



Zootaxa 3084: 1–95 (2011)  
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Monograph

ISSN 1175-5326 (print edition)

**ZOOTAXA**

ISSN 1175-5334 (online edition)

# ZOOTAXA

3084

## **Revision of the Western Palearctic Meteorini (Hymenoptera, Braconidae), with a molecular characterization of hidden Fennoscandian species diversity**

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Magnolia Press  
Auckland, New Zealand

*Accepted by J. Jennings: 29 Aug. 2011; published: 28 Oct. 2011*

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(*Zootaxa* 3084)

95 pp.; 30 cm.

28 Oct. 2011

ISBN 978-1-86977-817-0 (paperback)

ISBN 978-1-86977-818-7 (Online edition)

FIRST PUBLISHED IN 2011 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: [zootaxa@mapress.com](mailto:zootaxa@mapress.com)

<http://www.mapress.com/zootaxa/>

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ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

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## Abstract

The tribe Meteorini includes two genera, *Meteorus* and *Zele*, which are koinobiont endoparasitoids of larval Lepidoptera and Coleoptera. More than 300 species are known, about one fifth of which occur in the Western Palearctic. Here, we revise the Western Palearctic species, based partly on traditional approaches and partly on molecular analysis of recent Swedish and Finnish material. For the analyses of phylogenetic relationships and cryptic species diversity, we coded 17 morphological characters and sequenced two markers, 28S D2 (649 bp) and CO1 (665 bp). More than 1 970 specimens representing 54 species of *Meteorus* Haliday and 5 species of *Zele* Curtis were studied; of these, 177 specimens representing 41 species were sequenced. Seven new species are described, all from the Fennoscandian material: *Meteorus artocercus* **sp. nov.**, *M. densipilosus* **sp. nov.**, *M. eklundi* **sp. nov.**, *M. longipilosus* **sp. nov.**, *M. sibyllae* **sp. nov.**, *M. stenomastax* **sp. nov.**, and *M. subtilisulcus* **sp. nov.** Four new synonyms are introduced: *Z. chlorophthalmus* (Spinola 1808), **syn. nov.** for *M. pallidus* (Nees 1812), *M. punctifrons* Thomson 1895, **syn. nov.** for *M. varinervis* (Tobias 1986), *M. melanostictus* Capron 1887, **syn. nov.** for *M. monachae* (Tobias 1986), and *M. tenellus* Marshall 1887, **syn. nov.** for *M. boreus* (Tobias 1986). *Meteorus tenellus* is removed from synonymy with *M. cinctellus*. Sequence analysis indicated the presence of at least 12 additional cryptic species but these cannot be separated morphologically at this point and, therefore, we do not describe them here. The phylogenetic results suggest that *Zele* should be included within *Meteorus* but we refrain from formal changes of the generic classification until more comprehensive phylogenetic analyses of the tribe can be completed. A key to the known Western Palearctic species is presented.

**Key words:** parasitic wasps, molecular taxonomy, cryptic species, general mixed Yule coalescent, evolution, host preferences, identification keys

## Introduction

The Meteorini (Cresson 1887) are small to medium size (2–10 mm) euphorine braconids, classified into two genera: the species-rich and cosmopolitan *Meteorus* Haliday (1832) and the small Holarctic and Neotropical *Zeke* Curtis (1835). After accounting for the new species described herein, the two genera together include 337 species in the world (308 *Meteorus* and 29 *Zeke*, Yu et al. 2005, Shaw et al. 2009, Aguirre et al. 2010, 2011), 59 of which occur in the Western Palearctic (54 *Meteorus* and 5 *Zeke*) (Appendix I).

Unlike other euphorine braconids that largely attack adult insects, the Meteorini target Lepidoptera and Coleoptera larvae. The host larvae are typically hidden under bark, in wood, or in fungi (Maeto 1990a, Shaw et al. 1991). Most meteorines are solitary parasitoids but some species are gregarious. They attack their hosts in the same way as most other euphorines, namely by bending the abdomen under the thorax and pushing the ovipositor out so that it projects forwards, in front of the wasp. They seem to preferably attack mobile host larvae (Parker 1931, Tobias 1966). Oviposition occurs in young host larvae, while they are exposed, and development is completed before the host enters the pupal stage.

Members of *Meteorus* are either univoltine or multivoltine. Some species produce two complete generations upon one brood of host larvae, the first being upon very young individuals and the second upon those that are nearly mature (Clausen 1940). The solitary suspended cocoon made by some *Meteorus* larvae is unique amongst the Braconidae and only the Campopleginae amongst the Ichneumonidae have members that construct similar cocoons. No other hymenopterans are known to form suspended cocoons (Zitani 2003). The suspended cocoons are fully exposed whilst the non-suspended cocoons often are placed in a concealed environment.

Members of *Zeke* seem to be solitary parasitoids. In Britain, at least one species is noted to be bivoltine whilst others are univoltine (Shaw & Huddleston 1991). They overwinter as prepupae in a fusiform and felted cocoon in the pupation chamber of the host. *Zeke* adults are predominantly crepuscular or nocturnal and are also attracted to light (Huddleston and Gauld 1988). In both genera, the adult emerges from the cocoon by cutting the cap off of its anterior end.

The circumscription of the Meteorini has been a subject of controversy for some time (van Achterberg 1979, Huddleston 1980, Zitani 2003). Mason (1973), in his paper on the identity of *Zeke* (treated by him under the junior synonym *Zemiotus* Förster), proposed that the Meteorini formed an unnatural assemblage and that *Zeke* was more closely related to *Homolobus* Förster (subfam. Homolobinae) than to *Meteorus*. Mason based this hypothesis on the following similarities shared between *Homolobus* and *Zeke*: (1) radiellian cell broadening apically and divided by a transverse vein; (2) tarsal claws with a large basal tooth; (3) apical half or more of abdominal tergites 3–6 uniformly hairy, never with only a single, subapical, transverse row on each tergite; and (4) the cocoon covered with fine, fluffy whitish silk and never suspended on a cord or covered in coarse brown silk as in *Meteorus*. In his revision of the subfamily Zelinae, van Achterberg (1979) redefined *Zeke* and moved it to the tribe Meteorini of the subfamily Euphorinae. He thoroughly studied the similarities between *Zeke* and *Homolobus* listed by Mason (1973), as well as other characters potentially informative about the placement of *Zeke*, and came to the conclusion that *Zeke* is not the sister group to *Homolobus* but instead is likely to be the sister group to *Meteorus*.

Maeto (1990a) proposed two putative morphological synapomorphies for (*Meteorus* + *Zeke*): (1) the median longitudinal carinae of the propodeum divided just before the orifice, forming a subtriangular cell; and (2) eyes distinctly setose. The monophyly of (*Meteorus* + *Zeke*) was also strongly supported in the more extensive morphological phylogenetic analysis by Zitani (2003) and has been confirmed in several molecular analyses as well (Li et al. 2003, Shi et al. 2005, Pitz et al. 2007). We consider the monophyly of (*Meteorus* + *Zeke*) well established today.

The Meteorini (*Meteorus* + *Zeke*) are considered as a tribe within Euphorinae by some workers (Muesebeck 1923, Maeto 1986a, van Achterberg 1979 and 1984, Tobias 1986, Li et al. 2003) and as a separate subfamily by others (Foerster 1862, Shaw 1985, Maeto 1990a, Zitani 2003, Boring 2010). Based on morphology, Tobias (1966) placed *Meteorus* basally within the Euphorinae, without any comments on the position of *Zeke*. The molecular analyses by Li et al. (2003) and Shi et al. (2005) support the view that the Meteorini are the sister group of other Euphorinae.

If the sister-group hypothesis is correct, then the Meteorini could in principle be treated as a subfamily distinct from the Euphorinae. However, we treat the group as a tribe within the Euphorinae for several reasons. First, we consider it well established that the Meteorini and other Euphorinae form a monophyletic group. Second, we think

it is impractical to recognize such a small group as the Meteorini as a subfamily, since many of the other braconid subfamilies are much larger and more diverse. Finally, we do not yet consider it certain that the Meteorini are placed phylogenetically outside the remaining Euphorinae. Some recent analyses (Dowton et al. 1998, 2002; Pitz et al. 2007) do indeed place them as sister to the rest of the Euphorinae, but others suggest they may be more deeply nested within the Euphorinae (Belshaw et al. 2000; Belshaw and Quicke 2002; Li et al. 2003; Shi et al. 2005).

Three morphological or biological synapomorphies have been proposed for Euphorinae including Meteorini (van Achterberg 1984): (1) loss of the final ectoparasitic phase in larval development; (2) smooth toothless larval mandibles; and (3) development of parasitism of adults. Parasitism of adults is a doubtful synapomorphy at this level, however, since the Meteorini are larval parasitoids; it appears more likely to be a synapomorphy of the Euphorinae excluding the Meteorini. Monophyly of Euphorinae excluding Meteorini is also evidenced by two additional morphological characters: (1) reduction of the maxillary palp to five segments or less; and (2) strong curvature of the apical radial segment of the fore wing (Shaw 1985). The maxillary palp is six-segmented in *Meteorus* and *Zeleva*, and this is likely to be the plesiomorphic state for the Euphorinae.

Members of *Zeleva* are united by several distinct synapomorphies, including the scattered tergal setae, the large second submarginal cell of the fore wing, and the apically widened and transversely subdivided marginal cell of the hind wing (Maeto 1990a). However, it has been difficult to find morphological synapomorphies for the genus *Meteorus*, suggesting that *Meteorus* might be paraphyletic with respect to *Zeleva*. In his systematic studies of the Meteorini of Japan, Maeto (1989a, 1990a) recognized seven species groups of *Meteorus* based on morphology and biology (Table 1). He specifically lists two structural synapomorphies that support the hypothesis that members of *Zeleva* form a monophyletic group with only some clades (the *ictericus*, *rubens*, and *pulchricornis* groups; see Table 1 for details) within *Meteorus*: (1) tarsal claws with a submedial lobe; and (2) large ocelli. He suggested that the resulting taxonomic problem, a paraphyletic *Meteorus*, be solved by rearranging *Meteorus* into several monophyletic genera. However, he argued that such a rearrangement should wait until a more extensive sample of the world fauna has been analyzed phylogenetically.

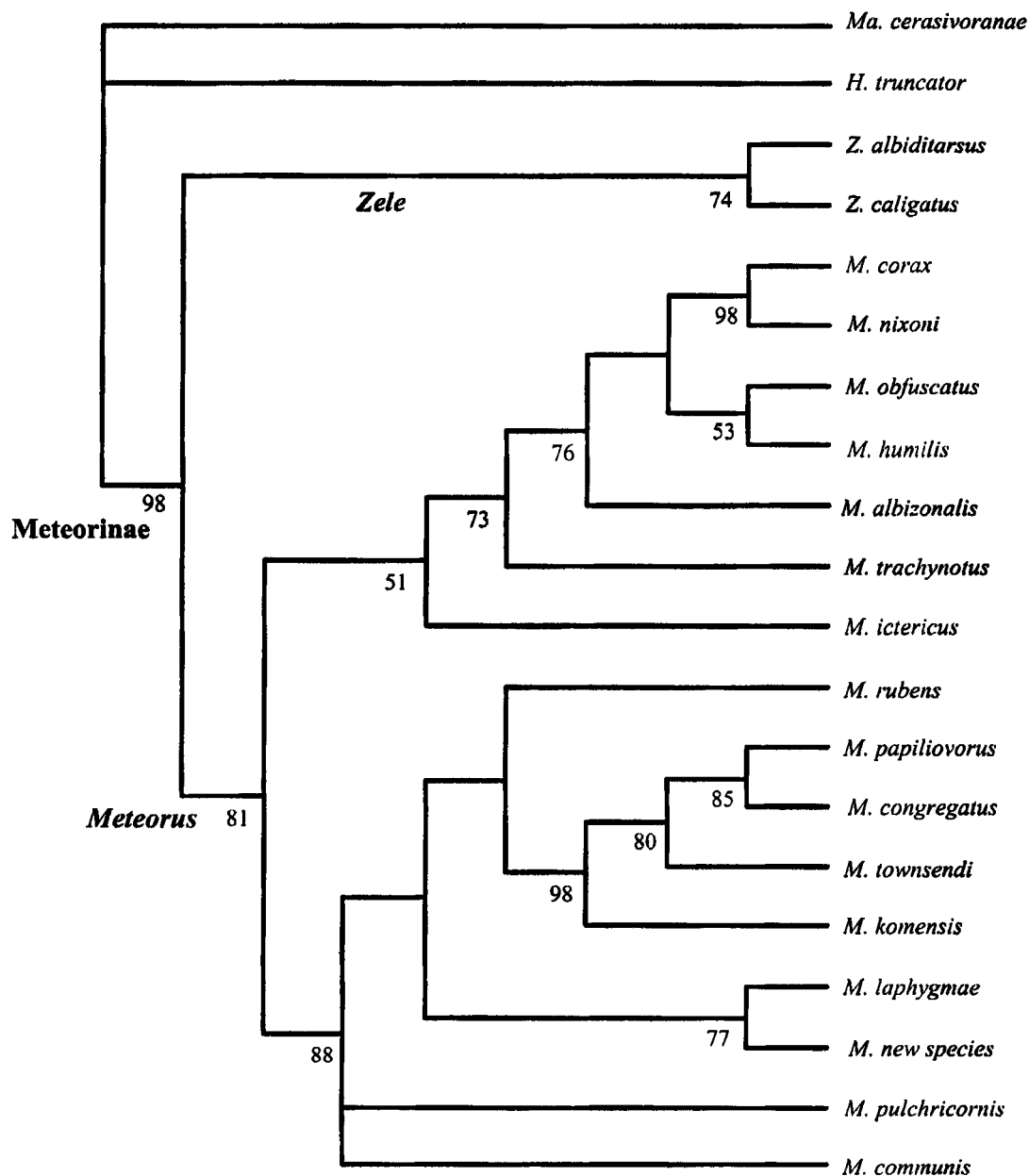
Using morphological characters from 16 species of *Meteorus* and two species of *Zeleva*, Zitani (2003) analyzed the relationships among species of *Meteorus* and between *Meteorus* and *Zeleva* (Fig. 1). The species were chosen to represent the species groups of Maeto. In total, 32 adult morphological characters and 7 cocoon characters were used. In contrast to the analysis of Maeto, Zitani's results indicated that: (1) *Zeleva* and *Meteorus* are reciprocally monophyletic groups; and (2) *Zeleva* is the sister group to *Meteorus*. However, the monophyly of *Meteorus* and *Zeleva* received only moderately high bootstrap support values (81 % and 74 %, respectively).

Huddleston (1980) presented a key to all Western Palearctic species of *Meteorus* known at the time. He also provided good species descriptions. There are additional keys to species of *Meteorus* for Japan (Maeto 1986a, b, 1988a, b, 1989a, b, 1990b), for China (Chen & Wu 2000), for Northern America (Muesebeck 1923), for the European part of Russia (Tobias 1986), for the Russian Far East (Belokobylskij 2000), for Columbia (Aguirre et al. 2011) and for Australia and New Guinea (Huddleston 1983). However, modern keys to the Western Palearctic fauna of *Meteorus* are missing. The Western Palearctic species of *Zeleva* were keyed by van Achterberg (1979, 1984).

In this paper, we revise the Western Palearctic species of Meteorini based partly on study of types and other material available in major natural history collections, and partly on morphological and molecular analysis of recent Fennoscandian material. The latter material comes mostly from the Swedish Malaise Trap Project (SMTP), a comprehensive three-year inventory of the Swedish insect fauna using Malaise traps (Karlsson et al. 2005), but also from Finland. More than 1 900 specimens were studied in total. We describe seven new species from the Fennoscandian material and present molecular evidence for the existence of at least 12 additional cryptic species. We have not been able to distinguish the latter morphologically, and refrain from describing them here. The phylogenetic results are used to examine the monophyly of *Meteorus* and *Zeleva* and to examine the evolution of host preferences. We conclude the paper with a key to the known Western Palearctic species of the tribe, particularly targeted at non-specialists. The key is shorter, more concise, and should be easier to use than the currently available ones.

**TABLE 1.** Maeto's (1989a, 1990a) classification of *Meteorus* into species groups.

Species group	<i>Meteorus</i> species placed in the group	Characteristics of group
<i>corax</i> group	<i>corax, sulcatus</i>	Petiolar tergum broad at base; deep and large dorsope; ♀ antennae subapically bearing a ventral field of densely placed basiconic pegs.
<i>hirsutipes</i> group	<i>angustatus, cespitator, cis, eadyi, filator, gotoi, hirsutipes, jaculator, jezoensis, kyushuensis, longicaudis, obfuscatus, vexator</i>	Shape of pterostigma broad with the vein r originating near middle; inwardly curved striations on petiolar tergum.
<i>albizonalis</i> group	<i>abdominator, acutus, albizonalis, consimilis, curvus, punctifrons</i>	Ovipositor distinctly curved ventrad; vein 3-SR of fore wing very short; pterostigma not broad and vein r originating beyond the middle of it.
<i>micropterus</i> group	<i>micropterus, salicorniae</i>	Face strongly convex; medio-dorsally interrupted occipital carina; 4 <sup>th</sup> antennal article on ♀ stout; hind femur stout; propodeum without median longitudinal carina.
<i>pulchricornis</i> group (subgroups: <i>pulchricornis, nodai, pendulus, colon, versicolor</i> )		Slender and strongly twisted mandibles.
subgroup: <i>pulchricornis</i>	<i>abscissus, communis, dimidiatus, hyphantriae lionotus, proximus, pulchricornis, unicolor</i>	Clypeus with a dense pile of erect hairs; median tubercle of frons absent; ventral borders of 1 <sup>st</sup> tergum joined in the middle of the segment or narrowly separated.
subgroup <i>nodai</i>	<i>nodai</i>	Ocelli very large; OOL/OD=0.5-0.7; median tubercle of frons absent; 1 <sup>st</sup> tergum without dorsope; the ventral borders joined at the basal 1/3.
subgroup <i>pendulus</i>	<i>pendulus, limbatus, naranage</i>	Median tubercle of frons absent; 1 <sup>st</sup> tergum with deep dorsope; ventral borders separated.
subgroup <i>colon</i>	<i>melanostictus, colon, cinctellus, watanabei</i>	Median tubercle of frons present; vein m-cu of fore wing usually postfurcal to vein 2-SR; 1 <sup>st</sup> tergum without dorsope (except <i>melanostictus</i> )
subgroup <i>versicolor</i>	<i>versicolor, takenoi, albifasciatus, camptolomae, kurokoi, obsoletus, insulicola</i>	Median tubercle of frons absent; 1 <sup>st</sup> tergum without dorsope; the ventral borders joined from the base to its basal 2/5 or 1/2
<i>ictericus</i> group	<i>affinis, campestris, endoclytae, graciliventris, ictericus, ruficeps, tabidus, trachynotus</i>	Large ocelli; mandibles stout and moderately twisted; ovipositor long and straight; eyes moderately or strongly convergent ventrad; tarsal claws usually with a submedial lobe.
<i>rubens</i> group	<i>heliophilus, rubens</i>	Second valvula swollen apically and with a minute subapical notch; large ocelli; short ovipositor; stout and moderately twisted mandibles or strongly twisted in the apical portion; gregarious parasitoids with unsuspended cocoons.



**FIGURE 1.** Results from the parsimony analysis of Meteorini relationships by Zitani (2003), based on morphological characters. Bootstrap values (> 50%) are shown below the nodes.

## Material and methods

### *Studied Material*

A total of 1 970 specimens were examined, of these 893 *Meteorus* and 87 *Zele* specimens were from the SMTP material. We studied all Meteorini material in the Swedish Museum of Natural History (NHRS), the Lund Zoological Museum (MZLU), the Uppsala University Department of Entomology (UUZM), the Natural History Museum in London (BMNH), the Nationaal Natuurhistorisch Museum in Leiden (RMNH) and the Zoological Institute in St. Petersburg (ZIN). Additional material, mostly type material, was borrowed from the Institut Royal des Sciences naturelles de Belgique (IRSNB), the Naturhistorisches Museum Wien (NHMW), the Museum für Naturkunde der Humboldt-Universität Berlin (ZMB), the Zoological Museum of the University of Copenhagen, Denmark (ZMUC) and from the Entomological laboratory, Faculty of Agriculture at Kyushu University Japan (KUEC).

All material from the SMTP was originally preserved in 80% ethanol. For exact measurements, illustrations and for addition to the reference material at the NHRS, some specimens were dry-pinned, including all holotypes and some paratypes. These specimens were treated in a mixture of alcohol and xylene (60:40) for 24 hours and then glued to a piece of cardboard. Some paratypes were left in 80% ethanol for future molecular or morphological study. Most of the material, the voucher specimens and the DNA extractions are deposited in NHRS. The voucher specimen and sequence data are listed in Appendix II.

### ***Terminology and Illustrations***

The terminology used for measurements (Figs 2A–D) and descriptions of morphological characters follows Huddleston (1980) and van Achterberg (1988). The abbreviation OOL stands for Ocellar Ocular Line (Fig. 2B). Drawings were made using a Leitz microscope with camera lucida, a digital drawing board or pencil and paper, and Adobe Photoshop. The 'stacked' photographs were taken with a computer-connected Olympus DP70 digital camera and an InfinityX digital camera mounted on an Olympus SZX12 stereo microscope. Specimens for scanning electron microscopy (SEM) were dried in an ethanol gradient from 80% to 99.6%, finishing with acetone. They were examined sputter-coated in a Hitachi S-4300. Additional images of most species studied here are available at Morphbank ([www.morphbank.net](http://www.morphbank.net)).

### ***Species descriptions***

We have underlined the distribution records verified by label data on specimens examined by us.

### ***Morphological Phylogenetic Analysis***

For the morphological phylogenetic analysis, we started with the 20 characters described by Maeto (1989a, 1990a) and coded by him for seven species groups in the Meteorini (Table 1). We deleted a few characters, for which it was difficult to distinguish the character states, ending up with a final set of 17 characters. These characters were coded for 45 species representing the Meteorini (Table 2). The species *Leiophron pallipes* Curtis of the Euphorinae was used as the outgroup; it is a fairly generalized euphorine without obvious morphological specializations. Characters were coded using a Leica Z9 stereomicroscope.

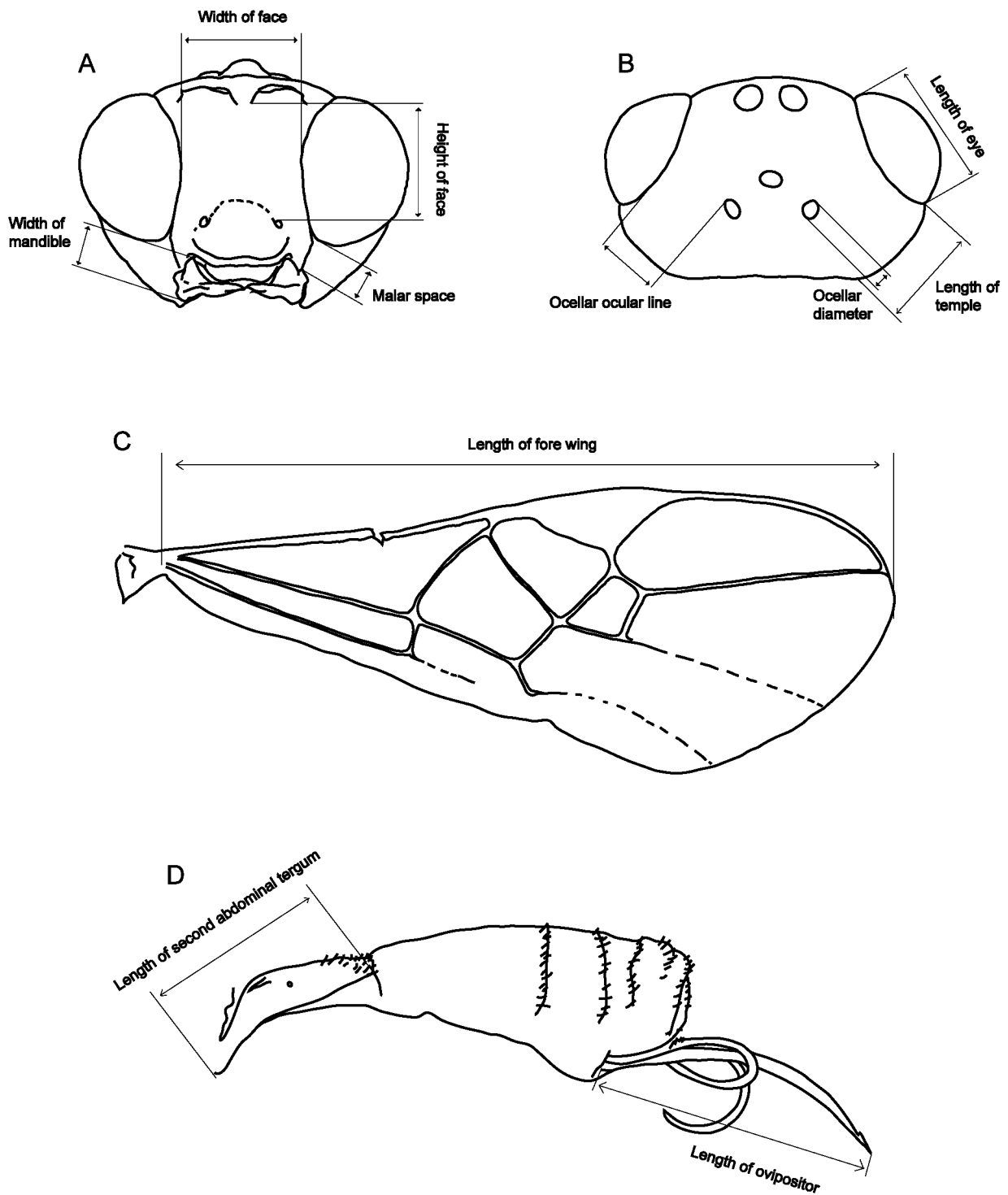
The analysis of the dataset, which only includes binary characters, was performed using TNT (Goloboff et al. 2008). A heuristic search was run using 2000 random addition sequence replicates with tree bisection reconnection (TBR) branch swapping. Ten trees were held at each step during stepwise addition. Support was measured using the Group – Conflict (GC) jackknife procedure (Farris et al. 1996; Goloboff 2003) with 2000 replicates and a deletion probability for each character of 36%.

### ***Molecular Analysis***

A total of 41 known species of Meteorini were studied (see Appendix II for taxa and GenBank accession numbers). The original sample of specimens from the SMTP material was chosen to cover the entire geographical range of each morphospecies identified in the material. If we suspected that a morphospecies might be a complex of cryptic species because of morphological variation or because of significant genetic variation in the initial sample of individuals, we included more specimens of the same species but from other collecting sites. We used six outgroup taxa representing five different tribes of Euphorinae (Centristini, Euphorini, Syntretini, Perilitini, Planitorini) (Boring 2010). All outgroup sequences were kindly provided by Dr A. Boring; the ingroup sequences are original to this study except the sequence of *M. corax*, which was accessed through GenBank (Appendix II).

DNA was extracted from specimens preserved in 80% ethanol or from dry-pinned specimens. In either case, only the hind leg was removed and used for DNA extraction. Two markers were sequenced for all taxa, namely the mitochondrial gene cytochrome oxidase 1 (CO1; 658 bp) and the D2 loop of the nuclear 28S ribosomal sequence (28S D2; 632 bp). The CO1 primers used were LCO and HCO (Folmer et al. 1994), while 28S D2 was sequenced using the fwd and rev primers used by Campbell et al. (1993). The PCR program for CO1 had an initial 5 min





**FIGURE 2.** Measurements used in this paper pertaining to: A) head, anterior view; B) head, dorsal view; C) metasoma; and D) fore wing. L = length, OOL = ocellar ocular length.

denaturation at 94 °C, followed by 40 cycles of (94 °C for 15 s, 46 °C for 15 s and 72 °C for 15 s), and ending with a 10 min extension period at 72 °C. The PCR program for 28S D2 had an initial 4 min denaturation at 95 °C, followed by 40 cycles of (94 °C for 30 s, 55 °C for 30 s and 72 °C for 30 s), and ending with a 10 min extension period at 72 °C. PCR products were purified using EXOFAP (EXO1 and FastAP). Gene regions were sequenced with the same primers, using the BigDye™ Terminator ver. 3.1 Cycle Sequencing Kit (Applied Biosystems). Sequencing reactions were purified using the DyeEx 96 kit (QIAGEN) and cycle sequencing reactions were run on an ABI Prism 3100 Genetic Analyzer (Applied Biosystems). All steps were performed according to the manufacturer's instructions. For assembling and viewing the sequence data and contigs the Pregap4 and Gap4 modules of

the Staden package (Staden et al., 1998) were used. The sequences were further processed in BioEdit (Hall, 1999) and 28S D2 was aligned using MAFFT online version (Kato et al. 2009). CO1 was aligned by eye.

The data were partitioned into three parts: 28S D2, CO1 codon positions 1+2, and CO1 codon position 3. Substitution models for the different partitions were found with MrAIC and MrModeltest (Nylander, 2004a, 2004b). GTR + I + Gamma was the optimal model for the two CO1 partitions, and GTR + Gamma for 28S D2. We used a standard non-clock tree model. The datasets for the two genes were analyzed separately and combined. In the combined analysis, all model parameters except topology and branch lengths were unlinked across partitions. Finally, we ran a combined analysis that also included the morphological characters in a separate partition.

Bayesian MCMC analyses were performed using MrBayes 3.2 (Huelsenbeck & Ronquist, 2001; Ronquist and Huelsenbeck 2003) under default settings except as follows. The analyses were run for 5–30 million generations, until the standard deviation of split frequencies was close to or below 0.01. The chains were sampled every 1 000 generations, and 25 % of the samples were discarded as burn-in. The run files are available on request.

### *Analysis of Species Circumscription*

The generalized mixed Yule-coalescent (GMYC) model (Pons et al. 2006) was used as a complement to visual inspection to establish putative species based on the molecular data. The GMYC analysis requires an ultrametric tree. To obtain one, we used the Compound Poisson Process relaxed clock model (Huelsenbeck et al. 2000) as implemented in MrBayes 3.2, with default priors. The substitution model was the same as before. The GMYC analysis was conducted with the R package ‘splits’ (Species Limits by Threshold Statistics) (<http://r-forge.r-project.org/projects/splits>) (Pons et al. 2006).

## **Results**

### *Morphological Phylogenetic Analysis*

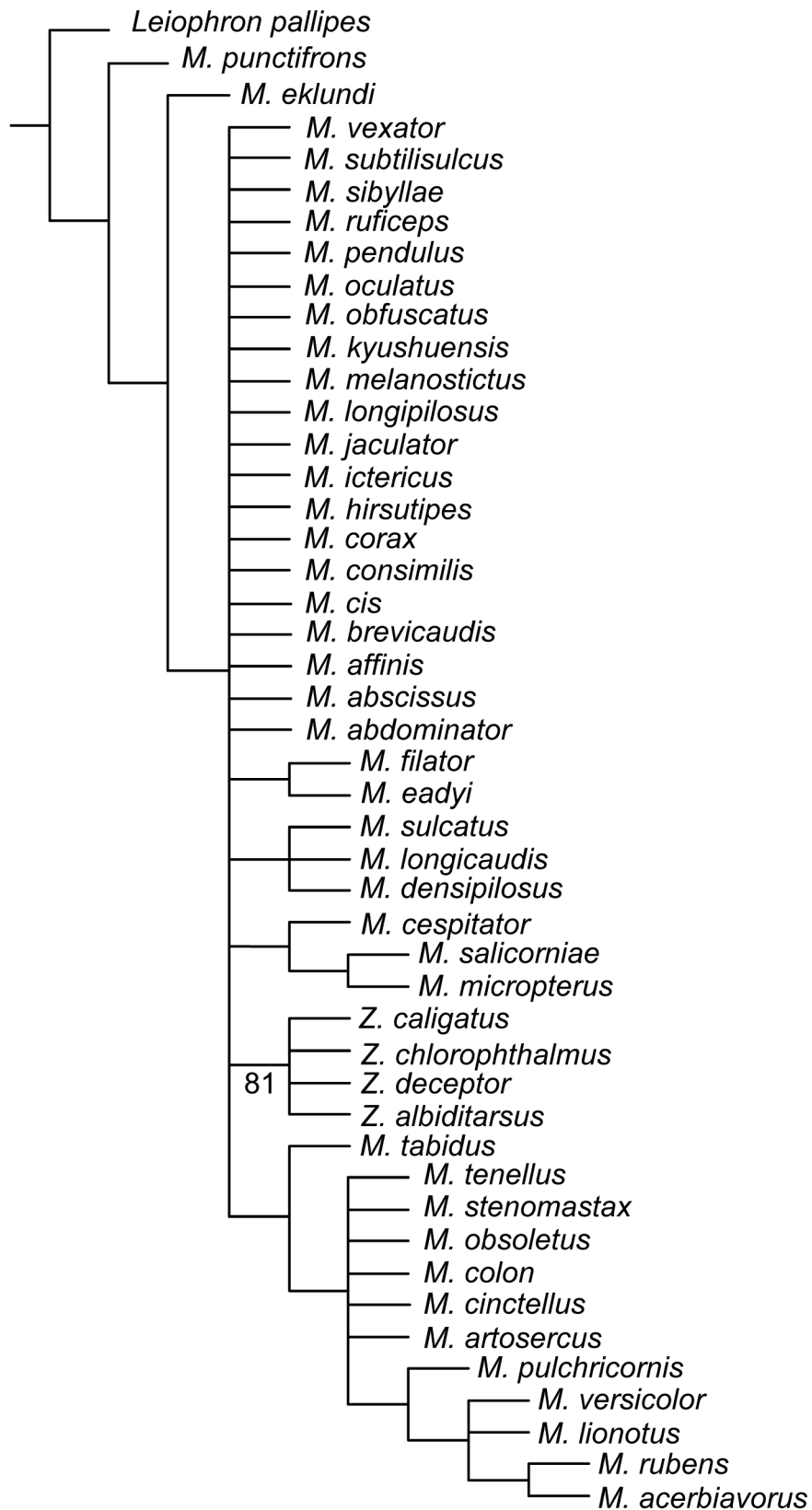
The following discrete morphological characters were scored across all species (Table 2):

1. Size of ocelli: (0) OOL more than 2.0 the width of the lateral ocellus (Fig. 24); (1) OOL less than 2.0 the width of the lateral ocellus (Fig. 24).
2. Shape of face: (0) slightly convex or flat; (1) strongly convex (like *M. micropterus* Fig. 34).
3. Occipital carina: (0) complete; (1) interrupted.
4. Shape of clypeus: (0) flat (Fig. 99); (1) strongly convex (Fig. 100).
5. Convergence of eyes: (0) not convergent (Figs 82, 89, 93); (1) convergent (Fig. 86, 92, 97).
6. Mandibles: (0) stout (Fig. 98); (1) slender and twisted (Fig. 132).
7. Position of fore wing cross-vein m-cu (recurrent vein) (0) postfurcal (Fig. 30); (1) antefurcal (Fig. 62).
8. Shape of second flagellomere: (0) slender (2.5–4 times longer than wide); (1) stout (1.7–2.5 times as long as wide).
9. Structure of dorsal propodeal carinae: (0) indistinct or absent (Fig. 38); (1) distinct (Fig. 37).
10. Structure of tarsal claws: (0) simple; (1) with a distinct basal lobe.
11. Shape of pterostigma: (0) slender, vein r projects apically (Figs 43, 57); (1) broad, vein r projects from middle of stigma (Figs 58, 62).
12. Marginal cell of hind wing: (0) subparallel (Fig. 10b); (1) widening (Fig. 10a).
13. Dorsope: (0) absent or traces of dorsope (Figs 18, 19); (1) present (Fig. 21).
14. Ventral margins of second abdominal tergum (petiole): (0) joined mid-ventrally, or almost joining (Figs 20, 25, 26); (1) completely separate (Fig. 22).
15. Pubescence on abdominal terga 3–8: (0) one single row of setae on each tergum (Fig. 12); (1) setae evenly scattered on each tergum (Fig. 11).
16. Shape of ovipositor: (0) straight; (1) curved.
17. Length of protruding part of ovipositor: (0) short, less than twice the length of the petiolar tergum; (1) long, more than twice the length of the petiolar tergum.

TABLE 2. Morphological character matrix.

Taxa/character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>M. abdominator</i>	0	0	1	0	0	0	1	0	1	0	0	0	1	1	0	1	1
<i>M. abscissus</i>	1	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0
<i>M. acerbiavorus</i>	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0
<i>M. affinis</i>	1	0	0	0	1	0	1	0	0	1	0	0	1	1	0	0	1
<i>M. artocercus</i>	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1
<i>M. brevicauda</i>	0	0	0	0	0	0	1	1	1	0	1	0	1	1	0	0	0
<i>M. cespitator</i>	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1
<i>M. cinctellus</i>	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1
<i>M. cis</i>	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	1
<i>M. colon</i>	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0
<i>M. consimilis</i>	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
<i>M. corax</i>	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	1
<i>M. densipilosus</i>	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0	0	1
<i>M. eadyi</i>	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	0
<i>M. eklundi</i>	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	1	0
<i>M. filator</i>	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1
<i>M. hirsutipes</i>	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1
<i>M. ictericus</i>	1	0	0	1	0	1	1	0	0	1	1	0	1	1	0	0	0
<i>M. jaculator</i>	0	0	0	0	0	0	1	0	1	1	1	0	1	1	0	0	1
<i>M. lionotus</i>	1	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0
<i>M. longicaudis</i>	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1
<i>M. longipilosus</i>	0	0	0	1	0	0	1	0	1	1	0	0	1	1	0	1	1
<i>M. melanostictus</i>	1	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0
<i>M. mellifacialis</i>	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	0	1
<i>M. micropterus</i>	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
<i>M. obfuscatus</i>	0	0	0	0	0	0	1	1	1	0	1	0	1	1	0	0	1
<i>M. obsoletus</i>	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1
<i>M. oculus</i>	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1
<i>M. pendulus</i>	1	0	0	1	1	1	0	0	0	1	0	0	1	1	0	0	0
<i>M. pulchricornis</i>	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0
<i>M. punctifrons</i>	0	0	1	0	0	0	?	0	0	0	1	0	1	1	0	1	0
<i>M. rubens</i>	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
<i>M. ruficeps</i>	1	0	0	1	1	1	1	0	1	1	0	0	1	1	0	0	1
<i>M. salicorniae</i>	0	1	0	0	0	0	1	1	0	0	1	0	1	1	0	0	1
<i>M. sibyllae</i>	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1
<i>M. stenomastax</i>	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1
<i>M. subtilisulcus</i>	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0
<i>M. sulcatus</i>	1	0	?	0	0	0	?	0	0	0	1	0	1	1	0	0	1
<i>M. tabidus</i>	1	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	1
<i>M. tenellus</i>	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1
<i>M. versicolor</i>	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0
<i>M. vexator</i>	0	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0	1
<i>Z. albiditarsus</i>	1	0	0	0	0	1	1	0	1	1	0	1	1	1	1	1	0
<i>Z. deceptor</i>	1	0	0	0	0	1	1	0	1	1	0	1	1	1	1	1	1
<i>Z. chlorophthalmus</i>	1	0	0	0	0	1	1	0	1	1	0	1	1	1	1	1	1
<i>Z. caligatus</i>	1	0	1	0	0	1	1	0	1	1	0	1	1	1	1	1	0
<i>Leiophron pallipes</i>	0	0	1	0	0	1	?	1	0	0	1	0	1	1	1	?	?

