

Two new species of Aeolothripidae from Baltic Tertiary amber (Insecta: Thysanoptera)

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Abstract

The present study deals with two fossil thrips species of the family Aeolothripidae (Insecta: Thysanoptera), *Rhipidothripoides juttae* sp. n. and *Mymarothrips groehni* sp. n. Both are preserved as inclusions in Baltic Tertiary Amber (Eocene). Furthermore, a method to facilitate microscopic examinations by embedding the amber in synthetic resin is suggested.

Key words: Fossil Thysanoptera, Aeolothripidae, Mymarothrips, Rhipidothripoides, Baltic Tertiary amber, conservation of amber.

1. Introduction

The Thysanoptera family Aeolothripidae contains about 200 extant species placed in 23 genera (THRIPS WIKI 2015). Considering the present diversity the number of fossil Aeolothripids appears rather rare: up to now 13 species (7 genera) have been described from different geological eras. These fossils range from the Permian (*Permothrips longipennis* MARTYNOV, 1935 [SHAROV 1972]) and Cretaceous (*Fusithrips crassipes* SHMAKOV, 2009 and *Cretothrips antiquus* GRIMALDI et al., 2004) to the Tertiary. Most of the fossils associated with Aeolothripidae have been originated from Tertiary layers where they have been found mainly as imprints in lime, potash and lignite (PRIESNER & QUIEVREUX 1936; VON SCHLECHTENDAHL 1887; SCUDDER 1875; SHMAKOV 2014). Due to their poor preservation in these matrices, their attribution on family status remains in large parts doubtful and requires review. From Baltic Tertiary (Eocene) amber, which presents a wide range of insect inclusions in excellent condition, only one single genus is known: *Rhipidothripoides* BAGNALL, 1923. At present, this genus includes two species described by monotypy of single female specimens (BAGNALL 1923; SCHLIEPHAKE 2001).

More than 50% of the extant Aeolothripidae genera are restricted to tropical countries (MOUND et al. 2012). Due to the warm and very humid climates in the bygone amber forests (GRÖHN 2013) these insects may have found similar living conditions just as in today's tropics. It is therefore realistic to believe that Aeolothripids were widespread in these ecosystems. Furthermore, it might be assumed that they had shown similar behavioural patterns as their related extant descendants, which appear to be obligate predators either high in the trees' canopy or at ground level.

The two species described below belong to the genera *Mymarothrips* BAGNALL, 1928 and *Rhipidothripoides*

BAGNALL, 1923. *Rhipidothripoides* is an exclusively fossil genus that was set up by BAGNALL (1923) in conformity of antennal structures to extant *Rhipidothrips* UZEL, 1895. Having antennal segments VII–IX connate, but the forewing with well developed cross veins and both longitudinal veins joining the ring vein well before the wing apex, it occupies a position between *Melanthrips* HALIDAY, 1836 and *Rhipidothrips*. (MOUND 1968; MOUND & MARULLO 1998; ZUR STRASSEN 2003). *Mymarothrips* in contrast up to now contains only extant species spread over the Old World tropics of Africa, India, China, Indonesia, and Australia. Concerning its morphologic structures, the fossil specimen corresponds considerably with the extant members of that genus. The invention of a possibly new fossil genus appeared useless therefore. According to MOUND & MARULLO (1998) the classification within extant *Mymarothrips* is not yet clear. Three species are currently listed but these possibly could represent local variants of one single species that occur with a range of intraspecific variation. However, it is not the purpose of the present paper to clarify taxonomic obscurities within that genus. The described specimens ipso facto appear interesting, revealing a first male of *Rhipidothripoides* and a first fossil of *Mymarothrips*.

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2. Material and methods

The present study deals with two amber inclusions of the Thysanoptera collection of the author. Originally these fossils derived from areas around the Baltic Sea. The inclusion of the *Mymarothrips* was generously ceded to the author by CARSTEN GRÖHN (formerly Coll. GRÖHN No. 3770 W, now: Coll. ULITZKA No. MU-Fos 36/1), the *Rhipidothripoides* fossil (Coll. ULITZKA No. MU-Fos 21/1) was bought in December 2013 from MARIUS VETA (Palaga, Lithuania). Both specimens are deposited in the Thysanoptera collection of the Senckenbergische Naturforschende Gesellschaft in Frankfurt am Main, Germany (reference numbers below).

