
A new, putatively primitive Cretaceous fossil braconid subfamily from New Jersey amber (Hymenoptera, Braconidae)

HASAN H. BASIBUYUK, ALEXANDR P. RASNITSYN, KEES VAN ACHTERBERG, MIKE G. FITTON & DONALD L. J. QUICKE

Accepted 17 December 1998

Basibuyuk, H. H., Rasnitsyn, A. P., Achterberg, C. van, Fitton, M. G. & Quicke, D. L. J. (1999) A new, putatively primitive Cretaceous fossil braconid subfamily from New Jersey amber (Hymenoptera, Braconidae). — *Zoologica Scripta* 28, 211–214.

Protorhyssalus goldmani gen. n., sp. n., in a new subfamily of braconid wasps, the Protorhyssalinae, is described from Late Cretaceous amber fossils from New Jersey, USA. The Protorhyssalinae appears to be cyclostome and shows a similar set of plesiomorphic characters to the extant Rhyssalinae. However, it possesses hindwing vein 2-CU, a feature only found among the cyclostome braconids in the rare and putatively primitive Chilean subfamily Apozyginae.

Hasan H. Basibuyuk, Unit of Parasitoid Systematics, CABI Bioscience UK Centre (Ascot), Department of Biology, Imperial College at Silwood Park, Ascot, Berkshire SL5 7PY, UK, Department of Entomology, The Natural History Museum, London, SW7 5BD, UK, and Department of Biology, Cumhuriyet University, 58140-Sivas, Turkey. E-mail: H.basibuyuk@nbn.ac.uk

Alexandr P. Rasnitsyn, Palaeontological Institute, Russian Academy of Sciences, 117647 Moscow, Russia.

Kees Van Achterberg, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, Netherlands.

Mike G. Fitton, Department of Entomology, The Natural History Museum, London, SW7 5BD, UK.

Donald L. J. Quicke, Unit of Parasitoid Systematics, CABI Bioscience UK Centre (Ascot), Department of Biology, Imperial College at Silwood Park, Ascot, Berkshire SL5 7PY, UK, and Department of Entomology, The Natural History Museum, London, SW7 5BD, UK.

Introduction

We have recently had the opportunity to examine nine amber fossils of Braconidae from the New Jersey Late Cretaceous (Turonian), which are approximately 92 million years old (Agosti *et al.* 1998). Although impression fossils of Braconidae are also known from the Cretaceous (Rasnitsyn 1983), the state of preservation of this new material is such that we have been able to see nearly all characters that are important for assessing subfamilial placement and relationships. The fossils appear to belong to a single species which displays a combination of characters not known in any extant subfamily and we therefore erect a new subfamily here to receive them. Further, the presence in these of both cyclostome mouthparts and hindwing vein 2-CU has led us to reappraise the homologies and significance of various features of hindwing venation within the family.

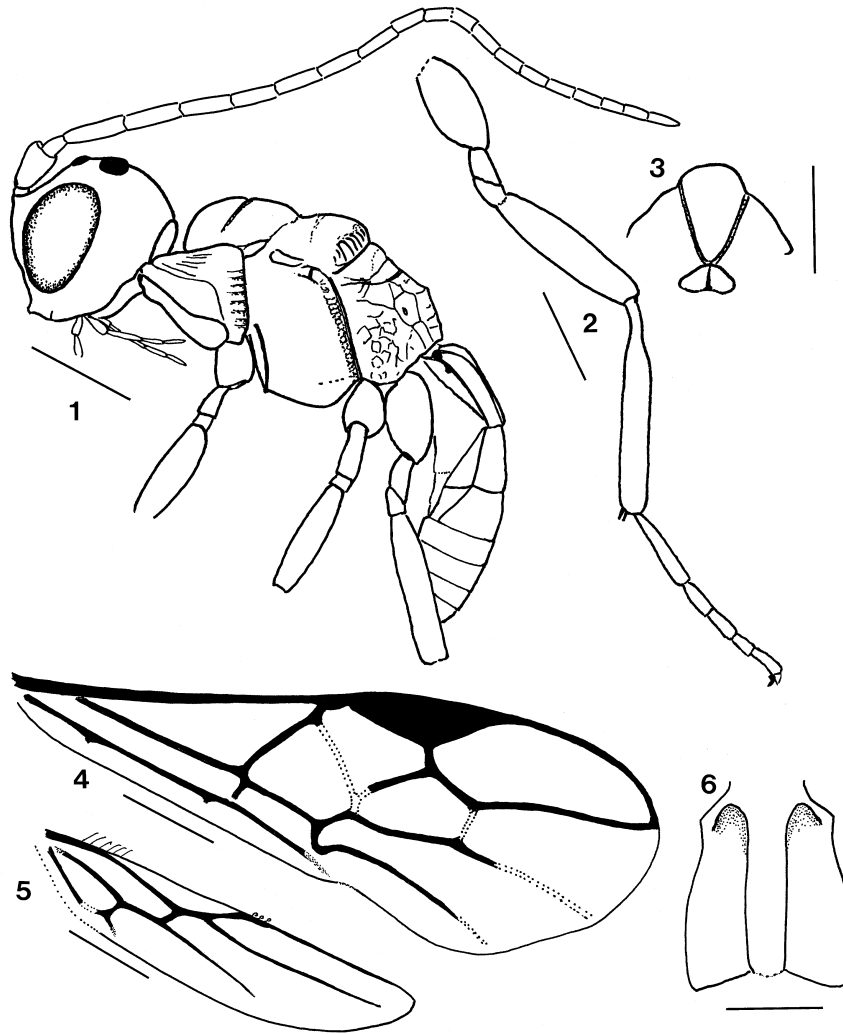
Terminology follows van Achterberg (1988, 1993). Abbreviation for the museum holding specimens, The American Museum of Natural History, New York is AMNH.