Parsimony analysis of the morphological data resulted in 1310 trees of equal length, the strict consensus of which was largely unresolved (Fig. 3). Jackknife analysis indicated fairly strong support (GC jackknife proportion 81%) for the monophyly of *Zelee* but no support above 50 % for any other group in the tree.



**FIGURE 3.** Results of parsimony analysis of the morphological matrix. GC jackknife support value (in percentage units) shown below the corresponding branch.

## Molecular and Combined Phylogenetic Analyses

The Bayesian MCMC analysis of the combined molecular data (Fig. 4) shows that the Meteorini fall into four well-supported clades. The first clade (Clade I, Fig. 4) includes *M. ictericus* and *M. ruficeps*; they form the sister group of the remaining Meteorini. The next clade (Clade II, Fig. 4) includes 13 species, all of which are parasitoids on Lepidoptera larvae. The members of Clade II are all slender and long-legged species, their ocelli tend to be large, most species are bicoloured, and most lack a dorsope except *M. abscissus*, *M. limbatus* and *M. pendulus*, which have a large, distinct dorsope, and *M. rubens* and *M. pulchrichornis*, which have a small and indistinct dorsope. *Meteorus micropterus* (Clade IIC) appears to be the sister lineage of the rest of Clade II, which falls into two strongly supported subclades of about equal size (Clade IIA and Clade IIB; Fig. 4).

Members of the third clade (Clade III, Fig. 4) parasitize both Lepidoptera and Coleoptera. They all have a distinct dorsope and small ocelli. Relationships among members of this clade are poorly resolved. The fourth clade (Clade IV, Fig. 7) consists entirely of species belonging to *Zele*. Within *Zele*, the two species *Z. albiditarsus* and *Z. deceptor*, previously considered conspecific, are clearly shown to be distinct species. The analysis suggests that Clade IV (*Zele*) is the sister of Clade III, but only with moderate support (79 % Posterior Probability (PP)).

The CO1 sequences on their own nicely separate species but higher relationships are poorly resolved for the most part (Fig. 5). However, Clade I and Clade IV are both strongly supported (100 % PP). The core of Clade II (IIA + IIB, that is, all species except *M. micropterus*) is also present (100 % PP), while Clade III falls into several different clades appearing in a large basal polytomy in the Meteorini. The monophyly of the Meteorini receives modest support (75 % PP).

The 28S topology (Fig 6) is poorly resolved at the species level but provides better support for the basal clades in the Meteorini. The monophyly of Meteorini receives moderate support (60 % PP), while Clade I, Clade II and Clade IV all are strongly supported as monophyletic (98 – 100 % PP). Clade III, on the other hand, falls into a number of separate lineages that appear basally in the group formed by (Clade II + III + IV). The monophyly of (Clade II + III + IV) receives moderate support (60 % PP).

When the molecular evidence is combined with morphological data for a slightly expanded set of species (45 compared with 39), the result is a highly polytomous topology (Fig. 7). The lack of resolution is entirely due to the difficulty of placing the six additional species based solely on their morphology; when these species are removed, the consensus from the analysis of the combined morphological and molecular data is very similar to that from the combined molecular analysis (cf. Fig. 4).

## Species Circumscription

All species recognized based on morphology appeared as reciprocally monophyletic in the combined molecular analysis (Fig. 4). The molecular data also indicated the presence of 12 additional, cryptic species in eight morphospecies: *M. ruficeps*, *M. tenellus*, *M. rubens*, *M. affinis*, *M. pendulus*, *M. cis*, *M. obfuscatus*, and *M. filator*. These cryptic species were separated from their closest relatives by considerable genetic distances (well over 5 %) in both the CO1 (Fig. 5) and combined analyses (Fig. 4). Five of these 12 cryptic species also have genetically distinct 28S sequences; the exceptions are *M. filator*, in which the 28S sequences are identical in the two cryptic species, and *M. tenellus*, in which the 28S sequences of the three cryptic species are part of an ancestral set of gene copies shared with *M. stenomastax*, *M. artocercus* and *M. cinctellus* (Fig. 6).

Despite careful study, we were not able to find consistent morphological differences separating the 12 cryptic species from their closest relatives. Some species complexes are morphologically homogeneous (*M. pendulus*, *M. filator*, *M. cis*), while others show considerable variation (*M. ruficeps*, *M. tenellus*, *M. rubens*, *M. affinis*) without the cryptic species being distinguishable. Many of the cryptic species have partially overlapping geographic ranges (those belonging to *M. tenellus*, *M. rubens*, *M. pendulus*, *M. filator*, and *M. cis* complexes), while others are separated geographically as far as can be judged from current data (those belonging to the *M. ruficeps*, *M. obfuscatus* and *M. affinis* complexes). We do not have biological data for the cryptic species, so it is impossible to determine whether there are differences among them in host preferences or other life-history traits.

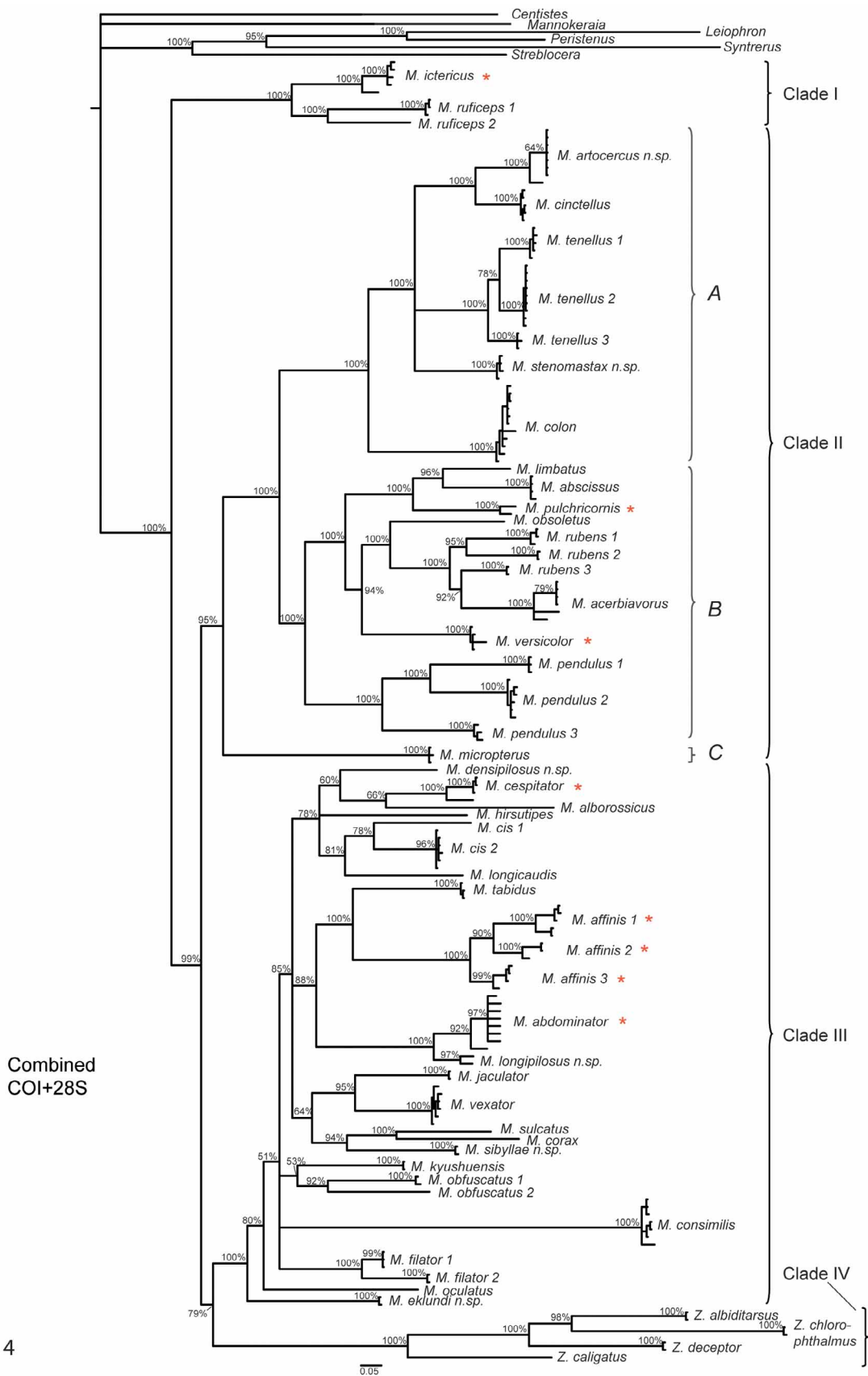


Fig. 4

**FIGURE 4.** Results from Bayesian phylogenetic analysis of the combined molecular data (COI and 28S D2). Numbers on branches are posterior probabilities (PP; in percent); branches with PP below 50 % are collapsed. PP values are not given for branches inside the terminal clusters corresponding to species. Putative major clades of the Meteorinae referred to in the text are indicated to the right. The scale bar represents nucleotide substitutions per site, and all Bayesian trees are rooted between the genera *Manokeria* and *Leiophron*.



**FIGURE 5.** Results from Bayesian phylogenetic analysis of the CO1 data. The scale bar represents nucleotide substitutions per site. For additional explanation, see Fig. 4.



**FIGURE 6.** Results from Bayesian phylogenetic analysis of the 28S D2 data. The scale bar represents nucleotide substitutions per site. For additional explanation, see Fig. 4.



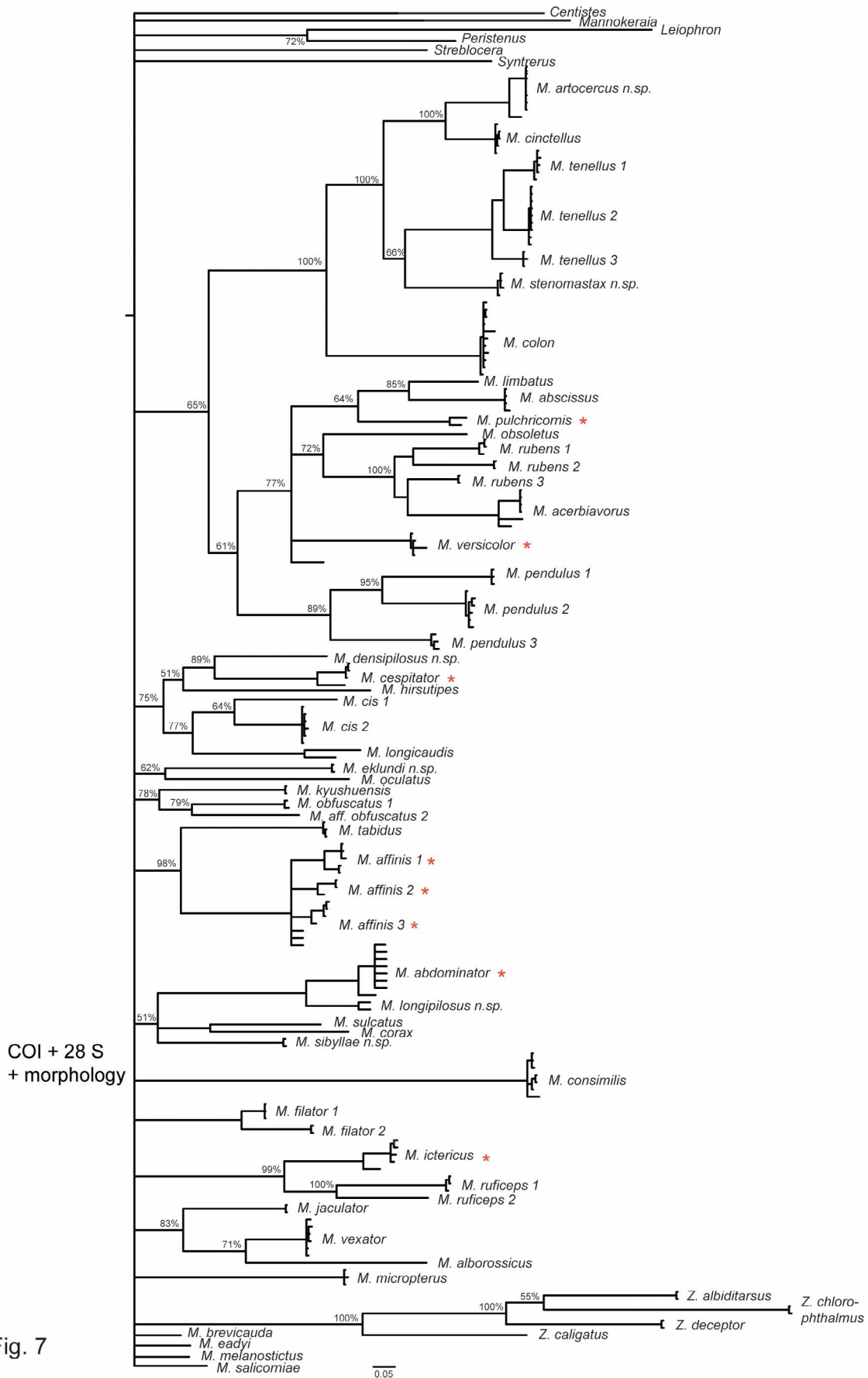


Fig. 7

**FIGURE 7.** Results from Bayesian phylogenetic analysis of the combined CO1, 28S D2 and morphology data. The scale bar represents nucleotide substitutions per site. For additional explanation, see Fig. 4.

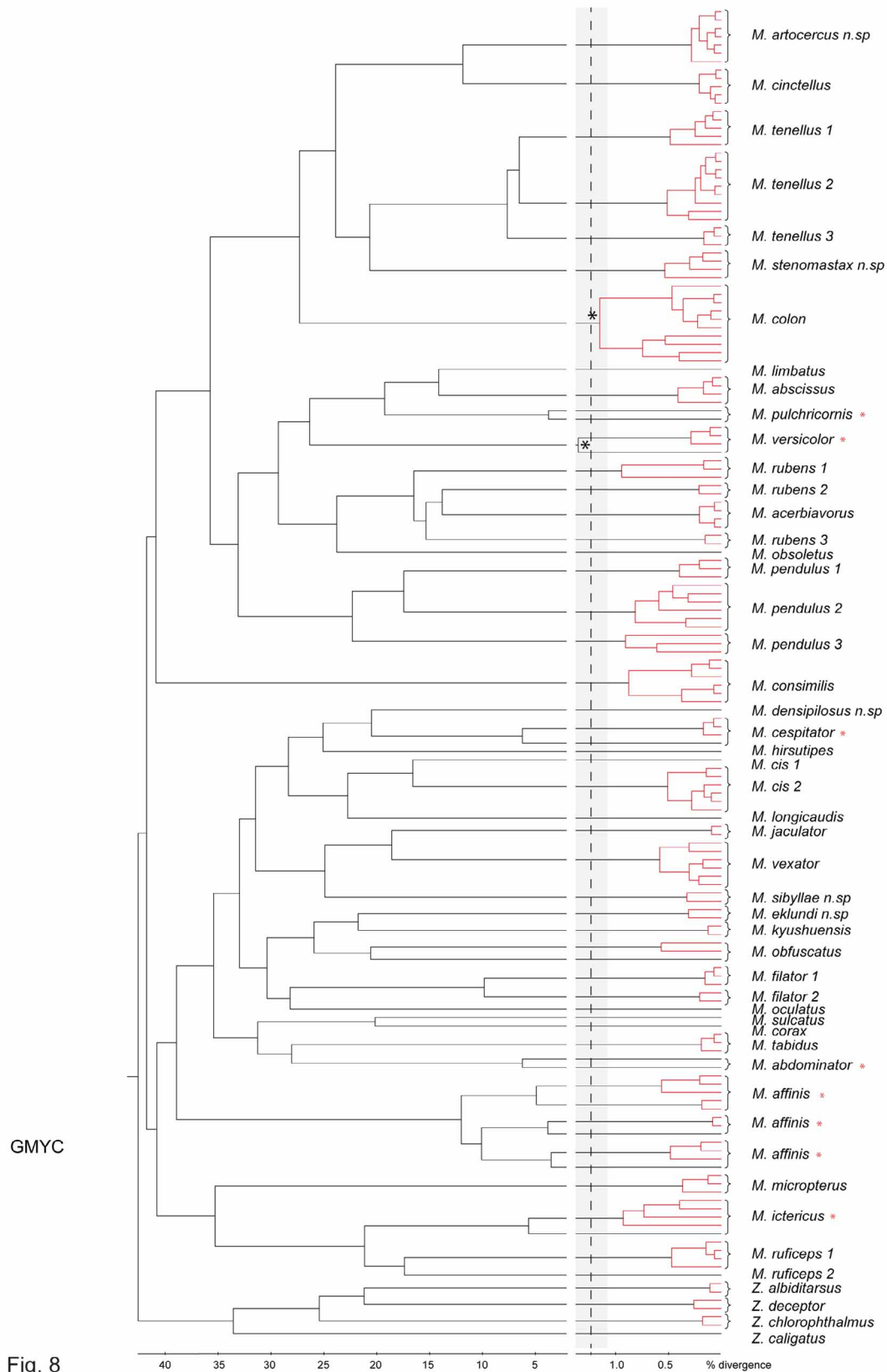


Fig. 8

**FIGURE 8.** Results from the GMYC analysis. The grey bar represents the confidence interval for the maximum likelihood estimate of the change point between the Yule and coalescent branching models ( $\pm 2$  log likelihood units from the maximum likelihood value). The terminal part of the tree is magnified 10 times for better visibility of the suggested species boundaries. Contiguous red clades are indicated to be conspecific according to the maximum likelihood estimate. The scale bar represents nucleotide substitutions per site.

The GMYC analysis of CO1 data confirmed the distinctness of the 12 cryptic species but indicated the presence of 8 additional species (Fig. 8). In general, the additional GMYC lineages represented single individuals that had unique CO1 sequences but shared 28S sequences with other specimens (Figs 4–6). In *M. affinis*, however, the five extra GMYC lineages represented significant CO1 variation across specimens, suggesting the presence of at least three major groups (Fig. 5). This was not reflected by the 28S sequences, which were mostly identical; two aberrant basal sequences were found in specimens that were deeply nested in the CO1 tree. The GMYC results were the same with or without identical CO1 sequences (haplotypes) removed.

### ***Evolution of Host Preferences***

When host preferences (Coleoptera or Lepidoptera) are mapped onto the tree from the combined molecular analysis, a clear pattern emerges (Fig. 9). Clades I, II, and IV are all completely specialized on lepidopteran hosts, which clearly suggests that this represents the ancestral host state of the Meteorini. Members of Clade III attack both coleopteran and lepidopteran hosts. The coleopteran parasitoids do not seem to form a monophyletic subgroup; instead, it appears that members of Clade III have shifted several times between lepidopteran and coleopteran hosts. However, support values are low for many groups, and host preferences are also unknown for some of the key taxa, making it difficult to draw robust conclusions concerning host shifts in this clade.

## **Discussion**

### ***Phylogeny***

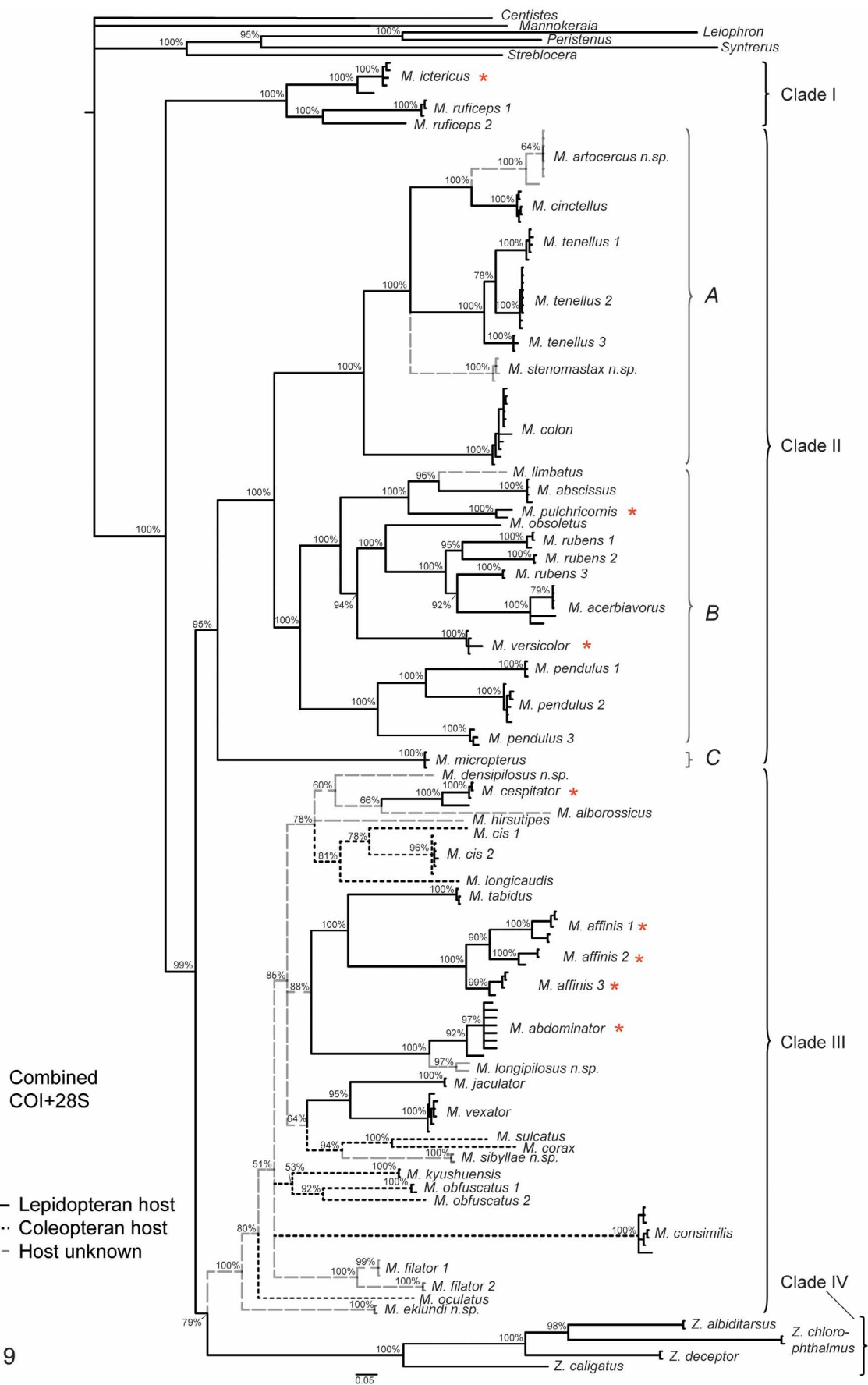
Our results clearly indicate that the Meteorini fall into four distinct clades, here named Clade I to Clade IV, with Clade I being the sister group of the others (Fig. 4). The results are weaker when it comes to relationships among Clades II, III, and IV, but they do suggest that Clade II may be the sister to (Clade III + Clade IV). Since Clade IV corresponds to *Zeke*, our results indicate that *Zeke* is deeply nested within *Meteorus*.

Our study thus conflicts with the results of Zitani's (2003) phylogenetic analyses based on 39 morphological characters, indicating that *Meteorus* and *Zeke* are sister groups (Fig. 1). One possible reason for the discrepancy might be that Zitani's selection of species is strongly biased in favor of lepidopteran parasitoids, while many of the closest relatives of *Zeke* in *Meteorus* are coleopteran parasitoids according to our analysis (Figs 4, 9). Our analysis (Figs 3, 7) also indicates that morphological characters are relatively uninformative about phylogeny in Meteorini, although it should be pointed out that Zitani used a larger set of morphological characters than that used by us, including a number of larval and pupal characters that we were unable to score for the species analyzed here.

Our study generally supports Maeto's (1990a) hypothesis of *Zeke* being nested within *Meteorus* but disagrees in the details. Maeto specifically suggested that *Zeke* forms a monophyletic group with his *ictericus*, *rubens* and *pulchricornis* groups (Table 1) of *Meteorus*. According to our results, however, the *ictericus*, *rubens* and *pulchricornis* groups of Maeto are not monophyletic, nor do they include the closest relatives of *Zeke*.

The species groups formed by Maeto (1990a) were based on morphology and mostly included Japanese species. They partly fit our phylogenetic results and partly conflict with them (Table 3). Maeto's *ictericus* group (Table 1) includes both *M. ictericus* and *M. ruficeps*, which form Clade I in our analysis (Fig. 4), and a number of other species that form scattered lineages in Clade III. The core of the *ictericus* group (our Clade I) is characterized by: (1) deep and large laterope and dorsope; (2) long antennae; (3) ovipositor longer than second abdominal tergum (petiole); (4) tarsal claws distinctly angulated and with a sharp basal tooth. Of the species listed by Maeto in the *ictericus* group, *M. affinis* and *M. tabidus* belong to Clade III (Fig. 4). We have not had access to material of the other species in Maeto's *ictericus* group (Table 1) and cannot comment on their position.

Our clade II falls into three separate lineages. The first one (Clade IIA) consists of *M. artocercus*, *M. colon*, *M. cinctellus*, *M. stenomastax*, and *M. tenellus*. It largely corresponds to Maeto's *colon* subgroup of the *pulchricornis* group. This group is characterized by: (1) no dorsope; (2) face narrow; (3) mandibles strongly twisted; (4) median tubercle on frons; (5) ovipositor long and slender. The first author examined type material of *M. melanostictus*, and concluded that this species is more closely related to Clade III than to the other species in Maeto's *colon* subgroup (Table 3). We have not seen material of *M. watanabei*, the last species included by Maeto in the *colon* subgroup.



**FIGURE 9.** Reconstruction of host preferences based on Fitch parsimony but marking ancestral branches as ambiguous when there is a complete lack of data on all descendants (most of these branches are reconstructed as having a lepidopteran host by Fitch parsimony).

**TABLE 3.** List of species studied in this paper, indicating the likely placement of each species in the major clades of the Meteorini that emerged in our phylogenetic analysis (Fig. 4). Species preceded by an asterisk were studied after the phylogenetic analysis had been completed; their placement is based on our interpretation of the available morphological evidence. The placement of all other species is based on the molecular phylogenetic analysis (Fig. 4).

Clade	Taxon	Distribution	Host family
<b>Clade I</b>	<i>M. ictericus</i> (Nees von Esenbeck, 1811)	Western Palearctic, Eastern Palearctic, Nearctic, Oriental, Australasia	Geometridae, Noctuidae, Tortricidae (Lep.)
	<i>M. ruficeps</i> (Nees von Esenbeck, 1811)	Western Palearctic	Geometridae, Tortricidae (Lep.)
<b>Clade IIA</b>	<i>M. artocercus</i> Stigenberg n.sp.	Western Palearctic	Arctiidae
	<i>M. cinctellus</i> Spinola, 1808	Western Palearctic, Eastern Palearctic, Australasia	Tortricidae (Lep.)
	<i>M. colon</i> (Haliday, 1835)	Western Palearctic, Eastern Palearctic	Noctuidae (Lep.)
	<i>M. tenellus</i> Marshall, 1887	Western Palearctic	Tortricidae (Lep.)
	<i>M. stenomastax</i> Stigenberg n.sp.	Western Palearctic	
<b>Clade IIB</b>	<i>M. abscissus</i> Thomson, 1895	Western Palearctic, Eastern Palearctic	Arctiidae, Geometridae, Noctuidae (Lep.)
	<i>M. acerbiavorus</i> Belokobylskij et al. 2011	Western Palearctic	Arctiidae (Lep.)
	* <i>M. heliophilus</i> (Fischer, 1970)	Western Palearctic, Eastern Palearctic	Arctiidae, Geometridae, Pyralidae, Tortricidae (Lep.)
	* <i>M. kurokoi</i> Maeto, 1989	Eastern Palearctic	Unknown
	* <i>M. insulicola</i> Maeto, 1989	Eastern Palearctic	Unknown
	<i>M. limbatus</i> Maeto, 1988	Western Palearctic, Eastern Palearctic	Unknown
	* <i>M. lionotus</i> Thomson, 1895	Western Palearctic	Geometridae (Lep.)
	* <i>M. nodai</i> Maeto, 1988	Eastern Palearctic	Unknown
	<i>M. obsoletus</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic	mostly Tortricidae (Lep.)
	<i>M. pendulus</i> (Müller, 1776)	Western Palearctic, Eastern Palearctic	Geometridae, Lasiocampidae, Lycaenidae, Lymantriidae, Noctuidae, Tortricidae (Lep.)
	* <i>M. politutele</i> Shenefelt, 1969	Western Palearctic	Unknown
	<i>M. pulchricornis</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic	18 families of Lepidoptera, mostly Noctuidae
	<i>M. rubens</i> (Nees, 1811)	Palearctic, Nearctic	Mostly Noctuidae (Lep.)
	* <i>M. rufus</i> (DeGeer, 1778)	Western Palearctic	7 families of Lepidoptera, especially Zygaenidae
	* <i>M. takenoi</i> Maeto, 1989	Eastern Palearctic	Unknown
	<i>M. versicolor</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic	mostly Geometridae, Lasiocampidae, Lymantriidae, Noctuidae (Lep.)
<b>Clade IIC</b>	<i>M. micropterus</i> (Haliday, 1835)	Western Palearctic, Eastern Palearctic	Hepialidae (Lep.)
<b>Clade III</b>	<i>M. abominator</i> (Nees, 1811)	Western Palearctic, Eastern Palearctic	mostly Geometridae (Lep.)
	<i>M. affinis</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic	mostly Psychidae (Lep.)
	<i>M. alborossicus</i> Lobodenko, 2000	Western Palearctic	Unknown

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TABLE 3 (continued)

Clade	Taxon	Distribution	Host family
	* <i>M. angiclypealis</i> van Achterberg, 2001	Western Palearctic	Unknown
	* <i>M. angustatus</i> Maeto, 1988		
	* <i>M. breviantennatus</i> Tobias, 1986	Western Palearctic, Eastern Palearctic	Curculionidae (Col.)
	* <i>M. brevicauda</i> Thomson, 1895	Western Palearctic, Eastern Palearctic	Chrysomelidae (Col.)
	<i>M. cespitator</i> (Thunberg, 1824)	Western Palearctic, Eastern Palearctic, Oceania	Tineidae (Lep.)
	<i>M. cis</i> (Bouché, 1834)	Western Palearctic, Eastern Palearctic	Curculionidae (Col.)
	<i>M. consimilis</i> (Nees, 1834)	Western Palearctic	Curculionidae (Col.)
	<i>M. corax</i> Marshall, 1898	Western Palearctic, Eastern Palearctic	mostly Cerambycidae (Col.)
	* <i>M. curvus</i> Maeto, 1988	Eastern Palearctic	Unknown
	<i>M. densipilosus</i> Stigenberg n.sp.	Western Palearctic	Unknown
	* <i>M. eadyi</i> Huddleston, 1980	Western Palearctic, Mongolia	Unknown
	<i>M. eklundi</i> Stigenberg n.sp.	Western Palearctic	Unknown
	* <i>M. endoclytae</i> Maeto, 1990	Eastern Palearctic	Hepialidae (Lep.)
	<i>M. filator</i> (Haliday, 1835)	Western Palearctic	Unknown
	* <i>M. gotoi</i> Maeto, 1988	Eastern Palearctic	Unknown
	<i>M. hirsutipes</i> Huddleston, 1980	Western Palearctic, Eastern Palearctic	Unknown
	* <i>M. ipidivorus</i> Tobias, 1986	Western Palearctic	Curculionidae (Col.)
	<i>M. jaculator</i> (Haliday, 1835)	Western Palearctic	Gelechiidae, Psychidae, Tineidae (Lep.)
	* <i>M. jezoensis</i> Maeto, 1988	Eastern Palearctic	Unknown
	<i>M. kyushuensis</i> Maeto, 1988	Western Palearctic, Eastern Palearctic	Erotylidae (Col.)
	<i>M. longicaudis</i> (Ratzeburg, 1848)	Western Palearctic	Tenebrionidae (Col.)
	<i>M. longipilosus</i> Stigenberg n.sp.	Western Palearctic	Unknown
	* <i>M. melanostictus</i> Capron, 1887	Western Palearctic, Eastern Palearctic	mostly Geometridae, Tortricidae
	* <i>M. micropilosus</i> Tobias, 1986	Western Palearctic	Unknown
	* <i>M. nadeshdae</i> Lobodenko, 2000	Eastern Palearctic	Unknown
	* <i>M. nixoni</i> Huddleston, 1980	Western Palearctic, Eastern Palearctic	Unknown
	<i>M. obfuscatus</i> (Nees, 1811)	Western Palearctic, Eastern Palearctic	Cerambycidae, Erotylidae, Melandryidae, Tenebrionidae (Col.)
	<i>M. oculatus</i> Ruthe, 1862	Western Palearctic	Psychidae (Lep.)
	* <i>M. punctifrons</i> Thomson, 1895	Western Palearctic	Tenebrionidae (Col.)
	* <i>M. radialis</i> Tobias, 1986	Western Palearctic	Unknown

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TABLE 3 (continued)

Clade	Taxon	Distribution	Host family
	* <i>M. rugosus</i> Maeto, 1986	Eastern Palearctic	Unknown
	* <i>M. salicorniae</i> Schmiedeknecht, 1897	Western Palearctic, Eastern Palearctic	Pyralidae (Lep.)
	<i>M. sibyllae</i> Stigenberg n.sp.	Western Palearctic	Unknown
	* <i>M. subjaculator</i> Tobias, 1986	Western Palearctic	Unknown
	* <i>M. subtilisulcus</i> Stigenberg n.sp.	Western Palearctic	Unknown
	<i>M. tabidus</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic	Coleophoridae, Geometridae, Psychidae, Tortricidae (Lep.)
	<i>M. vexator</i> (Haliday, 1835)	Western Palearctic	Psychidae (Lep.)
	* <i>M. zinaidae</i> Belokobylskij, 1987	Eastern Palearctic	Unknown
<b>Clade IV</b>	<i>Z. albiditarsus</i> Curtis, 1832	Western Palearctic, Eastern Palearctic, Nearctic, Neotropic, Oriental	mostly Noctuidae (Lep.) but also Hymenoptera
	* <i>Z. annulicrus</i> (Thomson, 1895)	Western Palearctic	Unknown
	<i>Z. caligatus</i> (Haliday, 1835)	Western Palearctic, Eastern Palearctic, Nearctic, Neotropic, Oriental	Geometridae, Nymphalidae (Lep.)
	<i>Z. chlorophthalmus</i> (Spinola, 1808)	Western Palearctic, Eastern Palearctic, Nearctic, Neotropic, Oriental	mostly Pyralidae (Lep.)
	<i>Z. deceptor</i> (Wesmael, 1835)	Western Palearctic, Eastern Palearctic, Nearctic, Neotropic, Oriental	mostly Geometridae (Lep.)

The second lineage (Clade IIB) consists of *M. abscissus*, *M. acerbiavorus*, *M. limbatus*, *M. obsoletus*, *M. pendulus*, *M. pulchricornis*, *M. rubens* and *M. versicolor* (Fig. 4) This lineage is characterized by: (1) no dorsope (except *M. pendulus*, *M. abscissus*, and *M. limbatus*); (2) face narrow; (3) mandibles strongly twisted; (4) no tubercle on frons; (5) ovipositor short. It largely corresponds to Maeto's *pulchricornis* group (except for the *colon* subgroup), and the *rubens* group. The first author examined material of *M. heliophilus*, *M. insulicola*, *M. kurokoi*, *M. lionotus*, *M. nodai*, *M. politutele*, *M. rufus* and *M. takenoi* and, and can confirm that they all are likely to belong to this lineage (Table 3).

Finally, the third lineage (Clade IIC) consists in our analysis solely of *M. micropterus*. Maeto also placed *M. salicorniae* in his *micropterus* group but study of material of *M. salicorniae* by the first author indicates that the character that groups them together, the strongly convex face, is most probably a parallelism and not a true synapomorphy. Judging from its morphology, *M. salicorniae* is more likely to belong to Clade III than to be closely related to *M. micropterus* (Table 3).

Our Clade III (Fig. 4) includes *M. abominator*, *M. affinis*, *M. alborossicus*, *M. cespitator*, *M. cis*, *M. consimilis*, *M. corax*, *M. densipilosus*, *M. eklundi*, *M. filator*, *M. hirsutipes*, *M. jaculator*, *M. kyushuensis*, *M. longicaudis*, *M. longipilosus*, *M. obfuscatus*, *M. oculus*, *M. sibyllae*, *M. sulcatus*, *M. tabidus*, and *M. vexator*. After examining dry-pinned material, the we can confirm that the following species also belong to Clade III: *M. acutus*, *M. albizonalis*, *M. angiclypealis*, *M. angustatus*, *M. breviantennatus*, *M. brevicauda*, *M. curvus*, *M. gotoi*, *M. ipidivorus*, *M. jezoensis*, *M. melanostictus*, *M. micropilosus*, *M. nadezhdae*, *M. nixonii*, *M. radialis*, *M. rugosus*, *M. subjaculator*, *M. subtilisulcus*, and *M. zinaidae* (Table 3). Clade III is rather heterogeneous morphologically and biologically, and it is quite difficult to find diagnostic morphological characters. The majority of species, however, appear to be

coleopteran parasitoids. Clade III corresponds to Maeto's *corax*, *hirsutipes* and *albizonalis* groups but also includes some members of his *ictericus* group, *micropterus* group, and *colon* subgroup of the *pulchricornis* group.

Our Clade IV corresponds to the genus *Zelev*, as circumscribed by van Achterberg and others. Thus far, we have not seen material of any *Meteor* species that seems more closely related to *Zelev* than to one of the three *Meteor* clades identified by us (Table 3).

