New representative of the family Panorpodidae (Insecta, Mecoptera) from Eocene Baltic Amber with a key to fossil species of genus Panorpodes

Agnieszka Soszyńska-Maj and Wiesław Krzemiński

ABSTRACT

Panorpodidae (short-faced scorpionflies) is a species-poor family of scorpionflies (Mecoptera). Fossils are extremely rare but indicate that this group was diverse in the past. Up to now, three species of the genus Panorpodes have been described from Eocene Baltic amber, as well as a possible panorpodid from the Lower Eocene of Patagonia. Panorpodes gedanensis sp. n. is the fourth species to be recognised in amber material. Wing markings are the most important character in the taxonomy of fossil short-faced scorpionflies. The new species described here shows a new pattern of markings – five dark spots and a terminal band. The Eocene representatives of the genus Panorpodes display different patterns of wing markings: highly transparent wings in P. brevicauda (Hagen, 1856), transparent wings with dark bands and spots in P. weitschati Soszyńska-Maj and Krzemiński, 2013, narrow transparent bands on a dark background in P. hageni Carpenter, 1954 and regular spots in P. gedanensis sp. n. This past diversity and distribution emphasises the relictual status of extant Panorpodidae. A key to fossil species of the genus Panorpodes based on characters of the forewing is provided.
The fossil panorpids are represented by two putative genera. *Austropanorpodes gennaken* Petrulevičius, 2009, from the Lower Eocene of Patagonia, is the sole representative of this genus (Petrulevičius, 2009). However, its affinity to Panorpodidae is not strongly supported, but if confirmed, it would be the only known member of the family from the Southern Hemisphere. The other genus known from fossils is *Panorpodes*, and in addition to the new species described here, three species have been recorded from Eocene Baltic amber: *P. brevicauda* (Hagen, 1856), *P. hageni* Carpenter, 1954 and *P. weitschati* Soszyńska-Maj and Krzemiński, 2013.

Amber inclusions of Mecoptera which are sufficiently well-preserved to be studied are very rare, and all fossil data are important for understanding the history of this family. Consequently, the discovery of a new fossil species of Panorpodidae is of great interest. To date, only 12 species from three families of Mecoptera have been recorded from Baltic amber: Bittacidae (five species), Panorpidae (three species) and Panorpodidae (four species, including the one described here) (Pictet-Baraban and Hagen, 1856; Carpenter 1954, 1955, 1976; Krzemiński, 2007, Krzemiński and Soszyńska-Maj, 2012; Soszyńska-Maj and Krzemiński, 2013).

A description of new species of Eocene Panorpodidae from Baltic amber and a key to fossil species of the genus *Panorpodes* based on the wings are presented here.

**MATERIALS AND METHODS**

The study was based on a single inclusion in Baltic amber, dated late Eocene, Priabonian (Perkovsky et al., 2007) from the collection of Christel and Hans Werner Hoffeins, Hamburg, Germany. The holotype will be deposited in Senckenberg Deutsches Entomologisches Institut (SDEI), Müncheberg, Germany.

The specimen was studied with the use of a Leica MZFLII stereomicroscope, under reflected and transmitted light. Photographs were made with a Leica DFC295 camera attached to the microscope. Drawings were made from the photographs on a digital tablet as proposed by Coleman (2003). The wing venation terminology follows Willmann (1989).

**RESULTS**

**Systematic Palaeontology**

Order MECOPTERA Packard, 1886  
Family PANORPOIDAE Byers, 1965  
Genus PANORPODES MacLachlan, 1875

**Type species.** *Panorpodes paradoxa* MacLachlan, 1875, by original designation.

*Panorpodes gedanensis* sp. n.  
Figure 1, 2

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**Holotype.** Sex unknown, No. 1193-2, amber embedded in polyester resin (Hoffeins, 2001). Inclusion with well-preserved head, thorax and complete wings, the ventral side not visible due to white milky coating; wings folded, therefore only forewing venation is clearly visible. The inclusion will be deposited as a part of the amber collection of the Senckenberg Deutsches Entomologisches Institut (SDEI), Müncheberg, Germany.

**Etymology.** The specific name refers to Gdańsk, Polish city famous for its amber tradition.

**Diagnosis.** Differs from all other fossil members of the genus in that the wings are transparent with five dark, oval spots and dark coloured apical parts, compared to narrow, unregular broken bands of *P. weitschati*, dark wings with narrow transparent bands of *P. hageni* and completely transparent wings of *P. brevicauda* from Baltic amber.

**Description.** Eyes large and round, rostrum short, only partly visible; antennae filiform, scapus and pedicel not visible, flagellum composed of 43 segments, mostly equal in length, gradually become narrower, last flagellomere thinner, half the length of previous one. Wings narrow; fore wing: 14.2 mm long, 4.1 mm wide; membrane transparent, with five clearly visible dark spots; one large spot in basal part of wing, four regularly distributed spots in central part, apical margin of wing with broad band extending from R2 to M3; Sc1 joining costa at the level of Rs fork, Sc2 reaches pterostigma at fork of R2+3; one crossevein c-sc in coastal area across fork of Rb; R1 characteristically sharply curved just above fork of R2+3, one oblique cross vein between Sc and R1 just across Rs fork; R2+3 about 0.2 longer than Rs and three times longer than R2, Rs twice as long as R2 and twice length of R4+5; R3 simple; R4 almost six times longer than R4+5; M1 slightly longer than M1+2 (about 0.125 longer); M4 seven times longer than M3+4; m-cu joins M4 with vein CuA; A1 joining posterior margin
of wing across the Rs fork; A2 reaching posterior edge in the middle of Rs; one crossvein between A1 and A2;

**Remarks.** The specimen was recognised as Panorpodidae from the following characters: rostrum short, wide, twice height of eye, wings with Sc two branched, one cross vein between humerus and basal branch of Sc, vein R1 characteristically sharply curved, Rs 5-6 branched, Ms four branched, anal veins simple.