Family BRACONIDAE

Subfamily Protorhyssalinae Basibuyuk, Quicke & van Achterberg, subfam. n. (Figs 1–6)

Type genus. Protorhyssalus gen. n. by present designation and monotypy

Description. Head orthognathous and almost certainly cyclostome (see Remarks). Clypeus short, lower margin concave medially and recessed. Mandibles robust with two teeth, upper tooth larger. Labio-maxillary complex slightly exerted. Maxillary palp with six segments. Pronotal collar long. Propleuron with longitudinal lateral carina produced posteriorly into a flange which partly overlaps pronotum. Notauli complete and uniting at posterior margin of mesoscutum. Transscutal articulation absent. Scutellum strongly raised. Metapostnotum laterally exposed, separated from propodeum by a groove. Vein R of forewing, where it forms part of the combined C + SC + R, confluent with pterostigma. Forewing vein CU1b absent. Vein 2 m-cu absent. Vein 1-SR distinct. Vein SR1 reaching



Figs. 1–6 *Protorhyssalus goldmani* sp. n. —1. Lateral view of holotype. —2. Hindleg of paratype NJ-269. —3. Dorsal view of mesoscutum showing notauli in holotype. —4. Forewing venation of paratype NJ-269. —5. Hindwing venation of paratype NJ-427B. —6. Dorsal view of first metasomal tergite of holotype. Scale bar = 0.25 mm for Figs 1–5; 0.15 mm for Fig. 6.

wing margin. Second submarginal cell closed. Clustered secondary hamuli of hindwing situated partly on weakly sclerotized spur of vein C. Vein 2-CU of hindwing present. Dorsal and dorso-lateral carinae of first metasomal tergite complete, lamelliform; dorsal carinae reaching posterior margin of tergite separately. First metasomal spiracle on tergum, before middle of tergite. Second metasomal spiracle in laterotergite. Fourth and following metasomal segments exposed, not hidden under third tergite.

Remarks. The front of the head can be seen reasonably clearly in only one specimen and in this the mouth area is somewhat obscured by cloudy-foggy material making difficult to see clearly many features. However, examination of other specimens from lateral aspect allowed us to conclude

with reasonable certainty that it is cyclostome, though the possibility that it is not cyclostome cannot be totally excluded.

The Protorhyssalinae differs from all other braconid subfamilies apart from the Apozyginae in being both cyclostome and in possessing hindwing vein 2-CU. The Apozyginae differs from Protorhyssalinae and all other braconid subfamilies in having vein 2 m-cu distinctly developed in the forewing. The forewing venation with a large, five sided second submarginal cell distinguishes the Protorhyssalinae from all other noncyclostome braconids that possess hindwing vein 2-CU apart from the Trachypetinae. The Trachypetinae differ from the Protorhyssalinae in having veins C and SC + R of the hindwing separate

from near the base of the wing, and in having a distinctly, apically open forewing costal cell.

The *Protorhyssalinae* possess no unique synapomorphies that we are aware of, and therefore the recognition of this subfamily is not strictly cladistic. However, the combination of characters displayed by *Protorhyssalus*, and the absence of any obvious synapomorphies with the extant subfamilies, makes it impossible to place it in any of the latter. We therefore consider the creation of a new subfamily for *Protorhyssalus* to be the most appropriate action at present.

Genus *Protorhyssalus*, Basibuyuk & Quicke gen. n.