### *Species Circumscription*

Our analysis of cryptic species diversity in the Meteorini was largely based on the Swedish SMTP material. A geographically and morphologically diverse sample of 177 specimens of 41 morphospecies was sequenced, selected from more than 900 specimens examined from the SMTP catches. The analysis resulted in the discovery of 12 cryptic species, which were clearly separated genetically although we were not able to distinguish them morphologically, not even after they had been identified in the molecular analysis.

The GMYC analysis indicated the presence of an additional 8 species, most of which were represented by single individuals with slightly deviating CO1 sequences. We suspect that studies of additional specimens will show that many of these variants do not represent distinct species. Nevertheless, further study of this genetic variation using additional specimens and more markers is clearly warranted.

If our sample is representative, this suggests that cryptic species may constitute 20% (12 / 59) to 34% (20 / 59) of the morphologically discoverable species diversity in the Meteorini. These results agree fairly well with those of other molecular studies of hidden species diversity in parasitic wasps (Smith et al. 2008, Fernández-Triana 2010). Smith et al. (2008) showed a 70% increase in species diversity based on 2.597 specimens and Fernández-Triana's study (2010), based on more than 12.000 specimens, indicated an increase with 50%.

Quicke (2001) discussed the cryptic species problem and proposed that specimens identified solely by molecular evidence would be labeled as molecularly Recognisable Taxonomic Units (mRTUs). He also pointed out the difficulty of associating existing scientific names with the correct mRTUs and suggested two possible solutions: either a non-argumentative approach, in which mRTUs are arbitrarily assigned to existing species names by the principle of priority (analogous to the first revisor principle), or a parallel approach, in which mRTUs are simply not named using traditional binomial nomenclature.

The problems discussed by Quicke are well exemplified by our study. For instance, consider the case of *M. pendulus*, which is apparently a complex of at least three mRTUs (Figs 4–6). *Meteor* *pendulus* currently has six synonyms meaning that seven scientific names are available for the three mRTUs. Matching the mRTUs to these names will require sequencing of old type material, which may not be possible. A practical approach in cases like this might be to sequence material from the type localities of the described species, and then assign mRTUs to names by matching geographic distributions, if possible, otherwise by arbitrary matching. Once the assignment of mRTUs to existing names has been made, the principle of priority would then be used to permanently link the names to diagnostic DNA sequences of the mRTUs.

Such an approach should be based on molecular study of material from a larger geographic region than the one targeted in this study. For this reason, among other things, we refrain from naming the mRTUs discovered here or trying to match them to existing species names; instead our treatment of the cryptic species is at the level of species complexes.

Which morphological characters are most useful in separating closely related species of *Meteor* and *Zelev*? There is considerable intraspecific variation in many characters, particularly in the males. Characters that nevertheless provide reliable diagnostic differences include the structure of the precoxal sulcus and the sculpture of the propodeum (Huddleston 1980). The colour patterns of females are also surprisingly stable, and can often be used for separating otherwise similar species.

Body size is quite variable and can only be used as a rough guide to differentiate species. The shape of the head and its various regions are sometimes diagnostic of species. However, the eyes vary in size among specimens, which can affect the appearance of these characters. If the eyes are small, they converge less strongly ventrally and the head tends to be more transverse in anterior view. Sexual dimorphism in the Meteorini is not pronounced, but males in *Meteor* have longer antennae and more flagellomeres than females, which should be born in mind when identifying specimens. The wing venation also tends to vary more in males than in females.



## Evolution of Host Preferences

Euphorines are well-known adult parasitoids of Coleoptera, Hemiptera, Hymenoptera, Neuroptera, Psocoptera, Orthoptera and Lepidoptera (Huddleston 1980, Shaw 1985 and 1988). They are also known to parasitize on nymphs (Loan 1974). The Meteorini are unique among euphorines in attacking insect larvae. Since adult hosts are very rare in other braconids, it seems likely that the Meteorini have retained the ancestral habit of the Euphorinae.

Čapek (1970) concluded, in his studies of larval morphology of Meteorini, that the ancestral hosts of the tribe were Lepidoptera larvae. In contrast, Shaw (1985) found in the first computerized analysis of Meteorini phylogeny, based on morphological data, that the most recent common ancestor of the Meteorini was likely to have attacked Coleoptera larvae. More recent studies, however, support the older idea of the ancestral hosts belonging to Lepidoptera (Li et al. 2003, Zitani 2003, Pitz et al. 2007, Boring 2010).

Our molecular results indicate that all coleopteran parasitoids in the Meteorini belong to a single clade, Clade III, which is nested inside other clades that are specialized on Lepidoptera. Counting both the species included in our phylogenetic analysis, and other species of which we have seen material, we have studied about 20 % of the Meteorini species, mostly from the Western Palearctic but also from other parts of the world. In this material, all coleopteran parasitoids appear to belong to Clade III. Therefore, we are fairly confident in concluding that the Meteorini originally attacked lepidopteran hosts, and that coleopteran parasitism is secondary.

Inferring the evolution of host preferences in more detail is difficult both because of the lack of data and because many of the published host records are erroneous due to incorrect identification of the *Meteorus* species. Nevertheless, some patterns seem to appear from the current analysis and will be discussed below. New host data based on reared material, which could be used in a more accurate future analysis, will be presented elsewhere (Stigenberg & Shaw in prep.).

Examining host preferences at the family level, we note that *M. ictericus* and *M. ruficeps*, which form Clade I (Fig. 4), mostly parasitize Tortricidae (Huddleston 1981, Yu et al. 2005). Clade II (Table 3, Fig. 7) is a group that parasitizes several lepidopteran families, the most frequent being the Noctuidae, Geometridae and Tortricidae (Huddleston 1981; Yu et al. 2005). The members of Clade II share morphological traits such as slender body, large ocelli, twisted mandibles and long ovipositor, which may partly represent adaptations to parasitism of lepidopteran larvae. An interesting feature in this clade is the gregarious lifestyles of *M. rubens* (Nees 1811) and *M. acerbiavorus* (Belokobylskij et al. 2011). This is shared also by *M. heliophilus* Fischer 1970 and several tropical species, including the Costa Rican species *M. papiliovorus* (Zitani 1997) and *M. oviedoi* (Shaw et al. 2005). Based on morphological features, all three species are likely to belong to Clade II. Gregariousness is likely to be a derived character in Clade II.

The hosts of Clade III (Table 3, Fig. 9) include both Coleoptera and Lepidoptera larvae. The attacked species belong to a wide range of families: hosts within Lepidoptera include members of the Noctuidae, Geometridae, Pyralidae and Tineidae, while coleopteran hosts include members of the Scolytidae, Cerambycidae, Melandryidae, Tenebrionidae and Cidae. It is difficult to infer the ancestral host of Clade III from available data. There are no host records on either *M. eklundi* or *M. filator*, both basal lineages in the clade, but since members of the rather basal species *M. oculatus* are parasitoids of Lepidoptera, it is possible that this is the ancestral host. Due to the poor resolution of relationships within Clade III, it is unclear whether parasitism of Coleoptera evolved once or repeatedly within the lineage. The members of Clade III that parasitize Coleoptera larvae tend to have small ocelli, less twisted mandibles, and long and slender ovipositors.

Members of *Zelee*, which form Clade IV (Fig. 4), mostly parasitize Geometridae, Noctuidae, Tortricidae, and Pyralidae. The shape of the ovipositor varies within *Zelee*. The species occurring in the Western Palearctic have moderately short and sturdy ovipositors. It is interesting to notice that the association with hosts in the Tortricidae recurs in three of the four major Meteorini clades. It may possibly indicate that the ancestral Meteorini hosts belonged to this family.

## Taxonomic Treatment with Keys

### The Tribe Meteorini Cresson 1887

Cresson, 1887, *Transactions of the American Entomological Society*, Supplement: 55, 60  
Syn.: Zelini Ashmead, 1900; Petiolarini Szépligeti, 1904; Zemiotini van Achterberg, 1976.

**Diagnosis:** Occipital carina complete, 3rd segment of labial palpi reduced or absent, anterior tentorial pits deep, medium sized to large; mesopleuron more or less protruding antero-dorsad; medial lobe of mesoscutum more or less rounded anteriorly; vein r-m of fore wing present; forewing with three submarginal cells, the second submarginal cell generally higher than long; petiolar tergum clearly petiolate, narrow at base and widened apically, spiracles on petiolar tergum situated submedially; ovipositor always exerted.

#### Key to European genera of *Meteorini*:

- 1 Marginal cell of hind wing widened apically (Fig. 10a), at least apical half of 3rd and following abdominal tergites setose (Fig. 11) ..... *Zele* (Curtis, 1832)
- Marginal cell of hind wing subparallel or narrowed apically (Fig. 10b), 3rd and following abdominal tergites with a single row of setae (Fig. 12) ..... *Meteorus* (Haliday, 1835)

#### Key to European species of *Zele*:

- 1 Vein cu-a of forewing antefurcal (Fig. 13a) ..... *Z. chlorophthalmus* (Spinola, 1808)
- Vein cu-a of forewing postfurcal (Fig. 13b) ..... 2
- 2 Precoxal sulcus narrow (Fig. 14) ..... 3
- Precoxal sulcus wide, not always strongly rugose (Fig. 15) (*albiditarsus* Curtis s.l.) ..... 4
- 3 Ovipositor short, 1.5 times petiolar tergum, (ovipositor sheath 0.19–0.28 times fore wing) ..... *Z. caligatus* (Haliday, 1835)
- Ovipositor long 2.5 times petiolar tergum (ovipositor sheath 0.38–0.39 times fore wing) ..... *Z. annulicrus* (Thomson, 1895)
- 4 Length of fore leg tibial spur 0.4–0.5 times fore basitarsus, fore femur swollen, 5.0–6.0 times as long as wide (Fig. 16) ..... *Z. albiditarsus* Curtis, 1832
- Length of fore leg tibial spur 0.2–0.4 times fore basitarsus, fore femur slender, 6.5–9.0 times as long as wide (Fig. 17) ..... *Z. deceptor* (Wesmael, 1835)

#### Key to European species of *Meteorus*:

- 1 Dorsope absent (Fig. 18), sometimes weakly indicated (Fig. 19), ventral borders of petiolar tergum (laterotergites) fused or almost joining in middle, from near the base of the petiolar tergum to its midpoint (Fig. 20) ..... 2
- Dorsope distinct; (Fig. 21) ventral borders of petiolar tergum not joining or fused, usually widely separated (Fig. 22) ..... 16
- 2 OOL=0.5–2 (Fig. 23); ocelli large; often yellow/reddish coloured body ..... 3
- OOL=2–3 (Fig. 24); ocelli small; often darker coloured body (except in *colon* where OOL=1.5–2 and body yellow to dark) ..... 9
- 3 Petiolar tergum with the baso-ventral triangular area elongate; tergum fused subbasally (Fig. 25); petiolar tergum often with traces of dorsope (Fig. 19) ..... 4
- Petiolar tergum fused ventrally from the base of the segment (Fig. 26); petiolar tergum without traces of dorsopes (Fig. 18) ..... 8
- 4 Setae on clypeus long (Fig. 27), clypeus short in height and wide, protruding ..... 5
- Setae on clypeus short (Fig. 28) or slightly longer than short; clypeus long, narrow and protruding ..... 6
- 5 Marginal cell of fore wing narrow and short (Fig. 29); antennal articles of ♀ 24–28 (♂ 26–30); upper tooth of mandible long; malar space of ♀ 0.5–0.8 times basal width of mandible; traces of dorsope on some specimens; colour varying ..... *M. rubens* (Nees, 1811)
- Marginal cell of fore wing wide and long (Fig. 30); antennal articles of ♀ 30–32; malar space of ♀ 0.4 times basal width of mandible; traces of dorsope more or less distinct; body yellow ..... *M. heliophilus* Fischer 1970

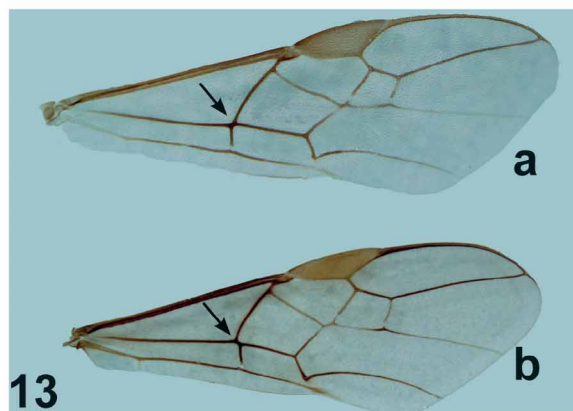
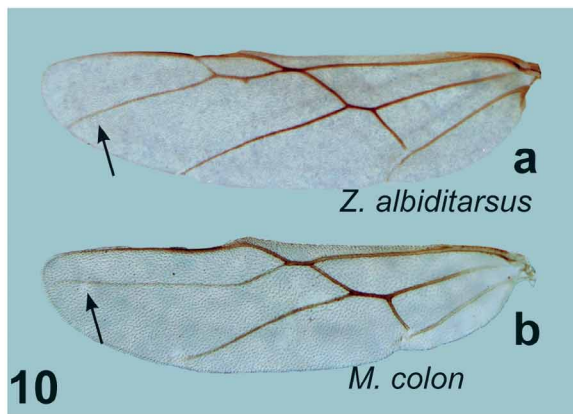
- 6 Body entirely black and rugose (Fig. 31); malar space of ♀ equal or slightly longer than basal width of mandible; antennal articles of ♀ 25–27; OOL=1.2–1.5; ovipositor 1.5–2.0 times length of petiolar tergum. . . . . *M. acerbiavorus* Belokobylskij et al. 2011  
 – Body with some parts mostly yellow-coloured. . . . . 7
- 7 Clypeus distinctly protruding, rounded (Fig. 105); OOL=0.5 (Fig. 32); setae on clypeus scattered; temples strongly contracted (Fig. 32); length of ovipositor about 1.5–2.0 times length of petiolar tergum; antennal articles of ♀ 31–33 . . . . . *M. lionotus* Thomson, 1895  
 – Clypeus with peculiar cushion-like shape, protruding but “flattened” (Fig. 28); OOL=1.5; setae on clypeus dense and short; temples rounded; ovipositor 1.5–2.0 times length of petiolar tergum; antennal articles of ♀ 29–33. . . . . *M. pulchricornis* (Wesmael, 1835)
- 8 Ovipositor slender, length 1.6–2.5 times petiolar tergum; eyes not protruding (Fig. 113); temples rounded; clypeus as wide as face; base of petiolar tergum brownish or blackish; antennal articles of ♀ 27–30. . . . . *M. obsoletus* (Wesmael, 1835)  
 – Ovipositor rather thick and 1.4–2.0 times length of petiolar tergum; eyes protruding (Fig. 132); base of petiolar tergum often pale yellow, almost translucent basally (Fig. 33); antennal articles of ♀ 29–33. . . . . *M. versicolor* (Wesmael, 1835)
- 9 Face forming a “shelf” (Fig. 34); wings short and narrow, often infumate (Fig. 35); face strongly convex; propodeum strongly reticulate–rugose, without distinct carinae; occipital carina interrupted medio-dorsally; body compact and dark brown (Fig. 36); antennal articles of ♀ 23–26 (♂ 24–28) OOL=3. . . . . *M. micropterus* (Haliday, 1835)  
 – Face without such shelf; wings longer and wider; body colour varying, often legs yellow; antennal articles of ♀ 21–34 . . . . . 10
- 10 Mandibles stout, not twisted, clypeus rather flat (Fig. 98); propodeum with strong anterior transverse carina and medial longitudinal carina (Fig. 37); vein m–cu of fore wing distinctly antefurcal or interstitial; antennal articles of ♀ 21–27; pterostigma dark brown. . . . . 11  
 – Mandibles small and more or less twisted (Fig. 86); clypeus rather protruding; propodeum without anterior transverse carina or with a median longitudinal carina (Fig. 38); vein m–cu of fore wing (sub) interstitial or postfurcal (Fig. 39), exceptionally shortly antefurcal; antennal articles of ♀ 24–34; pterostigma variable . . . . . 12
- 11 Clypeus wide and flat; face narrow, its minimum width about equal to its height (Fig. 98); eyes large protruding and converging; antennal articles slightly longer than broad and sturdier, basal articles lighter in colour than apical ones (Fig. 40), antennal articles of ♀ 21–25 (♂ 27–31); length of ovipositor 2 times petiolar tergum; OOL=2.5–3. . . . . *M. filator* (Haliday, 1835)  
**Note:** Males of *M. filator* have wider face and smaller eyes, very easy to go wrong here but check antennal length.  
 – Clypeus narrow and protruding; face wider, its minimum width about 1.5 times its height (Fig. 96); eyes smaller less converging; antennal articles long and slender, base of antenna concolorous with apex or nearly so (Fig. 41), antennal articles 26–27; length of ovipositor 1.5 times petiolar tergum; OOL=2.5–3 . . . . . *M. eadyi* Huddleston, 1980
- 12 OOL=1.5–2; body frequently yellow or pale brown, sometimes black; pterostigma yellowish or pale brown, elongated (Fig. 30); subapical antennal articles of ♀ distinctly longer than wide; ovipositor 1.0–2.0 times petiolar tergum; antenna of ♀ with 30–34 articles; precoxal sulcus narrow; vein m–cu of fore wing distinctly postfurcal, usually with about 2 times width of vein (Fig. 30); vertex reddish near eyes; hind femur yellowish, as tibia; frons convex medially; hind coxa with some rugosity. . . . . *M. colon* (Haliday, 1835)  
 – OOL=2–3 times; body mostly black, legs and details on head yellow to brown; pterostigma varying from brown to yellow (Fig. 42, 43); ovipositor 2.0–4.0 times petiolar tergum; antenna of ♀ with 24–30 articles; precoxal sulcus wider . . . . . 13
- 13 Pterostigma except basal 3<sup>rd</sup> dark brown (Fig. 42); subapical antennal articles of ♀ subquadrate (Fig. 44); hind femur more or less dark brown or infusate apically; antennal articles of ♀ 24–29 (♂ 25–30); length of ovipositor 2.5–3.0 times petiolar tergum, 5.5–5.6 times fore wing; eye 1.9–2.0 times as long as temple in dorsal view; length of malar space 0.6 times basal width of mandible; precoxal sulcus wide . . . . . *M. cinctellus* (Spinola, 1808)  
 – Pterostigma lighter in colour, not dark brown (Fig. 43); all antennal articles long (Fig. 45) . . . . . 14
- 14 Mesosoma with dark reddish–brown pattern (Fig. 46); ovipositor 2.4 times petiolar tergum and 5.3 times fore wing; eye about 1.5 times as long as temple in dorsal view; malar space 0.6 times basal width of mandible; second submarginal cell elongated, postfurcal; face equally broad as high; OOL=1.9; antenna of ♀ with 27–28 articles. . . . . *M. stenomastax* sp. nov.  
 – Mesosoma dark–black, not reddish but sometimes with a lighter yellowish spot . . . . . 15
- 15 Ovipositor long, 2.0–4.0 times petiolar tergum (Fig. 47); vein mc-u of fore wing interstitial or postfurcal (Fig. 43); third abdominal tergum yellow–brown, lighter than following tergum; median longitudinal carinae on propodeum visible to various degrees; antennae (♀) with 27–30 articles; no orange–red markings adjacent to precoxal sulcus . . . . . *M. tenellus* Marshall, 1887  
 – Ovipositor short, 1.6–2.0 times petiolar tergum (Fig. 48); vein mc-u of fore wing interstitial or antefurcal (Fig. 49); median longitudinal carinae on propodeum weak or obsolescent; antennae (♀) with 27 articles; some specimens have orange–red markings on both sides of precoxal sulcus . . . . . *M. artocercus* sp. nov.

16	Third abdominal tergum smooth (Fig. 50); petiolar tergum slender or variable; dorsopes situated medially (Fig. 21); face variable; body size smaller and body colour varying; antennae with about 30 articles or less. . . . .	17
–	Third abdominal tergum striated, petiolar tergum wide and stout (Fig. 51); dorsopes situated basally; face transverse; body large and dark; antennae with 30–40 articles . . . . .	52
17	Hind tibia wide, parallel-sided and medially about as wide as apex of femur (Fig. 52); eyes strongly convergent, large and strongly protruding (Fig. 114); mandibles slightly twisted; face as wide as broad; antennal articles of ♀ 30–33; OOL about 2.5 . . . . .	<i>M. oculatus</i> Ruthe, 1862
–	Hind tibia gradually widened to apex but not as wide as femur (Fig. 53) . . . . .	18
18	Small species, less than about 3.5 mm in length. Ovipositor about two times petiolar tergum. Seldom collected (except <i>M. vexator</i> and <i>M. jaculator</i> ) . . . . .	19
–	Larger species, more than about 3.5 mm in length. Ovipositor length variable. More frequently collected . . . . .	31
19	Antennae with 20–23 articles, clypeus sometimes with a ventral notch (Fig. 91); (if eyes large and greatly converging <i>M. vexator</i> (Fig. 133) or if ovipositor 3–4 times petiolar tergum <i>M. jaculator</i> cf. couplet 22) . . . . .	20
–	Antennae with more articles, clypeus without a notch . . . . .	22
20	Clypeus rather wide (Fig. 87), malar space very short; hind coxa punctate; ovipositor almost twice petiolar tergum; propodeum reticulate with median longitudinal and transverse carina . . . . .	<i>M. brevantennatus</i> Tobias 1986
–	Clypeus rather narrow (Fig. 91, 127) . . . . .	21
21	Malar space almost as wide as mandible base; eyes only slightly converging, head subcubic (Fig. 91); hind coxa often only partly rugose; ovipositor 2 times petiolar tergum . . . . .	<i>M. cis</i> (Bouché, 1834)
–	Malar space slightly shorter than mandible base; eyes converging slightly, head somewhat transverse (Fig. 127); hind coxa punctate; ovipositor 3.5 times length of petiolar tergum. . . . .	<i>M. subjaculator</i> Tobias 1986
22	Ovipositor about 1.5–2.0 times petiolar tergum, dark small species around 3.5 mm, face often transverse . . . . .	23
–	Ovipositor longer, 2.0–4.0 times petiolar tergum, colour, size etc varying . . . . .	26
23	Fore wing RS bent upward making marginal cell short and slightly narrow (Fig. 54). . . . .	<i>M. ipidivorus</i> Tobias, 1986
–	Fore wing RS straight, marginal cell “normal” (Fig. 39, 42, 43) . . . . .	24
24	Frons between ocelli and eyes with distinct punctures (Fig. 55); clypeus narrower than face (Fig. 119); ovipositor down-curved; OOL=4; temple distinctly widened ventrally (Fig. 55); ♀ antennal articles 25–27; head subcubic; hind coxa more or less darkened; eyes protruding, cheeks also protruding; mandibles stout; very small in body size, about 2 mm . . . . .	<i>M. punctifrons</i> Thomson, 1895
–	Frons between ocelli and eyes without distinct punctures, sometimes small indistinct punctures; clypeus variable; head not subcubic. . . . .	25
25	Clypeus as wide as face, lateral corner of clypeus reaching inner level of eye (Fig. 88); OOL=3; vein m-cu antefurcal; antennal articles of ♀ 24–27 . . . . .	<i>M. brevicauda</i> Thomson, 1895
–	Clypeus small and square (Fig. 109); OOL about 3; frons between ocelli and eyes with small indistinct punctures; vein m-cu distinctly postfurcal; antennal articles of ♀ 27 . . . . .	<i>M. micropilosus</i> Tobias, 1986
26	Marginal cell very narrow (Fig. 56); mesopleuron, pronotum, propodeum and coxae very rugose, whole specimen gives a rugose impression . . . . .	<i>M. radialis</i> (Tobias, 1986)
–	Marginal cell as in Figs 39, 42, 43; mesopleuron, pronotum, propodeum and coxae if rugose then only partially . . . . .	27
27	Face higher than broad, very narrow; mandibles slender; clypeus narrow (Fig. 84) . . . . .	28
–	Face broader than high, transverse, mandibles stout; clypeus wide, sometimes as wide as face (Fig. 102) . . . . .	30
28	Fore wing vein 1-SR+M only partial (Fig. 57); antennae of ♀ with 26–28 articles; eyes large, protruding and converging (Fig. 84); ovipositor 2.5 times petiolar tergum; hind coxae rugose, clypeus as wide as face . . . . .	<i>M. alborossicus</i> (Lobodenko, 2000)
–	Fore wing vein 1-SR+M fully sclerotized (Fig. 58); antennae of ♀ 20–25 articles; eyes large, protruding and strongly converging (Fig. 133); ovipositor 2–3 times petiolar tergum; hind coxa slightly rugose; clypeus broader than face. . . . .	<i>M. vexator</i> (Haliday, 1835)
29	Head rounded; fore wing vein r equal in length to 3-SR; hind coxae largely smooth . . . . .	<i>M. angiclypealis</i> van Achterberg, 2001
–	Head transverse; fore wing vein r distinctly shorter than 3-SR; hind coxae rugose dorsally . . . . .	30
30	Antennal articles of ♀ 18–22; propodeum with distinct carinae, smooth inbetween; clypeus rather flat and as wide as face (Fig. 102); OOL=3–4; ovipositor 3–4 times petiolar tergum. . . . .	<i>M. jaculator</i> (Haliday, 1835)

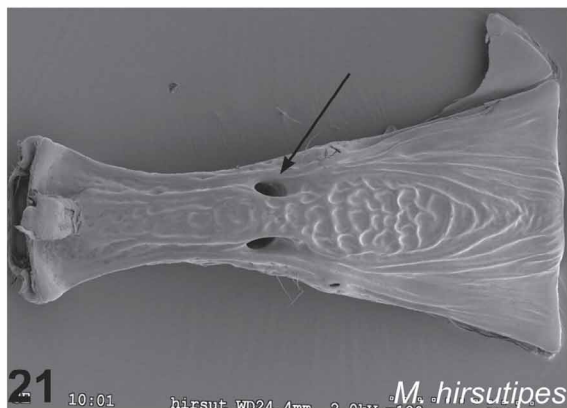
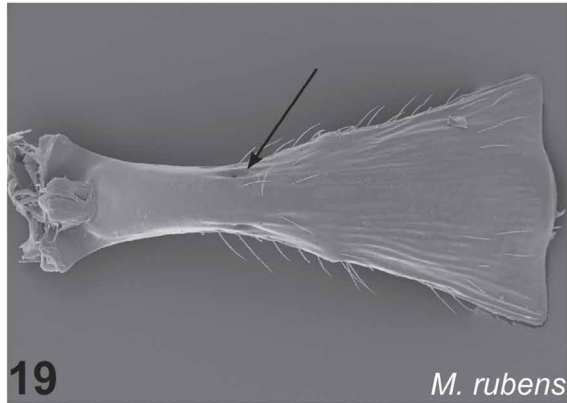
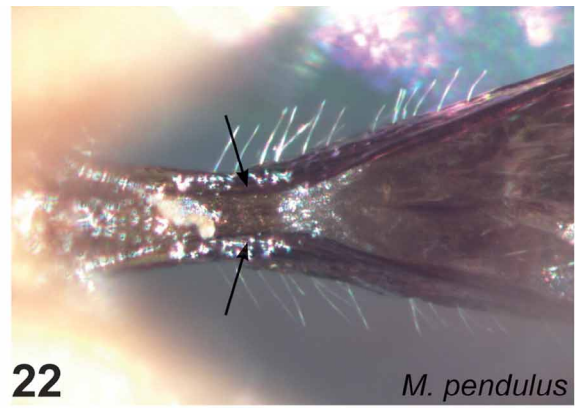
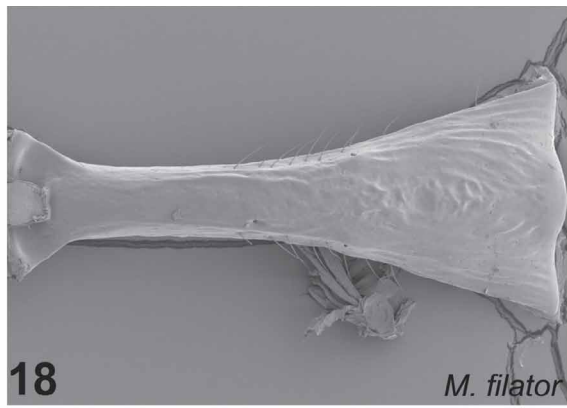
- Antennal articles of ♀ 24–26; propodeum with indistinct carinae, weakly rugose; clypeus as wide as face, distinctly separated from face, convex (Fig. 125); OOL=3–3.5; ovipositor 3.5–4 times petiolar tergum . . . . . *M. sibyllae* sp. nov
- 31 Petiolar tergum with two dark black spots (Fig. 59). Whole body punctate (face, pronotum, mesonotum etc); OOL=1.5. . . . .  
 . . . . . *M. politutele* Shenefeldt, 1969  
 – Petiolar tergum without any spots. Body with other surface structure . . . . . 32
- 32 Wings infusate (Fig. 60, 62) . . . . . 33  
 – Wings not infusate, clear (Fig. 58) . . . . . 35
- 33 Ovipositor short, thick and down-curved, length equal to petiolar tergum; length of malar space of ♀ 1.5–2.0 times (♂ 1.3–1.4 times) basal width of mandible; ♀ antennae with pale band (Fig. 61); second submarginal cell of fore wing strongly narrowed anteriorly (Fig. 62); ♀ antenna 32–33 articles (♂ up to 36); OOL=1.5–2.0. . . . . *M. consimilis* (Nees, 1834)  
 – Ovipositor longer; ocelli small, OOL=2.5–4.0 . . . . . 34
- 34 Ovipositor about twice the length of petiolar tergum and slightly down-curved (Fig. 63); OOL=3.5–4.0; malar space slightly shorter than mandible base; antennal articles of ♀ 22–26 (♂ 25–31). . . . . *M. abdominalator* (Nees, 1811)  
 – Ovipositor about three times the length of petiolar tergum, straight (Fig. 64); OOL=2.5; malar space 0.5 times mandible base; antennal articles of ♀ 25 . . . . . *M. longipilosus* sp. nov
- 35 Face wider than high, width seldom equal to height (except *M. eklundi*. Fig. 97) (Fig. 106); ocelli often small; OOL=2–3 . . 36  
 – Face not wide, mostly higher than wide or height and width equal (Fig. 122); ocelli often large; OOL=1–2 . . . . . 44
- 36 Ovipositor very long, 2.5–4.0 times petiolar tergum (if 2.5 then ovipositor sheaths with long erect hairs *M. salicorniae*, cf. couplet 38). . . . . 37  
 – Ovipositor shorter, 1.0–2.5 times petiolar tergum. . . . . 38
- 37 Face transverse, wider than high, and eyes small (Fig. 106); antennal articles of ♀ 29–32; ovipositor 4.5 times petiolar tergum . . . . . *M. longicaudis* (Ratzeburg 1848)  
 – Face not so transverse and eyes large (Fig. 89); antennal articles of ♀ 23–27; ovipositor 3–4 times petiolar tergum. . . . .  
 . . . . . *M. cespitator* (Thunberg, 1822)
- 38 Ovipositor sheath with long erect hairs, the hairs two times the width of the sheath (Fig. 65); face very transverse and eyes small (Fig. 124); antennal articles 33–35; ovipositor 2.5 times petiolar tergum. . . . . *M. salicorniae* Schmiedeknecht, 1897  
 – Ovipositor sheath with normal hairs; antennal articles of ♀ 23–32; ovipositor 1.5–2.5 times petiolar tergum . . . . . 39
- 39 Clypeus slightly protruding (Fig. 66); hind coxae smooth, punctate; face 1.5 times as wide as high (Fig. 112); subapical antennal articles of ♀ robust, squarish; length of ovipositor 1.7–2.0 times petiolar tergum; clypeus often similarly brownish as face . . . . . *M. obfuscatus* (Nees, 1812)  
 – Clypeus rather flat and wide (Fig. 103); hind coxae rugose (except *M. kyushuensis*) . . . . . 40
- 40 Face wide, at least twice as wide as high (Fig. 99) . . . . . 41  
 – Face not as wide, at most twice as wide as high (Fig. 128) . . . . . 42
- 41 Clypeus flat and wide, mandibles large, not twisted (Fig. 99); pronotum yellowish, contrasting with dark mesoscutum (Fig. 67); tarsal claws very long and slender; length of ovipositor 2.2–2.5 times petiolar tergum; ♀ antennal articles 26–30 . . . . .  
 . . . . . *M. hirsutipes* Huddleston, 1980  
 – Clypeus flat but not so wide, narrower than width of face (Fig. 103); mandibles large, slightly twisted; pronotum orange-brown; tarsal claws not so long; ovipositor about twice as long as petiolar tergum; ♀ antennal articles 23; colour of face orange  
*M. kyushuensis* Maeto 1988
- 42 Precoxal sulcus broad (Fig. 68); ovipositor 1.6–2.0 times petiolar tergum, if 1.6 times then clypeus narrow . . . . . 43  
 – Precoxal sulcus narrow (Fig. 69); ovipositor 1.6 times petiolar tergum and clypeus as wide as face . . *M. subtilisulcus* sp. nov.
- 43 Clypeus broad but narrower than face, punctate and flat but with ridges forming a sinuate ventral border (Fig. 95); face broader than high; ovipositor 2 times length of petiolar tergum; antennal articles 28, all articles longer than wide; OOL=2.5 . . . . .  
 . . . . . *M. densipilosus* sp. nov.  
 – Clypeus narrow but as wide as face (Fig. 96); face almost equally broad as high; ovipositor 1.6 times petiolar tergum, slender and slightly bent downward; antennal articles of ♀ 22–25, stout, half of them quadrate; OOL=3 . . . . . *M. eklundi* sp. nov.  
**Note:** If face rugose, rugosity extending down on clypeus, ovipositor straight, antennae not quadrate but longer than wide . . .  
 . . . . . *M. nadezdhae* Lobodenko, 2000, Kamchatka, East Russia.
- 44 Laterope wide and rugose (Fig. 70); pit in front of anterior ocelli (Fig. 71); OOL=1–2; length of ovipositor 1.5–3 times petiolar tergum; if about 2 times then propodeum largely smooth and at most with strong transverse carina; hind coxae slender (*icteri-*

- cus* and *ruficeps*) or rugose (*abscissus*, *limbatus*) . . . . . **45**
- Laterope wide but not so rugose (Fig. 72) or not wide but rugose; mostly no pit in front of anterior ocelli but sometimes a linear impression; OOL=1.0–2.4; length of ovipositor 1.0–3.5 times petiolar tergum; hind coxa reticulate–punctate . . . . . **48**
- 45** Clypeus smoothly arched and/or rather flattened, densely covered with setae (Figs 73, 75); ovipositor 1.5–2.0 times petiolar tergum; hind coxae rugose and yellow to brown; ♀ antennal articles 30–33; precoxal sulcus wide and strongly reticulate–rugose . . . . . **46**
- Clypeus distinctly protruding, with scattered setae (Fig. 74); ovipositor 2.5–3.0 times petiolar tergum; hind coxa only dorsally (dorso-laterally) rugose, yellowish; pterostigma pale yellowish; ♀ antennal articles 26–33; precoxal sulcus narrow . . . . . **47**
- 46** Clypeus flattened, setae short and dense (Fig. 73) . . . . . *M. abscissus* Thomson, 1895
- Clypeus smoothly velved, setae long (Fig. 75) . . . . . *M. limbatus* Maeto 1988
- 47** OOL=1.5–2.0; eyes converging (Fig. 122); occiput of ♀ usually largely black; medio-transverse propodeal carina stronger than other sculpture; subapical antennal articles of ♀ about as wide as long; eyes nearly touching clypeus; antennal articles of ♀ 26–31; eye in dorsal view about 2 times temple . . . . . *M. ruficeps* (Nees, 1834)
- OOL=1.0–1.5; eyes not strongly converging (Fig. 100); occiput of ♀ usually yellowish; transverse propodeal carina as weak as other rugae; subapical antennal articles of ♀ distinctly longer than wide; distance wider between eye and clypeus; apex of hind tibia and of hind basitarsus infuscate; antennal articles of ♀ 26–33; eye in dorsal view 2–3 times temple . . . . . *M. ictericus* (Nees, 1811)
- 48** Frons with a blunt tubercle in front of anterior ocellus; propodeum usually without medio-longitudinal carina, its transverse carina may be strongly raised and other sculpture coarser; ovipositor 1.5 times petiolar tergum; antennal articles of ♀ 25–31 . . . . . *M. melanostictus* Capron, 1887
- Frons without tubercle in front of anterior ocellus; propodeum variable; antennal articles of ♀ 27–36 . . . . . **49**
- 49** Length of ovipositor 1.5–2.0 times petiolar tergum; body colour often orange-testaceous . . . . . **50**
- Length of ovipositor 2.5–3.5 times petiolar tergum; body colour often darker to black . . . . . **51**
- 50** Length of ovipositor 1.5–2.0 times petiolar tergum; OOL=1.0–1.5; ovipositor straight and thick; face slightly broader than high; apex of hind tibia usually distinctly darkened; antennal articles of ♀ 30–35 (♂ up to 37) . . . *M. pendulus* (Müller, 1776)
- Length of ovipositor 2.0 times petiolar tergum; OOL=1.7–2.0; precoxal sulcus wide, strongly reticulate rugose; face 1.5–2 times wider than high; antennae up to 36 articles . . . . . *M. rufus* (De Geer, 1778)
- 51** Malar space about 0.6 times basal width of mandible; precoxal sulcus wide; clypeus protuberant; ovipositor stout, 2.5–3 times length of petiolar tergum; OOL=2; antennal articles of ♀ 28–31 . . . . . *M. tabidus* (Wesmael, 1835)
- Malar space about 0.2–0.5 times basal width of mandible (Fig. 83); precoxal sulcus narrow; clypeus not strongly protuberant; ovipositor slender, 2.5–3.5 times length of petiolar tergum; OOL=1.5–2.0; antennal articles of ♀ 27–30 . . . . . *M. affinis* (Wesmael, 1835)
- 52** Temples shorter than eyes (Fig. 76); clypeus wide; mandibles large and not twisted; third abdominal tergum only with a few striae . . . . . *M. nixonii* (Huddleston, 1981)
- Temples longer than eyes (Fig. 77); clypeus narrow; mandibles short and apically twisted; third abdominal tergum with abundant striae (Figs 51, 78) . . . . . **53**
- 53** Antennal articles of ♀ 31–36; petiolar tergum almost as broad at its middle as at the apex, flat and sculpture reticulate (Fig. 78) *M. sulcatus* (Haliday, 1835)
- Antennal articles of ♀ 39–41; petiolar tergum gradually narrowing from apex to base, sculpture of petiolar tergum striate and slightly reticulate (Fig. 51) . . . . . *M. corax* (Marshall, 1898)



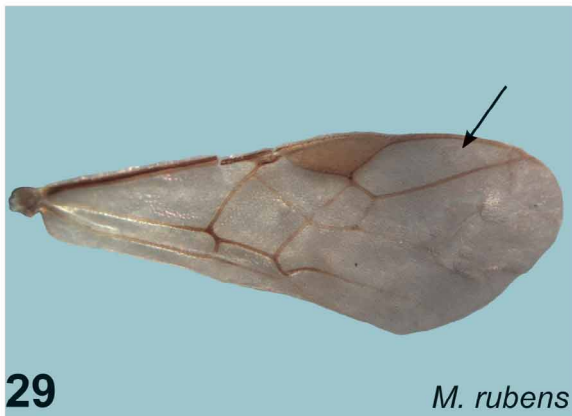
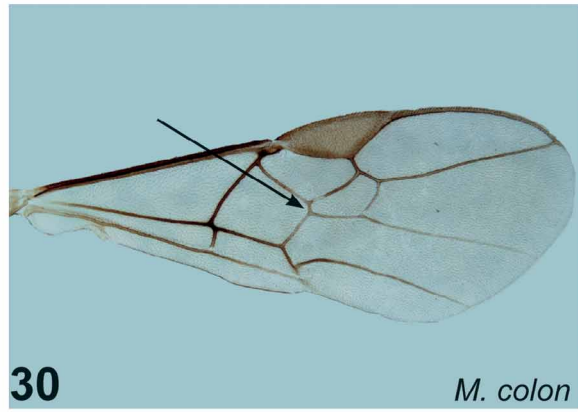


**FIGURES 10–17.** Characters used in key to species. 10a) hind wing of *Z. albiditarsus*, 10b) hind wing of *M. colon*, 11) metaoma of *Z. deceptor*, 12) metasoma of *M. pendulus*, 13a) fore wing of *Z. chlorophthalmus*, 13b) fore wing of *Z. albiditarsus*, 14) mesosoma of *Z. caligatus*, 15) mesosoma of *Z. deceptor*, 16) fore femur and tibial spur of *Z. albiditarsus*, 17) fore femur and tibial spur of *Z. deceptor*.