To prepare the fossils for the microscopic examination the amber first was cut and polished to slices of about 3 mm thickness. Centring the thrips inclusions midway, these slices were embedded in XOR-Crystal-Resin and finally ground again and polished with a water-fed flat lap to the size of a standard microscope slide (76 x 26mm) and a thickness of at most 2 mm (Fig. 1). As not only the synthetic resin but also the amber was wet again by this procedure, the complete preparation was varnished with Acrüdur R 40 single-component polyurethane resin (Adolf C.C. Rüegg GmbH & Co Hamburg, Germany). This method of embedding the amber in such thin microscope slide-like arti-

ficial resin blocks permits accurate front and rear view of the bioinclusion (see Figs. 2 and 3). The resin stabilizes the amber and prevents oxidation. Furthermore, centring the tiny inclusions makes its handling much more suitable during the microscopic examinations, just as the comfortable size of standard microscope slides, which over and above simplifies storing these samples in normal slide boxes (see also ULITZKA 2015).

All examinations were carried out using a Zeiss standard microscope with the following objectives: Zeiss Plan 10/0, 22 160/-, Nikon M Plan 20x ELWD 210 mm and Nikon M Plan 40x ELWD 0.5NA 210 mm. Illumination was implemented merging transmission light with two or three white-light-LED incident illuminators. White paper was used as a diffusor for incident illumination to prevent reflections in the amber; different coloured paper sheets were inserted under the slide with transmission light to get the inclusion in better contrast to the yellowish translucent amber. Photo micrography was performed with a digital camera attached to the microscope (Canon EOS 70d). The presented photos were produced in focus stacking technique with Helicon Focus software. Nik Sharpener Pro and Adobe Photoshop CS3 were used for final colour adjustment and sharpening. Subsequently, details of the thrips inclusions were drawn using a Zeiss drawing tube attached to the microscope.

3. Descriptions of the new species

Rhipidothripoides juttae sp. n.

Figs. 2, 3, 7, 8

Etymology: This gracile species named “*juttae*” is dedicated in love and as a wedding gift to my fiancée and partner for



Fig. 1. Microscope slide-like block of polished XOR-Crystal-Resin containing the midway centred amber inclusion of *Rhipidothripoides juttae* sp. n. and *Mymarothrips groehni* sp. n. Measurements in mm (length/width/thickness): 76 x 26 x 1.8.



Fig. 2. *Rhipidothripoides juttae* sp. n. ♂ (ventral view) close to syninclusions of an aphid and a stellate hair presumably of an oak tree.



Fig. 3. *Rhipidothripoides juttae* sp. n. ♂.

many years, JUTTA MOROZ. She encouraged me countless times to keep on studying thrips species and supports all my scientific work on these insects.

Material studied: Holotype male; Lithuania, Baltic Sea, bought from MARIUS VETA (Palanga, Lithuania); Collection ULITZKA No. MU-Fos 27/1; deposited in the Senckenbergische Naturforschende Gesellschaft: SMF T 19262).

Gender: Male.

Description: Colour difficult to assess. At least head, prothorax and distal abdominal segments appear to have been dark brown (Fig. 3); remaining parts of the body and legs light brown; basal segments of all tarsi distally with a narrow ring-like dark brown shading. Antennae (Fig. 7) light brown; segments III–VII distally dark brown; segments VIII and IX dark brown. Wings without any visible shading; fringes of forewing dark brown.