Type species. *Protorhyssalus goldmani* sp. n., by present designation and monotypy.

Etymology. The name *Protorhyssalus* is derived from *proto*-meaning first, primitive or simple, combined with *Rhyssalus*. Gender: masculine.

Description. Antenna with 20 or more segments. Multiporous plate sensilla of antenna rather sparse, those on apical flagellomeres basal and occupying approximately 0.75 of length of segment. Basal flagellomeres of almost equal length, following segments becoming gradually shorter. Scapus subcylindrical, almost truncate apically; pedicellus rather large. Basal segment of maxillary palp very small, fourth one longest. Glossa bilobed. Mandibles small and robust. Malar suture absent, malar space short. Hypoclypeal depression wide, weakly convex dorsally. Clypeus protruding, with sparse long setae, separated from face by a well-developed suture. Anterior tentorial pits small. Eyes glabrous, not emarginate. Face medium sized. Vertex and occiput smooth, sparsely setose; vertex not deeply impressed behind antennal sockets. Lengths of frons and vertex almost equal in dorsal aspect (1.1 : 1.0). Occipital carina complete, curved to join hypostomal carina before base of mandible.

Mesosoma. Pronotum laterally longitudinally striate; posteriorly coarsely longitudinally striate, epomia absent. Mesopleural suture strongly crenulate. Dorsal and lateral pronopes absent. Notauli deep and crenulate. Anterior subalar depression with single transverse carina. Prepectal carina well developed and complete. Precoxal suture weakly developed on posterior half of mesopleuron, smooth. Postpectal carina absent. Axillary region strongly crenulate. Medio-posterior depression of scutellum present. Metapleural sculpturing foveate to rugulose-lacunose. Propodeum with a narrow but long triangular areola medially.

Forewing. Costal cell present apically but very short and narrow. Parastigmal sensillar plate present. Vein r originating beyond middle of pterostigma. Marginal cell moderately long, vein SR1 slightly curved anteriorly, reaching the wing tip. Second submarginal cell complete, slightly shorter than first. Vein m-cu entering 2nd submarginal cell. Subdiscal cell rather narrow. Vein 2-SR + M & r-m more or less vertical. Vein CU1b absent, CU1a and 3-CU1 forming a smooth curve. Vein cu-a postfurcal. Traces of veins 2 A and a present.

Hindwing. Marginal cell more or less parallel sided. Vein 1r-m as long as half length of 1-M, slightly shorter than 2-SC + R, without vein 2-1 A. Secondary hamuli present beyond apex of C + SC + R.

Legs. Legs moderately setose. Claws simple. Fore tibial spur with a comb. Apex of hind tibia without a medial comb. Hind tibia moderately robust. Hind basitarsus rather long but shorter than combined length of following segments.

Metanotum. Dorsope large and deep. Parameres of male densely setose at apex.

Protorhyssalus goldmani Basibuyuk & Quicke, sp. n.

Holotype. Male, AMNH NJ-243.

Type locality. White Oaks Pit, Middlesex Co. Sayreville, New Jersey, USA. Late Cretaceous (Turonian) amber.

Paratypes. AMNH NJ-269, 1 male; AMNH NJ-427 A, 1 male; AMNH NJ-427B, 3 males in the same block of amber; AMNH NJ-427E, 1 male, all from type locality.

Other material. Two specimens from type locality, not well preserved, probably belonging to the same species but excluded from the type series, AMNH NJ-147, AMNH NJ-68.

Etymology. *P. goldmani*, as acknowledgement to Yale Goldman, collector of the holotype.

Description. Males. Length of head and body 1.55–2.00 mm, of antenna 1.55–2.00 mm, of forewing 1.30–1.60 mm, of mesosoma 0.55–0.80 mm and of metasoma 0.70–0.90 mm.

Head. Antenna with 20–22 segments. Terminal flagellomere slightly longer than penultimate, slightly longer than half length of first flagellomere. Terminal flagellomere

2.2 × longer than wide, distinctly acuminate. Penultimate flagellomere 1.7 × longer than wide. First 6-7 flagellomeres almost in equal length, 3.5 × longer than wide, following ones gradually shortened. Pedicellus 1.5 × longer than wide. Scape 1.6 × longer than wide. Ratio of height of clypeus: malar space = 1.0: 0.5. Face smooth and shining with scattered punctures. Ratios of height of eye: width of face: width of head = 1.0: 1.1: 1.8.

Mesosoma. Approximately 1.45 longer than high. Mesoscutum and scutellum sparsely with semierect setae. Scutellar sulcus weakly impressed. Median area of metanotum raised, triangular, crenulated anteriorly and latero-posteriorly.

