respiratory horn bearing 5 openings, thoracic process m5 short and almost straight, 5th abdominal segment with long mediodorsal and lateral processes. Female with short 3rd palpal segment, proximal flagellomeres spherical, distal teeth of mandible larger than proximal. Male genitalia with aedeagus bearing pointed, triangular caudo-median process, unique within the subgenus.

**Larva** (4th instar) (Figs 5-7). – Total length 2.2 - 2.4 mm. Brown, head darker than body. Head (Fig. 5 B): Antenna on stout tubercle; tubercle distinctly shorter than antenna, covered with dense, fine nodules. Seta p on rough tubercle; slightly serrated, directed orally. Seta t about two times longer than antenna, smooth, somewhat curved. Setae s, u, v similar; smooth, finely curved. Nodules of head of two types: first large, relatively sparse, on dorsal surface; of second type fine, dense, covering almost all head. Dorsal surface of head convex. Laterodorsal tubercle broad with evenly rounded tip (Fig. 5 B).

Thoracic and abdominal segments: each segment 1-11 with pair of mediodorsal serrated setae d on short broad tubercle (fig 6 B d); each seta longer than its tubercle; tubercle covered with short cuticular nodules. Anterolateral seta al on tubercle of similar shape as above; similarly serrated and much longer than seta d. Thoracic segments 1-2 bearing setae al and pl on tubercles. Segments 3-11 with short, stout club-like tubercle pl lacking apical seta; processes pl, or tubercles pl, dark, covered with heavily sclerotized, sparse, stout nodules (Fig. 6 B pl). Lateroventral setae e, f smooth, short.

Anal segment (12) (Fig. 7 B) with 2 pairs of dorsal tubercles; proximal pair lacking seta, short, broad with rounded apices; distal pair bearing slightly serrated, curved seta. Dorsal and lateral surfaces of anal segment covered with short nodules; lateroventral surface bare.

**Pupa** (Fig. 9). – Total length 1.4-1.7 mm. Brown.

Head: Setae slightly curved and serrated, on long processes.

Thorax: Respiratory horn short, with 5 openings (Fig. 9 th). Mesothoracic processes m1, 2 with serrated and short apical seta (Fig. 9 m1, m2). Processes m3-6 lacking apical seta. Process m5 relatively short and only slightly curved (Fig. 9 m5).

Abdomen: Mediodorsal processes of segments 1-5 slender and serrated, also bearing serrated apical setae (Fig. 9 d2). Pair of lateral processes of segments 2-5 separated, smooth and short (Fig. 9 l2). Bases of lateral processes of first abdominal segment fused (Fig. 9 l1); smaller one with apical seta of same length as its process.

**Female** (Figs 10-13 B). – Body brown, legs more pale, brownish. Eyes bare. Proximal flagellomeres spherical (Fig. 13 B), distal flagellomeres elongate. Antennal ratio (AR) 1.80-2.20. Palpus relatively short (Fig. 11 B). Third palpal segment short, only 2.6–2.9 as long as its greatest width. Sensory pit small, at midlength. Proboscis short, straight. Mandible armed with 21-23 teeth, their size gradually increasing distad in series (Fig. 12 B). Wing length 1.36-1.42 mm, costal ratio (CR) 0.67-0.69; macrotrichia below basal radial cell not numerous, in 1-2 rows (Fig. 10 B).

**Male** (Fig. 14 B). – Similar to female with usual sexual differences. Third palpal segment 3.2-3.4 times as long as greatest width (Fig. 14 B). Wing length 1.25-1.30 mm, costal ratio (CR) 0.62–0.69, antennal ratio (AR) 0.9-1.1. Wing membrane with some macrotrichia at apex. Male genitalia as in Fig. 14 B. Aedeagus unique within subgenus, with well shaped, triangular, distinctly pointed apicomedian process.

**Material examined.** – Poland: Raciąż, Wysocki Młyn and Kosowa Niwa nr. Tuchola, under rotting bark, logs and fallen branches of *Pinus silvestris* L., 5 Oct. 1991 - 18 larvae; 16 Oct. 1993 - 70 larvae; 30 Oct. 1993 - 3 larvae, reared - 12 ♂, 24 ♀; W. Gilka.

**Distribution and biology.** – The species is of Holarctic distribution and, according to Remm (1988), restricted to the forest zone. Larvae are terrestrial and found only under rotting bark and wood of *Pinus silvestris*. Females were attracted to cantharidin and its analogues in experiments (Neindorf 1959; Abdullah 1964, after Wirth 1980; Frenzel 1992). Immature stages are described for the first time here.