Head (Fig. 8) slightly retracted under pronotum; wider than long, transversely sculptured on posterior half and produced in

front of the eyes; antennae attached more ventrally, therefore antennal segment I and base of II not visible from above; with 2 pairs of small ocellar setae and 3–4 pairs of minute postocular setae close to the inner hind margin of the compound eyes; vertex without any setae. Compound eyes large and protruding in front of convex cheeks; fore ocellus protruding and directed forwards. Mouth cone short and pointed. Maxillary palps 3-segmented; labial palps 4-segmented. Antennae (Fig. 7) about half as long as body; 9-segmented; segment II cup-shaped, segments III–VI parallel-sided and elongate, segment VII elongate cone-shaped and connate to segments VIII and IX that are forming a short 2-segmented conical style; segments III–VII bearing many prominent setae that are longer than the diameter of the antennal segments; segment IV with a small oval sensorium on apex (sensoria on segments III not visible); each of the segments V and VI bearing one slender sense cone. Prothorax (Fig. 8) wider than long. Pronotum smooth; without any longer setae. Mesonotum with 2 pairs of minute setae on its posterior margin. Metanotum as far as visible with faintly elongate sculpture. Wings (Fig. 3) with microtrichia; distally broadly rounded; forewings with 4 cross veins; costa with about 27 minute setae, anterior vein (radius) bearing a row of 14 small setae and posterior vein (media) bearing a row of 12 setae; both longitudinal veins join the ring vein well before the wing apex; posterior fringes straight. Legs long and slender; all femora and tibiae with rings of microtrichia; all basal tarsal segments about three times as long as broad; hamus on the fore tarsi not visible due to the position of the legs. Abdomen distally with long delicate setae; abdominal tergite I with two diverging longitudinal ridges; microtrichia visible laterally on tergites II–VII; tergite VIII completely covered with rows of dense microtrichia; hind edge of tergite IX medially with a comb-like structure bearing tiny teeth.

Measurements (holotype male, in microns): Body length 705 (slightly contracted). Head, length 105; width across the eyes 140; width behind the eyes 124. Eyes, length 50, width 47. Hind ocelli length 19, width 14; distance between the hind ocelli 19. Ocellar setae about 8; postocular setae about 11. Pronotum, length 101; middle width 136; pterothorax, largest width 213. Abdomen, length 388; largest width (at base of segment III) 144; abdominal tergite I, length 74; setae on segments IX and X 43–58. Antennae, length 352; length (width) of segment I 16 (27), II 39 (23), III 66 (16), IV 70 (16), V 58 (16), VI 50 (16), VII 39 (basally 14, distally 10), VIII 8 (5), IX 6 (4). Forewings, length 600; width in the middle 43. Forelegs, length of femora 132, tibiae 124, basal segments of tarsi 35; mid legs, length of femora 132, tibiae 140, basal segments of tarsi 35; hind legs, length of femora 160, tibiae 167, basal segments of tarsi 50.

Differential diagnosis: Members of the genus *Rhipidothripoides* have antennal segments VII–IX connate as in *Rhipidothrips* but the forewing has well developed cross veins and both longitudinal veins join the ring vein well before the wing apex as in *Melanthrips* (MOUND, 1968). Presenting this conspicuous combination of characteristics, the new species is clearly attributable with *Rhipidothripoides*. Up to now, two species have been described in that genus: *R. abdominalis* BAGNALL, 1923 and *R. involvus* SCHLIEPHAKE, 2001, each one based on a single holotype female. Further specimens are not known or remained unpublished. Whereas in *R. abdominalis* the ocellar setae as well as all prothoracic setae are well developed, these setae are minute or lacking in *R. involvus* (BAGNALL 1923; MOUND 1968; SCHLIEPHAKE 2001). The new species resembles *R. involvus* in the missing of the major setae; however, its antennae are conspicuously longer even though its body length

is much smaller. Furthermore, in *R. involvus* the antennal segments III–VI are not completely parallel sided but slightly convex. Even assuming gender-dependent varying size ratios linked to an intraspecific sexual dimorphism concerning the antennae, *R. involvus* differs in having the compound eyes much larger, occupying nearly the complete sides of the head. Besides this, in *R. juttai* sp. n. the head shape is completely different: the head is constricted behind and produced in front of the compound eyes; the fore ocellus is protruding and directed forwards. These characteristics and the visual morphological appearance of the holotype female of *R. involvus* (as far as assessable due to the milky covering of this specimen) refute the presumption that the present specimen could represent an according male.

Syninclusions: One non-identified aphid (Insecta: Aphidoidea) and some stellate hairs presumably from oak trees (Fig. 2).

Mymarothrips groehni sp. n.