Forewing. Ratios of length of veins r: 3-SR: SR1 = 1.0: 2.75: 9.0. Ratios of length of vein r-m: 3-SR: 2-SR = 1.0: 1.5: 2. Ratio of veins 3-CU1: m-cu = 1.0: 1.5. First submarginal cell slightly longer than first discal cell.

Legs. Ratios of length of fore femur: tibia: tarsus = 1.00: 1.16: 1.38. Ratios of length of middle femur: tibia: tarsus = 1.00: 1.13: 1.30. Ratios of length of hind femur: tibia: tarsus = 1.0: 1.35: 1.35. Hind tibial spurs short and strongly setose, less than 0.2 length of basitarsus.

Metasoma. With 7 visible tergites. Tergite 2 weakly longitudinally striate on the basal 0.3. Second metasomal suture smooth.

Colour. Brown, stemmaticum black. Wings clear with most veins pale brown but with 1-M, M + CU1, 1-CU1 and 2-CU1 considerably darker.

Discussion

Only two cyclostome braconids, *Protorhyssalus* and the enigmatic *Apozyx penyai* Mason (Apozyginae) from Chile have hindwing vein 2-CU, whereas it is lost in all other cyclostomes. Outside of the cyclostome braconids, it occurs in only five other braconid subfamilies, the Agathidinae, Sigalphinae, Pselaphaninae, Meteorideinae and Trachypetinae, apart from a small trace in the enigmatic genus *Urosigalphus* Ashmead, which is currently included in the Helconinae. Of these, the first three appear to be closely related on the basis of molecular (Belshaw *et al.* 1998; in prep.) and morphological characters (Quicke & van Achterberg 1990; Rahman *et al.* 1998). The affinities of

the Meteorideinae are less certain but some morphological evidence indicates a relationship with the Agathidinae, Sigalphinae and Pselaphaninae (Quicke & van Achterberg 1990). The Trachypetinae is possibly the most basal extant braconid subfamily (Quicke *et al.* 1999). As hindwing vein 2-CU is found in Ichneumonidae and many other Apocrita, we consider its presence to be plesiomorphic. The distribution of 2-CU in the Braconidae suggests that the Protorhyssalinae, Apozyginae, Agathidinae, Sigalphinae, Pselaphaninae, Meteorideinae and Trachypetinae may be basal groups within the family and that vein 2-CU has been lost on several occasions. The significance of the Protorhyssalinae for our understanding of relationships among the Ichneumonoidea as a whole and between the major groups of Braconidae are examined in greater depth in a companion paper (Quicke *et al.* 1999).

Acknowledgements

We wish to thank Dr David Grimaldi (AMNH) for the loan of the specimens. This work was supported in part by a Leverhulme Trust research grant to DQ and MF and the NERC Initiative in Taxonomy.

References

- van Achterberg, C. (1988). Revision of the subfamily Blacinae Foerster (Hymenoptera, Braconidae). *Zoologische Verhandelingen, Leiden*, 249, 1–324.
- van Achterberg, C. (1993). Illustrated key to the subfamilies of the Braconidae (Hymenoptera: Ichneumonoidea). *Zoologische Verhandelingen, Leiden*, 283, 1–189.
- Agosti, D., Grimaldi, D. & Carpenter, J. M. (1998). Oldest known ant fossil discovered. *Nature*, 391, 447.
- Belshaw, R., Fitton, M., Herniou, E., Gimeno, C. & Quicke, D. L. J. (1998). A phylogenetic reconstruction of the Ichneumonoidea (Hymenoptera) based on D2 variable region of 28S ribosomal RNA. *Systematic Entomology*, 23, 109–123.
- Quicke, D. L. J., Basibuyuk, H. H., Fitton, M. G. & Rasnitsyn, A. P. (1999). Morphological, palaeontological and molecular aspects of ichneumonoid phylogeny (Hymenoptera, Insecta). *Zoologica Scripta*, 28, 175–202.
- Quicke, D. L. J. & van Achterberg, C. (1990). Phylogeny of the subfamilies of Braconidae (Hymenoptera: Ichneumonoidea). *Zoologische Verhandelingen, Leiden*, 258, 1–95.
- Rahman, H., Fitton, M. G. & Quicke, D. L. J. (1998). Ovipositor internal microsculpture in the Braconidae (Insecta, Hymenoptera). *Zoologica Scripta*, 27, 319–331.
- Rasnitsyn, A. P. (1983). Ichneumonoidea (Hymenoptera) from the Lower Cretaceous of Mongolia. *Contributions of the American Entomological Institute*, 20, 259–265.