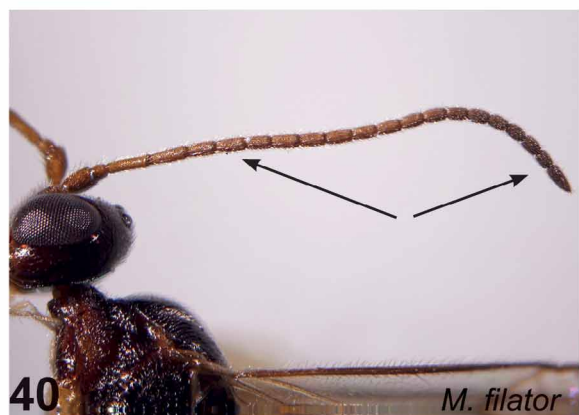
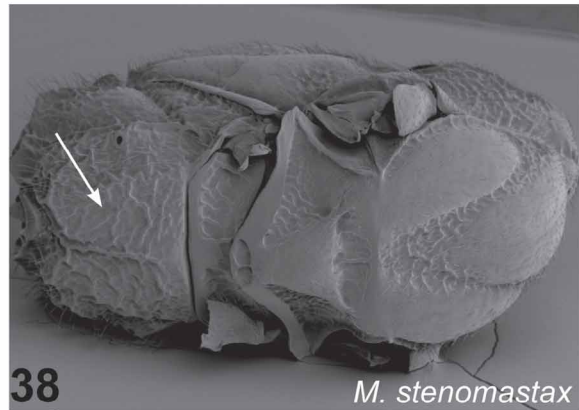
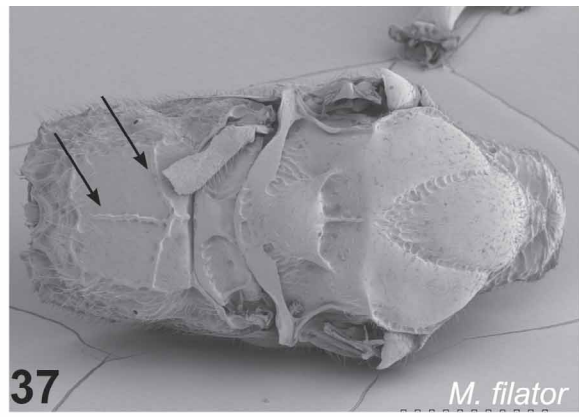


**FIGURES 18–25.** Characters used in key to species. 18) dorsal view of the petiolar tergum of *M. filator*, 19) dorsal view of the petiolar tergum of *M. rubens*, 20) ventral view of the petiolar tergum of *M. colon*, 21) dorsal view of the petiolar tergum of *M. hirsutipes*, 22) ventral view of the petiolar tergum of *M. pendulus*, 23) dorsal view of the head of *M. pulchricornis*, 24) dorsal view of the head of *M. filator*, 25) ventral view of the petiolar tergum of *M. rubens*.



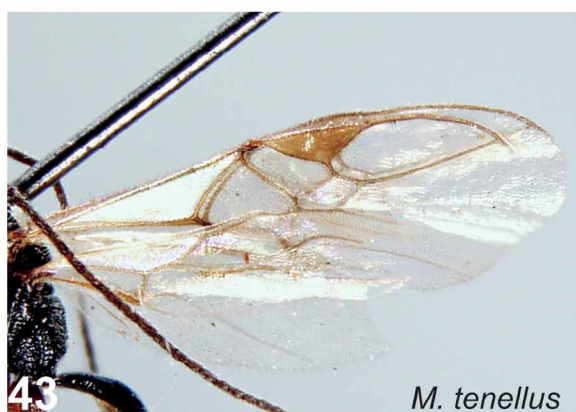
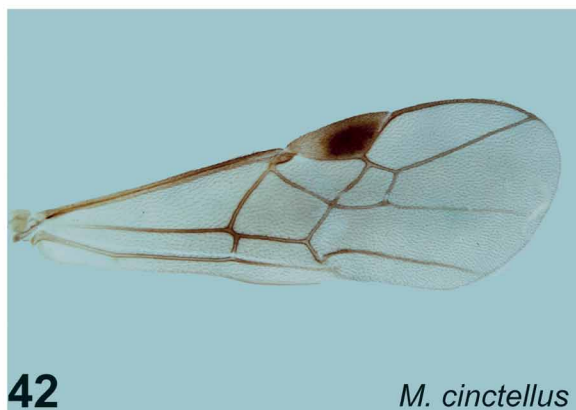


**FIGURES 26–32.** Characters used in key to species. 26) ventral view of the petiolar tergum of *M. versicolor*, 27) head in lateral view of *M. rubens*, 28) head in lateral view of *M. pulchricornis*, 30) fore wing of *M. colon*, 31) habitus of *M. acerbiavorus*, 32) dorsal view of the head of *M. lionotus*.

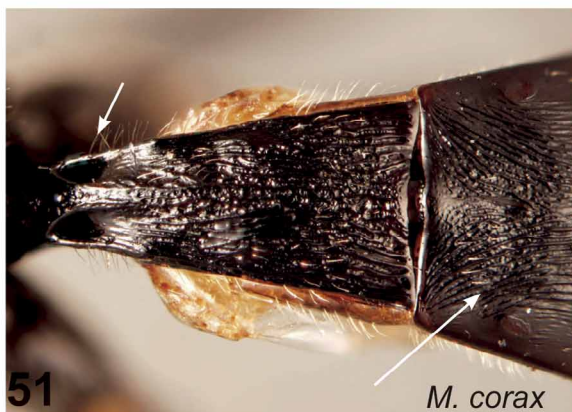


**FIGURES 33–40.** Characters used in key to species. 33) habitus of *M. versicolor*, 34) head in lateral view of *M. micropterus*, 35) fore wing of *M. micropterus*, 36) habitus of *M. micropterus*, 37) dorsal view of the mesosoma of *M. filator*, 38) dorsal view of the mesosoma of *M. stenomastax* sp. nov., 39) fore wing of *M. stenomastax* sp. nov., 40) antennae of *M. filator*.





**FIGURES 41–48.** Characters used in key to species. 41) antennae of *M. eadyi*, 42) fore wing of *M. cinctellus*, 43) fore wing of *M. tenellus*, 44) antennae of *M. cinctellus*, 45) antennae of *M. tenellus*, 46) habitus of *M. stenomastax* sp. nov., 47) metasoma of *M. tenellus*, 48) metasoma of *M. artocercus* sp. nov.

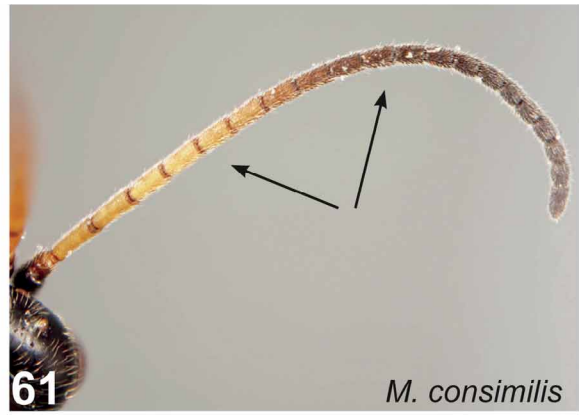


**FIGURES 49–56.** Characters used in key to species. 49) fore wing of *M. artocercus* sp. nov., 50) metasomal tergites two and three of *M. pendulus*, 51) metasomal tergites two and three of *M. corax*, 52) hind leg of *M. oculatus*, 53) hind leg of *M. vexator*, 54) fore wing of *M. ipidivorus*, 55) dorsal view of the head of *M. punctifrons*, 56) fore wing of *M. radialis*.





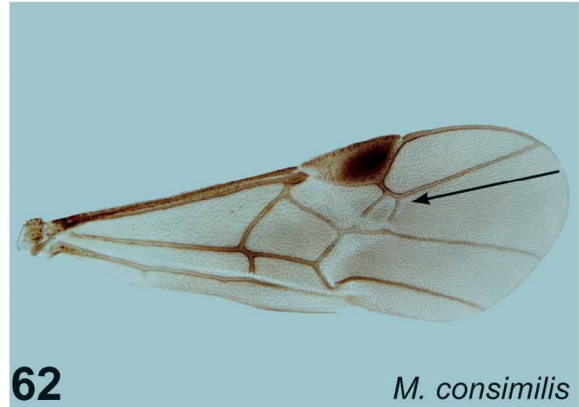
57 *M. alborossicus*



61 *M. consimilis*



58 *M. vexator*



62 *M. consimilis*



59 *M. politutele*



63 *M. vexator*

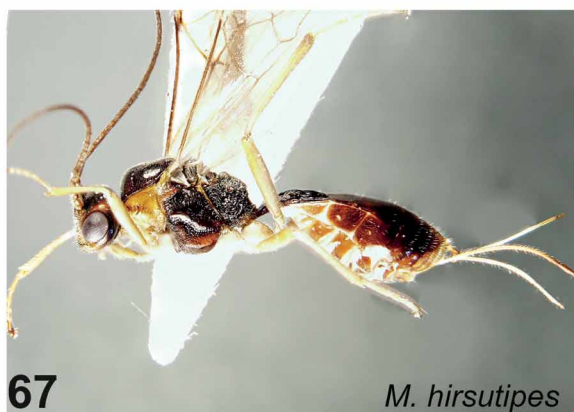


60 *M. abdominalator*



64 *M. longipilosus*

**FIGURES 57–64.** Characters used in key to species. 57) for wing of *M. alborossicus*, 58) for wing of *M. vexator*, 59) dorsal view of the petiolar tergum of *M. politutele*, 60) fore wing of *M. abdominalator*, 61) antennae of *M. consimilis*, 62) fore wing of *M. consimilis*, 63) lateral view of the metasoma of *M. vexator*, 64) lateral view of mesosoma and metasoma of *M. longipilosus*.



**FIGURES 65–72.** Characters used in key to species. 65) lateral view of metasomal part with ovipositor of *M. salicorniae*, 66) lateral view of the head of *M. obfuscatus*, 67) habitus of *M. hirsutipes*, 68) lateral view of mesosoma of *M. eklundi* sp.nov. 69) lateral view of mesosoma of *M. subtilisulcus* sp.nov., 70) lateral view of petiolar tergum of *M. ictericus*, 71) dorso-lateral view of the pit in front of the anterior ocelli of *M. ictericus*, 72) lateral view of petiolar tergum of *M. pendulus*.





**FIGURES 73–78.** Characters used in key to species. 73) lateral view of the head of *M. abscissus*, 74) lateral view of the head of *M. ictericus*, 75) lateral view of the head of *M. limbatus*, 76) dorsal view of the head of *M. nixonii*, 76) dorsal view of the head of *M. corax*, 78) dorsal view of the petiolar tergum of *M. sulcatus*.

## Genus *ZeZe* Curtis

*ZeZe* Curtis 1832:415. Type species: *ZeZe testaceator* Curtis, 1832.

*Zemiotus* Foerster, 1862:253. Type species: *Perilitus albiditarsus* Nees, 1834. Synonymized by Van Achterberg 1979:376

*Protelus* Foerster, 1862:253. Type species: *Perilitus chrysophthalmus* Nees 1811.

*Meteorus* Haliday, 1835:24. Type species: *Ichneumon pendulator* Latreille 1799.

**Diagnosis:** The genus *ZeZe* is at a first glance most similar to Homolobinae. The larger and more common species (*Z. albiditarsus*, *Z. chlorophthalmus* and *Z. deceptor*), in particular, are similar in size and colour to Homolobinae, but the shape of the second abdominal (petiolar) tergum is a good diagnostic character: it is almost parallel and only slightly broadening in Homolobinae and widely broadening in *ZeZe*. The smaller species of *ZeZe* (*Z. annulicrus* and *Z. caligatus*) are more similar to species of the genus *Meteorus*, but are easily distinguished from the latter by the apically widened marginal cell of the hind wing (Fig. 12a), and the setose 3rd and following abdominal tergites. The marginal cell in *Meteorus* is apically narrowed and the abdominal tergites only have one row of setae each.

**Distribution:** Western and Eastern Palearctic, Nearctic, Neotropical, Oceanic, and Oriental regions.

**Biology:** The species of *ZeZe* mentioned here are all solitary except possibly *Z. caligatus*. As far as known, they all parasitize on Lepidoptera larvae. They are caught in Malaise traps from June to October. Some species are attracted to light.

### *ZeZe albiditarsus* Curtis, 1832

Fig. 10a, 16, 134

*ZeZe albiditarsus* Curtis, 1832:415 Holotype ♂ Great Britain: "Regents Park, England" (NMV, Melbourne).

*ZeZe testaceator* Curtis, 1832:415 Lectotype ♀, (NMV, Melbourne). Synonymized by Van Achterberg 1979:376

*Perilitus albitarsus* Nees von Eisenbeck, 1834:34

*Meteorus albitarsis* Haliday, 1835:24

*Perilitus dispar* Wesmael, 1835:22 Lectotype ♀, Belgium: Brussels, Wesmael coll. (IRSNB, Brussels).

*Meteorus calcitrator* Curtis, 1837:118 Synonymized by Van Achterberg 1979:376

*Meteorus*(*Perilitus*) *wesmaeli* Boie 1850:214 Lectotype ♀ (ZM, Kiel).

*Perilitus pallitarsis* Cresson, 1872:81 Holotype ♂, (ANSP, Philadelphia). Synonymized by Van Achterberg 1979:376

*Meteorus testatrix* Schulz 1906: Spolia Hymenopterologica. Paderborn (Junfermann). 356pp.

*Meteorus maximus* Muesebeck 1923:13 Holotype ♀, (USNM Smithsonian Institute, Washington). Synonymized by Van Achterberg 1979:376

**Diagnosis:** Most similar to *Z. deceptor*, from which some specimens may be hard to separate. The variability in size and colour is very large in *Z. albiditarsus* but the short and wide fore femur (5.0–6.0 times as long as wide) and the long fore tibia spur (0.4–0.5 times fore basitarsus) are good characters to distinguish this species from *Z. deceptor*, which has a more slender fore femur (6.5–9.0 times as long as wide) and a shorter fore tibia spur (0.2–0.4 times fore basitarsus).

**Studied Material:** ~ 200 specimens.

**Description:** Antennal articles 37–50. Ocelli large, OOL=1. Eyes large, protuberant and not convergent. Malar space about 0.25 times mandible base. Face 1.4 times wider than high. Clypeus wide as face and slightly protuberant. Mandibles stout and twisted. Precoxal sulcus broad. Propodeum with distinct lateral and median longitudinal carinae. Length of petiolar tergum 2.5 times basal width; with dorsople. Laterople deep and joined dorsally with dorsople. Ventral borders of petiolar tergum not touching, widely separated by sternite. Ovipositor short and stout, 1.6 times as long as petiolar tergum. Hind coxa smooth punctate, tarsal claws lobed. Vein cu-a of fore wing postfurcal or interstitial, exceptionally antifurcal. Colour testaceous.

**Distribution:** Occurs throughout the Palearctic. Country records: Armenia; Austria; Azerbaijan; Belgium; Bulgaria; Canada; China; Croatia; Czechoslovakia; Denmark; Finland; France; Georgia; Germany; Greece; Hungary; India; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Latvia; Lithuania; Mexico; Moldova; Mongolia; Nepal; Netherlands; Norway; Poland; Romania; Russia; Slovakia; Sweden; Switzerland; Turkey; USA; Ukraine; United Kingdom; Yugoslavia.



**Biology:** *Zeke albiditarsus* is known to emerge from both the larval and pupal stage of the host. It is a solitary parasitoid that has been recorded as parasitizing on several Lepidoptera families: Geometridae, Noctuidae, Nymphalidae, Pyralidae, Saturniidae, Tortricidae and the Hymenoptera families Diprionidae and Ichneumonidae (Yu et al. 2005). We found 64 specimens in the SMTP material caught during the period June to October. Of these, 49 were caught in the same trap placed in a Hornbeam forest in the southern parts of Sweden.

### *Zeke annulicrus* (Thomson, 1895)

Fig. 135

*Meteorus annulicrus* Thomson, 1895:2161 Lectotype ♀, Sweden: (MZLU, Lund)—examined.

**Diagnosis:** Precoxal sulcus narrower and smaller than in other *Zeke* species except *Zeke caligatus*. However, the species is easily distinguished from the latter by the ovipositor being much longer (2.5 times petiolar tergum in *Z. annulicrus* and 1.5 times petiolar tergum in *Z. caligatus*).

**Studied Material:** ~ 20 specimens.

**Description:** Antennal articles 31. OOL=1.3. Eyes large, protuberant and not convergent. Malar space 0.4 times basal width of mandibles. Face 1.5 times higher than broad. Clypeus protuberant. Mandibles stout. Precoxal sulcus narrow. Length of petiolar tergum 1.7 times its apical width, the surface distinctly rugulose. Ovipositor sheath 0.19 times fore wing. Hind coxa weakly punctate, tarsal claws with distinct lobe. Vein cu-a of fore wing postfurcal; pterostigma dark brown.

**Distribution:** Austria; Norway; Poland; Sweden.

**Biology:** A rare species where the biology is unknown.

### *Zeke caligatus* (Haliday, 1835)

Fig. 14, 136

*Meteorus caligatus* Haliday, 1835:25 Lectotype ♀, Ireland: (NMI, Dublin).

*Meteorus neesii* Ruthe, 1862:22 Holotype ♀, Germany: (BMNH, London).

*Dyscoletes alaskensis* Ashmead, 1902:247 Alaska: (USMN, Washington). Synonymized by Van Achterberg 1979:364.

*Meteorus sibiricus* Fahringer, 1930:8, Type ♀, Russia: Kamtchatka (NHRS, Stockholm). Synonymized by Van Achterberg 1979:364—examined

**Diagnosis:** Similar to *Z. annulicrus* in the small size and narrow shape of the precoxal sulcus, but differs from that species in having a distinctly shorter ovipositor (2.5 times petiolar tergum in *Z. annulicrus* and only 1.5 times petiolar tergum in *Z. caligatus*).

**Studied Material:** ~ 50 specimens.

**Description:** Antennal articles 35–37. OOL=1.5. Eyes large, protuberant and not convergent. Malar space 0.4 times basal width of mandibles. Face 1.5 times wider than high. Clypeus almost as wide as face, punctate and protuberant. Mandibles stout and twisted. Precoxal sulcus narrow. Length of petiolar tergum 1.7–1.8 times its apical width. Propodeum with a weak transverse carina. Ovipositor length 1.1–1.4 times petiolar tergum. Petiolar tergum with deep laterope joining dorsally with dorsope. Ventral borders of the petiolar tergum widely separated. Hind coxa weakly punctulate, tarsal claws lobed. Vein cu-a of fore wing postfurcal; the studied specimens were dark reddish brown.

**Distribution:** Occurs throughout the Palearctic and Nearctic. Country records: China; Finland; Germany; Ireland; Italy Japan; Netherlands; Norway; Poland; Russia; Sweden; Switzerland; U.S.A.; United Kingdom.

**Biology:** *Zeke caligatus* is more frequent than *Z. annulicrus* but is still rather rare. It is a solitary parasitoid on Geometridae and Nymphalidae and emerges from the larval stage (Yu et al. 2005). Known hosts of the examined specimens all belong to the genus *Eupithecia* (Geometridae) (van Achterberg 1979, Stigenberg & Shaw in prep.). One record of a gregarious rearing is mentioned in Hammond et al. (1957), where the material was determined by G. E. J. Nixon. The cocoon of *Z. caligatus* is whitish and the species is attracted to light and caught in Malaise traps. In the SMTP one specimen was caught in a Malaise trap in July in an old aspen forest.

## ***Zelex chlorophthalmus* (Spinola, 1808)**

Fig. 137

*Bracon chlorophthalmus* Spinola, 1808:133 Neotype ♀ (RMNH, Leiden)

*Bracon chrysophthalmus* Nees von Esenbeck, 1811:21 Neotype ♀, Wesmael coll. (IRSNB, Brussels). Synonymized by Van Achterberg 1979:370.

*Bracon pallidus* Nees von Esenbeck, 1811:22 Type material lost. **Syn. n.**

*Ichneumon nudator* Thunberg, 1822:263 Holotype ♂, Thunberg coll. (UDE, Uppsala). Synonymized by Van Achterberg 1979:364.

*Meteorus splendens* Costa, 1884:171 Holotype ♀, Italy: Sardinia. A. de Costa Lima coll. (USN, Naples). Synonymized by Van Achterberg 1979:364.

*Meteorus (Zemiotetes) nigricollis* Thomson, 1895:2150 Holotype ♀, Sweden, Degerberga (MZLU, Lund). Synonymized by Van Achterberg 1979:364

**Diagnosis:** *Zelex chlorophthalmus* has a slightly darker and more slender appearance than the two other “larger” *Zelex* species: *Z. deceptor* and *Z. albiditarsus*. The best way to separate *Z. chlorophthalmus* from the other two is to study the wing vein cu-a of the fore wing. This vein is antefurcal in *Z. chlorophthalmus* and postfurcal in *Z. deceptor* and *Z. albiditarsus*. Also, the ovipositor is longer (2.6 times petiolar tergum) in *Z. chlorophthalmus* than in *Z. albiditarsus* and *Z. deceptor* (1.6 times petiolar tergum in both species).

**Studied material:** ~ 50 specimens.

**Description:** Antennal articles 36–42. OOL=1.2. Eyes large, slightly protuberant and not convergent. Malar space 0.1 times basal width of mandibles, eyes almost touching mandibles. Face 1.3 times wider than high. Clypeus almost as wide as face, protuberant and punctate. Mandibles stout and twisted. Precoxal sulcus wide. Length of petiolar tergite 2.1–2.4 times its apical width. Propodeum with a median carinae. Ovipositor long, 2.6 times petiolar tergum. The petiolar tergum with deep laterope joining dorsally with dorsope. Ventral borders widely separated. Hind coxa punctulate, tarsal claws lobed. Vein cu-a of fore wing antefurcal or interstitial. Large, and body colour variable, varies from yellow or brown to mainly dark brown or blackish.

**Distribution:** Eastern and Western Palearctic; Madagascar and India. Country records: Norway; Sweden; United Kingdom.

**Biology:** *Zelex chlorophthalmus* is a solitary parasitoid recorded as parasitizing on the larval stages of eight different Lepidoptera families: Depressariidae, Geometridae, Lasiocampidae, Lymantriidae, Noctuidae, Pyralidae, Tortricidae and Zygaenidae (Yu et al. 2005). It has been used as a biocontrol agent for *Ostrina nubilalis* (Lepidoptera). We found 9 specimens within the SMTP. They were caught from June to August in deciduous forest or in close vicinity of meadows.

## ***Zelex deceptor* (Wesmael, 1835)**

Fig. 11, 15, 17, 138

*Perilitus deceptor* Wesmael, 1835:26 Lectotype ♀, Belgium: Brussels, Wesmael coll. (IRSNB, Brussels). Synonymized by Van Achterberg 1979:376 and stat. nov. as valid species 1984:110

*Perilitus pallitarsis* Cresson, 1872:81 Holotype ♂, (ANSP, Philadelphia). Synonymized by Van Achterberg 1984:110

*Meteorus (Zemiotetes) rufulus* Thomson, 1895:2149 Lectotype ♂, Sweden: (ZML, Lund). Synonymized by Van Achterberg 1984:110

*Meteorus maximus* Muesebeck 1923:13 Holotype ♀, (USNM, Smithsonian Institute, Washington). Synonym for *rufulus*. Synonymized by Van Achterberg 1984:110

*Meteorus reticulatus* Muesebeck 1923:14 Type ♀ (USNM, Washington). Synonymized by Van Achterberg 1984:110

*Meteorus (Zemiotetes) romani* Fahringer, 1930:8 Holotype ♀, (NHRS, Stockholm). Synonymized with *M. rufulus* by Van Achterberg 1984:110 - examined

*Meteorus separandus* Fischer, 1957:3 Paralectotype ♂, (NHRS, Stockholm). Synonymized by Van Achterberg 1984:110—examined

**Diagnosis:** In general, *Zelex deceptor* is similar to the other large *Zelex* species, *Z. chlorophthalmus* and *Z. albiditarsus*. It can be distinguished from the former based on wing venation and ovipositor characters, as described under that species, but it can be difficult to distinguish from *Z. albiditarsus* because of the large variability in size and

colour. However, the slender fore femur (slender, 6.5–9.0 times as long as wide) and the short fore tibia spur (0.2–0.4 times fore basitarsus) are good characters to distinguish *Z. deceptor* from *Z. albiditarsus*, which has a stouter fore femur (5.0–6.0 times as long as wide) and a longer fore tibia spur (0.4–0.5 times fore basitarsus).

**Studied material:** ~ 200 specimens.

**Description:** Antennal articles 32–43. OOL=1. Eyes large, protuberant and not convergent. Malar space 0.3 times basal width of mandibles. Face 1.1–1.3 times wider than high. Clypeus protuberant almost as wide as face. Mandibles stout and twisted. Precoxal sulcus wide. Length of petiolar tergum 2.1–2.5 times its apical width. Propodeum with weak median and lateral longitudinal carina, dorsal transverse carina weak. Ovipositor stout, 1.6 times petiolar tergum, slightly longer than half of abdomen. Petiolar tergum with smooth laterope joining dorsally with dorsope, its ventral borders widely separated. Hind coxa smooth, tarsal claws lobed. Vein cu–a of fore wing post-furcal, seldom interstitial; Colour mostly testaceous but variation in size and colour is very large in *M. deceptor*.

**Distribution:** Palearctic and Nearctic. Country records: Albania; Austria; Belgium; Bulgaria; Canada; China; Croatia; Czechoslovakia; Denmark; Finland; France; Georgia; Germany; Hungary; Ireland; Italy; Japan; Kazakhstan; Latvia; Lithuania; Mexico; Netherlands; Norway; Poland; Romania; Russia; Slovakia; Sweden; Switzerland; USA; United Kingdom; Yugoslavia.

**Biology:** *Zelee deceptor* seems to be as frequent as *Z. albiditarsus* in museum collections. It is a solitary parasitoid, also attracted to light, and emerges from the larval stages of various lepidopteran families, such as Geometridae, Noctuidae, Pyralidae and Saturniidae (Yu et al. 2005). 19 specimens of *Z. deceptor* were caught in SMTP from July to October in various biotopes. A trap situated in a grazed calcareous pine forest collected most specimens (5).

## Genus *Meteorus* Haliday

*Meteorus* Haliday, 1835, (as subgenus of *Perilitus*); Type species *Ichneumon pendulator* Latreille, 1799, designated by Haliday in Westwood, 1840.

*Saprostichus* Holmgren 1868, Type species: *Saprostichus chinensis* Holmgren 1868, designated by Viereck 1914.

*Pachythechus* Cameron, 1912:84; Type species: *Pachythechus ruficeps* Cameron 1912, designated by Viereck, 1914. (*Meteorus cameroni* Shenefelt, 1969, replacement name for *ruficeps* Cameron 1912, preoccupied by *M. ruficeps* Nees, 1834).

**Diagnosis:** The species of *Meteorus* vary greatly in size from 2–10 mm. They are easily distinguished from other braconids by the petiolate second abdominal tergum in combination with the second submarginal cell in the fore wing and the presence of only one row of setae (dorsally) on each abdominal tergite from the 3<sup>rd</sup> and onwards. The larger species might at first glance be mistaken for members of *Zelee* but are distinguished from the latter by the single row of setae on the abdominal tergites.

**Distribution:** Western and Eastern Palearctic, Nearctic, Neotropic, African, Oceanic and Oriental regions.

**Biology:** *Meteorus* contains both solitary and gregarious species. They parasitize on both Lepidoptera and Coleoptera. Some species have been used in biological control programmes (Huddleston 1980, Yu et al. 2005).

## *Meteorus abdominalator* (Nees von Esenbeck)

Fig. 60, 80

*Perilitus abdominalator* Nees von Esenbeck, 1811:24. Syntypes ♂ and ♀, Germany destroyed.

*Perilitus brunnipes* Ruthe, 1862:37. Lectotype ♀, Germany: Ruthe coll. (BMNH, London) examined.

*Meteorus brevipesalis* Shenefelt, 1969:55. Holotype ♀, Belgium: Wesmael coll. (IRSNB, Brussels)

**Diagnosis:** *Meteorus abdominalator* is similar to *M. consimilis* and *M. longipilosus* but the size of ocelli and length of ovipositor separate them. The OOL in *M. abdominalator* is 3.5–4.0 and the ovipositor length 2.0–2.5 times the length of the petiolar tergum. In *M. consimilis* the OOL is 1.5 and the ovipositor is short, thick and downcurved; at most equal in length to the petiolar tergum. *M. longipilosus* is very similar to *M. abdominalator* but has an OOL of 2.5 and an ovipositor length of 3.1 times the length of the petiolar tergum.

**Studied material:** ~ 100 specimens.

**Description:** Size about 4–5mm. Antennal articles 22–25; flagellum thick and at apex as broad as long, in some specimens the basal flagellar articles is lighter in colour. Head and face distinctly transverse, about twice as broad as high. Ocelli small, OOL=3.5–4.0. Eyes not so large, converging slightly. Malar space slightly shorter than basal breadth of mandible. Tentorial pits deep. Clypeus strongly protuberant. Mandible stout, twisted. Precoxal sulcus broad. Propodeum reticulate-rugose and carinae distinct, sometimes obscured. Petiolar tergum stout, with distinct dorsal pits. Ovipositor 2.0–2.5 times length of petiolar tergum and down-curved. Legs stout, hind coxae dorsally punctuate to rugose, tarsal claws not strongly bent but swollen at base. Wings short, infumate; second submarginal cell of fore wing more or less strongly contracted anteriorly. Colour dark - black; Male antennae longer, 25–31 articles.

**Distribution:** Palearctic. Country records: Armenia; Azerbaijan; Belgium; Bosnia Hercegovina; Bulgaria; Croatia; Czechoslovakia; Denmark; Finland; France; Germany; Hungary; Ireland; Italy; Kazakhstan; Korea; Latvia; Lithuania; Moldova; Netherlands; Norway; Poland; Romania; Russia; Sweden; Switzerland; Ukraine; United Kingdom; Yugoslavia.

**Biology:** Parasitizes on Lepidoptera, mostly Geometridae (Huddleston 1980, Yu et al. 2005). We found 48 specimens within the SMTP and they were caught from June to November. Based on these records, *M. abdominalis* seems to prefer deciduous forests.

### ***Meteorus abscissus* Thomson**

Fig. 73, 81

*Meteorus abscissus* Thomson, 1895:2156. Lectotype ♀, Sweden: (MZLU, Lund)—examined.

**Diagnosis:** *Meteorus abscissus* is close to *M. pulchricornis*. They both share the character of having short dense setae on the clypeus. However, *M. abscissus* has a more stout body shape and its clypeus is more flat and the sculpture of hind coxae and mesosoma is more strongly rugose. Furthermore, *M. abscissus* has the ventral sides of the petiolar tergum separated, contrary to *M. pulchricornis*, which has the ventral sides of the petiolar tergum closed. Finally, *M. abscissus* has a true dorsope even though it can sometimes be so small that it is difficult to separate from the small indication of a dorsope present in *M. pulchricornis*.

**Studied material:** ~ 20 specimens.

**Description:** Size about 4–5mm. Antennal articles 30–33, all flagellar articles distinctly long. Head broad, temples strongly contracted behind eyes. Ocelli large OOL=2. Eyes large, moderately convergent. Malar space about equal to basal breadth of mandible. Face 1.5 times as wide as high, not strongly protuberant. Clypeus peculiarly flattened, slightly protuberant. Mandibles slender and twisted. Precoxal sulcus broad. Propodeum broad, strongly convex and reticulate-rugose. Petiolar tergum long with distinct dorsal pits and shallow glymmae. Ovipositor 1.5–2.0 times length of petiolar tergum, straight. Hind coxa strongly rugose. Tarsal claws with a distinct basal lobe. Colour on holotype is dark red with black markings but some specimens are brownish testaceous. ♂ 34–36 antennal articles; petiolar tergum narrower; sculpture of hind coxa sometimes obsolescent.

**Distribution:** Palearctic. Country records: Albania; Austria; Bulgaria; China; China-Fujian; Croatia; Czechoslovakia; Germany; Hungary; Ireland; Italy; Korea; Norway; Romania; Russia; Slovakia; Slovenia; Spain; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** *Meteorus abscissus* is recorded as a parasitoid of several Lepidoptera families, in particular Arctiidae, Geometridae and Noctuidae (Yu et al. 2005). Old host records might be erroneous due to the difficulties in properly separating some intermediate specimens from *M. pulchricornis*. We found 4 specimens within the SMTP. They were caught in late July and early August in arid, exposed environments.

### ***Meteorus acerbiavorus* Belokobylskij, Stigenberg and Vikberg**

Fig. 31, 82

*Meteorus acerbiavorus* Belokobylskij et al., 2011. Holotype ♀, “Finland 767:325. Enontekiö Lapland: Jehkats, June 2009, Harry Lonka leg”.

**Diagnosis:** A very distinctive species, large, dark and rugose. The colour and sculpture can vary between localities and rearings from black to brown and from heavily to more weakly rugose, almost smooth in certain parts. The petiolar tergum also varies from specimens without a dorsope to specimens with a distinct dorsope. *M. acerbiavorus* is most similar to *M. rubens*, being easily separated by colour (completely black or brownish in the former, varying from completely reddish to partially, but never completely, black in the latter), body sculpture (largely rugulose-granulate in the former, smoother with only certain parts rugose in the latter), and the shape of the ovipositor tip (with a distinct dorsal node at the tip of the ovipositor in the former, without a distinct node in the latter) (illustrated in Stigenberg et al. 2011).

**Studied material:** 13 specimens.

**Description:** Size 4.3–4.6 mm. Antennal articles 25–27. Head transverse. OOL=1.5. Eyes large and protuberant, weakly convergent. Malar space equal to width of mandible base. Face 1.3 times wider than high, rugose. Clypeus almost as wide as face and protuberant. Mandibles twisted. Precoxal sulcus wide and entirely coarsely rugose-reticulate. Propodeum roundly convex, strongly reticulate. Petiolar tergum with no dorsope, finely striate at apical end. Length of petiolar tergum about twice as long as apically broad. Ovipositor 1.2–1.4 times longer than petiolar tergum. Legs long; hind coxae entirely rugose; tarsal claws without lobe. Colour black. ♂ antennal articles 24–27.

**Distribution:** Finland.

**Biology:** *Meteorus acerbiavorus* is only known from specimens reared from cocoons of the arctiid moth *Acerbia alpina* collected in June in northern Finland (Stigenberg et al. 2011). It is gregarious and 39 to 98 parasitoid cocoons have been found in a single host cocoon.

### *Meteorus affinis* (Wesmael)

Fig. 83

*Perilitus affinis* Wesmael, 1835:31. Holotype ♀, Belgium: Wesmael coll. (IRSNB Brussels) examined.

*Meteorus punctiventris* Ruthe, 1862:25. Holotype ♀, Germany: Ruthe coll. (BMNH London) examined

*Meteorus gracilis* Ruthe, 1862:31. Holotype ♀, Germany: Ruthe coll. (BMNH London). Junior primary homonym of *gracilis* Ratzeburg, 1852.

*Meteorus ruthei* Schmiedeknecht, 1897:205. Replacement name for *gracilis* Ruthe, 1862. Synonymized by Huddleston 1980:22.

*Meteorus voloscensis* Fischer, 1959:14 Holotype ♀ Yugoslavia: Volosca, Graeffe coll. (NM, Vienna) Synonymized by Huddleston, 1980:22 examined.

**Diagnosis:** *Meteorus affinis* is similar to *M. vexator* but has distinctly lobed claws and larger ocelli than the latter. These differences are visible also in small specimens, which are otherwise very similar due to their weaker sculpture and the reduction in the number of antennal articles. The mesosoma of *M. affinis* sometimes has yellow markings, but we never found this to be true for *M. vexator*.

**Studied material:** ~ 100 specimens.

**Description:** Size about 4 mm. Antennal articles 27–30. Head strongly rounded behind eyes. Ocelli large, OOL=1.5–2.0. Eyes large, protuberant and strongly convergent. Malar space short, much less than basal width of mandible. Face as broad as high, not protuberant but rugulose. Clypeus not strongly protuberant. Mandible stout, moderately twisted. Precoxal sulcus foveolate. Propodeum rugose, the transverse carinae of the propodeum often most developed. Petiolar tergum narrow with distinct dorsal pits, about twice as long as apically broad. Ovipositor long, 3.0–3.5 times length of petiolar tergum, slender. Legs long, slender; hind coxae rugose ventrolaterally; tarsal claws with small but distinct lobe. Colour generally black with yellow areas. ♂ antennal articles 30–33; eyes smaller and not strongly convergent; sculpture of precoxal sulcus and of hind coxa obsolescent.