## Review of descriptions of *Atrichopogon* immatures in Europe

Generally adults of *Atrichopogon* are difficult to

separate to species. In contrast the immature stages, especially larvae, are excellent for species recognition (Nielsen 1951, Ewen & Saunders 1958, Chan & Linley 1988). The subgeneric classification within *Atrichopogon* is poorly understood and is primarily based on adult characters. It is weakly supported, or even obscured by characters found in larvae and pupae. We found it difficult to construct keys for the subgenera even for the Palaearctic or Holarctic species. Therefore the present keys are only for the European fauna and should be treated as preliminary. The subgeneric classification of European *Atrichopogon* was developed by Remm and summarized in the Catalogue of Palaearctic Diptera (Remm 1988). It includes the following subgenera: *Psilokempia* Enderlein, *Meloehalea* Wirth, *Lophomyidium* Cordero (= *Rostropogon* Remm; synonymy proposed by Wirth 1994), *Psammopogon* Remm, and *Atrichopogon* Kieffer.

Our larval and pupal keys to subgenera are based on the European species listed below and on some North American species described by Ewen & Saunders (1958).

In Europe immature stages of the following species are known:

### Subgenus *Psammopogon*

*A. muelleri* (Kieffer in Müller, 1905). – Fully aquatic species. Larva and pupa described from Thuringia in Germany by Müller (1905). Larvae were found on the lower side of stones in a cold stream. Bangerter (1933, as *A. trifasciatus*) found larvae in streams in Switzerland among fallen leaves and on moist stones. Larvae and pupae, collected by Thienemann in rills in Sweden, were described by Mayer (1934) as *A. trifasciatus* var. *globularis* but probably belong to *A. muelleri*. Subsequently, Nielsen (1951, as *A. cornutus* Nielsen) found larvae of this species in small rills in Denmark.

### Subgenus *Psilokempia*

*A. forcipatus* (Winnertz). – Larvae terrestrial. Found in Switzerland under rotting leaves (Bangerter 1933, as *Kempia hamifera* Goetghebuer). Larvae have very long lateral processes and pupae lack processes and setae on most abdominal segments. They fit into group C as proposed by Ewen & Saunders (1958) for some Canadian species.

### Subgenus *Lophomyidium* (= *Rostropogon*)

*A. fuscus* (Coquillett) (= *A. polydactylus* Nielsen, synonymy proposed by Wirth 1994). – Larvae seem to be semiaquatic and were found on stones in the rills in Denmark by Nielsen (1951) and in moss along the edge of a slough in Canada (Ewen & Saunders 1958).

Kieffer (1922a) described two species, *Gymnohelea haesitans* and *Atrichopogon putredinis*, from adult material reared from larvae found in detritus at the margin of lake in Schleswig-Holstein. These two species are presently identified as *A. (A.) haesitans* (Kieffer) and *A. (L.) fuscus* (Coquillett). Lenz (in Goetghebuer & Lenz 1934) described the larva and pupa of both of Kieffer's



species, apparently based on original, topotypical material. Curiously, Lenz' description of *haesitans* immatures evidently refers to a species of subgenus *Lophomyidium* (*A. fuscus* or *A. rostratus* (Winnertz)) while his description of *putredinis* immatures is typical of subgenus *Atrichopogon*. This suggests that the material of immatures for these species had been inadvertently interchanged. The type materials are not preserved.

**Subgenus *Atrichopogon***

Larvae are semiaquatic, aquatic or terrestrial.

*A. alveolatus* Nielsen, *A. dubius* Nielsen. – Larvae on stones in rills in Denmark (Nielsen 1951).

*A. fuscus* (Meigen). – Larvae in algae on the surface of ponds in Belgium (Goetghebuer 1923; Ewen & Saunders 1958).

*A. haesitans* (Kieffer). – Larvae found among leaves in small drain canal (*A. putredinis* sensu Lenz, see discussion above).

*A. hexastichus* Nielsen. – Among mosses at the edges of stream (Nielsen 1951).

*A. minutus* (Meigen). – Larvae terrestrial or semiaquatic, found under wood in a swamp in England, on bare rotten wood and on rotten wood in streams in Canada (Ewen & Saunders 1958).

*A. speculiger* Nielsen. – Larvae on stones in rills in Denmark (Nielsen 1951).

*A. thienemanni* Kieffer (= *nitens* Kieffer). – Larvae found in springs in Schleswig-Holstein (Kieffer 1921). Subsequently Lenz (*in* Goetghebuer & Lenz 1934) describes the larva and pupa.