Figs. 4–6

Etymology: This remarkable species is named “*groehni*” to honour the research work on amber of CARSTEN GRÖHN (first chairman of the Verein zur Förderung des Geologisch-Paläontologischen Museums der Universität Hamburg e.V., “Arbeitskreis Bernstein”). He was the owner of the specimen before description.

Material studied: *M. groehni* sp. n. holotype female; Baltic Sea, exact origin not known; Collection ULITZKA No. MU-Fos 36/1; deposited in the Senckenbergische Naturforschende Gesellschaft: SMF T 19263).

Gender: The sex of this specimen is at first difficult to assess. The assumption that it is a female is supported by the intraspecific sexual dimorphism of extant *Mymarothrips* species: They have sensoria on antennal segments III and IV transverse around the apex ventrally in females, but prolonged dorso-laterally to near the base of the segment and then recurved ventrally in males (BHATTI 2006; MOUND & MARULLO 1998). *M. groehni* corresponds in these structures with extant females and therefore its sex is clearly decidable. The barely perceptible pointed structure could also be interpreted as the distal part of an ovipositor that is retracted in the abdomen.

Description: Colour of body and head light brown (Fig. 4), colour of the antennae not easy to assess: light brown, segments VII–IX on the left antenna appear slightly darker. All major setae pale. Forewings with traces of a presumably broad median shading (not clearly assessable); fringes pale.

Head wider than long; not produced in front of the eyes. Ocelli and eyes large; compound eyes not distended ventrally. Ocellar setae removed, but at least the points of insertion of two pairs visible; vertex with three pairs of very small postocular setae. Mouth cone short. Maxillary palps 3-segmented. Antennae (Fig. 5) about one third as long as body, 9-segmented; segments III–VII moniliform, but almost rectangular, with prominent setae and slender pedicels at base; VIII cone-shaped; IX slender, forming a slightly cone shaped pedicel. Segments III and IV each with a ventral transverse kidney-shaped sensorium around the apex. Prothorax much wider than long. Pronotum smooth except for some faint lines of transverse sculpture close to the lateral margins; without longer setae except for one pair of prominent posteroangular setae. Pterothorax not clearly visible; at least metanotum transversely sculptured. Forewings typi-



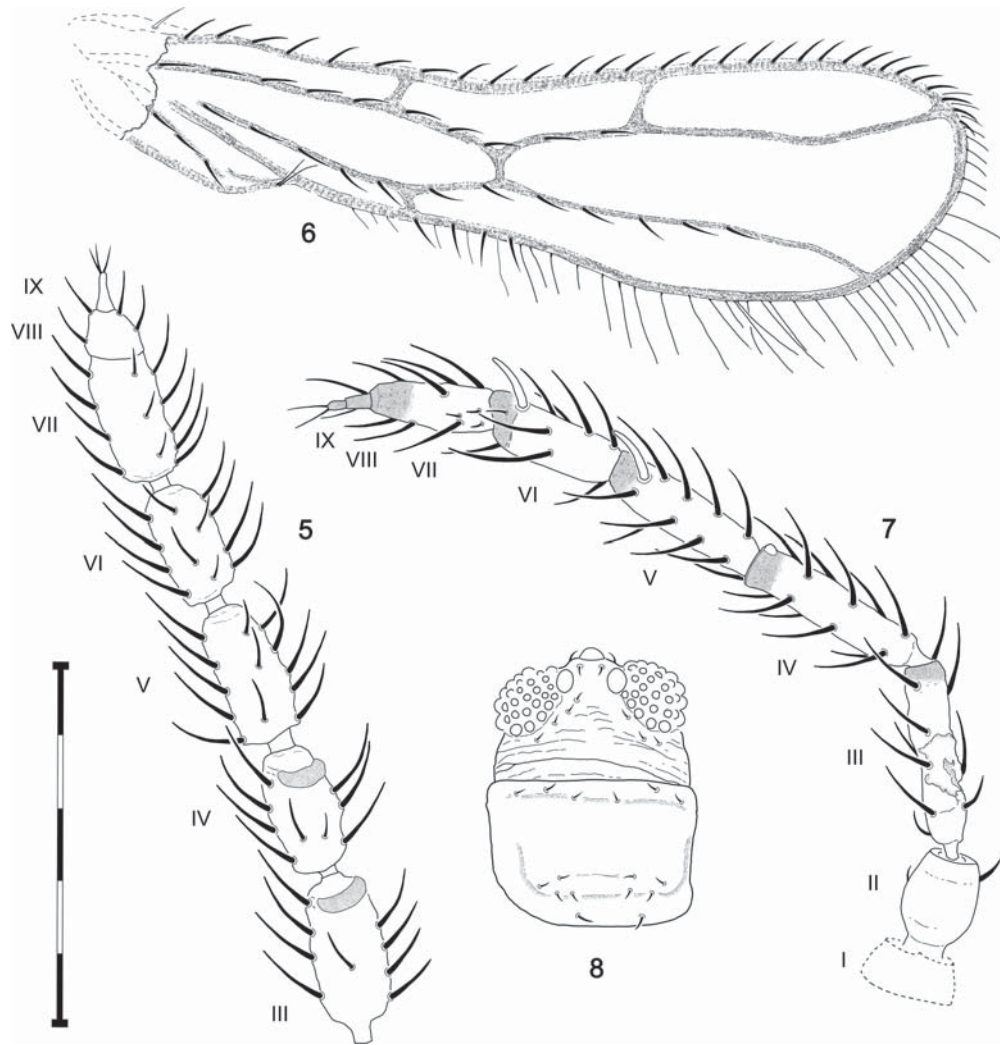
Fig. 4. *Mymarothrips groehni* sp. n. ♂.