**Distribution:** Western and Eastern Palearctic. Country records: Armenia; Belgium; Bulgaria; China; Croatia; Czechoslovakia; Finland; France; Germany; Hungary; Ireland; Italy; Korea; Netherlands; Norway; Romania; Russia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** *Meteorus affinis* is a solitary endoparasitoid that is attracted to light. Most host records involve the lepidopteran family Psychidae (Yu et al. 2005). We found 59 specimens within the SMTP. *M. affinis* was caught from June to November in both deciduous and coniferous forests.

### ***Meteorus alborossicus* Lobodenko**

Fig. 57, 84

*Meteorus alborossicus* Lobodenko, 2000. Holotype ♀, Russia: 'Byelorussia, Beresina Nat. Res., Postrezhie, 1vii–1.viii.1996' (Lobodenko) (ZIN. St. Petersburg)—examined.

**Diagnosis:** *Meteorus alborossicus* is close to *M. vexator* but the fore wing venation easily distinguishes them: while *M. alborossicus* has the fore wing vein 1–SR+M incomplete, it is complete in *M. vexator*. *M. alborossicus* is actually the only species of *Meteorus* in Europe with an incomplete 1–SR+M vein.

**Studied material:** ~ 20 specimens.

**Description:** Size about 3–4mm. Antennal articles 29. Ocelli small, OOL=2–2.5. Eyes protuberant, large and converging. Malar space narrow, 0.4 times basal width of mandibles. Face as wide as high and punctate, clypeus also punctate. Clypeus protruding and variable in width, sometimes as wide as face. Mandibles only slightly twisted. Precoxal sulcus wide. Propodeum with transverse carinae. Petiolar tergum rugose centrally, striate laterally. Ovipositor long and slender, more than 2.5 times petiolar tergum. Fore and middle coxa light coloured (whitish), hind coxa dark and rugose. Fore wing vein 1–SR+M not complete. Claws slender but with a slight widening at base.

**Distribution:** Western Palearctic. Country records: Belarus; Sweden; United Kingdom.

**Biology:** We found a single specimen within the SMTP; it was caught on a sandy railway in August. Three specimens were reared in an ongoing study on saproxylic insects on wet stumps at the Swedish University of Agricultural Sciences (Ols in prep.)

### ***Meteorus angiclypealis* van Achterberg**

Fig. 85

*Meteorus angiclypealis*, 2001:397. Holotype ♀, Netherlands: (RMNH, Leiden)—examined

**Diagnosis:** This species is close to *M. sibyllae* but is distinguished by two good characters: (1) the shape of the head, which is transverse in *M. sibyllae* and rounded in *M. angiclypealis*; and (2) the length of the ovipositor, which is 3.5–4.0 times petiolar tergum in *M. sibyllae* and 2.7 times petiolar tergum in *M. angiclypealis*.

**Studied material:** One specimen, the holotype.

**Description:** Size about 3mm. Antennal articles 24, all articles longer than broad. Head rounded behind eyes. OOL=3.5. Eyes small, not converging. Length of malar space 0.6 times basal width of mandible; mandibles hardly or not twisted apically. Face punctulate, dorsally with some rugae. Clypeus protruding, punctate and with some long setae, width of clypeus 0.7 times minimum width of face. Precoxal sulcus narrow. Propodeum with transverse carina, without median carina. Surface of propodeum largely smooth except for subbasal transverse carina. Length of petiolar tergum 1.6 times its apical width, surface punctate medially and laterally striated. Dorsople distinct but rather small. Length of ovipositor sheath 0.54 times fore wing and 2.7 times petiolar tergum. Hind coxa largely smooth, claws without lobe. Fore wing m-cu antefurcal. Pterostigma dark brown, basally with small pale spot.

**Distribution:** Switzerland.

**Biology:** The holotype of *M. angiclypealis* was caught in a light trap.

### ***Meteorus artocercus* Stigenberg sp. nov.**

Fig. 48, 49, 79A, 86

**Diagnosis:** *Meteorus artocercus* can be distinguished from similar species by its longer flagellomeres, the colour of the pterostigma and the length of the ovipositor sheaths. In Huddleston's key *M. artocercus* runs to *M. cinctellus* but *M. artocercus* has longer antennal articles than *M. cinctellus*, the ovipositor is shorter (1.6–2.0 times petiolar tergum in the former, and 2.5–3.0 times in the latter), and the pterostigma is pale (dark brown except for the basal third in the latter). *M. tenellus* is another similar species but this species has a longer ovipositor (2.0–4.0 times petiolar tergum) and a postfurcal m-cu vein of the forewing (antefurcal in *M. artocercus*).

**Studied material:** 10 specimens.

Holotype: 1 ♀ SE. Lapl. Gällivare kommun. Ätnarova försökspark, Pelttovaara. 29.vii–13.viii.2004. (leg. SMTP), NHRS–HYME 5178. Paratypes: 2 ♀ SE. Lapl. Gällivare kommun. Ätnarova försökspark, Pelttovaara. 29.vii–13.viii.2004. One in ethanol (DNA voucher specimen DNA 1) and one drypinned (one leg damaged and glued separately on the dry pinned specimen) NHRS–HYME 5176 (leg. SMTP), Paratype: 1 ♀ SE. Nb. Pajala kommun. Vasikkavuoma. 14.ix–05.x.2003. (left hind tarsi damaged and glued separately). (leg. SMTP), NHRS–HYME 5177, DNA 2. Paratype: 1 ♀ SE. Vb. Vindelns kommun. Kulbäckslidens försökspark. 01.viii–18.viii.2003. Kept in 80 % ethanol. (leg. SMTP), DNA 47. Paratype: 4 ♀ SE. Bdn. Jokkmokks kommun, Muddus nationalpark 18.vi–20.vii.2004. All are kept in 80 % ethanol and all are DNA voucher specimens (leg. SMTP), NHRS–HYME 5182, DNA 55; NHRS–HYME 5181, DNA 56; NHRS–HYME 5180, DNA 57; NHRS–HYME 5179, DNA 58.

**Description:** Body 3.2 mm, fore wing 3.0 mm.

Head: Length of eye 1.5 times length of temple in dorsal aspect; eyes large, convergent and protuberant; width of face 1.25 times its height; OOL=2; vertex smooth; frons above antennal sockets depressed, with a median ridge forming a slight tubercle in front of fore ocellus; face convex; clypeus as wide as minimum width of face, distinctly separated from face, convex, tentorial pits distinct; length of malar space 0.6 times basal width of mandible; mandibles twisted; antennal articles 27; 3rd and 4th antennal article 3.6 times longer than wide; all articles longer than wide, subapical articles more than 1.5 times longer than broad.

Mesosoma: Precoxal sulcus narrow.

Wings: Fore wing:  $r/3-SR=0.6$ ;  $C+SC+R/SR1=1.45$ ;  $m-cu$  interstitial; pterostigma brown with apical corner light. Hind wing:  $1-M/cu-a=1.5$ ;

Legs: Hind coxa rugose dorsally; hind femur 4.8 times longer than wide; tarsal claws small with lobe.

Metasoma: Petiolar tergum apically 2.1 times longer than wide, petiolar tergum 4.5 times fore wing; dorsope absent; ventral folds of petiolar tergum joined in middle; ovipositor straight, slender; length of ovipositor 2.0 times that of petiolar tergum and 0.35 times forewing; propodeum convex, reticulate–rugose and with no distinct carina. Colour: Frons and vertex black with large yellow patch between posterior ocelli and eye; face yellow; pronotum and mesopleuron black with brown–red patch posterior; petiolar tergum black; 3<sup>rd</sup> abdominal tergite yellow otherwise brown; legs dark yellow, hind tarsi brown.

**Distribution:** Sweden.

**Biology:** We found 10 specimens within the SMTP. They were caught from July to October in northern Sweden, predominantly in pine forests.

**Etymology:** The name *artocercus* is derived from the Latin word *arto*—close and the Greek word *cercus*—tail.

### ***Meteorus breviantennatus* Tobias**

Fig. 87

*Meteorus breviantennatus* Tobias, 1986:345. Holotype ♀, Russia: (ZIN. St. Petersburg)—examined.

**Diagnosis:** *Meteorus breviantennatus* is similar to *M. cis* but the clypeus of *M. breviantennatus* is almost as wide as the face while the clypeus of *M. cis* is narrower. Also the malar space (shorter than mandibular base on *M. breviantennatus*, as wide as mandibular base on *M. cis*) and the face (slightly transverse in *M. breviantennatus*, round in *M. cis*) should separate these species.

**Studied material:** 11 specimens.

**Description:** Size about 3mm. Antennae 20–22 articles, the basal articles lighter in colour. Head slightly transverse. Ocelli small, OOL=3–3.5. Eyes small, slightly protuberant, convergent. Malar space shorter than basal breadth of mandible. Face about 1.3 times as broad as high, punctate, not strongly protuberant. Clypeus almost as wide as face, protruding, in some specimen with a notch similar to *M. cis*. Tentorial pits distinct. Mandibles short and moderately twisted. Precoxal sulcus rather wide. Propodeum with carinae, otherwise reticulate. Dorsal pits of the petiolar tergum small, dorsal surface rugose with longitudinal striae laterally. Ovipositor about twice the length of petiolar tergum. Legs slender; hind coxa punctuate with small punctures. Tarsal claws long and slender. Colour dark brown; clypeus, mandibles and usually third abdominal tergum of lighter colour than the rest of body; coxa and legs brownish-yellow.

**Distribution:** Western and Eastern Palearctic. Country records: Austria; China; France; Germany; Ireland; Japan; Korea; Netherlands; Russia; Sweden; United Kingdom.

**Biology:** According to Tobias (1986) it is a parasitoid of *Ips acuminatus* (Gyllenhal, 1827) and *Tomicus minor* (Hartig, 1834) (Coleoptera).

### ***Meteorus brevicauda* Thomson**

Fig. 88

*Meteorus brevicauda* Thomson, 1895:2165. Lectotype ♀, Sweden (MZLU, Lund - examined)

*Meteorus thuringiacus* Schmiedeknecht, 1897:190. Syntypes ♀, Germany (lost). Synonymized by Huddleston 1980:23.

*Meteorus mongolicus* Fahringer, 1935:10. Holotype ♀, China: S. Kansu (Hummel) (NHRS Stockholm)—examined. Synonymized by Huddleston 1980:23.

**Diagnosis:** *Meteorus brevicauda* is a very small species and is easily distinguished amongst the other small species based on the shape of the clypeus (as wide as the face) and mandibles (large, stout and not twisted). *M. micropilosus* have a small, square clypeus and slightly twisted but stout mandibles. *M. punctifrons* is distinguished by the presence of punctures on the frons, which lack in *M. brevicauda*. *M. breviantennatus* have a wide clypeus similar to that of *M. brevicauda*, but it can easily be distinguished from the latter by having a longer ovipositor (twice the length of petiolar tergum in the former, 1.5 times petiolar tergum in the latter).

**Studied material:** ~ 10 specimens.

**Description:** Size about 3mm. Antennal articles 24–27, articles slightly longer than broad. Ocelli small, OOL=3. Eyes not strongly protuberant, slightly converging. Malar space very short. Face rather flat and about 2 times as broad as high. Clypeus large, flat and as wide as face. Tentorial pits large. Mandibles large, stout and not twisted. Precoxal sulcus foveolate. Propodeum short with distinct carinae. Petiolar tergum with distinct dorsal pits and glymmae. Ovipositor short, about 1.5 times the length of petiolar tergum. Legs short, the hind coxa smooth, punctuate; tarsal claws with no basal lobe but slightly swollen at the base. Colour generally black except antennae at base, clypeus, mandibles and prothorax ventrally testaceous, legs yellow. Fore wing vein m-cu antefurcal.

**Distribution:** Palearctic. Country records: Austria; Bulgaria; China; Finland; Germany; Hungary; Italy; Lithuania; Poland; Sweden; Switzerland; United Kingdom.

**Biology:** *Meteorus brevicauda* parasitizes on the leaf-feeding larvae of *Zeugophora subspinosa* (Fabricius) (Coleoptera, Chrysomelidae) (Shaw, 1988).

### ***Meteorus cespitator* (Thunberg)**

Fig. 89

*Ichneumon cespitator* Thunberg, 1822:269. Holotype ♀, Sweden (UDE, Uppsala) – examined.

*Zele atrator* Curtis, 1832: folio 415. Syntypes, Great Britain: Wilts, ‘Durnford House’ (NMV, Melbourne) Synonymised by Roman, 1912:289.

*Perilitus similator* Nees von Esenbeck, 1834:41 Syntypes ♀, Germany (destroyed). Synonymised by Haliday, 1835:32

*Bracon humeralis* Zetterstedt, 1838:399. Lectotype ♀, Lapponia: ‘Öfv. Tor.’ (Övertorneå in Sweden). “mihi tantum inter Muonioniska et Kengis”. Synonymised by Papp, 1994:305

*Bracon rufipes* Zetterstedt, 1838:399. Lectotype ♀, ‘Johs. Ro.’ (Johannisro, Norrbotten). “Hab. cum priori rarius” (*B. humeralis*). Synonymised by Papp, 1994:305

*Meteorus ambiguus* Ruthe, 1862:30. Holotype ♀, Germany: Ruthe coll., 4.10.55 (BMNH, London) examined.

**Diagnosis:** The size, the transverse head and the long ovipositor are characters that distinguish this species. *Meteorus cespitator* mostly resembles *M. obfuscatus* and the new species *M. eklundi* and *M. densipilosus* described in this paper. However, the long ovipositor of *M. cespitator* (3–4 times length of the petiolar tergum) clearly separates it from these species, which have ovipositors that are at most up to twice the length of the petiolar tergum.

**Studied material:** ~ 50 specimens.

**Description:** Size about 4–5mm. Antennal articles 23–27. Head transverse, temples shorter than eyes. Ocelli small, OOL=2.5–3.0. Eyes large, protuberant, convergent but not strongly so. Malar space distinctly shorter than



basal breadth of mandible. Face about 1.5 times as broad as high. Clypeus only slightly protuberant, distinctly divided from face. Precoxal sulcus deep. Propodeum irregularly rugose with distinct carinae. Ovipositor long, 3–4 times length of petiolar tergum. Hind coxae rugose, tarsal claws long, slightly swollen at base but not lobed. Colour generally dark - black with yellow parts.

**Distribution:** Palearctic and Oceania. Country records: Algeria; Azerbaijan; Belgium; Bulgaria; Canary Islands; China; Denmark; Faeroe Islands; Finland; France; Georgia; Germany; Hungary; Iceland; Ireland; Italy; Japan; Latvia; Lithuania; Luxembourg; Netherlands; New Zealand; Norway; Poland; Romania; Russia; Sweden; Switzerland; Turkey; United Kingdom.

**Biology:** *Meteorus cespitator* was accidentally introduced to New Zealand and there it was found to parasitize on *Trichophaga tapetiella* from ply-wood (Parrot 1955). *M. cespitator* parasitizes on Tineidae (Lepidoptera) (Hinton 1956) and it is attracted to light (Yu et al. 2005). We found 21 specimens within the SMTP; they were caught in deciduous or spruce forests from the end of June to the beginning of September.

### *Meteorus cinctellus* (Spinola)

Fig. 42, 44, 90

*Bracon cinctellus* Spinola, 1808:135, Holotype ♂, Italy (MZS, Turin).

*Bracon necator* Trentepohl, Isis 1829 p 958 n. 75 ♀, [excl. Synon.] of *Bracon cinctellus* Nees 1811

*Perilitus fuscipes* Wesmael, 1835:48, Holotype ♀, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels) synonymized by Huddleston, 1980:25 – examined.

*Meteorus tenellus* Marshall, 1887:125. Lectotype ♀, Great Britain (BMNH, London), synonymized by Huddleston, 1980:25—examined.

**Diagnosis:** *Meteorus cinctellus* has a blunt tubercle in front of the fore ocellus, the pterostigma is dark brown with white edges, the subapical antennal articles are as long as broad and the ovipositor is 2.0–2.5 times petiolar tergum. Other similar species, such as *M. tenellus*, *M. artocercus* and *M. colon*, also have the blunt tubercle but have a pale pterostigma without white edges.

**Studied material:** ~ 100 specimens.

**Description:** Size about 4mm. Antennae with 24–29 articles; Subapical antennal articles as long as broad. Frons depressed with a blunt tubercle in front of the fore ocellus. Ocelli small, OOL=2.5. Eyes large, protuberant and strongly convergent. Malar space shorter than the basal breadth of the mandible. Face about as high as broad with a medial tubercle just below the antennal sockets. Clypeus narrow, strongly protuberant. Tentorial pits deep. Mandible small and strongly twisted. Precoxal sulcus deep, foveolate and generally broadened anteriorly. Propodeum rather flat, regularly reticulate-rugose, sometimes with a strong medial transverse carina. Petiolar tergum long, dorsal pits absent. Ventral borders generally touching but sometimes open. Ovipositor 2.0–2.5 times length of petiolar tergum. Legs long and slender; hind coxae rugose. Tarsal claws small and with a distinct basal lobe. Colour black/yellow; legs and generally 3<sup>rd</sup> abdominal tergite testaceous. ♂ antenna 28–30 articles; ocelli slightly larger; eyes less strongly convergent; colour often darker.

**Distribution:** Palearctic. Country records: Albania; Austria; Belgium; Bulgaria; China; Czechoslovakia; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Japan; Korea; Latvia; Madeira Islands; Netherlands; New Zealand; Norway; Poland; Portugal; Romania; Slovenia; Sweden; Switzerland; Ukraine; United Kingdom; Yugoslavia.

**Biology:** *Meteorus cinctellus* parasitizes on Tortricidae (Lepidoptera) (Yu et al. 2005). We found 99 specimens within the SMTP; they were caught in a variety of biotopes, including deciduous and coniferous forests. Flying time is from June to September.

**Remarks:** The name *Ichneumon necator* (Fabricius, 1777) is not the type of *M. cinctellus* (Yu et al. 2005, Broad et al. 2009). The name *necator* (Fabricius, 1777) refers to the Microgastrinae species *Apanteles necator* and is not a Euphorinae. In the description of *Ichneumon necator* (Fabricius, 1777:246) there is a reference to one of Rösels' illustrations (Table IV Fig. 4 in Rösels). The depicted braconid is clearly a Microgastrinae.

## ***Meteorus cis* (Bouché)**

Fig. 91

*Bracon cis* Bouché, 1834:149. Type material unknown.

*Perilitus profligator* Haliday, 1835:33. Syntypes ♀ Ireland (lost). Synonymized by Fahringer 1928:505.

**Diagnosis:** *Meteorus cis* is similar to *M. brevi antennatus* but the clypeus of the latter is almost as wide as the face while the clypeus of *M. cis* is narrow. Also the malar space (shorter than mandibular base on *M. brevi antennatus*, as wide as mandibular base on *M. cis*) and the face (slightly more transverse face in *M. brevi antennatus*, round face in *M. cis*) should separate these species.

**Studied material:** ~ 20 specimens.

**Description:** Size about 2.5–3.5mm. Antennae 20–22 articles. Head rounded behind eyes. Ocelli small, OOL=3. Eyes small, not strongly protuberant, slightly convergent. Malar space slightly shorter than basal breadth of mandible. Face 1.5–2.0 times as broad as high, smooth, punctate, not strongly protuberant. Clypeus narrower than face, almost flat, its apical border weakly notched medially and usually with a weak vertical impression behind the notch. Tentorial pits distinct. Mandibles short, stout and moderately twisted. Precoxal sulcus foveolate, sometimes broadening anteriorly. Mesopleuron dorsally reticulate-rugose, otherwise smoothly punctate. Propodeum with carinae with very weak rugose sculpture in between. Petiolar tergum with large distinct dorsal pits, dorsal surface generally reticulate-rugose with a few longitudinal striae laterally. Ovipositor about twice the length of petiolar tergum, slender. Legs slender; hind coxa never strongly rugose but often with a trace of obsolescent rugosity at the base and on the outer surface. Tarsal claws not lobed but somewhat swollen basally. Colour testaceous to brown; clypeus, mandibles and usually 3<sup>rd</sup> abdominal tergite reddish testaceous; coxa and legs yellow. Pterostigma dark with light border around, more so anteriorly. Fore wing m-cu antefurcal, vein 2-SR+M almost as long as vein r, at most 0.7 times).

**Distribution:** Palearctic. Country records: Austria; China; France; Germany; Ireland; Japan; Korea; Netherlands; Sweden; United Kingdom.

**Biology:** *Meteorus cis* is recorded as a parasitoid of *Cis boleti* Scopoli, 1763 (Bouché 1834). We found 12 specimens within the SMTP; they were caught in both deciduous and coniferous forests. Flying time is from July to October.

## ***Meteorus colon* (Haliday)**

Fig. 10b, 20, 30, 92

*Perilitus colon* Haliday, 1835:30. Syntypes ♀, Ireland (lost).

*Perilitus fragilis* Wesmael, 1835:52 Lectotype ♂, Belgium: Brussels (IRSNB, Brussels). Synonymized by Huddleston, 1980:26.

*Perilitus fasciatus* Ratzeburg, 1844:77. Syntypes ♀, Germany (lost). Synonymized with *fragilis* by Ruthe, 1862:55.

*Meteorus luridus* Ruthe, 1862:57 Lectotype ♀, Germany: Ruthe coll. (BMNH, London)—examined

**Diagnosis:** *Meteorus colon* has a blunt tubercle on frons in front of the fore ocellus. This character is shared with *M. cinctellus*, *M. tenellus*, *M. artocercus*, *M. stenomastax* and *M. melanostictus*. *M. colon* is distinguished from these other species by having a distinctly postfurcal second submarginal cell and a pale pterostigma.

**Studied material:** ~ 200 specimens.

**Description:** Size about 4mm. Antennae long, 30–34 articles, all flagellar articles long. Head contracted behind eyes; frons with a blunt tubercle in front of the fore ocellus. Ocelli rather large but not conspicuously so, OOL=2. Eyes convergent but not strongly so. Malar space short, slightly less than basal breadth of mandible. Face not strongly protuberant. Clypeus strongly protuberant; narrower than face. Mandibles small, strongly twisted. Precoxal sulcus foveolate. Propodeum finely rugose, carinae often weak and indistinct. Petiolar tergum long, slender, without dorsal pits, the ventral borders generally slightly separated. Ovipositor 1.5 times length of petiolar tergum. Legs very long and slender; tarsal claws small with a distinct basal lobe. Forewing m-cu distinctly postfurcal, the second submarginal cell rather elongate. Colour black to yellow; ♂ antenna 31–35 articles.

**Distribution:** Western and Eastern Palearctic. Country records: Armenia; Austria; Azerbaijan; Belgium; Bulgaria; China; Croatia; Czechoslovakia; Denmark; Finland; France; Georgia; Germany; Hungary; Ireland; Italy; Japan; Lithuania; Moldova; Netherlands; Norway; Poland; Russia; Slovakia; Sweden; Switzerland; Turkey; United Kingdom; Yugoslavia.

**Biology:** Host records of *Meteorus colon* include ten different families of Lepidoptera, with most records involving species of Noctuidae (Huddleston 1980, Yu et al. 2005). We found 124 specimens within the SMTP; they were caught in both deciduous and coniferous forests but predominantly in spruce forests. Flying time is from July to October.

### ***Meteorus consimilis* (Nees von Esenbeck)**

Fig. 61, 62, 93

*Perilitus consimilis* Nees von Esenbeck, 1834:42. Syntypes ♂, Germany (destroyed).

*Perilitus brevipes* Wesmael, 1835:33 Lectotype ♂, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels), Synonymized with *albicornis* Ruthe by Marshall, 1887:110.

*Meteorus albicornis* Ruthe, 1862:34. lectotype ♀, Germany: Ruthe coll. (BMNH, London). Synonymized with *consimilis* by Thomson, 1895:2160—examined

**Diagnosis:** The only species that could be confused with this species is *M. abdominalis*. A good separating character is the length of the malar space (almost two times basal breadth of mandible in *M. consimilis*, at most as long as basal breadth of mandible in *M. abdominalis*). The length and shape of the ovipositor also differ between these species. The ovipositor of *M. consimilis* is thick, distinctly down-curved and short (equal in length to petiolar tergum), while *M. abdominalis* has a thin and long (2.0–2.5 times length of petiolar tergum), and only slightly down-curved ovipositor.

**Studied material:** ~ 60 specimens.

**Description:** Size about 3–4mm. Antennae 32–33 articles; basally whitish. Head strongly contracted behind eyes. Ocelli large, OOL=1.5. Eyes small, not convergent. Malar space long, almost twice basal breadth of mandible. Clypeus strongly protuberant. Tentorial pits deep. Mandibles slender; strongly twisted. Precoxal sulcus deep, broad, reticulate-rugose. Propodeum strongly reticulate-rugose. Petiolar tergum short, wide, with distinct dorsal pits. Ovipositor short, at most equal in length to petiolar tergum; thick down-curved. Wings infumate and short. Colour dark. ♂ antennae 32–36 articles with no pale band.

**Distribution:** Western Palearctic. Country records: Belgium; Croatia; Denmark; Finland; France; Germany; Hungary; Ireland; Latvia; Netherlands; Poland; Romania; Slovenia; Sweden; Switzerland; Turkey; Turkmenistan; Ukraine; United Kingdom; Yugoslavia.

**Biology:** *Meteorus consimilis* is recorded as a parasitoid of *Scolytus multistriatus* (Yu et al. 2005). We found 58 specimens within the SMTP; they were caught in both deciduous and coniferous forests. Flying time is from middle of July to end of October.

### ***Meteorus corax* Marshall**

Fig. 51, 77, 94

*Meteorus corax* Marshall, 1898:220. Lectotype ♀ Switzerland: Val Somvix/25.vii.1891/Marshall det. (NMB, Bern)

*Meteorus monachami* Fischer, 1957c:17. Holotype ♀ Austria: Lunz (Haberfelner), ex *Monochamus saltuarius* Gebl. (ZSBS, Munich) Synonymized by Fischer, 1966:395.

**Diagnosis:** This is one of the larger species of *Meteorus*, at least in the Palearctic Region, averaging about 9 mm in body length. It is most easily confused with *M. nixoni*. However, *M. corax* has twisted mandibles (straight in *M. nixoni*), the temples are wider than in *M. nixoni*, and the 3<sup>rd</sup> abdominal tergum is densely covered with striae (only a few striae present in *M. nixoni*).

**Studied material:** ~ 10 specimens.

**Description:** Size about 6–10mm. Antennae 39–41 articles. Head rather square. Ocelli small, OOL=3. Eyes small, converging only very slightly. Face about twice as long as broad. Clypeus distinctly narrower than face; pro-

tuberant. Tentorial pits wide and deep. Mandibles very stout and slightly twisted, with striate-punctate sculpture and long setae. Precoxal sulcus deep, foveolate with, anteriorly, a reticulate-foveolate patch beneath. Propodeum strongly reticulate-rugose with basal and medial transverse carinae. Petiolar tergum with longitudinal sculpture laterally, reticulate-rugose centrally; spiracles distinctly before the middle; large dorsal pits present, borders of petiolar tergum not meeting ventrally. The ovipositor about 4 times length of petiolar tergum. Outer surface of hind coxa and femur densely reticulate - punctate; hind tibia strongly swollen though not as wide as femur; tarsal claws large, strongly curved, not lobed but strongly swollen at base. Colour black or dark brown.

**Distribution:** Palearctic. Country records: Austria; Finland; Germany; Italy; Japan; Korea; Russia; Sweden; Switzerland.

**Biology:** Most host records of *Meteorus corax* involve the coleopteran family Cerambycidae (Huddleston 1980).

### ***Meteorus densipilosus* Stigenberg sp. nov.**

Fig. 79B, 95

**Diagnosis:** The clypeus of *Meteorus densipilosus* is unique within *Meteorus* in being flat and having a sinuate ventral margin with a median notch similar to that of *M. cis*. The setose face, straight ovipositor, and distinct carinae on the propodeum are also good characters that distinguish it from related species. In Huddleston's (1980) key, *M. densipilosus* runs to *M. brevicauda*, but there are distinct differences. While *M. brevicauda* belongs to the smallest of the *Meteorus* species (less than 3.5 mm), *M. densipilosus* is larger at about 5 mm. *M. densipilosus* has a distinct malar space (0.5 times basal width of mandible) while *M. brevicauda* hardly has any space at all between the eye and the mandible. The ovipositor is also longer in *M. densipilosus* (2.0 times petiolar tergum) than in *M. brevicauda* (1.5 times petiolar tergum). In our key, this species groups with *M. eklundi*, but it is clearly separated from the latter based on the number of antennal articles (28 in *M. densipilosus* and only 22–25 in *M. eklundi*).

**Studied material:** 1♀. Holotype: 1♀ SE. Sm. Nybro kommun. Bäckebo. 24.viii–12.ix.2005. (leg. SMTP), NHRS–HYME 4936, DNA 7.

**Description:** Body 5.2 mm, fore wing 3.47 mm.

Head: Length of eye 0.9 times length of temple in dorsal aspect; eyes small, protuberant, not converging; width of face 1.7 times its height; OOL=2.5, ocelli only slightly protruding; vertex smooth, convex but with a ridge running towards face; face striate medially, the striae running to clypeus forming ridges; clypeus as wide as face, not distinctly divided from face and flat with ventral border sinuate seen from dorsal view; length of malar space 0.5 the times basal width of mandible; mandible stout, not twisted; hypostomal carina wide; antennal articles 28; 3rd antennal article 4.75 times longer than wide; 4th antennal article 3.2 times longer than wide; all antennal articles longer than wide.

Mesosoma: Precoxal sulcus wide.

Wings: Fore wing:  $r/3-SR=0.6$ ;  $C+SC+R/SR1=1.48$ ;  $m-cu$  antefurcal; pterostigma dark brown with light dorsal border. Hind wing:  $1-M/cu-a=1.6$ .

Legs: Hind coxa rugose; hind femur 5 times longer than wide; tarsal claws slender without lobe.

Metasoma: Petiolar tergum 1.85 times longer than wide apically, 4.5 times fore wing; dorsope present; ventral folds of petiolar tergum not joined; ovipositor slender and straight, length of ovipositor sheaths 2.0 times petiolar tergum and 0.45 times fore wing; propodeum convex, reticulate rugose and with 2 distinct transversal and one medial longitudinal carina; propodeum not strongly excavate medially.

Colour: Black except: yellow patch between eye and posterior ocelli; gena dark brown; clypeus and palpi yellow; antennae brown; petiolar tergum black and metasoma dark brown; legs yellow.

**Distribution:** Sweden.

**Biology:** The specimen was caught in a Malaise Trap in late August – early September in southern Sweden. The locality, Grytsjöns naturreservat, mostly consists of an old aspen forest in boulder terrain.

**Etymology:** The name *densipilosus* refers to the dense setosity on the head, being composed of the words *densi* (Latin, meaning thick), and *pilosus* (Greek, meaning hairy).

## *Meteorus eadyi* Huddleston

Fig. 41, 96

*Meteorus eadyi* Huddleston, 1980:29. Holotype ♀ Great Britain: Northhamptonshire, Spratton, x.1975 (Gauld) (BMNH, London)—examined.

Paratypes. Bulgaria: 1 ♀, Rhodopi, Markovo, 13.viii.1977 (Zaykov) (PZ, Plavodiv). Great Britain: 17 ♀s, 1 ♂, England, Northhamptonshire, Spratton, v.-x.1975 (Gauld) 1 female, E., oxfordshire, Waterferry Common, 5.viii.1969 (Brock) (BMNH); 1 ♀, Greater London, Kew, 22.vii.1979 (Eastop) (BMNH). Germany: 1 ♀, Bonn, Waldhauhofenweg, 18.xi.1960 (Schmidt) (CNC, Ottawa). Netherlands: 6 females, Wijster (opp, biol. station); 3, 13–26.viii.1973; 1, 7–14.vii.1974; 10–17.ix.1976; 1, 16–23.vi.1978 (van Achterberg) (RNH, Leiden); 7 ♀s, Waarder (ZH), Oosteinde; 1, 1–15.ix.1973; 1, 17–22.vi.1974; 1, 1–5.viii.1974; 2, 1–6.ix.1974; 1, 15–22.vi.1975; 1, 21–31.x.1975 (van Achterberg) (RNH, Leiden); 1 ♀, Ede, 15.ix.1970 (Zwakhals) (RNH, Leiden). Yugoslavia: 1 ♀, Plitvice, 4–10.vii.1955 (Coie) (BMNH).

**Diagnosis:** *Meteorus eadyi* is close to *M. filator* but can be distinguished by its smaller, less convergent eyes, and by the shape of the clypeus being narrow and protruding, not wide and flat as in *M. filator*. The antennae (26–27 articles) are long and slender in *M. eadyi*, while *M. filator* has stouter antennae with about 21–25 articles. The ovipositor is 1.5 times petiolar tergum in *M. eadyi* and 2.0 times petiolar tergum in *M. filator*.

**Studied material:** ~ 20 specimens.

**Description:** Size 4–5mm. Antennae 26–27 articles, all articles longer than broad. Head rounded behind eyes. Ocelli small, OOL=2.5–3.0. Eyes small, protuberant and not strongly convergent. Face about 1.5 times as broad as high. Clypeus not strongly protuberant. Mandibles not twisted, the upper tooth rather long. Precoxal sulcus foveolate. Propodeum carinated with three longitudinal and two transverse carinae. Petiolar tergum long, slender, about twice as long as apically broad; no dorsal pits; ventral borders of petiolar tergum conjoined. Ovipositor short, about 1.5 times as long as petiolar tergum, down-curved. Legs slender, hind coxae partly rugose; tarsal claws without a basal lobe. Colour black with yellow parts, basal antennal articles usually slightly lighter than the rest. Male same as female except that the eyes are smaller and less convergent.

**Distribution:** Western Palearctic and Mongolia. Country records: Armenia; Bulgaria; Czechoslovakia; France; Germany; Hungary; Korea; Lithuania; Mongolia; Netherlands; Romania; Russia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** *Meteorus eadyi* is attracted to light (Yu et al. 2005). It flies during June to September and the host is unknown.

**Remarks:** *M. eadyi* is here reported as new for Sweden. In the material from MZLU we found 1 ♀ from Skåne.

## *Meteorus eklundi* Stigenberg sp. nov.

Fig. 68, 79C, 97

**Diagnosis:** *Meteorus eklundi* can be distinguished from related species by the stout antenna with articles that are quadrate in shape. *M. eklundi* mostly resembles *M. nadezhae* (East Russia) but the latter species has a rugose face, with the rugosity extending down onto the clypeus, and a strongly rugose petiolar tergum, whereas *M. eklundi* is only equipped with light sculpture in these body regions. *M. eklundi* also resembles *M. obfuscatus* but differs from this species by larger and more convergent eyes, narrower face (face wider than high in the latter) and shorter malar space (0.4 times basal width of mandible in the former, 0.5 times in the latter).

**Studied material:** 12.

Holotype: 1 ♀ SE. Sm. Älmhults kommun. Stenbrohult. 26.vi–15.vii.2003. (leg. SMTP), NHRS–HYME 4937, DNA 8. Paratype: 1 ♀ SE. Öl. Mörbylånga kommun. Kalkstad. 25.vi–13.vii.2003. NHRS–HYME 4939, DNA 28. 1 ♀ SE. Öl. Mörbylånga kommun. Kalkstad. 2.v–18.vi.2006 (leg. SMTP), NHRS–HYME 4938. 4 ♀ specimens at ZIN collected in Belarus, earlier misidentified as Paratypes of *M. nadezhae*, these are included as Paratypes of *M. eklundi*. 1 ♀ Netherlands: N.B. Udenhout, “De Brand” 26.v.2.VII.1990 UTM FT 476225, Mal.trap Ins. W.G. KNNV-Tilburg. 1 ♀ SE Bulgaria (Mal tr 1) Brodilovo, nr Achtopol c 20 m, 7.v–8.vi.1998, C.v.Achterberg, R de Vries, P.V. Atanassova, RMNH’98. 1 ♀ Västerbotten, Romelsön RN7208/1759 Mal.trap 21.6–29.8.03. R. Petterson. 1 ♀ Chippenham Fen, Cambs. TL 650693 Malaise trap: carr at reedbed edge.A. 9–20.07.84. J. Field. RMSNH 1986.021. 1 ♀ Chippenham Fen, Cambs. TL 650693 Malaise trap: carr at reedbed edge.A. 25.06–09.07.85. J. Field. RMSNH 1986.021.

**Description:** Body 4.2 mm, fore wing 3.5 mm.

Head: Length of eye 1.5 times length of temple in dorsal aspect; eyes large, convergent, not strongly protuberant; width of face 1.5 times its height; OOL=3, ocelli only slightly protruding; vertex smooth; face punctulate; clypeus as wide as face, distinctly divided from face, punctate, flat with slight notch; length of malar space 0.4 times basal width of mandible; mandible stout, slightly twisted; hypostomal carina wide; number of antennal articles 22 (21–25); 3<sup>rd</sup> antennal article 2 times longer than wide; 4th antennal article 1.4 times longer than wide; penultimate articles as wide as broad or slightly wider.

Mesosoma: Precoxal sulcus wide.

Wings: Fore wing:  $r/3-SR=0.4$ ;  $C+SC+R/SR1=1.6$ ; m-cu antefurcal; pterostigma dark brown with light border. Hind wing:  $1-M/cu-a=1.2$ ;

Legs: Hind coxa rugose; hind femur 5 times longer than wide; tarsal claws slender without lobe.

Metasoma: Petiolar tergum 1.8 times longer than wide apically, 4.2 times fore wing; dorsope present; ventral folds of petiolar tergum not joined; ovipositor weakly curved downward, length of ovipositor sheaths 1.6 times petiolar tergum, and 0.45 times fore wing; propodeum strongly convex, reticulate rugose and with no distinct carina; strongly excavate medially.

Colour: Black except: clypeus and palpi yellow; antennae brown; petiolar tergum and metasoma dark brown; legs yellow to brown; hind coxa darker brown at base.

**Distribution:** Western Palearctic. Country records: Belarus; Bulgaria; Netherlands, Sweden; United Kingdom.

**Biology:** *Meteorus eklundi* is caught in malaise traps during the summer months June, July and August. The three specimens that were caught within the SMTP were found in localities with deciduous forests. Host unknown.

**Etymology:** Named after my best friend Mr Niclas Eklund.

### *Meteorus filator* (Haliday)

Fig. 18, 24, 40, 98

*Perilitus filator* Haliday, 1835:32. Holotype ♀, Ireland: 'British Haliday 20.2.82' (NMI, Dublin)

*Perilitus laticeps* Wesmael, 1835:47. Lectotype ♀, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels), Considered valid species by Fischer, 1970a. Synonymized by Huddleston, 1980:30.