'*A. fossicola* Kieffer'. – Larvae on dead leaves at small drain canal. Larva and pupa briefly described by Lenz (*in* Goetghebuer & Lenz 1934). This name is a junior synonym of *A. fuscus* (Meigen) but Lenz' description refers to a different species.

**Subgenus *Meloehalea***

Larvae terrestrial (see above).

**Key to subgenera of European *Atrichopogon***

*Larvae*

- 1. Body segments with short mediodorsal processes positioned lateral to the base of anterolateral processes. Each anterolateral process very long and armed with very short apical seta ..... *Psilokempia*
- Body segments with short or long processes or setae in dorsal position. Each anterolateral process short or long, with long apical seta ..... 2
- 2. Body segments 2 and 4-10 with distinct smooth dorsal elliptic 'respiratory' fields located between dorsal setae ..... *Psammopogon*
- Body segments without smooth dorsal distinct 'respiratory' fields or with indistinct smooth fields on all body segments 2-10 ..... 3
- 3. Lateral processes very long, armed with long seta apically ..... *Lophomyidium*
- Anterolateral processes short, if long then armed with subapical long seta ..... 4
- 4. Posterolateral processes of body segments 1-2 with stout apical seta, not club-like. Body segments 3-11 with club-like stout posterolateral processes ..... *Meloehalea*

- Posterolateral processes of body segments 1 or 2 or 1-2 club like, without strong apical seta. Other body segments with or without club-like posterolateral processes ..... *Atrichopogon*

*Pupae*

- 1. Abdominal segments 1-3 with or without small, simple lateral processes ..... *Psilokempia*
- Abdominal segments 1-4 or more with lateral processes ..... 2
- 2. Abdominal segments 1-8 with long, simple, finger-like lateral processes. Spiracular openings in convoluted, U-shaped row looping around distal end ..... *Lophomyidium*
- Abdominal segments 1-4 with simple or branching lateral processes. Spiracular openings arranged in a simple row ..... 3
- 3. Dorsum of thorax with 1 pair of long processes ..... *Psammopogon*
- Dorsum of thorax with 2-6 pairs of long processes ..... 4
- 4. Abdominal segments 2-4 with 2 distinct, simple lateral processes ..... *Meloehalea*
- Abdominal segments 2-4 with single, branching or simple lateral processes ..... *Atrichopogon*

*Females*

- 1. Two seminal capsules present. Eyes bare ..... 2
- One seminal capsule present. Eyes bare or pubescent ..... 3
- 2. Proboscis short, straight or bent anteriorly. 3rd palpal segment with sensory pit located at midlength ..... *Meloehalea*
- Proboscis very long, with apex bent posteriorly. 3rd palpal segment with sensory pit located near apex ..... *Lophomyidium*
- 3. Abdominal sternites 7 and 8 with armature composed of distinct spines. Eyes pubescent. 5th palpal segment usually conical ..... *Psilokempia*
- Abdomen without special armature. Eyes bare or pubescent. 5th palpal segment with rounded apex ..... 4
- 4. Paratergite with 1, rarely 2 setae. Thorax and head more or less uniformly coloured. Eyes bare or pubescent ..... *Atrichopogon*
- Paratergite with more than 3 setae. Thorax and head bicoloured, yellow and brown; scutum with yellow stripes. Eyes bare ..... *Psammopogon*

*Males*

- 1. Scutum brown with yellow stripes. Genitalia large, broader than tip of abdomen; gonostylus with bifid or trifid apex. Wing membrane with macrotrichia ..... *Psammopogon*
- Scutum more or less uniformly coloured. Genitalia not enlarged, as broad as tip of abdomen; gonostylus with simple pointed apex. Wing membrane bare or with macrotrichia ..... 2
- 2. Proboscis longer than head height, with apex bent posteriorly. 3rd palpal segment with sensory pit located near apex. Eyes bare. Wing membrane usually bare ..... *Lophomyidium*
- Proboscis shorter than head height, straight or bent anteriorly. Third palpal segment with sensory pit located at midlength or near apex. Wing membrane bare or with macrotrichia ..... 3

3. Wing membrane with macrotrichia. Eyes bare  
..... *Meloehalea*  
- Wing membrane bare or with some macrotrichia; if macrotrichia present then eyes pubescent ..... 4
4. 5th palpal segment conical. Eyes pubescent. Paratergite with 1 seta. Wing membrane bare. Second radial cell almost the same length as first one ..... *Psilokempia*  
- 5th palpal segment rounded apically. Eyes bare or pubescent. Paratergite with 1-2 setae. Wing membrane bare or with some macrotrichia at wing tip. Second radial cell much longer than first one ..... *Atrichopogon*

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