cally *Mymarothrips*-shaped (Fig. 6), with base slender, but apex broadly rounded; covered with microtrichia; forewings with 4 cross veins; costa with 29 setae; anterior vein (radius) bearing 8 setae between its base and the median cross vein (distal setae not visible), posterior vein (media) bearing about 13 setae. Fringes of the forewing short and straight. Legs long and slender; tarsi two segmented. Basal segments of abdomen not visible (covered by wings), distal segments without microtrichia; sternites without discal setae.

Measurements (holotype female, in microns): Body length 858 (slightly contracted). Head, length about 150 (retracted under pronotum, therefore difficult to measure); width across the eyes 169. Eyes, length 90, width 68. Hind ocelli length 19, width 14; distance between the hind ocelli 15. Pronotum, length 83; width 165; Abdomen, length 450. Antennae, length segment III–IX 287 (segments I and II not measurable); length (width) of segment III 58 (23), IV 49 (20), V 54 (19), VI 45 (19), VII 47 (20), VIII 17 (basally 16, distally 8), IX 12 (4). Forewings, length 600; largest width 176. Forelegs, length of femora 135, tibiae 135, basal segments of tarsi 45; mid legs, length of femora 132, tibiae 135, basal segments of tarsi 60; hind legs, length of femora 180, tibiae 143, basal segments of tarsi 60.

Differential diagnosis: As mentioned above, the genus *Mymarothrips* currently contains three extant species. The female of *M. groehni* sp. n. is the first fossil representative. Due to its distinctive racket-shaped forewings with the distal part about twice as broad as the base and due to its characteristic antenna with segments III–VII similar in size and shape, it can be clearly classified as a member of that genus. Species vary in the course of time and therefore each of them has a limited period of existence only (ZUR STRASSEN 1973). Based on this fact alone the fossil *Mymarothrips* of the Tertiary era is not attributable to any Recent species. Furthermore, and contrary to all the extant species, *M. groehni* sp. n. differs in having only one pair of pronotal prominent setae (setae posteroangulares). Beside this, antennal segment VIII is much wider at its base and therefore more cone-shaped than in extant species.

Syninclusions: A fossil wasp of the family Diapriidae (Insecta: Hymenoptera), a mite (Arachnida: Acari) and some stellate hairs presumably from oak trees.



Figs. 5, 6. *Mymarothrips groehni* sp. n. ♂. 5: Right antenna, segments III–IX. 6: Right forewing (microtrichia are not shown).

Figs. 7, 8. *Rhipidothripoides juttai* sp. n. ♂. 7: Right antenna. 8: Head and prothorax. The scale shown above is equal to 250 µm in Figs. 6 and 8; in Figs. 5 and 7 it is equal to 125 µm.

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