*Meteorus hodisensis* Fischer, 1970b:285. Holotype ♀, Austria: 'Bgl., Markt. Hodis, Rechnitz, 7.viii.1961' (Fischer) (NHM, Vienna). Synonymized by Huddleston, 1980:30—examined.

**Diagnosis:** Males of *Meteorus filator* look very similar to those of *M. eadyi* but the shape of the clypeus is a good diagnostic character (wide in *M. filator*, narrow and protruding in *M. eadyi*).

**Studied material:** ~ 60 specimens.

**Description:** Size about 4.5mm. Antennal articles 21–25. Head broad, temples rounded. Ocelli small, OOL=2.5–3.0. Eyes large, strongly convergent. Face about as wide as high, not strongly protuberant. Clypeus wide, not strongly protuberant. Malar space short, less than half the basal breadth of mandible. Mandible large, not twisted. Precoxal sulcus wide. Propodeum rather depressed with three longitudinal and two transverse carinae. Petiolar tergum long, almost equal in length to rest of abdomen, slender, ventral borders joined from the base of the segment to its midpoint. Ovipositor long, 2.5 times length of petiolar tergum. Legs long, slender; hind coxa partly reticulate-rugose; tarsal claws simple, long, slightly swollen at base. Colour mostly black. Male same as female except eyes are smaller and less convergent so that the face is about twice as broad as high and the malar space longer; antennae longer, 27–30 articles, all articles of flagellum at least twice as long as broad, darker in colour, rarely distinctly yellow in basal half of flagellum.

**Distribution:** Western Palearctic. Country records: Austria; Azerbaijan; Belgium; Bulgaria; Czechoslovakia; Denmark; Finland; France; Georgia; Germany; Hungary; Ireland; Italy; Lithuania; Mongolia; Netherlands; Norway; Poland; Russia; Slovakia; Sweden; Switzerland; United Kingdom.

**Biology:** Haliday (1835) states "locis fungiferis autumnno" for this species, meaning that it occurs amongst fungi in autumn. Also, Capron mentions to Marshall (1887) that he has taken several females of this species by shaking species of *Trametes versicolor* (Fungi, Polyporaceae) and the males were abundantly collected in the autumn by sweeping. We found 41 specimens within the SMTP, most of them were from a Malaise trap placed on a sandy railway. They were caught during the summer months July to August.

### ***Meteorus heliophilus* Fischer, 1970**

Fig. 115

*Meteorus heliophilus* Fischer, 1970b:284. Holotype ♀, Austria: Burgenland, Reichnitz, 2.viii.1958 (Fischer) (NM, Vienna).

**Diagnosis:** Similar to *M. rubens* but *M. heliophilus* has a larger marginal cell and longer antennae with 30–32 antennal articles (24–28 in *M. rubens*).

**Studied material:** ~ 10 specimens.

**Description:** Size about 4 mm. Antennae long with 30–32 articles. All articles much longer than broad. Head strongly contracted behind eyes. Eye in dorsal view 2.5–3.0 times as long as temple. Ocelli large OOL=1.0–1.5. Eyes large, not strongly convergent but protuberant. Malar space short, less than half the basal breadth of mandible. Face about as high as broad, not strongly protuberant, slightly raised medially where it is transversely rugose, laterally punctate. Clypeus protuberant but not strongly, smooth with scattered coarse punctures. Tentorial pits small, indistinct. Mandibles strongly twisted, the upper tooth not long. Pronotum laterally smooth with a little fine rugose sculpture medially. Mesonotum punctate, sometimes the central lobe reticulate-punctate, at least in part; notaulices weakly impressed. Precoxal sulcus weakly rugose, sometimes obsolescent posteriorly. Propodeum shining with weak carinae and weak, largely obsolescent rugae dorsally. Petiolar tergum long, slender, ventral borders meeting beneath at the mid-part of the segment, not joined at the base of the segment; dorsal surface weakly longitudinally striate; no glymmae or dorsal pits. Ovipositor about twice the length of petiolar tergum, thick, strongly expanded at the base and the apical sixth much narrowed. Legs long, slender; hind coxa mainly smooth but sometimes with a trace of rugosity dorsally. Colour testaceous, the legs generally a paler shade of yellow. Male same as female except antennae 31–33 articles.

**Distribution:** Palearctic. Country records: Austria; Belgium; Bulgaria; China; Czechoslovakia; Denmark; Finland; France; Germany; Hungary; Italy; Japan; Latvia; Moldova; Mongolia; Poland; Slovakia; Sweden; Switzerland; United Kingdom.

**Biology:** *M. heliophilus* is a gregarious parasitoid (Tobias 1976, Huddleston 1980). Hosts: *Polia nebulosa* (Hufnagel), *Litophane ornitopus* (Hufnagel), *Noctua fimbriata* (Schreber), *Xestia triangulum* (Hufnagel), *Orthosia stabilis* (Denis & Schiffermüller) (Lepidoptera, Noctuidae) (Huddleston 1980).

### ***Meteorus hirsutipes* Huddleston**

Fig. 21, 67, 99

*Meteorus hirsutipes* Huddleston, 1980:34. Holotype ♀ Finland: Valamo, Ladoga, NE. of monastery Hainwald 24.viii.1935 (Kerrich) (BMNH, London) examined.

Paratypes. Germany: 1 ♀ Bavaria, Schliersee, 28.vii.1958 (Townes) (CNC, Ottawa). Ireland: 1 ♀, Co. Wicklow, Deputy's Pass, 7.viii.1932 (Stelfox) (USNM, Washington).

**Diagnosis:** *Meteorus hirsutipes* is an easily diagnosed species. It is a rather large species with an unusually wide face. The colour is black except for the prothorax and legs, which are testaceous. Above all, however, the species is characterized by the very long, sickle-shaped claws.

**Studied material:** ~ 20 specimens.

**Description:** Size about 4.5–6mm. Antennal articles 28–30, thin. Head strongly narrowed behind eyes, occiput concave. Ocelli small, OOL=3. Eyes protuberant, slightly convergent. Face about twice as broad as high, not strongly protuberant. Clypeus not strongly protuberant, as broad as face. Mandible very large, stout and not twisted. Precoxal sulcus deep, foveolate. Propodeum with strong longitudinal and transverse carinae. Petiolar tergum with longitudinal striae, joining to form a transverse rugose area; medial part of petiolar tergum anteriorly reticulate-rugose. Ovipositor 2.5 times length of petiolar tergum, straight. Hind coxa punctate or reticulate-punctate; tarsi with long setae, the longest of which at the apices of the tarsal segment are at least twice the maximum breadth of the segment. Tarsal claws simple, very long, sickle-shaped. Colour black, prothorax and legs testaceous.

**Distribution:** Western and Eastern Palearctic. Country records: China; Croatia; Finland; Germany; Ireland; Japan; Norway; Switzerland; Sweden; United Kingdom.

**Biology:** We found 5 specimens within the SMTP and they were all caught in August in a mixed forest.

***Meteorus ictericus* (Nees von Esenbeck)**

Fig. 70, 71, 74, 100

*Bracon ictericus* Nees von Esenbeck, 1811:22. Syntypes ♀, Germany (destroyed).

*Ichneumon minor* Thunberg, 1822:266. Holotype ♀ (UDE, Uppsala) Synonymized by Roman 1912:267.

*Zele ephippium* Curtis, 1832: folio 415. Syntypes, Great Britain: 'Coomb Wood' (NMV, Melbourne). Synonymized by Curtis 1837.

*Perilitus xanthomelas* Wesmael, 1835:29. Lectotype ♂, Belgium: Brussels (IRSNB, Brussels). Synonymized by Fischer, 1970b:263.

*Meteorus confinis* Ruthe, 1862:18. Lectotype ♀, Germany: Ruthe coll. (BMNH, London). Synonymized by Huddleston, 1980:34.

*Meteorus fallax* Ruthe, 1862:18. Lectotype ♀, Germany: Ruthe coll. (BMNH, London). Synonymized by Huddleston, 1980:34.

*Meteorus pleuralis* Ruthe, 1862:19. Lectotype ♀, Germany: Ruthe coll. (BMNH, London). Synonymized by Huddleston, 1980:34.

*Meteorus liquis* Ruthe, 1862:20. Lectotype ♀, Germany: Ruthe coll. (BMNH, London). Synonymized by Huddleston, 1980:34.

*Meteorus consors* Ruthe, 1862:44. Lectotype ♀, Germany: Ruthe coll. (BMNH, London) examined. Synonymized by Fischer, 1970b:263.

*Meteorus crassicus* Thomson, 1895:2154. Lectotype ♀, Sweden: Skåne, Arrie (MZLU, Lund)—examined

*Meteorus lophyrphagus* Fahringer in Schönwiese, 1934:495. Holotype ♀, Austria (IFF, Vienna)

*Meteorus adoxophyesi* Minamikawa, 1954:41. Holotype ♀, Japan: Kanaya Shizuoka-ken, 10.iv.1948 (Sonan) (NIAS, Yatabe) Synonymized by Huddleston, 1980:34.

**Diagnosis:** *Meteorus ictericus* is most similar to *M. ruficeps* but the latter species has converging eyes, whereas the eyes of *M. ictericus* are only slightly converging. *M. ictericus* can sometimes be hard to separate from *M. pendulus* but *M. ictericus* has whitish hairs between the eyes and the clypeus (absent in *M. pendulus*), rugose glymmae (smoother in *M. pendulus*) and longer ovipositor (2.5–3.0 times length of petiolar tergum in *M. ictericus*, 1.5–2.0 times petiolar tergum in *M. pendulus*).

**Studied material:** ~ 200 specimens.

**Description:** Size about 4.5–5.5mm. Antennal articles 26–33, long. Head strongly contracted behind the eyes. Ocelli large, OOL=1.0–1.5, protuberant, the ocellar area raised and there is a pit in front of anterior ocelli, the size of the pit varies. Eyes large, protuberant, inner margins converging very slightly. Malar space short, at most equal to half basal breadth of mandible. Face often only slightly raised medially. Clypeus narrower than face, protuberant. Tentorial pits small. Mandibles moderately twisted, short and rather stout. Precoxal sulcus foveolate, narrow. The propodeum is excavated with a strong medial transverse carina marking the excavation, the weak medial longitudinal carina is surrounded by an area on both sides with smooth or very faint structure. Petiolar tergum long, slender with distinct dorsal pits and rugose glymmae. Ovipositor long, 2.5–3.0 times length of petiolar tergum, stout. Legs long, slender; hind coxa smooth, tarsal claws strongly bent and with a large basal lobe. Colour varying. Males look the same as females, the only one we studied had antennae with 28 articles. Males are very rare and only one was found in the SMTP.

**Distribution:** Palearctic. Country records: Armenia; Australia; Austria; Azerbaijan; Belarus; Belgium; Bulgaria; China; Croatia; Czechoslovakia; Denmark; Finland; France; Germany; Hungary; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Latvia; Lithuania; Moldova; Netherlands; Norway; Poland; Romania; Russia; Slovakia; Slovenia; Sweden; Switzerland; Turkey; USA; Ukraine; United Kingdom; Yugoslavia.

**Biology:** *Meteorus ictericus* is readily caught in Malaise Traps but is also attracted to light. Host records include 14 different lepidopteran families, but the majority of records involve the Tortricidae (Huddleston 1980, Yu et al. 2005). We found 89 specimens (only one male) within the SMTP and they were caught in forests, both deciduous, coniferous and mixed forests, though with a slight preference towards spruce forests. The period of flight seems to be from June to October.



### *Meteorus ipidivorus* Tobias

Fig. 54, 101

*Meteorus ipidivorus* Tobias 1986:340, 351 Holotype ♀, Russia:

**Diagnosis:** *Meteorus ipidivorus* belongs to the group of smaller *Meteorus* species with body length less than 3.5 mm. It is easily distinguished by being the only small *Meteorus* with the fore wing RS bent upward.

**Studied material:** 1 specimen

**Description:** Size about 3mm. Antennal articles 28–29. Head rounded behind eyes, ocelli very minute OOL=4. Eyes smaller, converging slightly. Malar space 0.5 times mandible base. Mandibles stout and not twisted. Face 1.5 times broader than high, not protruding. Clypeus flat and as wide as face. Precoxal sulcus broad, punctuated otherwise smooth. Propodeum carinated but smooth inbetween. Fore wing 4 times the length of petiolar tergum. Petiolar tergum with dorsal pits, rugose dorsally. Ovipositor short, slightly longer than petiolar tergum and curved. Hind coxae rugose, dark brown. Fore wing radial vein not straight, stigma brown.

**Distribution:** Russia

**Biology:** *Meteorus ipidivorus* is recorded as a parasitoid of *Ips acuminatus* and *Blastophagus minor* (Curculionidae) (Tobias 1986). The specimen studied here is the holotype from ZIN and this specimen was found in the gallery of *Ips acuminatus* in Novosibirsk in September 1965.

### *Meteorus jaculator* (Haliday)

Fig. 102

*Perilitus jaculator* Haliday, 1835:34. Syntypes ♀, Ireland (lost).

*Meteorus obscurellus* Ruthe, 1862:29. Holotype ♀, Germany: Ruthe coll. (BMNH, London) examined. Synonymized by Marshall, 1887:108.

*Meteorus tenuicornis* Thomson, 1895:2164. Lectotype ♀, Sweden: Skåne, Påljö (ZI, Lund)—examined

**Diagnosis:** *Meteorus jaculator* is similar to *M. cis* and *M. vexator*. However, *M. vexator* is easily distinguished from the other two based on the strongly converging eyes. The eyes are only slightly converging in the other two species, which are most easily distinguished by the length of the ovipositor. *M. jaculator* has an ovipositor length of 3–4 times the length of the petiolar tergum, whereas *M. cis* has a much shorter ovipositor, only 2 times the length of the petiolar tergum.

**Studied material:** ~ 20 specimens.

**Description:** Size about 3mm. Antennae short, 18–22 articles, slender. Head swollen behind eyes; temples longer than eyes. Ocelli small, OOL=3–4. Eyes small, slightly convergent. Malar space at least slightly shorter than basal breadth of mandible. Face about twice as broad as high, protuberant. Clypeus wide as face and smooth, with scattered large punctures, not strongly protuberant. Tentorial pits small. Mandibles stout, slightly twisted. Precoxal sulcus narrow. Propodeum with weak but distinct carinae. The medial longitudinal area of the petiolar tergum is strongly raised ending apically in reticulate rugosity. Ovipositor 3–4 times length of petiolar tergum. Hind coxa often strongly rugose. Tarsal claws short with no basal lobe. Colour dark brown to black; legs testaceous but sometimes the coxae darker; clypeus and mandibles often yellow. Male same as female except that the antennae are much longer, up to 29 articles, all flagellar articles conspicuously longer than broad. Fore wing vein r is as long as vein 3–SR and m-cu antefurcal.

**Distribution:** Western Palearctic. Country records: Austria; Bulgaria; Croatia; Czechoslovakia; Denmark; Finland; France; Germany; Hungary; Ireland; Netherlands; Norway; Poland; Russia; Slovakia; Sweden; Switzerland; Turkey; United Kingdom; Yugoslavia.

**Biology:** *M. jaculator* is recorded as being a parasitoid on three lepidopteran families (Gelechiidae, Psychidae and Tineidae) (Yu et al. 2005). We found 6 specimens within the SMTP. They were caught from July to October in northern Sweden, predominantly in deciduous forests.

### ***Meteorus kyushuensis* Maeto**

Fig. 103

*Meteorus kyushuensis* Maeto, 1988:328. Holotype ♀, (Type No. 2567, Kyushu Univ.) Japan: Gokanosho, Kumamoto Pref., Kyushu 14.v.1980, K. Ohara [L.T.]—examined.

**Diagnosis:** In Huddleston's key this species runs to *M. hirsutipes*, and it also groups with this species in our key. The main characters separating these species are the claws (long and slender in *M. hirsutipes*, of ordinary length in *M. kyushuensis*) and the clypeus (very flat and wide in *M. hirsutipes*, flat but not at all wide in *M. kyushuensis*).

**Studied material:** 5 specimens.

**Description:** Size about 3.0–4.5. Antennal articles 23–24. Head broad, rounded behind eyes. Length of eye 1.4–1.7 times temple. Ocelli small, OOL=2.6–2.8. Eyes small, only slightly convergent. Malar space about 0.7 times basal breadth of mandible. Face not protuberant, twice as broad as high. Clypeus 0.65 as wide as face, distinctly divided, punctate. Tentorial pits indistinct. Mandibles stout, not twisted. Precoxal sulcus narrow. Propodeum convex, rugose and with weak carina; excavate medially. Petiolar tergum 1.5 times longer than wide apically; dorsope distinct; ventral folds of petiolar tergum not joined. Ovipositor very long, 4.5 times length of petiolar tergum. Ovipositor very weakly curved downward, length of ovipositor sheaths 2.0 times petiolar tergum, and 0.95 times fore wing. Hind coxa punctate or reticulate–punctate; tarsal claws with simple but somewhat thickened at base. Colour black to brown; antennae, head, prothorax and legs yellow–brown; the head is yellowish–brown to orange, except for occiput and frons. Male similar to female except antennae 28 articles, malar space 0.9 times basal width of mandible and length of eye 1.3 times length of temple.

**Distribution:** Japan; Sweden.

**Biology:** In Japan *M. kyushuensis* is recorded as a parasitoid of the larvae of the fungus beetle *Neotriplax lewisi* (Coleoptera: Erotylidae) (Maeto, 1988a). We found 4 specimens within the SMTP and they were caught from July to September in an Alder wood ravine and in a 15 yr old spruce plantation.

### ***Meteorus limbatus* Maeto**

Fig. 75, 104

*Meteorus limbatus* Maeto, 1989:581. Holotype ♀, (Type No. 2655, Kyushu Univ.) Japan: Bonto, Akkeshi, Hokkaido, 10.vii.1977, K. Yamagishi—examined.

**Diagnosis:** *Meteorus limbatus* is very similar to *M. abscissus* in size and structure but the long scattered setae on the clypeus are quite distinct from the dense, short setae of *M. abscissus*.

**Studied material:** ~ 10 specimens.

**Description:** Size 3.5–5.0 mm. Antennae with 29–31 articles, all articles longer than wide. Length of eye is more than double the length of temple in dorsal aspect; eyes large, slightly convergent and protuberant; width of face equal its height; OOL=1.5; clypeus equals the width of face, not distinctly divided from face, smoothly arched, tentorial pits distinct; length of malar space 0.75 times basal width of mandible; mandibles slender and twisted. Precoxal sulcus deep and moderately wide. Petiolar tergum apically 1.8–2.3 times longer than wide; dorsope present, laterope deep; ventral folds of petiolar tergum not joined, dorsal aspect with distinct striae; ovipositor straight, thick; length of ovipositor 1.8 times that of petiolar tergum; propodeum with no carina, reticulate and smoothly velved. Fore wing m–cu slightly antefurcal; pterostigma brown with lighter boarder. Hind coxa rugose; tarsal claws with a toothed lobe. Colour dark brown with yellow distinct markings. Ocellar area and neck dark. Propodeum, petiolar tergum, precoxal sulcus and mesoscutum dark, scutellum yellow. Dark specimens are known from northern Japan. Male unknown.

**Distribution:** Palearctic. Country records: France; Italy; Japan; Norway; Sweden; United Kingdom.

**Biology:** We found one specimen within the SMTP and it was caught in July. This specimen was caught in an alder wood ravine.

### *Meteorus lionotus* Thomson

Fig. 32, 105

*Meteorus lionotus* Thomson, 1895:2160. Lectotype ♂, Sweden: Norrland (MZLU, Lund)—examined.

*Meteorus ruficoloratus* Fischer, 1957b:4. Holotype ♂, Germany:München, 15.vii.1884. (Kreichbaumer) (ZSBS, München).

**Diagnosis:** The extremely contracted head along with the size of the ocelli make this species easy to distinguish. The only similar species that it can be mistaken for is *M. versicolor* but the contracted head and the ocellar size (OOL=0.5) of *M. lionotus* is well distinguished from the more rounded head and smaller ocelli (OOL=1) of *M. versicolor*.

**Studied material:** ~ 10 specimens.

**Description:** Size about 4–5mm. Antennae with 31–33 articles, long. Head very strongly contracted behind the eyes. Ocelli very large, OOL=0.5, protuberant. Eyes not strongly protuberant. Clypeus strongly protuberant. Mandibles strongly twisted, small. Precoxal sulcus shallow, rugose. Propodeum generally depressed, with distinct lateral carinae and occasionally with a weak medial transverse carina. Petiolar tergum long with no dorsal pits; ventral borders conjoined at midpoint of segment. Ovipositor about 1.5 times length of petiolar tergum. Legs long, slender; tarsal claws with strong basal lobe. Colour testaceous, black around ocelli and occipital region, legs are always light in colour. Male same as female except that ocelli and eyes slightly smaller.

**Distribution:** Western Palearctic. Country records: Austria; China; Czechoslovakia; Finland; Germany; Greece; Norway; Poland; Slovakia; Sweden; Switzerland; United Kingdom.

**Biology:** *M. lionotus* is most commonly recorded as a parasitoid of Geometridae larvae (Huddleston 1980, Yu et al. 2005).

### *Meteorus longicaudis* (Ratzeburg)

Fig. 106

*Perilitus longicaudis* Ratzeburg, 1884:55. Syntypes ♀, Germany (destroyed).

**Diagnosis:** Very long ovipositor and transverse head makes this species similar to *M. corax* and *M. nixoni* but the number of antennal articles separates *M. longicaudis* (29–32) from *M. corax* (39–41) and *M. nixoni* (43).

**Studied material:** ~ 10 specimens.

**Description:** Size about 5 mm. Antennal articles 29–32. Head broad, strongly rounded behind eyes. Ocelli small, OOL=3. Eyes slightly convergent. Malar space about equal to basal breadth of mandible. Face not strongly protuberant, about twice as broad as high. Clypeus moderately convex with scattered deep punctures and a broad polished reflexed border. Tentorial pits indistinct. Mandibles stout, slightly twisted. Precoxal sulcus rugose, always broadened anteriorly into a reticulate-rugose area. Propodeum strongly rugose, the carinae strong but not easily seen. Petiolar tergum very broad, length about 1.5 times apical breadth; dorsal pits large, distinct. Ovipositor very long, 4.5 times length of petiolar tergum. Legs long, hind coxa weakly rugose dorsally; tarsal claws simple but somewhat thickened at base, strongly curved. Colour black; antennae, head, prothorax and legs orange-testaceous; the basal half of hind tibia lighter yellow, almost ivory; the head is sometimes infuscated, at least in part, and 3<sup>rd</sup> abdominal tergite is often lighter in colour than rest of body. Male same as female except antennae longer, up to 36 articles.

**Distribution:** Western Palearctic. Country records: Croatia; Finland; Germany; Netherlands; Poland; Sweden; Yugoslavia.

**Biology:** *M. longicaudis* is recorded as a parasitoid of two beetles, *Orchesia micans* (Melandryidae) and *Eleonoprius amatus* (Tenebrionidae) (Huddleston 1980, Yu et al. 2005).

***Meteorus longipilosus* Stigenberg sp. nov.**

Fig. 64, 79D, 107

**Diagnosis:** *Meteorus longipilosus* at first looks like a hybrid between *M. abdominalator* and *M. cespitator*. Ovipositor length and head shape is similar to *M. cespitator* while the setae on the gena are long and scattered as in *M. abdominalator*. Also the wing venation resembles *M. abdominalator*. The face of *M. longipilosus* is “meaner looking” (eyes more strongly converging) and the malar space is shorter than in *M. abdominalator*. The two *M. longipilosus* specimens that we studied differ in size and colour: the paratype is smaller and more brownish than the holotype.

**Studied material:** Holotype: 1 ♀ SE. Vb. Vindelns kommun. Kulbäckslidens försökspark. 01.viii–18.viii.2003. (leg. SMTP), NHRS–HYME 4977, DNA 144. Paratype: 1 ♀ SE. Vr. Munkfors kommun. Ransäter, Rudstorp. 23.vii–12.viii.2005. (leg. SMTP), NHRS–HYME 4978, DNA 85.

**Description:** Body 3.6 mm, fore wing 3.1 mm.

Head: Length of eye 1.4 times length of temple in dorsal aspect; eyes large, convergent, not protuberant; width of face 1.6 times its height; OOL=2.5, ocelli hardly protruding; vertex smooth; clypeus almost as wide as face, distinctly divided from face, rather flat; length of malar space 0.5 times basal width of mandible; mandible stout, not twisted; number of antennal articles 25; 3rd antennal article 4.5 times longer than wide; 4th antennal article 3.6 times longer than wide; penultimate articles as wide as broad or slightly wider.

Mesosoma: Pronotum rugose all the way to the sides. Precoxal sulcus deep and narrow.

Wings: Fore wing:  $r/3-SR=0.7$ ;  $C+SC+R/SR=1.4$ ;  $m-cu$  antefurcal; pterostigma brown with. Hind wing:  $1-M/cu-a=1.1$ ;

Legs: Hind coxa smooth; hind femur 5.8 times longer than wide; tarsal claws slender with a very small lobe.

Metasoma: Petiolar tergum 1.9 times longer than wide apically, 4.1 times fore wing; dorsope present; ventral borders of petiolar tergum not joined, petiolar tergum striate with no dorsal central rugosity; ovipositor long and weakly curved downward, length of ovipositor 3.1 times petiolar tergum, and 0.75 times fore wing. Propodeum strongly convex, reticulate rugose and with all carina distinct, between carina with weak reticulation.

Colour: Black except: clypeus and palpi yellow; antennae yellow basally to brown apically; petiolar tergum brown and metasoma, legs and hind coxa yellow.

**Distribution:** Sweden.

**Biology:** The specimens of *Meteorus longipilosus* were caught in Malaise traps in late July to August. One was caught in a 15 yrs old spruce plantation and the other was caught on a sandy railway embankment through a pasture.

**Etymology:** The name *longipilosus* refers to the long setae that this species has.

***Meteorus melanostictus* Capron**

Fig. 108

*Meteorus melanostictus* Capron in Marshall 1887:115. Syntypes ♀, Great Britain (lost).

*Meteorus niger* Lyle, 1913:244. Lectotype ♀, Great Britain: England, Hampshire, New Forest, 13.v.1911 (Lyle), *H. syringaria* (BMNH, London) Synonymized by Huddleston, 1980:38.

*Meteorus monachae* Tobias, 1986:350 Holotype ♀, Russia: (ZIN. St. Petersburg)—examined. **Syn. n.**

**Diagnosis:** Similar to *M. cinctellus*. Both have a blunt tubercle in front of the fore ocellus but the large ocelli and the presence of a dorsope on the petiolar tergum clearly distinguish *M. melanostictus* from *M. cinctellus*, which has small ocelli and no dorsope. *M. melanostictus* also resembles *M. pendulus*, which has a dorsope and large ocelli but lacks the blunt tubercle in front of the fore ocellus.

**Studied material:** 31 specimens.

**Description:** Size about 4–5 mm. Antennal articles 25–27, all articles at least twice as long as broad. Head strongly contracted behind eyes; a blunt tubercle medially in front of the fore ocellus. Ocelli large, OOL=1.0–1.5. Eyes large, protuberant, moderately convergent. Malar space short, distinctly less than half the basal breadth of mandible. Face about as wide as high, not strongly protuberant. Clypeus strongly protuberant. Tentorial pits deep. Mandibles strongly twisted. Precoxal sulcus thin, foveolate. Propodeum short, with only a strongly raised medial

transverse carina. Petiolar tergum rather stout with distinct dorsal pits and large glymmae; ventral borders of petiolar tergum widely separated. Ovipositor short, about 1.5 times length of petiolar tergum. Legs short; hind coxa smooth, punctate; tarsal claws with a distinct basal lobe. Colour black; head mostly yellow, prothorax, legs yellow.

**Distribution:** Western and Eastern Palearctic. Country records: Bulgaria; Germany; Hungary; Ireland; Japan; Korea; Russia; Sweden; Switzerland; United Kingdom.

**Biology:** *M. melanostictus* mostly parasitizes on Geometridae but also on Tortricidae (Yu et al. 2005).

### *Meteorus micropilosus* Tobias

Fig. 109

*Meteorus micropilosus* Tobias, 1986:350. Russia: 'city Soch, Lazarevskoe, 8-9.V.1975' (Tobias) (ZIN. St. Petersburg)—examined.

**Diagnosis:** *Meteorus micropilosus* is similar to *M. brevicauda* but *M. micropilosus* has a postfurcal vein m-cu and narrow clypeus, whereas *M. brevicauda* has an antifurcal m-cu vein and a very broad clypeus that almost reaches the eyes.

**Studied material:** Holotype.

**Description:** Size about 3 mm. Antennae with 27 articles, all articles at least twice as long as broad. Head rounded behind eyes; a vague punctuated line going from the fore ocellus in between the antennae. Ocelli small, OOL=3. Eyes smaller, protuberant, not convergent. Malar space slightly less than the basal breadth of mandible. Face wider than high, not protuberant. Clypeus slightly protuberant with a few small punctures. Tentorial pits small. Mandibles stout and only slightly twisted. Precoxal sulcus wide, clearly invaginated. Propodeum with all carinae strongly raised, smooth in between. Petiolar tergum rather stout with distinct dorsal pits and large glymmae, noticeably angulate at spiracles; surface rugose centrally turning in to lineate structure laterally; ventral borders of petiolar tergum separated; Ovipositor short, about 1.5–2 times length of petiolar tergum. Hind coxa smooth-punctate; tarsal claws slender. Colour black; clypeus and legs yellow-brown. Pterostigma dark with only small light apical corner. Fore wing vein m-cu postfurcal.

**Distribution:** Russia.

**Biology:** The Holotype was caught in the beginning of May in a forest with terrace slopes by the city of Soch, Lazarevskoe in Russia.

### *Meteorus micropterus* (Haliday)

Fig. 34, 35, 36, 110

*Perilitus micropterus* Haliday, 1835:27. Lectotype ♀, Ireland: 'British, Haliday, 20.2.82' (NMI, Dublin).

**Diagnosis:** The shape of the head of *Meteorus micropilosus* is very characteristic by having a flattened frons and a strongly protuberant face, a shelf-shaped face. The only other *Meteorus* with a similarly shaped head is *M. salicorniae* but there should be no risk of confusing these species since *M. micropterus* is small (3 mm), black and slender with a round head whilst *M. salicorniae* is large (4–5 mm), reddish brown and with a transverse head.

**Studied material:** ~ 150 specimens.

**Description:** Size about 3mm. Antennal articles 23–26, short and thick. Ocelli small, OOL=3. Eyes small, inner orbits parallel; length of malar space at least equal to basal breadth of mandible. Face protuberant, punctate, projecting outward. Clypeus broad, smooth, distinctly divided from the face. Tentorial pits large and deep. Mandibles moderately twisted, large, stout. Precoxal sulcus foveolate. Propodeum reticulate-rugose, without distinct carinae. Petiolar tergum smooth, ventral borders fused beneath for at least the proximal half of the segment. Ovipositor twice length of petiolar tergum, straight. Legs stout; hind coxae rugose dorsally; tarsal claws without a lobe but strongly swollen at base. Wings short, narrow, usually infumate. Colour brownish black. Male same as female except eyes smaller; antennae with 24–28 articles, and articles longer.

**Distribution:** Palearctic. Country records: Czechoslovakia; Denmark; Finland; Germany; Ireland; Japan; Russia; Slovakia; Sweden; United Kingdom.

**Biology:** *M. micropterus* is a parasitoid of the Lepidoptera family Hepialidae (Huddleston 1980). We found 113 specimens (only 12 were female) within the SMTP. They were caught from July to November but the majority during August and September. They occur in both deciduous and coniferous forests.

### ***Meteorus nixonii* Huddleston**

Fig. 76, 111

*Meteorus nixonii* Huddleston 1980:40. Holotype ♀, Austria: Tyrol, Oberau, vii.1938 (Nixon) (BMNH, London)—examined.

**Diagnosis:** *Meteorus nixonii* is closely related to *M. corax* and *M. sulcatus*. All are large and dark species with a wide face. However, *M. nixonii* has large mandibles that are not twisted and its third abdominal tergum is equipped with only a few striae. *M. corax* and *M. sulcatus* both have short, twisted mandibles and they both have the third abdominal tergum densely covered with striae.

**Studied material:** 4 specimens.

**Description:** Size up to almost 1 cm. Antennae with 43 articles, long, all articles at least longer than broad. Head broad, contracted behind eyes but not strongly so; temples shorter than eyes. Ocelli small, OOL=2.5 times OD. Eyes small, protuberant, not or very little convergent. Malar space slightly shorter than basal breadth of mandible. Face about twice as broad as high, not strongly protuberant, centrally reticulate-rugose, laterally reticulate-punctate. Clypeus broad, only slightly narrower than face, not strongly protuberant but deeply impressed at the junction with face and with a strongly reflexed apical margin, sparsely punctured; clypeal hair conspicuously longer than facial hair. Tentorial pits deep and large. Mandibles large, not twisted. Pronotum strongly rugose. Mesonotum rather narrow, densely almost reticulately punctate, especially on the central lobe; notaulices thin, deeply impressed. Precoxal sulcus reticulate-rugose; rest of mesopleurae polished, punctate except for a subalar patch of rugosity. Propodeum with basal and medial transverse carinae and a central longitudinal carina, with rugose sculpture between. Petiolar tergum rather broad at base, apically only 2.5 times as broad as at narrowest point, the spiracles distinctly before mid-point; dorsal pits large and deep, behind dorsal pits strongly longitudinally strigose. 3<sup>rd</sup> abdominal tergum with distinct thyridia and a trace of longitudinal strigose sculpture. Ovipositor long, about 4 times length of petiolar tergum. Legs long; hind coxa shining, punctured but not densely so; hind femur densely reticulate-punctate; hind tibia swollen, though not as broad as femur, and narrow at base; tarsal claws thick, strongly curved and strongly swollen at base, almost with a basal lobe. Wings large, infumate. Colour: dark reddish-brown; mandibles, palps, fore and mid legs testaceous, hind coxa and femur brown, tibia black except at the base which is light yellow, hind tarsi black except at base and apex which are light yellow; malar space and clypeus slightly lighter in colour than rest of head.

**Distribution:** Palearctic. Country records: Austria; Japan; Korea; Russia.

**Biology:** The holotype was caught in July.

### ***Meteorus obfuscatus* (Nees von Esenbeck)**

Fig. 66, 112

*Bracon obfuscatus* Nees von Esenbeck, 1811:22. Syntypes, Germany (destroyed).

*Zelex thoracicus* Curtis, 1832: folio 415. Syntypes, Great Britain: England, Regent's Park (NMV, Melbourne) synonymized by Haliday, 1835:31.

*Perilitus formosus* Wesmael, 1835:36. Lectotype ♀, Belgium: Liege, coll. Wesmael (IRSNB, Brussels), synonymized by Marshall, 1887:106.

*Meteorus fodori* Papp, 1973:3 Holotype ♀, Yugoslavia: Montenegro, Bjela Gora, Grahovo, 1929 (Fodor) (HMHM, Budapest), synonymized by Huddleston, 1981:41. Male from same coll examined

**Diagnosis:** *Meteorus obfuscatus* is similar to *M. cespitator* and to *M. hirsutipes* but has a much shorter ovipositor (1.7–2.0 times petiolar tergum). The ovipositor is 3–4 times the petiolar tergum in *M. cespitator* and 2.2–2.5 times the petiolar tergum in *M. hirsutipes*.

**Studied material:** ~ 50 specimens.

**Description:** Size about 4–5mm. Antennae short, 23–29 articles, the basal articles about twice as long as broad, often shorter; the apical half are as long as broad. Head behind eyes contracted, rounded. Ocelli small, OOL=2.5. Eyes large, protuberant, slightly convergent. Malar space short, half the basal breadth of mandible. Face 1.5 times as broad as high, not strongly protuberant. Clypeus protuberant, slightly narrower than face sometimes with an impression in the medial part of the apical border. Tentorial pits small. Mandibles stout, moderately twisted. Precoxal sulcus deep and foveolate. Propodeum with distinct carinae, rugae in between. Petiolar tergum stout with distinct dorsal pits; generally somewhat raised medially. Ovipositor twice the length of petiolar tergum, slender, usually straight but in some down-curved. Legs long, slender; hind coxa smooth punctate; tarsal claws long, without a basal lobe but slightly swollen at base. Colour brownish black, legs always more or less yellow, prothorax usually orange-testaceous as well as sometimes antennae, head, mesothorax and abdomen. Male same as female, antennae longer, 29–32 articles.

**Distribution:** Palearctic. Country records: Belgium; Czechoslovakia; Finland; France; Germany; Hungary; Italy; Japan; Poland; Romania; Russia; Slovakia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** We found 3 specimens of *M. obfuscatus* within the SMTP. They were caught during August and September in an old heath with old beeches and in an old aspen forest. Host records of *M. obfuscatus* include five different coleopteran families: Cerambycidae, Erotylidae, Melandryidae (*Orchesia micans*) and Tenebrionidae (Huddleston 1980, Yu et al. 2005).

### *Meteorus obsoletus* (Wesmael)

Fig. 113

*Perilitus obsoletus* Wesmael, 1835:49. Lectotype ♀, Belgium: Brussels, coll Wesmael (IRSNB, Brussels).

*Meteorus viridane* Johansson, 1964:251. Holotype ♀, Sweden: Borgholm, 30.vi.1954, ex larva of *Tortrix viridanae* (L.) coll. 13–16.vi.1954 (Johansson) (MZLU, Lund) synonymized by Huddleston, 1980:42—examined

**Diagnosis:** *Meteorus obsoletus* is very similar to *M. versicolor*. The best diagnostic characters to separate these species are the length and shape of the ovipositor (slender and long, 2.0–2.5 times petiolar tergum in the former; stouter, 1.5–2.0 times petiolar tergum in the latter), the shape of the eyes (not so protruding in the former, strongly protruding in the latter) and the temple (longer and more rounded in the former, more contracted in the latter).

**Studied material:** ~ 10 specimens.

**Description:** Size about 3.5–4mm. Antennal articles 27–30. Head rounded behind eyes. Ocelli large, OOL=OD. Eyes not protuberant, slightly convergent. Clypeus slightly protuberant. Tentorial pits small and shallow. Mandibles small, strongly twisted. Precoxal sulcus reticulate-rugose. Propodeum rounded with a weak medial impression posteriorly, irregularly reticulate-rugose. Petiolar tergum slender, finely longitudinally striate dorsally, without dorsal pits. Ovipositor 2.0–2.5 times length of petiolar tergum, straight and slender. Hind coxa smooth, tarsal claws with strong basal lobe. Colour brownish black; head, prothorax, legs, mesothorax and abdomen usually testaceous. Male same as female except eyes and ocelli smaller.