See Table 1 and Figure 3 for key to fossil species.

### DISCUSSION

There are 757 species of scorpionflies in the extant fauna (Zhang, 2011), the majority belonging to two of the nine recognised families. More than 400 fossil species of Mecoptera have been described in 16-27 families, depending on the author (Willmann, 1978; Carpenter, 1992, Novokshonov, 2002) and including recently described families (Bashkuev, 2011, Archibald et al., 2013, Krzeminski et al., 2015). The huge morphological diversity combined with the modest number of extant taxa supports the view that extant Mecoptera are only the remnants of a once very diverse group (Penny, 1975). Family Panorpidae is cur-

### Table 1. Key to fossil species of *Panorpodes* based on fore wing characters.

<table>
<thead>
<tr>
<th>1</th>
<th>wing transparent</th>
<th>(Figure 3.1)</th>
<th><em>P. brevicauda</em> (Hagen, 1856)</th>
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<tr>
<td></td>
<td>wing coloured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>dark wing with narrow transparent bands</td>
<td>(Figure 3.2)</td>
<td><em>P. hageni</em> Carpenter, 1954</td>
</tr>
<tr>
<td></td>
<td>transparent membrane with dark spots and bands</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>five dark regular spots and dark coloured apical part of the wing</td>
<td>(Figure 3.3)</td>
<td><em>P. gedanensis</em> sp. n.</td>
</tr>
<tr>
<td></td>
<td>four irregular spots and two narrow, irregular broken bands in distal part of the wing</td>
<td>(Figure 3.4)</td>
<td><em>P. weitschati</em> Soszyńska-Maj and Krzeminski, 2013</td>
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</table>
Currently the most diverse and abundant, containing about 400 species belonging to six genera (Chau and Byers, 1978; Cai et al., 2008; Cai and Hua, 2009; Ma and Hua, 2011; Zhong and Hua, 2013). This family has a disjunctive holarctic distribution with some representatives in the oriental region (Archibald et al., 2013) and to date there is no fossil evidence for a wider past distribution (Ding et al., 2014). The second most abundant family of scorpionflies is Bittacidae, with ca. 170 species in 16-20 genera distributed worldwide (Penny, 1997; Petrulevičius, 2003; Tan and Hua, 2009; Yang et al., 2012).

In comparison, the short-faced scorpionflies (Panorpodidae) is a small family containing 13 extant species within the genera Brachypanorpa Carpenter, 1931 and Panorpodes MacLachlan, 1875 (Byers, 2005; Zhong et al., 2011). All five representatives of the genus Brachypanorpa and one Panorpodes species live only in North America (Byers, 2005), whilst the remaining Panorpodes species occur in Japan, Korea and China (Tan and Hua, 2008; Zhong et al., 2011). However, in the Eocene Panorpodidae were probably more diverse; the four described species from Baltic amber being numerically equivalent to 50% of extant species in this genus. In comparison, the two species of the genus Panorpa and five bittacids of the genus Bittacus described from Baltic amber equate to merely 0.8% of extant species of Panorpa and 4% of the genus Bittacus, respectively. Nevertheless, representatives of Panorpodidae and Panorpidae are less abundant than Bittacidae in amber (Krzemiński and Soszyńska-Maj, unp. data). Wing markings are the most important character in the taxonomy of fossil short-faced scorpionflies. The newly described taxon shows a new pattern of markings – five regular dark spots and a terminal band. The fossil representatives of the genus Panorpodes, all Eocene, display different patterns of wing markings: highly transparent wings in P. brevicauda, transparent wings with dark bands and spots in P. weitschati, regular spots in P. gedanensis sp. n. and narrow transparent bands on a dark background in P. hageni. However, only one species, P. brevicauda with transparent wings, is common in Baltic amber, whereas the remainder are known only from single specimens (Soszyńska-Maj and Krzemiński, 2013). Fully transparent wings predominate in extant Panorpidae, being characteristic of five species. Only three living species have coloured wings (Zhong et al., 2011).

The distribution of extant panorpodids is limited to a small area of the Northern Hemisphere. The fossil evidence indicates that Panorpodidae were present in Europe during the late Eocene and possibly also in South America. They subsequently became extinct in these regions and declined in overall diversity. The past distribution and diversity emphasises the relictual status of extant Panorpodidae.

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**REFERENCES**


Tan, J.L. and Hua, B.Z. 2009. *Bicaubittacus*, a new genus of the Oriental Bittacidae (Mecoptera) with
_Fossilum Catalogus, Animalia_, 124:1-139.