**Distribution:** Palearctic. Country records: Austria; Belgium; Bulgaria; Czechoslovakia; France; Germany; Ireland; Italy; Japan; Korea; Moldova; Netherlands; Sweden; Switzerland; Turkey; Ukraine; United Kingdom; Yugoslavia.

**Biology:** We found one specimen within the SMTP. It was caught in the middle of July in an old spruce forest. Host records of *M. obsoletus* include four different Lepidoptera families, but the predominant hosts appear to belong to the family Tortricidae. In Japan they were found on the species *Choristoneura diversana* (Tortricidae) and Huddleston (1980) also mentions the species *Tortrix viridana* and *Gypsonoma dealbana* (Tortricidae).

### *Meteorus oculatus* Ruthe

Fig. 114

*Meteorus oculatus* Ruthe, 1862:23. Lectotype ♀, Germany: Ruthe coll. (BMNH, London)—examined.

*Meteorus pachypus* Schmiedeknecht, 1897:207. Lectotype ♀, Germany: coll. Schmiedeknecht (ZMHB, Berlin), synonymized by Huddleston, 1980:42.

**Diagnosis:** The eyes of *Meteorus oculatus* are very large, protruding and strongly converging, a unique combination of characters among western Palearctic species. The Asian species (Japan, Korea and China) *M. graciliventris* and *M. endoclytae* also have large, protruding and converging eyes but they are much larger species with body length up to 7 mm.

**Studied material:** ~ 40 specimens.

**Description:** Size about 4–5mm. Antennal articles 30–33, rather slender, in apical half of the flagellum, the articles are only slightly longer than broad. Head broad, strongly contracted behind eyes. Ocelli small, OOL about 2.5. Eyes very large, protuberant, strongly convergent. Malar space very short, much less than half the basal breadth of a mandible. Face about as broad as high. Clypeus slightly protuberant. Tentorial pits large. Mandibles slightly twisted. Precoxal sulcus deep. Propodeum rather narrow, strongly rugose with indistinct carinae. Petiolar tergum long, slender; dorsal pits distinct but small. Ovipositor long and straight, about 3 times length of petiolar tergum. Hind tibia strongly swollen, about as thick as femur but constricted at base. Tarsal claws short, simple and thick, strongly expanded at base. Colour black, legs testaceous; antennae, clypeus, mandibles, pronotum ventrally and 3<sup>rd</sup> abdominal tergite also lighter in colour; wings infumate. Male same as female except that eyes are less strongly convergent and hind tibia not strongly swollen.

**Distribution:** Western Palearctic. Country records: Austria; Bulgaria; Czechoslovakia; Finland; Germany; Hungary; Kyrgyzstan; Lithuania; Norway; Poland; Sweden; Switzerland; Turkey; United Kingdom.

**Biology:** We found 29 specimens within the SMTP. They were caught from end of June to the end of September in mixed forests or in open terrain. *M. oculatus* is only recorded from *Taleporia tubulosa* (Lepidoptera Psychidae) (Yu et al. 2005).

### *Meteorus pendulus* (Müller, 1776)

Fig. 12, 22, 50, 72, 116

*Meteorus pendulus* Müller, 1776:106

*Meteorus pendulator* Latreille, 1799:138. *M. pendulator* is an invalid emendation of *M. pendulus* Müller, 1776 (Yu et al., 2005)

*Ichneumon gyrator* Thunberg, 1822:261. Holotype ♂, Sweden (UDE, Uppsala) synonymized by van Achterberg et al. 2009:790—examined.

*Perilitus scutellator* Nees von Esenbeck, 1834:38. Syntypes, Germany (lost), synonymized by Roman, 1912:289.

*Bracon petiolator* Zetterstedt, 1838:399. Lectotype, Sweden: Scandinavia Lapponia. (MZLU, Lund) synonymized by Papp, 1994:306—examined

*Meteorus melanostictus* Capron in Marshall, 1887:115. Males only from type-series.

*Meteorus parvulus* Thomson, 1895:2156. Holotype ♀, Sweden: Öland (MZLU, Lund) synonymized by Huddleston, 1980:32—examined.

**Diagnosis:** *Meteorus pendulus* resembles *M. ictericus* but there are some good characters separating them. *M. ictericus* has whitish hairs between the eyes and the clypeus, rugose glymmae, and a long ovipositor (2.5–3.0 times length of petiolar tergum). *M. pendulus* lacks the whitish hairs on the face, the glymmae are smoother, and the ovipositor is short and stout (only 1.5–2.0 times petiolar tergum).

**Studied material:** ~ 60 specimens.

**Description:** Size about 4.5–5mm. Antennae long, 30–34 articles. Head always contracted behind eyes, occasionally strongly rounded. Frons with a depression in front of the fore ocellus. Ocelli large, OOL=1.0–1.5 (seldom OOL=2). Eyes large, protuberant, slightly convergent. Malar space equal or a little less than basal breadth of mandible. Face little broader than high, slightly protuberant. Clypeus strongly protuberant. Mandibles long, strongly twisted. Precoxal sulcus narrow, foveolate. Propodeum broad, rather flat, with dense, fine rugosity, with a central longitudinal carina. Petiolar tergum with dorsal pits, shallow glymmae. Ovipositor short, 1.5–2.0 times length of petiolar tergum, thick. Legs long, thin; hind coxa smooth, punctate, often laterally with a trace of rugosity. Tarsal claws with a basal lobe. The pterostigma always uniformly pale testaceous. Forewing vein m-cu mostly interstitial



but in some specimen postfurcal. Colour mostly orange-testaceous with sometimes some black areas. Male same as female except eyes smaller and malar space longer; colour darker, the pterostigma often dark with a pale border.

**Distribution:** Western and Eastern Palearctic. Country records: Austria; Azerbaijan; Belgium; Bulgaria; China; Croatia; Cyprus; Czechoslovakia; Denmark; Egypt; Finland; France; Germany; Greece; Hungary; Iran; Ireland; Israel; Italy; Japan; Korea; Latvia; Lithuania; Madeira Islands; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Slovakia; Sweden; Switzerland; Turkey; Ukraine; United Kingdom; Yugoslavia.

**Biology:** We found 29 specimens within the SMTP. They were mostly caught during July and August in a wide variety of biotopes with a slight preference towards pine forests. Host records of *M. pendulus* include the lepidopteran families Geometridae, Lasiocampidae, Lycaenidae, Lymantriidae, Noctuidae and Tortricidae (Huddleston 1980, Yu et al. 2005).

### *Meteorus politutele* Shenefelt

Fig. 59, 117

*Meteorus politutele* Shenefelt, 1969:86.

*Meteorus politus* Telenga, 1950

**Diagnosis:** This is a large, punctate, yellow species with two dark spots on the petiolar tergum, a unique combination of characters in the genus.

**Studied material:** 1 specimen.

**Description:** Size 4–5mm. Antennal articles about 30, all longer than broad, basal articles darker in colour. Head broad, strongly contracted behind eyes. OOL=1.5. Frons with rather deep ventrally striated invagination. Eyes large, protuberant and only slightly converging. Malar space equal to mandible base or slightly shorter. Face 1.6 broader than high, not protruding. Clypeus protuberant, mandibles somewhat smaller and slightly twisted. Precoxal sulcus broad, whole area strongly punctate. Propodeum broad and with no distinct carina. Petiolar tergum with dorsope, dorsal surface finely striated. Petiolar tergum 3.7 times fore wing. Hind coxae slightly punctate.

**Distribution:** Turkey; Uzbekistan.

**Biology:** The male lectotype was caught in Uzbekistan, in May 1929.

### *Meteorus pulchricornis* (Wesmael)

Fig. 23, 28, 50, 72, 118

*Perilitus pulchricornis* Wesmael, 1835:42. Lectotype ♀, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels).

*Meteorus striatus* Thomson, 1885:2157. Lectotype ♀, Sweden: Skåne, Pålsjö (MZLU, Lund) synonymized by Huddleston, 1980:45—examined.

*Meteorus thomsoni* Marshall, 1899: 301.

*Meteorus japonicus* Ashmead, 1906:190. Lectotype ♀, Japan:Gifu, viii.1902 (USNM, Washington), synonymized by Marsh (1979).

*Meteorus nipponensis* Viereck, 1912:624. Holotype ♀, Japan (USNM, Washington) synonymized by Watanabe, 1939

*Meteorus macedonicus* Fischer, 1957a:104. Holotype ♀, Yugoslavia: Macedonia, treskaslucht (NHM, Vienna), synonymized by Huddleston, 1980:45

*Meteorus graeffei* Fischer, 1957a:107. Holotype ♀, Italy: 'Triest' (NHM, Vienna), synonymized with *macedonicus* by Fischer, 1970b:287.

*Meteorus tuberculifer* Fischer, 1957a:108. Holotype ♀, Italy: 'Trieste Küstenland, coll Graeffe (NHM, Vienna), synonymized by Huddleston, 1980:45.

*Meteorus baicalensis* Telenga, 1950, synonymized by Belokobylskij 2000:209.

**Diagnosis:** The dense, short and erect setae on the clypeus along with the indications of dorsope on the petiolar tergum are good characters for distinguishing *M. pulchricornis*. It is closest to, and easily confused with *M. abscissus*. *M. abscissus* has the ventral sides of the petiolar tergum not closed, contrary to *M. pulchricornis* which have the ventral sides of the petiolar tergum closed. The dorsal pits on the petiolar tergum of *M. abscissus* are sometimes small and complicates the identification with *M. pulchricornis* that has no true dorsal pits.

**Studied material:** ~ 80 specimens.

**Description:** Size about 5mm. Antennae with 29–33 articles, long, slender; all articles distinctly longer than broad. Ocelli large, OOL=1.5. Eyes large, protuberant, moderately convergent. Malar space slightly shorter than basal breadth of mandible. Face not strongly protuberant but slightly raised medially. Clypeus strongly protuberant, evenly convex with a dense pile of erect setae. Mandibles small and strongly twisted. Precoxal sulcus reticulate-rugose with emphasis on reticulate. Propodeum without distinct carinae, strongly reticulate-rugose. Petiolar tergum longitudinally striate, usually with no dorsal pits but with indications of pits. Ovipositor 1.5–2.0 times length of petiolar tergum. Legs long, slender; hind coxa generally completely rugose, this sculpture always fine, never reticulate though sometimes transverse. Tarsal claws with a strong basal lobe. Colour mostly yellow. Completely pale specimens sometimes occur. Male same as female except antennae slightly longer; face occasionally strongly raised medially; propodeum with greater variation in sculpture, smaller, and more depressed.

**Distribution:** Palearctic, Oceanic and Nearctic. Country records: Armenia; Austria; Azerbaijan; Belarus; Belgium; Bulgaria; Chile; China; Croatia; Cyprus; Czechoslovakia; Finland; France; Georgia; Germany; Greece; Hungary; India; Iran; Ireland; Israel; Italy; Japan; Korea; Lithuania; Macedonia; Moldova; Morocco; Netherlands; New Zealand; Norway; Poland; Portugal; Romania; Russia; Slovenia; Spain; Sweden; Switzerland; Turkey; Ukraine; United Kingdom; USA; Yugoslavia.

**Biology:** We found two specimens within the SMTP. They were caught in September, one in a mixed forest and the other in a heather heath. *M. pulchricornis* is primarily a parasitoid of Noctuidae, although there are records from 17 other lepidopteran families (Yu et al. 2005). Amongst the studied *Meteorus* material at Hokkaido University in Japan, we found specimens that was reared from *Evergestis forficalis*, *Leucania separate*, *Zanclognatha fractalis*, and *Ilema sorocula*. The biology and ecology of this species have been studied extensively (Askari et al. 1977, 1978, Fuester et al. 1993, Berry et al. 2004, Chau et al. 2009).

### *Meteorus punctifrons* Thomson

Fig. 55, 119

*Meteorus punctifrons* Thomson, 1895:2166. Holotype ♀, Sweden: Åreskutan i Jämtland (MZLU, Lund)—examined.

*Meteorus varinervis* Tobias, 1986:339, Holotype ♀, Russia: 'City Archangelsk, [Pityogenes chalcographus and Pityophthorus micrographus] 6.VII.1964' (Pryakhina), (ZIN. St. Petersburg)—examined. **Syn. n.**

**Diagnosis:** This is a small, slender species, and it is rare, at least in collections. It is easily recognized by the characteristic frontal punctuation, the subcubic head and the minute ocelli. Similar small species are *M. brevicauda* and *M. micropilosus*, but neither of them has a subcubic head with large frontal punctures.

**Studied specimens:** ~ 10 specimens.

**Description:** Size small. Antennal articles 26–27. Head subcubic. Ocelli very small OOL=4 times OD. Eyes small, only slightly convergent. Face about twice as broad as high; frons with a short groove in front of ocellus. There is a patch, between ocelli and eye, of large punctures separated at most by a distance equal to their diameter. Mandible stout, slightly twisted. Propodeum short, with distinct carinae, excavate apically. Petiolar tergum short and wide, with small but distinct dorsal pits. Ovipositor short, about 1.5 times length of petiolar tergum, down-curved. Legs very long, slender; hind coxa only slightly rugose at the base; tarsal claws long, slightly swollen at base. Colour brownish black with testaceous parts. Male same as female.

**Distribution:** Western Palearctic. Country records: France; Norway; Russia; Sweden.

**Biology:** *Meteorus punctifrons* is a parasitoid of *Corticus longulus* (Coleoptera, Tenebrionidae) (Huddleston, 1980).

### *Meteorus radialis* Tobias

Fig. 56, 120

*Meteorus radialis* Tobias, 1986:341. Holotype ♀, Russia: (ZIN. St. Petersburg)—examined.

**Diagnosis:** The radial cell, small ocelli and long ovipositor are striking features. No other European *Meteorus* species has a wing venation like *Meteorus radialis*.

**Studied material:** Holotype.

**Description:** Size medium to small. Antennal articles 24. Head rounded behind the eyes. Ocelli very small, OOL up to 6 times OD. Eyes large, protruding and converging. Malar space 0.6 times mandible base. Mandibles stout not twisted. Face 1.4 times broader than high, not protruding but medially rugose. Clypeus protruding, with long setae and as wide as face, punctate. Precoxal sulcus very broad, punctuate, about 90% of mesopecta reticulate-punctate. Propodeum reticulate – rugose and with longitudinal and transverse carina. Petiolar tergum with dorsal pits and dorsal striate. Fore wing 4.2 times petiolar tergum. Ovipositor long, 2.3 times petiolar tergum. Hind coxae rugose. Radial cell of forewing very narrow, stigma narrow and brown.

**Distribution:** Kola peninsula, Russia.

**Biology:** Both the holotype and the paratype were caught in July in a forest. Otherwise the biology is unknown.

### ***Meteorus rubens* (Nees von Esenbeck)**

Fig. 19, 25, 27, 29, 121

*Bracon rubens* Nees von Esenbeck, 1811:22. Syntypes ♀, Germany lost

*Perilitus leviventris* Wesmael, 1835:46. Lectotype ♀, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels), synonymized by Fischer, 1970b:260—examined.

*Meteorus islandicus* Ruthe, 1859:317. Syntypes, Iceland: Staudinger coll. (NM, Vienna), synonymized by Roman, 1917:4—examined.

*Meteorus medianus* Ruthe, 1862:53. Lectotype ♀, Germany: Ruthe coll. (BMNH, London), synonymized with *leviventris* by Marshall, 1887:126—examined.

*Meteorus scutatus* Costa, 1884:172. Holotype ♀, Italy: Oristano (MZ, Naples), synonymized by Huddleston, 1980:47

*Meteorus heteroneurus* Thomson, 1895:2158. Holotype ♀, Sweden: Västergötland (MZLU, Lund), synonymized by Fischer, 1970b:260—examined.

*Meteorus szechuanensis* Fahringer, 1935:11. Lectotype ♀, China: No Szechuan (NHRS, Stockholm), synonymized by Huddleston, 1980:47—examined.

*Meteorus mesopotamicus* Fischer, 1957a:105. Holotype ♀, Iraq: Mosul (NM, Vienna), synonymized by Huddleston, 1980:47—examined.

**Diagnosis:** The traces of dorsopes on the petiolar tergum, the shortened marginal cell and the ovipositor are key characters for *Meteorus rubens*. The closest species to *M. rubens* is *M. heliophilus*, but the longer marginal cell of the latter and the more numerous antennal articles (30–32 in *M. heliophilus*, 24–28 in *M. rubens*) are good characters to separate these species.

**Studied material:** ~ 100 specimens.

**Description:** Size about 4–5mm. Antennae short, 24–28 articles; the articles in the distal half of the flagellum often only as long as broad but sometimes longer than this. Ocelli large, OO= 1.0–1.5. Eyes only slightly convergent. Malar space slightly less than basal breadth of mandible. Face a little less than twice as wide as high, protuberant with a medial longitudinal raised area which is finely transversely rugose. Clypeus protuberant, transverse with long setae. Tentorial pits large, distinct. Mandibles long, moderately twisted, the upper tooth generally rather long. Precoxal sulcus a shallow rugose furrow. Propodeum rugose and generally with only a medial longitudinal carina. Petiolar tergum often with traces of dorsal pits. Ventral borders of petiolar tergum conjoined in the midpart of the segment. Ovipositor twice length of petiolar tergum, thick, strongly swollen at the base. Hind coxa smooth, punctuate–weak rugosity dorsally at the base. Tarsal claws never strongly bent and usually only swollen at the base. Colour varies from completely black to completely yellow with all intermediate stages represented. Male same as female except antennae longer, 26–30 articles, all flagellar articles distinctly longer than broad; the propodeum is more depressed, often less strongly rugose and with the carinae more distinct.

**Distribution:** Palearctic and Nearctic. Country records: Algeria; Argentina; Armenia; Austria; Azerbaijan; Belgium; Bulgaria; Canada; China; Costa Rica; Croatia; Cyprus; Czechoslovakia; Denmark; Egypt; Faeroe Islands; Finland; France; Germany; Greece; Greenland; Hungary; Iceland; Iran; Iraq; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Latvia; Lithuania; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Tunisia; Turkey; Turkmenistan; USA; Ukraine; United Kingdom; Yugoslavia.

**Biology:** We found 35 specimens within the SMTP. They were caught from July to September in both deciduous and coniferous forests. *Meteorus rubens* has been recorded as a parasitoid of several families of Lepidoptera, but members of the Noctuidae appear to be the primary hosts (Yu et al. 2005).

### *Meteorus ruficeps* (Nees)

Fig. 122

*Meteorus ruficeps* Nees, 1834:39. Type material lost. Synonymized by Papp 1983:318.

*Perilitus pallipes* Wesmael, 1835:29. Lectotype ♀, Belgium: coll. Wesmael (IRSNB, Brussels). Synonymized by Papp 1983:318.

*Meteorus nigritarsis* Ruthe, 1862:21. Holotype ♀, Germany: Ruthe coll. (BMNH, London), synonymized with *pallipes* by Huddleston, 1980:43—examined.

**Diagnosis:** *Meteorus ruficeps* and *M. ictericus* are quite similar morphologically. The main differences between them involve the size of the ocelli and the convergence of the eyes. *Meteorus ruficeps* has converging eyes, the face is higher than broad, and the ocelli are slightly smaller (OOL=1.5–2.0). The eyes of *M. ictericus* are not so converging, the face is as wide as high, and the ocelli are larger (OOL=1.0–1.5).

**Studied material:** ~ 30 specimens.

**Description:** Size about 4–5mm. Antennal articles 26–31, all articles slightly longer than broad. Head strongly rounded behind eyes. Ocelli large, OOL=1.5–2 times OD. Eyes strongly convergent. Malar space short, about half basal breadth of mandible. Face with a slightly raised medial longitudinal area. Tentorial pits deep. Mandibles stout, moderately twisted. Precoxal sulcus foveolate. Propodeum rugose with usually only the medial transverse carina developed. Petiolar tergum stout with distinct dorsal pits and glymmae. Ovipositor 2.5–3.0 times length of petiolar tergum. Hind coxa smooth, punctate; tarsal claws with distinct basal lobe. Colour black, legs always yellow; head at least in part yellow. Male same as female except antennae longer, eyes not strongly convergent.

**Distribution:** Western Palearctic. Country records: Austria; Bulgaria; Czechoslovakia; France; Germany; Hungary; Japan, Latvia; Macedonia; Norway; Poland; Slovakia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** We found 11 specimens within the SMTP. They were caught from July to September, mostly in coniferous forests. *M. ruficeps* is primarily a parasitoid of Tortricidae (Lepidoptera) but it has also been recorded as attacking Gelechiidae, Geometridae, Noctuidae and Tineidae (Huddleston 1980, Yu et al. 2005).

### *Meteorus rufus* (De Geer)

Fig. 123

*Ichneumon rufus* De Geer, 1778:596. Type material lost.

*Perilitus unicolor* Wesmael, 1835:41. Lectotype ♀, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels)—examined.

*Saprotichus chinensis* Holmgren, 1868:430. Holotype ♀, China (NHRS, Stockholm), synonymized by Huddleston, 1980:51—examined.

**Diagnosis:** *Meteorus rufus* is similar to *M. pendulus* but it has longer antennae with more antennal articles (35–36 articles in the former, 30–34 in the latter) and larger ocelli (OOL=2 in the former, OOL=1–1.5 in the latter).

**Studied material:** ~ 10 specimens.

**Description:** Size about 5.5 mm. Antennae long, up to 36 articles; all articles of flagellum distinctly longer than broad, most at least twice as long as broad. Ocelli large, OOL=2 times, protuberant. Eyes protuberant, slightly convergent. Malar space about equal in length to basal breadth of mandible. Face 1.5–2.0 times as broad as high, not strongly protuberant but distinctly raised medially and there with transverse structure. Clypeus strongly protuberant, densely rugulose-punctate with scattered long setae. Mandibles long, slender, strongly twisted. Precoxal sulcus broadened, strongly reticulate-rugose. Propodeum broad and with no distinct carinae dorsally. Petiolar tergum stout with large dorsal pits and distinct glymmae; ventral borders of petiolar tergum only narrowly separated at mid point of segment; dorsal surface longitudinally striate. Ovipositor twice the length of petiolar tergum, thick,

strongly swollen at base, straight. Hind coxa foveolate laterally, often with a few strong rugae dorsally. Tarsal claws with a large basal lobe. Colour testaceous, base of petiolar tergum paler yellow.

**Distribution:** Western Palearctic. Country records: Austria; Belgium; Croatia; Cyprus; Czechoslovakia; France; Germany; Hungary; India; Ireland; Israel; Italy; Poland; Romania; Sweden; Switzerland; Turkey; Ukraine; United Kingdom; Yugoslavia.

**Biology:** *Meteorus rufus* is recorded in the literature as a parasitoid of seven different lepidopteran families: Geometridae, Lymantriidae, Noctuidae, Pieridae, Pyralidae, Tortricidae and Zygaenidae (Huddleston 1980, Yu et al. 2005). The specimens we studied were all associated with Zygaenidae when host data were available.

**Remarks:** De Geer collected a specimen at his estate in Sweden that he described in 1778 as *Ichneumon rufus*. According to the German Braconidae checklist by Belokobylskij et al. (2003), *Ichneumon rufus* De Geer, 1778 is a synonym for *M. unicolor*. We have studied the type material of *M. unicolor* (lectotype) from Belgium and conclude that it agrees with our interpretation of the description of *M. rufus*. We have also studied the De Geer collection but, as Huddleston wrote in his revision in 1980, there is no specimen of *Ichneumon rufus* present and no pinhole in the cork below the label. The specimen has probably been lost prior to the relocation of the De Geer specimens into new drawers.

### ***Meteorus salicorniae* Schmiedeknecht**

Fig. 65, 124

*Meteorus salicorniae* Schmiedeknecht, 1897:189. Lectotype ♀, Germany: Artern (ZMHB, Berlin).

*Meteorus ocellatus* Watanabe, 1951:45. Holotype ♀, Japan: Kyushu Hikosan, 17.v.1948 (Yasumatsu) (EI, Sapporo), synonymized by Huddleston, 1980:48.

**Diagnosis:** *Meteorus salicorniae* has four characteristics of the head that are very distinctive: the protruding face, the depression in the frons, the transverse face and the shape of the antennae. The only species in the Western Palearctic with a similarly protruding face is *M. micropterus*, but *M. micropterus* has a subcubic face, not transverse, and the antennae are only slightly tapering to the apex, not strongly so as in *M. salicorniae*.

**Studied material:** ~ 10 specimens.

**Description:** Size 4–5mm. Antennal articles 33–35. The articles are thick at base and strongly tapering to apex. The antennae are set in a depression in the frons. Ocelli small, OO= 2.5–3.5. Eyes small and not convergent. Face protuberant. Malar space slightly longer than the basal breadth of mandible. Face transverse, about twice as broad as high, minutely punctured. Clypeus protuberant and not as broad as face. Mandibles large, not twisted. Precoxal sulcus very deep. Propodeum high, rounded with diffuse carinae though strongly reticulate-rugose. Petiolar tergum with small but distinct dorsal pits. Ovipositor about 2.5 times the length of petiolar tergum. The ovipositor sheaths with erect long setae. Colour testaceous.

**Distribution:** Western and Eastern Palearctic. Country records: Austria; Bulgaria; Croatia; Czechoslovakia; Germany; Greece; Hungary; Italy; Japan; Korea; Romania; Switzerland; Turkey; Yugoslavia.

**Biology:** *M. salicorniae* is recorded as a parasitoid of the lepidopteran family Pyralidae (Yu et al. 2005).

### ***Meteorus sibyllae* Stigenberg sp nov.**

Fig. 79E, 125

**Diagnosis:** *Meteorus sibyllae* is most similar to *M. cespitator* and *M. jaculator*. It is most easily separated from *M. cespitator* on the body size. Whilst *M. sibyllae* belongs to the smaller species in the genus (length < 3.5 mm), *M. cespitator* is distinctly larger (length > 3.5 mm). The face of *M. sibyllae* is also more transverse and wider than that of *M. cespitator* (face 1.8 times as wide as high in the former, 1.5 times in the latter). *M. jaculator* is as small as *M. sibyllae* but has fewer antennal articles (18–22 in *M. jaculator*, 24–26 in *M. sibyllae*).

**Studied material:** 3 ♀. Holotype: 1 ♀ SE. Sm. Nybro kommun. Alsterbro/Alsterån. 19.viii–05.ix.2006. (leg. SMTP), NHRS–HYME 5208, DNA 172. Paratype: 2 ♀ SE. Dr. Sätters kommun. Säterdalen, Näsåkerspussen. 21.vii–04.viii.2003. (leg. SMTP), NHRS–HYME 5220, NHRS–HYME 5218 is mounted for SEM.

**Description:** Body 3.0 mm, forewing 3.2 mm of holotype. Paratypes have 2.7–3.0 mm in body lengths.

Head: Length of eye equals the length of temple in dorsal aspect; eyes small, not convergent, slightly protuberant, smooth with punctation; width of face 1.8 times its height; OOL=3–3.5; clypeus distinctly shorter than the width of face, distinctly divided from face, convex, tentorial pits distinct; length of malar space 0.6 times basal width of mandible; mandibles stout and not twisted; antennal articles 24–26; 3rd antennal article 3.5 times longer than wide; all articles longer than wide, subapical articles 1.5 times longer than wide.

Mesosoma: Precoxal sulcus deep and narrow.

Wings: Fore wing:  $r/3-SR=0.4$ ;  $C+SC+R/SR1=1.37$ ; m-cu antefurcal; pterostigma brown with apical corner light. Hind wing:  $1-M/cu-a=1.2$ ;

Legs: Hind coxa rugose dorsally; hind femur 4.8 times longer than wide; tarsal claws small with no lobe.

Metasoma: Petiolar tergum apically 1.5 times longer than wide, 4.2 times as long as forewing; dorsope present; ventral folds of petiolar tergum not joined, dorsal aspect with no ridges, evenly curved with weak rugosity medially and striae laterally; ovipositor straight, slender; length of ovipositor 3.5–4.0 times that of petiolar tergum and 0.75 times forewing; propodeum with vague carina and reticulation.

Colour: Dark brown - black, clypeus yellow, legs yellow - brown, coxae dark brown.

**Distribution:** Sweden.

**Biology:** We found 3 specimens within the SMTP. They were caught in August in deciduous and mixed forests.

**Etymology:** This species is named after Ms Sibyllae Noack, a fellow PhD student.

### *Meteorus stenomastax* Stigenberg sp. nov.

Fig. 38, 39, 46, 79F, 126

**Diagnosis:** The body has a unique colour combination of light red and darker red-brown patches and that in combination with the slender antennae and long, yellow-brown coloured pterostigma distinguish *Meteorus stenomastax* from related species. In Huddleston's key it runs to *M. cinctellus* but the long and slender antennae and ovipositor length (length of ovipositor 1.8 times petiolar tergum in the former and 2.0–2.5 in the latter) distinguish it from *M. cinctellus*, which has rather stout antennae.

**Studied material:** 6 ♀. Holotype: 1 ♀ SE. Vb. Vindelns kommun. Kulbäckslidens försökspark. 01.ix–22.ix.2003. (leg. SMTP), NHRS–HYME 5052, DNA 17. DNA voucher specimen. Paratypes: 3 ♀ SE. Lapl. Kiruna kommun. Abisko national park. 08.vii–05.viii.2004. One dry-pinned (left hind leg damaged and glued separately) NHRS–HYME 5051, and one in ethanol DNA 16, and the third is a mounted SEM specimen and DNA 119 (leg. SMTP), in NHRS. SE. Sö. Huddinge kommun. Sofielunds återvinningsanläggning. 16.vi.30.vi.2004. (leg. SMTP), NHRS–HYME 5213, DNA 173. 1 ♀ Dalarna, (UUZM).

**Description:** Body 4.4 mm, fore wing 3.7 mm.

Head: Length of eye 1.6 times length of temple in dorsal aspect; eyes large, convergent and protuberant; face as wide as high; OOL=1.9; vertex smooth; frons with a prominent tubercle; clypeus as wide as minimum width of face, protruding and distinctly divided from face, convex with large punctuation; tentorial pits distinct; length of malar space 0.5 times basal width of mandible; mandibles twisted; antennal articles 28; 3rd antennal article 3.5 times longer than wide and 4th antennal article 3.25 times longer than wide; all articles longer than wide, subapically at least 1.5 times longer.

Mesosoma: Precoxal sulcus broader than narrow.

Wings: Fore wing:  $r/3-SR=0.3$ ;  $C+SC+R/SR1=1.6$ ; m-cu antefurcal; pterostigma yellow–brown. Hind wing:  $1-M/cu-a=1.1$ ;

Legs: Hind coxa granulate; hind femur 6.2 times longer than wide; tarsal claws small with lobe.

Metasoma: Petiolar tergum 2.25 times longer than wide apically, 4.5 times fore wing; dorsope absent; ventral folds of petiolar tergum not joined, a little gap remaining; ovipositor straight; length of ovipositor 1.8 times petiolar tergum, and 0.45 times fore wing; propodeum convex, reticulate–rugose and with a central longitudinal carina;

Colour: Frons black; occiput and vertex brown; otherwise yellow–brown; pronotum and mesopleuron red–brown; propodeum black with a red–brown patch laterally; petiolar tergum black; 3rd abdominal tergite yellow rest is brown; legs dark yellow to brown.

**Distribution:** Sweden.

**Biology:** We found 5 specimens within the SMTP. Three specimens were caught in alpine birch forest, one was caught in spruce/larch forest, and one was caught in a recycling facility in a spruce forest. The specimens were caught from the end of June to the middle of September.

**Etymology:** The name *stenomastax* is derived from the Greek words *steno* (narrow), and *mastax* (mouth), referring to the narrow clypeus of this species.

### ***Meteorus subjaculator* Tobias**

Fig. 127

*Meteorus subjaculator* Tobias, 1986:344 Holotype ♀, Russia: 'Altai river Katun, 9.viii.1909' (Gorchakovskiy) (ZIN, St. Petersburg)—examined.

**Diagnosis:** *Meteorus subjaculator* is similar to *M. cis* but has a longer ovipositor (3.5 times the length of the petiolar tergum in the former, 2.0 in the latter). Another character separating these two species is the sculpture of the propodeum. *M. subjaculator* has the propodeum set with vague carinae, hidden in rugosity, whilst *M. cis* has distinct carinae and smooth areas in between.

**Studied material:** 2 specimens.

**Description:** Size 3.5 mm. Antennal articles 23. Head slightly transverse but rounded behind eyes. Ocelli small, OOL=4. Eyes small, slightly protuberant. Malar space slightly shorter than basal breadth of mandible. Face 1.2 times as broad as high, punctate, not strongly protuberant. Clypeus narrower than face, almost flat, its apical border weakly notched medially and usually with a weak vertical impression behind the notch. Tentorial pits distinct. Mandibles short, stout and moderately twisted. Precoxal sulcus wide, rugose. Propodeum with slight carinae, quite rugose. Petiolar tergum with small dorsal pits, dorsal surface, from base to apical end, reticulate-rugose with a few longitudinal striae laterally. Ovipositor 3.5 times the length of petiolar tergum, slender. Legs slender; hind coxa punctate. Tarsal claws not lobed but somewhat swollen basally. Colour testaceous to brown; clypeus, mandibles and usually 3<sup>rd</sup> abdominal tergum reddish testaceous; coxa and legs yellow. Pterostigma dark with light upper border. Fore wing m-cu antefurcal, vein 2-SR+M as long as vein r.

**Distribution:** Russia.

**Biology:** Unknown.

### ***Meteorus subtilisulcus* Stigenberg sp nov.**

Fig. 69, 79g, 128

**Diagnosis:** The short (1.6 times petiolar tergum), straight ovipositor in combination with the wide and flat clypeus and short malar space (0.1 times the width of mandible base) clearly distinguish this species. It mostly resembles *M. densipilosus*, but this species has a longer ovipositor (2.0 times the length of the petiolar tergum), a slightly convex and narrow clypeus and a wider malar space (0.5 times the width of mandible base).

**Studied material:** Holotype ♀ FIN. Turunja Porin Lääni, SSW. Dragsfjärd, 29.vii.1992. M. Söderlund, RMNH'97.

**Description:** Body 3.5 mm, fore wing 3.8 mm.

Head: Length of eye 0.6 times length of temple in dorsal aspect; eyes large, converging and slightly protuberant; width of face 1.7 times its height; OOL=2.3; vertex smooth but setate; face punctulate; clypeus as wide as face and short in length, slightly longer than mandible width, clypeus distinctly divided, punctate, flat with a sinuate apical border; length of malar space 0.1 times basal width of mandible; mandibles not twisted; antennal articles 27; 3rd antennal article 3.3 times longer than wide; 4th antennal article 3 times longer than wide; all articles longer than wide.

Mesosoma: Precoxal sulcus narrow and shallow.

Wings: Fore wing: r/3-SR=0.5; C+SC+R/SR1=1.5; m-cu shortly antefurcal; pterostigma with dark brown center and light borders, the apical corner light. Hind wing: 1-M/cu-a=0.8;

Legs: Hind coxa smooth to punctate; hind femur 4.1 times longer than wide; tarsal claws slender with lobe.



Metasoma: Petiolar tergum 1.5 times longer than wide apically; dorsope distinct; ventral folds of petiolar tergum not joined; petiolar tergum striate with dorsal central rugosity running from the base of the tergum past the spiracles and ending surrounded by enclosing striae; ovipositor straight, length of ovipositor sheaths 1.6 times petiolar tergum, and 0.35 times fore wing; propodeum with strong carina, smooth inbetween.

Colour: Dark brown–black: clypeus brown–yellow, legs yellow.

**Distribution:** Finland.

**Biology:** The holotype was caught at the end of July.

**Etymology:** The name *subtilisulcus* refers to the very subtle impression of the precoxal sulcus.

### ***Meteorus sulcatus* Szépligeti**

Fig. 78, 129

*Meteorus sulcatus* Szépligeti, 1896:310. Holotype ♀, Yugoslavia: Croatia, Grehovica, 10.v.1885 (published as 1882) (Biró) (HNHM, Budapest).

*Meteorus insignis* Muesebeck, 1939:83. Holotype ♀, Great Britain: England, Herefordshire, Brickett Wood, 17.vi.1936 (Benson) (BMNH, London) synonymized by Fischer, 1966:395—examined.

*Meteorus molorchi* Fischer, 1966:391. Holotype ♀, Austria: 'Österreich, Wien XIII, ob. Tirolergarten, ex *Molorchus umbellatarum*, vi.1964 (Holzschuh)' (NHM, Vienna) synonymized by Huddleston, 1980:49.

**Diagnosis:** *Meteorus sulcatus* is closely related to *M. corax* and *M. nixonii*. All are large and dark species with a wide face. However, *M. sulcatus* is the smallest amongst these with a length of about 4 mm, *M. corax* and *M. nixonii* both are about 10 mm. The petiolar tergum of the former is almost parallel whilst on both the latter species it is distinctly widening apically.

**Studied material:** ~ 5 specimens.

**Description:** Size about 4 mm. Antennae 31–36 articles. Clypeus flat, punctate. Mandibles stout and twisted. OOL=1.5–2.0. Propodeum depressed, rugose. Petiolar tergum broad, reticulate dorsally. Petiolar tergum longitudinally striate, with distinct thyridia. Ovipositor long, 3.0–3.5 times petiolar tergum. Tarsal claws without basal lobe but swollen at the base. Second submarginal cell much higher than wide.

**Distribution:** Western and Eastern Palearctic. Country records: Austria; Croatia; Czechoslovakia; France; Germany; Hungary; Japan; Netherlands; Russia; Slovakia; United Kingdom.

**Biology:** *Meteorus sulcatus* is recorded as a parasitoid of Coleoptera: Buprestidae, Cerambycidae, and Chrysomelidae (Yu et al. 2005).

### ***Meteorus tabidus* (Wesmael)**

Fig. 130

*Perilitus tabidus* Wesmael, 1835:32. Lectotype ♂, Belgium: Brussels, coll. Wesmael (IRSNB, Brussels).

*Meteorus fascialis* Ruthe, 1862:22. Holotype ♀, Germany. Ruthe coll. (BMNH, London), synonymized by Schmiedeknecht, 1897:187—examined.

*Meteorus dubius* Ruthe, 1862:27. Holotype ♀, Germany. Ruthe coll. (BMNH, London), synonymized by Huddleston, 1980:50 examined.

*Meteorus penteri* Fischer, 1970b:262. Holotype ♂, Yugoslavia: Stolac (Penther) (NHM, Vienna), synonymized by Huddleston, 1980:50.

**Diagnosis:** *Meteorus tabidus* is very similar to *M. affinis* but *M. tabidus* has a more protuberant clypeus, the precoxal sulcus is reticulate-rugose and not foveolate as in *M. affinis*, and *M. tabidus* is generally a slightly more robust wasp than *M. affinis*.

**Studied material:** ~ 20 specimens.

**Description:** Size about 4.5–5mm. Antennae 28–31 articles, thick, the penultimate five or so articles not longer than broad. Head contracted behind eyes, not distinctly rounded, the occiput not distinctly concave. OOL=2. Eyes large, strongly convergent. Malar space short, about half basal breadth of mandible. Face not strongly convex.

Clypeus strongly protuberant. Tentorial pits wide and deep, very close to orbits. Mandibles at most moderately twisted. Precoxal sulcus broad, reticulate-rugose. Propodeum strongly rugose, sometimes reticulate-rugose, often with a distinct basal transverse carina and less distinct central longitudinal and medial transverse carinae. Petiolar tergum long, narrow, with distinct dorsal pits. Ovipositor long, 2.5–3.0 times length of petiolar tergum, thick. Legs long; hind coxa strongly rugose; tarsal claws with a distinct basal lobe. Colour black; abdominal tergites 3 and 4 and legs testaceous. The face and base of the antennae sometimes lighter. Male same as female except much darker; the antennae longer, 32–35 articles, the ocelli slightly larger; the eyes not strongly convergent; propodeum depressed.

**Distribution:** Palearctic. Country records: Austria; Belgium; Bosnia Hercegovina; Bulgaria; Croatia; Czechoslovakia; France; Georgia; Germany; Greece; Hungary; Ireland; Italy; Korea; Lithuania; Mongolia; Netherlands; Poland; Romania; Slovakia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** *M. tabidus* is recorded in the literature as a parasitoid of both Coleoptera (Cerambycidae) (Giraud et al. 1877) and Lepidoptera (Coleophoridae, Geometridae, Psychidae and Tortricidae). We have not been able to verify any host records.

### ***Meteorus tenellus* Marshall sp. reinst.**

Fig. 43, 45, 47, 131

*Meteorus tenellus* Marshall, 1887:125 Lectotype ♀ Great Britain (BMNH)—examined.

*Meteorus boreus* Tobias, 1986:333. Holotype ♀, Russia: Kola Peninsula, ‘Vitti-guva, Imandra Lake, Arkhangel’sk Province, 3.ix.1929’ (Cheburova) (ZIN. St. Petersburg)—examined. **Syn. n.**

**Diagnosis:** *Meteorus tenellus* is very close to *M. cinctellus*. *M. tenellus* has a light yellow pterostigma and *M. cinctellus* has a dark brown pterostigma with whitish edges. The subapical five antennal articles are longer than broad in *M. tenellus* (0.6 times as wide as long), as long as broad in *M. cinctellus* (0.8–1.0 times as wide as long).

**Studied material:** 35 specimens.

**Description:** Size about 4mm. Antennal articles 27–30, all articles longer than broad. Head strongly contracted behind eyes. OOL=2. Eyes protruding and large. Malar space 0.4–0.6 times basal width of mandibles. Face slightly (0.9–1.1 times) broader than high and with a medial tubercle just below the antennal sockets. Clypeus protuberant and with long setae, mandibles small and strongly twisted. Precoxal sulcus deep and broad, rugose, otherwise area smooth. Propodeum with a longitudinal carina that sometime is hard to distinguish from other rugosity. Petiolar tergum long, slender and without dorsal pits. Ovipositor 2.0–4.0 times petiolar tergum. Fore wing 5 times the length of petiolar tergum. Hind coxa rugose dorsally. Forewing m-cu postfurcal or interstitial. Colour generally dark, face yellow to brown, sometimes with lighter details on the head, the legs yellow to brown.

**Distribution:** Western Palearctic. Country records: Austria; Finland; Lithuania; Russia: Sweden; United Kingdom; Yugoslavia.

**Biology:** This species was described by Marshall (1887) from six females bred by Bignell on the host *Acleris hastiana* (Lepidoptera, Tortricidae).

**Remarks:** This species, distributed in Sweden, Lithuania and Russia, was synonymized by Huddleston (1981) under *M. cinctellus* (Spinola 1808), a name that later turned out to be a synonym of *M. cinctellus* (Fabricius 1777) (Yu et al. 2005). Examination of the types of *M. tenellus* and *M. cinctellus*, and of specimens from a variety of locations, has led us to conclude that *M. tenellus* is a good species.

### ***Meteorus versicolor* (Wesmael)**

Fig. 26, 33, 132

*Perilitus versicolor* Wesmael, 1835:43. Lectotype ♀, Belgium: Charleroy (IRSNB, Brussels), designated by Marsh (1979).

*Perilitus bimaculatus* Wesmael, 1835:45. Lectotype ♀, Belgium: Charleroy (IRSNB, Brussels), designated by Marsh (1979), synonymized by Muesebeck, 1923:36.

*Perilitus unicolor* Hartig, 1838:245. Lectotype ♀, Germany (ZSBS, München), (Junior primary homonym of *unicolor* Wesmael 1835).

*Perilitus brevicornis* ratzeburg, 1844:77. Holotype ♀, Germany: Ratzeburg coll (IP, Eberswalde), synonymized by Köningsmann, 1964:654.

*Perilitus rugator* Ratzeburg, 1852:59. Lectotype ♀, Germany: '741/neust Br./Peril rugator and 30 art', Ratzeburg coll. (IP, Eberswalde), synonymized by Huddleston, 1980:52.

*Meteorus decoloratus* Ruthe, 1862:48. Lectotype ♀, Germany: Ruthe coll. (BMNH, London), synonymized by Muesebeck, 1923:36—examined.

*Meteorus camptolomae* Watanabe, 1939:25. Holotype ♀, Japan: 'Okikuba, Tokyo' (EI, Sapporo), synonymized by Huddleston, 1980:52.

*Meteorus ikonomovi* Fischer, 1959:5. Holotype ♀, Yugoslavia: Dalmatien, Gravosa (NHM, Vienna), synonymized by Huddleston, 1980:52.

*Meteorus hartigi* Shenefelt, 1969:69 (Replacement name for *unicolor* Hartig, 1838), synonymized by Huddleston, 1980:52.

**Diagnosis:** This species is most similar to *M. obsoletus*. The compound eye of *M. versicolor* is more protruding and the ovipositor is thicker and slightly shorter than that of *M. obsoletus*. Also, the temples are shorter and more flat in *M. versicolor*, appearing rather narrow in dorsal view. In *M. obsoletus*, the temples are longer and more convex, appearing more rounded and less narrow in dorsal view.

**Studied material:** ~ 100 specimens.

**Description:** Size about 4.5–5mm. Antennae with 29–33 articles; flagellum thick basally, tapering to apex, all articles of flagellum distinctly longer than broad. Head broad, more or less strongly contracted behind eyes. Ocelli large, OOL=OD, protuberant. Eyes large, protuberant, only slightly convergent. Malar space short, always less than the basal breadth of the mandible. Face about 1.5 times as broad as high, not strongly protuberant but somewhat raised medially. Clypeus protuberant. Mandibles small, delicate, strongly twisted. Precoxal sulcus weakly rugose and foveolate, generally broader. Propodeum short, broad, strongly rugose, often reticulate-rugose with no distinct carinae but with a distinct medial impression posteriorly. Petiolar tergum long, rather slender at the base with no dorsal pits, its ventral borders joined from shortly before the midpoint of the segment to its base, dorsal surface finely striate. Ovipositor short, 1.5–2.0 times length of petiolar tergum, thick, strongly tapered shortly before apex. Legs stout, hind coxa smooth, punctate, often with weak transverse rugae dorsally; tarsal claws strongly curved with a pronounced basal lobe. Colour varies from almost completely testaceous to almost completely brown. The base of petiolar tergum generally pale yellow. Male same as female except that eyes generally are smaller and less protuberant. Pale yellow base of petiolar tergum is easily seen but check also the size of ocelli to be sure.

**Distribution:** Western and Eastern Palearctic. Country records: Armenia; Austria; Azerbaijan; Belgium; Bulgaria; Canada; China; Croatia; Czechoslovakia; Finland; France; Germany; Greece; Hungary; Ireland; Israel; Italy; Japan; Korea; Latvia; Lithuania; Madeira Islands; Moldova; Mongolia; Netherlands; Norway; Palestine; Poland; Portugal Romania; Russia; Slovakia; Spain; Sweden; Switzerland; Tajikistan; Turkey; USA; Ukraine; United Kingdom; Uzbekistan; Yugoslavia.

**Biology:** *Meteorus versicolor* is recorded as a parasitoid of 14 different lepidopteran families. There are also some records indicating that the species parasitizes different families of Chalcidoidea or the Ichneumonidae (Yu et al. 2005).

### ***Meteorus vexator* (Haliday)**

Fig. 58, 63, 133

*Perilitus vexator* Haliday, 1935:33. Neotype ♀, Ireland: Co. Kd., R. Canal, (2), 11.vii.1943 (Stelfox) (USNM, Washington), designated by Fischer (1959:12).

**Diagnosis:** *Meteorus vexator* is close to *M. affinis* but *M. affinis* has lobed claws (simple in *M. vexator*) and larger ocelli, characters that are distinct also in small specimens that are otherwise quite difficult to separate because of their weaker body sculpture and smaller number of antennal articles. Furthermore, the mesosoma of *M. affinis* sometimes has yellow markings, unlike *M. vexator*.

**Studied material:** ~ 100 specimens.

**Description:** Size about 2.5–4mm. Antennae 20–24 articles, slender, all flagellar articles distinctly longer than broad. Ocelli small, OOL=2.5–3.0. Eyes large, protuberant, very strongly convergent. Malar space short, much less than basal breadth of mandible. Face about as broad as high, not protuberant, smooth, punctate. Clypeus moder-

ately protuberant, smooth, punctate. Mandibles short, stout, moderately twisted. Pronotum laterally generally with weak rugose sculpture. Precoxal sulcus narrow, foveolate, sometimes with a small punctate patch beneath. Propodeum small, distinctly carinate, generally rather smooth between the carinae but sometimes weakly rugulose. Petiolar tergum with distinct dorsal pits. Ovipositor 2.5–3.0 times length of petiolar tergum. Legs long, slender, hind coxa generally at least slightly rugose ventro-laterally though sometimes reticulate-punctate; tarsal claws without a basal lobe. Colour brownish black. Male same as female except antennae longer, up to 27 articles; eyes less convergent and sculpture of precoxal sulcus and of hind coxa sometimes obsolete.

**Distribution:** Western Palearctic. Country records: Austria; Bulgaria; Croatia; Czechoslovakia; Denmark; Finland; Germany; Hungary; Ireland; Latvia; Netherlands; Russia; Slovenia; Sweden; Switzerland; United Kingdom; Yugoslavia.

**Biology:** *Meteorus vexator* has been recorded as a parasitoid of Biphyllidae (Coleoptera) (Morley 1912) but as Huddleston points out, this record is doubtful. We received specimens from T. Munk that were reared from *Dahlica lichinella* (Lepidoptera: Psychidae), which is more in line with expectations.

Species still classified as **nomina dubia**, the types lost or not found:

*Perilitus (Meteorus) delator* (Haliday, 1874). Type material not found.

*Perilitus dilatus* (Ratzeburg, 1844). Type material lost.

*Meteorus effeminatus* Ruthe, 1862. These male specimens were examined by Huddleston in 1981 and by JS in 2010 without any conclusion about their placement within *Meteorus*.

*Perilitus flaviceps* (Ratzeburg 1844). Type material lost.

*Perilitus longicornis* (Ratzeburg 1844). Type material lost.

*Meteorus stenostigma* Thomson 1895. Type material lost. The two specimens in Thomson's collection above the name *stenostigma* were determined by JS as *M. ictericus* Nees, 1811, and *M. pendulus* (Müller, 1776). Neither of them agrees with Thomson's description and neither is from the type locality (Huddleston 1980).

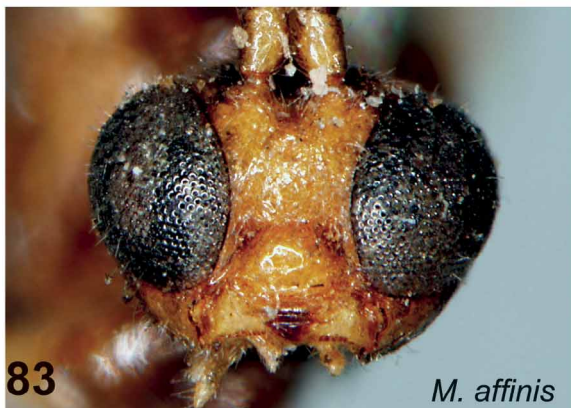
## Acknowledgements

We wish to thank the following people for loan of material and assistance in the study of specimens: S. Belokobylskij (ZIN), R. Danielsson and R. Bygebjerg (MZLU), H. Mejlou (UUZM), G. Broad and D. Notton (BMNH), S. Shaw (UWIM), D. Zimmermann (NHMW), F. Koch (ZMHB), O. Tadauchi (Kyushu University), T. Munk, P. Grootaert (IRSNB), Y. Braet, and A. Ribes Escolá. A. Boring (Univ. of Kentucky) supplied us with outgroup sequences and a lot of helpful advice on euphorines. JS is most grateful to Dr M. Forshage and Dr J. Ferrer for taxonomical help. We are particularly grateful to Prof. C van Achterberg for sharing data and for helping this study along in many important ways, and to Dr J. Jennings, The University of Adelade for valuable comments on the manuscript. The work was supported by a grant from The Swedish Taxonomy Initiative (Dha 167/08 1.4).



**FIGURE 79.** Habitus images of the seven new species described in this paper. A) *Meteorus artocercus*, B) *M. densipilosus*, C) *M. eklundi*, D) *M. longipilosus*, E) *M. sibyllae*, F) *M. stenomastax*, G) *M. subtilisulcus*.

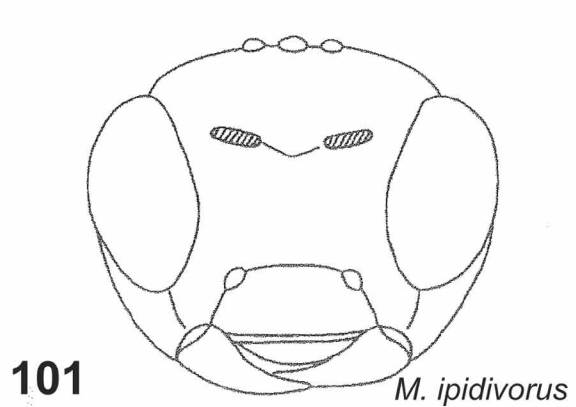








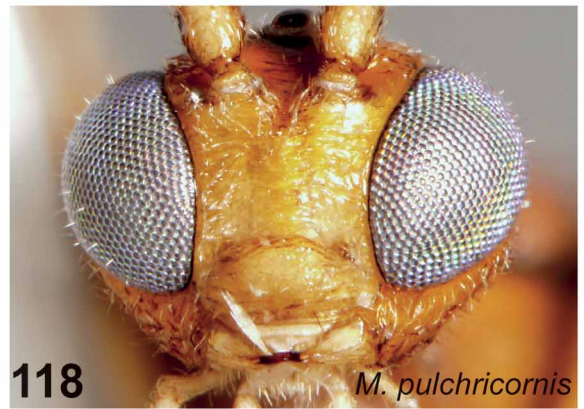
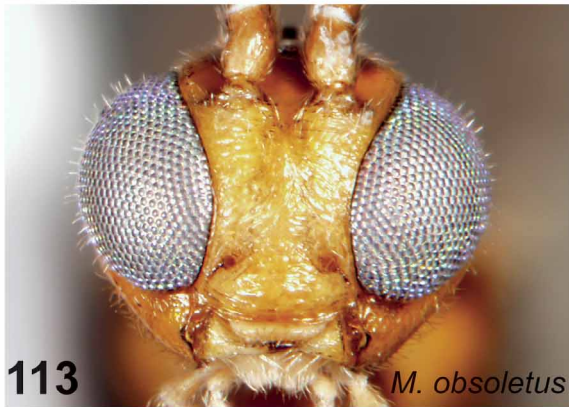




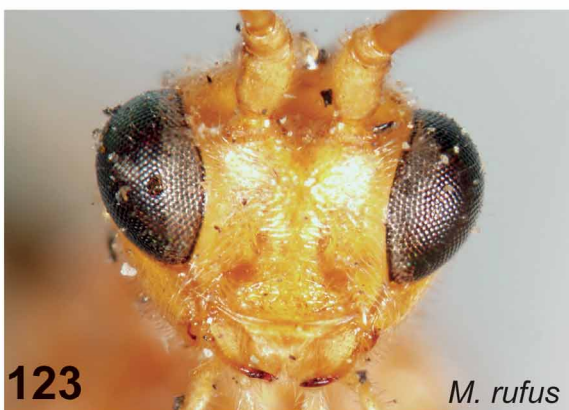








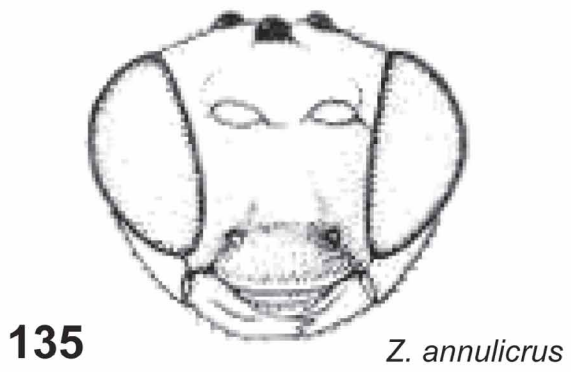








FIGURES 80–133. Anterior view of the head of *Meteorus* species (except for *M. politutele*, which is depicted in lateral view).



FIGURES 134–138. Anterior view of the head of *Zele* species.

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## Appendix I

### List of species, with synonyms

#### *Meteorus*

- abdominator* (Nees, 1811)  
*brevipesalis* Shenefeldt, 1969  
*brunnipes* (Ruthe, 1862)  
*abscissus* Thomson, 1859  
*affinis* (Wesmael, 1385)  
*gracilis* Ruthe, 1862  
*punctiventris* Ruthe, 1862  
*ruthei* Schmiedeknecht, 1897  
*voloscensis* Fisher, 1959  
*alborossicus* Lobodenko, 2000  
*acerbiavorus* Belokobylskij et al., 2011  
*angiclypealis* van Achterberg, 2001  
*artocercus* Stigenberg **sp. nov.**  
*breviantennatus* Tobias, 1986  
*brevicauda* Thomson, 1895  
*mongolicus* Fahringer, 1935  
*thuringiacus* Schmiedeknecht, 1897  
*cespicator* (Thunberg, 1824)  
*ambiguus* Ruthe, 1862  
*atrator* (Curtis, 1832)  
*humeralis* (Zetterstedt, 1838)  
*rufipes* (Zetterstedt, 1838)  
*similator* (Nees, 1834)  
*cinctellus* (Spinola, 1808)  
*fuscipes* (Wesmael, 1835)  
*necator* (Trentepohl, 1829)  
*tenellus* Marshall, 1887  
*cis* (Bouché, 1834)  
*profligator* Haliday, 1835  
*colon* (Haliday, 1835)  
*fasciatus* (Ratzeburg, 1844)  
*fragilis* (Wesmael, 1835)  
*luridus* Ruthe, 1862  
*consimilis* (Nees, 1834)  
*albicornis* Ruthe, 1862  
*brevipes* (Wesmael, 1835)  
*corax* Marshall, 1898  
*monochami* Fischer, 1957  
*densipilosus* Stigenberg **sp. nov.**  
*eadyi* Huddleston, 1980  
*eklundii* Stigenberg **sp. nov.**  
*filator* (Haliday, 1835)  
*laticeps* (Wesmael, 1835)  
*hodisensis* Fischer, 1970  
*heliophilus* Fisher, 1970  
*hirsutipes* Huddleston, 1980  
*ictericus* (Nees, 1811)  
*adoxophyesi* Minamikawa, 1954  
*confinis* Ruthe, 1862  
*consors* Ruthe, 1862  
*crassicrus* Thomson, 1895  
*ephippium* (Curtis, 1832)  
*fallax* Ruthe, 1862  
*liquis* Ruthe, 1862  
*lophyriphagus* Fahringer, 1934  
*minutor* (Thunberg, 1822)  
*pleuralis* Ruthe, 1862  
*xanthomelas* (Wesmael, 1835)  
*ipidivorus* Tobias, 1986  
*jaculator* (Haliday, 1835)  
*obscurellus* Ruthe, 1862  
*tenuicornis* Thomson, 1895  
*kyushuensis* Maeto, 1988  
*limbatus* Maeto, 1989  
*lionotus* Thomson, 1895  
*ruficoloratus* Fischer, 1957  
*longicaudis* (Ratzeburg, 1884)  
*longipilosus* Stigenberg **sp. nov.**  
*melanostictus* Capron, 1887  
*monachae* Tobias, 1986  
*niger* Lyle, 1913  
*micropilosus* Tobias, 1986  
*micropterus* (Haliday, 1835)  
*nixonii* Huddleston, 1980  
*obfuscatus* (Nees, 1811)  
*fodori* Papp, 1973  
*formosus* (Wesmael, 1835)  
*thoracicus* (Curtis, 1832)  
*obsoletus* (Wesmael, 1835)  
*viridanae* Johansson, 1964  
*oculatus* Ruthe, 1862  
*pachypus* Schmiedeknecht, 1897  
*pendulus* (Müller, 1776)  
*gyrator* (Thunberg, 1822)  
*parvulus* Thomson, 1895  
*scutellator* (Nees, 1834)  
*politutele* Shenefeldt, 1969  
*politus* Telenga, 1950  
*pulchricornis* (Wesmael, 1835)  
*baicalensis* Telenga, 1950  
*graeffei* Fischer, 1957  
*japonicus* Ashmead, 1906  
*macedonicus* Fischer, 1957  
*nipponensis* Viereck, 1912  
*striatus* Thomson, 1885  
*thomsoni* Marshall, 1899  
*tuberculifer* Fischer, 1957

*punctifrons* Thomson, 1895  
*varinervis* Tobias **syn.n**  
*radialis* Tobias, 1986  
*rubens* (Nees, 1811)  
*heteroneurus* Thomson, 1895  
*islandicus* Ruthe, 1859  
*leviventris* (Wesmael, 1835)  
*medianus* Ruthe, 1862  
*mesopotamicus* Fischer, 1957  
*scutatus* Costa, 1884  
*szechuanensis* Fahringer, 1935  
*ruficeps* (Nees, 1834)  
*nigritarsis* Ruthe, 1862  
*pallipes* (Wesmael, 1835)  
*rufus* (De Geer, 1778)  
*chinensis* (Holmgren, 1868)  
*unicolor* (Wesmael, 1835)  
*salicorniae* Schmiedeknecht, 1897  
*ocellatus* Watanabe, 1951  
*sibyllae* Stigenberg **sp.nov**  
*stenomastax* Stigenberg **sp.nov**  
*subjaculator* Tobias, 1986  
*subtilisulcus* Stigenberg **sp.nov**  
*sulcatus* Szépligeti, 1896  
*insignis* Muesebeck, 1939  
*molorchi* Fischer, 1966  
*tabidus* (Wesmael, 1835)  
*fascialis* Ruthe, 1862  
*dubius* Ruthe, 1862  
*pentheri* Fischer, 1970  
*tenellus* Marshall **sp reinst.**  
*boreus* Tobias **syn.n**  
*versicolor* (Wesmael, 1835)  
*bimaculatus* (Wesmael, 1835)  
*brevicornis* (Ratzeburg, 1844)  
*camptolomae* Watanabe, 1939

*decoloratus* Ruthe, 1862  
*hartigi* Shenefelt, 1969  
*ikonomovi* Fischer, 1959  
*rugator* (Ratzeburg, 1852)  
*unicolor* (Hartig, 1838)  
*vexator* (Haliday, 1935)

#### *Zele*

*albiditarsus* Curtis, 1832  
*albitarsus* (Nees, 1834)  
*albitarsis* (Haliday, 1835)  
*calcitrator* (Curtis, 1837)  
*dispar* (Wesmael, 1835)  
*maximus* (Muesebeck, 1923)  
*pallitarsis* (Cresson, 1872)  
*testaceator* Curtis, 1832  
*testatrix* (Schulz, 1906)  
*wesmaeli* (Boie, 1850)  
*annulicrus* (Thomson, 1895)  
*caligatus* (Haliday, 1835)  
*alaskensis* (Ashmead, 1902)  
*neesii* (Ruthe, 1862)  
*sibiricus* (Fahringer, 1930)  
*chlorophthalmus* (Spinola, 1808)  
*chrysophthalmus* (Nees, 1811)  
*nigricollis* (Thomson, 1895)  
*nudator* (Thunberg, 1822)  
*pallidus* (Nees, 1812)  
*splendens* (Costa, 1884)  
*deceptor* (Wesmael, 1835)  
*maximus* (Muesebeck, 1923)  
*pallitarsis* (Cresson, 1872)  
*reticulatus* (Muesebeck, 1923)  
*romani* (Fahringer, 1930)  
*rufulus* (Thomson, 1895)  
*separandus* (Fischer, 1957)

## Appendix II

Voucher specimens and GenBank accession numbers. Specimens with an asterisk (\*) was previously used in Stigenberg et al. 2011.

Genus	Species	Sex	Type	DNA Nr	NHRS HYME ID	GenBank COI	GenBank 28S
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	1	ethanol coll.	HQ263896	HQ263720
<i>Meteorus</i> *	<i>artocercus</i>	female	Paratype	2	000005177	HQ263897	HQ263721
<i>Meteorus</i>	<i>tenellus</i>	female		3	000005166	HQ263898	HQ263722
<i>Meteorus</i>	<i>tenellus</i>	female		4	*	HQ263899	HQ263723
<i>Meteorus</i> *	<i>tenellus</i>	female		5	000005073	HQ263900	HQ263724
<i>Meteorus</i>	<i>tenellus</i>	female		6	000005174	HQ263901	HQ263725
<i>Meteorus</i>	<i>densipilosus</i>	female	Holotype	7	000004936	HQ263902	HQ263726
<i>Meteorus</i>	<i>eklundii</i>	female	Holotype	8	000004937	HQ263903	HQ263727
<i>Meteorus</i>	<i>hirsutipes</i>	female		9	000004944	HQ263904	HQ263728
<i>Meteorus</i> *	<i>limbatus</i>	female		10	000004891	HQ263905	HQ263729
<i>Meteorus</i>	<i>kyushuensis</i>	female		11	000004975	HQ263906	HQ263730
<i>Meteorus</i>	<i>kyushuensis</i>	female		12	000004974	HQ263907	HQ263731
<i>Meteorus</i> *	<i>obsoletus</i>	female		13	000005007	HQ263908	HQ263732
<i>Meteorus</i>	<i>tenellus</i>	female		14	000005074	HQ263909	HQ263733
<i>Meteorus</i> *	<i>pulchricornis</i>	female		15	000005027	HQ263910	HQ263734
<i>Meteorus</i>	<i>stenomastax</i>	female		16	000005051	HQ263911	HQ263735
<i>Meteorus</i> *	<i>stenomastax</i>	female		17	000005052	HQ263912	HQ263736
<i>Meteorus</i> *	<i>tabidus</i>	female		18	000005058	HQ263913	HQ263737
<i>Meteorus</i> *	<i>tenellus</i>	female		19	000005170	HQ263914	HQ263738
<i>Meteorus</i> *	<i>tenellus</i>	female		20	000005075	HQ263915	HQ263739
<i>Meteorus</i> *	<i>versicolor</i>	female		21	000005065	HQ263916	HQ263740
<i>Meteorus</i> *	<i>obfuscatus</i>	female		22	000004979	HQ263917	HQ263741
<i>Meteorus</i>	<i>tenellus</i>	female		23	000005168	HQ263918	HQ263742
<i>Meteorus</i> *	<i>cinctellus</i>	female		24	000005076	HQ263919	HQ263743
<i>Meteorus</i>	<i>colon</i>	female		25	000005077	HQ263920	HQ263744
<i>Meteorus</i>	<i>abdominator</i>	female		26	000005078	HQ263921	HQ263745
<i>Meteorus</i>	<i>affinis</i>	female		27	000005079	HQ263922	HQ263746
<i>Meteorus</i>	<i>eklundii</i>	female	Paratype	28	000004939	HQ263923	HQ263747
<i>Meteorus</i>	<i>cis</i>	female		30	000005080	HQ263924	HQ263748
<i>Meteorus</i>	<i>colon</i>	female		31	000005081	HQ263925	HQ263749
<i>Meteorus</i>	<i>consimilis</i>	female		32	000005082	HQ263926	HQ263750
<i>Meteorus</i>	<i>filator</i>	female		33	000005083	HQ263927	HQ263751
<i>Meteorus</i>	<i>ictericus</i>	female		34	000005084	HQ263928	HQ263752
<i>Meteorus</i>	<i>jaculator</i>	female		35	000005085	HQ263929	HQ263753
<i>Meteorus</i>	<i>micropterus</i>	female		36	000005086	HQ263930	HQ263754
<i>Meteorus</i>	<i>oculatus</i>	female		37	000005087	HQ263931	HQ263755
<i>Meteorus</i>	<i>ruficeps</i>	female		38	000005088	HQ263932	HQ263756
<i>Meteorus</i>	<i>pendulus</i>	female		39	000005116	HQ263933	HQ263757
<i>Meteorus</i>	<i>rubens</i>	female		40	000005117	HQ263934	HQ263758
<i>Meteorus</i>	<i>vexator</i>	female		41	000005118	HQ263935	HQ263759
<i>Zelee</i>	<i>albiditarsus</i>	female		42	000005089	HQ263936	HQ263760
<i>Zelee</i>	<i>deceptor</i>	female		43	000005090	HQ263937	HQ263761
<i>Zelee</i>	<i>chlorophthalmus</i>	female		44	000005091	HQ263938	HQ263762
<i>Meteorus</i>	<i>abdominator</i>	female		45	000005092	n.a	HQ263763
<i>Meteorus</i>	<i>affinis</i>	female		46	000005093	HQ263939	HQ263764
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	47	*	HQ263940	HQ263765

..... continued on the next page



**Appendix II** (continued)

Genus	Species	Sex	Type	DNA Nr	NHRS HYME ID	GenBank COI	GenBank 28S
<i>Meteorus</i>	<i>cespicator</i>	female		48	000005094	HQ263941	HQ263766
<i>Meteorus</i>	<i>cespicator</i>	female		49	000005095	HQ263942	HQ263767
<i>Meteorus</i>	<i>cinctellus</i>	female		50	000004918	HQ263943	HQ263768
<i>Meteorus</i>	<i>artocercus</i>	female		51	000005073	n.a	HQ263769
<i>Meteorus</i>	<i>cinctellus</i>	female		52	000004917	HQ263944	HQ263770
<i>Meteorus</i> *	<i>cinctellus</i>	female		53	000004916	HQ263945	HQ263771
<i>Meteorus</i> *	<i>cinctellus</i>	female		54	000004915	HQ263946	HQ263772
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	55	000005182	HQ263947	HQ263773
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	56	000005181	HQ263948	HQ263774
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	57	000005180	HQ263949	HQ263775
<i>Meteorus</i>	<i>artocercus</i>	female	Paratype	58	000005179	HQ263950	HQ263776
<i>Meteorus</i>	<i>cis</i>	female		59	000005096	HQ263951	HQ263777
<i>Meteorus</i> *	<i>colon</i>	female		60	000005097	HQ263952	HQ263778
<i>Meteorus</i>	<i>colon</i>	female		61	000005098	n.a	HQ263779
<i>Meteorus</i> *	<i>colon</i>	female		62	000005099	HQ263953	HQ263780
<i>Meteorus</i>	<i>abdominator</i>	female		63	000005100	HQ263954	HQ263781
<i>Meteorus</i>	<i>consimilis</i>	female		64	000005101	HQ263955	HQ263782
<i>Meteorus</i>	<i>ictericus</i>	female		65	000005102	HQ263956	HQ263783
<i>Meteorus</i>	<i>ictericus</i>	female		66	000005103	HQ263957	HQ263784
<i>Meteorus</i>	<i>ruficeps</i>	female		67	000005104	HQ263958	HQ263785
<i>Meteorus</i>	<i>jaculator</i>	female		68	000005105	HQ263959	HQ263786
<i>Meteorus</i> *	<i>micropterus</i>	male		69	000005106	HQ263960	HQ263787
<i>Meteorus</i> *	<i>micropterus</i>	male		70	000005107	HQ263961	HQ263788
<i>Meteorus</i> *	<i>ruficeps</i>	female		71	000005048	HQ263962	HQ263789
<i>Meteorus</i> *	<i>vexator</i>	female		72	000005108	HQ263963	HQ263790
<i>Zelev</i>	<i>deceptor</i>	female		73	000005109	HQ263964	HQ263791
<i>Zelev</i>	<i>albiditarsus</i>	female		74	000005111	HQ263965	HQ263792
<i>Zelev</i>	<i>chlorophthalmus</i>	female		75	000005110	HQ263966	HQ263793
<i>Meteorus</i>	<i>tenellus</i>	female		76	000005169	HQ263967	HQ263794
<i>Meteorus</i>	<i>tenellus</i>	female		77	000005171	HQ263968	HQ263795
<i>Meteorus</i> *	<i>tenellus</i>	female		78	000005172	HQ263969	HQ263796
<i>Meteorus</i>	<i>tenellus</i>	female		79	000005173	HQ263970	HQ263797
<i>Meteorus</i>	<i>tenellus</i>	female		80	000005167	HQ263971	HQ263798
<i>Meteorus</i>	<i>tenellus</i>	female		82	000005175	HQ263972	HQ263799
<i>Zelev</i>	<i>caligatus</i>	female		84	000005112	HQ263973	HQ263800
<i>Meteorus</i>	<i>longipilosus</i>	female	Holotype	85	000004978	n.a	HQ263801
<i>Meteorus</i>	<i>affinis</i>	female		86	000005113	HQ263974	HQ263802
<i>Meteorus</i>	<i>affinis</i>	female		87	000005114	HQ263975	HQ263803
<i>Meteorus</i>	<i>affinis</i>	female		88	000005115	HQ263976	HQ263804
<i>Meteorus</i>	<i>affinis</i>	female		89	000005119	HQ263977	HQ263805
<i>Meteorus</i>	<i>affinis</i>	male		95	000005120	HQ263978	HQ263806
<i>Meteorus</i>	<i>tabidus</i>	male		96	000005121	HQ263979	HQ263807
<i>Meteorus</i>	<i>tabidus</i>	male		97	000005122	HQ263980	HQ263808
<i>Meteorus</i>	<i>tenellus</i>	male		99	000005124	HQ263981	HQ263809
<i>Meteorus</i> *	<i>tenellus</i>	male		100	000005125	HQ263982	HQ263810
<i>Meteorus</i>	<i>sulcatus</i>	female		101	RMNH	HQ263983	HQ263811
<i>Meteorus</i>	<i>obfuscatus</i>	female		102	RMNH	HQ263984	HQ263812

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**Appendix II** (continued)

Genus	Species	Sex	Type	DNA Nr	NHRS HYME ID	GenBank COI	GenBank 28S
<i>Meteorus</i>	<i>longicaudis</i>	female		103	RMNH	HQ263985	HQ263813
<i>Meteorus</i> *	<i>abscissus</i>	male		104	000005126	HQ263986	HQ263814
<i>Meteorus</i> *	<i>tenellus</i>	male		105	000005128	HQ263987	HQ263815
<i>Meteorus</i>	<i>vexator</i>	female		106	000005217	HQ263988	HQ263816
<i>Meteorus</i>	<i>pendulus</i>	female		107	000005127	HQ263989	HQ263817
<i>Meteorus</i>	<i>pendulus</i>	female		108	000005129	HQ263990	HQ263818
<i>Meteorus</i>	<i>pendulus</i>	female		109	000005130	HQ263991	HQ263819
<i>Meteorus</i>	<i>pendulus</i>	female		110	000005131	HQ263992	HQ263820
<i>Meteorus</i>	<i>pendulus</i>	female		111	000005132	HQ263993	HQ263821
<i>Meteorus</i>	<i>pendulus</i>	female		112	000005133	HQ263994	HQ263822
<i>Meteorus</i>	<i>pendulus</i>	female		113	000005134	HQ263995	HQ263823
<i>Meteorus</i>	<i>colon</i>	female		114	000005135	HQ263996	HQ263824
<i>Meteorus</i>	<i>colon</i>	female		115	000005136	HQ263997	HQ263825
<i>Meteorus</i>	<i>colon</i>	female		116	000005137	HQ263998	HQ263826
<i>Meteorus</i>	<i>colon</i>	female		117	000005138	HQ263999	HQ263827
<i>Meteorus</i>	<i>colon</i>	female		118	000005139	HQ264000	HQ263828
<i>Meteorus</i>	<i>stenomastax</i>	female		119	*	HQ264001	HQ263829
<i>Meteorus</i> *	<i>rubens</i>	female		120	000005140	HQ264002	HQ263830
<i>Meteorus</i> *	<i>rubens</i>	female		121	000005141	HQ264003	HQ263831
<i>Meteorus</i> *	<i>rubens</i>	male		122	000005142	HQ264004	HQ263832
<i>Meteorus</i> *	<i>rubens</i>	female		123	000005143	HQ264005	HQ263833
<i>Meteorus</i>	<i>vexator</i>	female		124	000005144	HQ264006	HQ263834
<i>Meteorus</i>	<i>vexator</i>	female		125	000005145	HQ264007	HQ263835
<i>Meteorus</i>	<i>alborossicus</i>	female		126	000005146	n.a	HQ263836
<i>Meteorus</i>	<i>vexator</i>	female		127	000005147	HQ264008	HQ263837
<i>Meteorus</i> *	<i>versicolor</i>	female		128	000005148	HQ264009	HQ263838
<i>Meteorus</i> *	<i>pulchricornis</i>	female		129	000005149	HQ264010	HQ263839
<i>Meteorus</i> *	<i>versicolor</i>	female		130	000005150	HQ264011	HQ263840
<i>Meteorus</i> *	<i>versicolor</i>	female		131	000005151	HQ264012	HQ263841
<i>Meteorus</i>	<i>ictericus</i>	female		132	000005153	HQ264013	HQ263842
<i>Meteorus</i>	<i>ruficeps</i>	female		133	000005154	HQ264014	HQ263843
<i>Meteorus</i>	<i>ruficeps</i>	female		134	000005152	HQ264015	HQ263844
<i>Meteorus</i>	<i>ictericus</i>	female		135	000005155	HQ264016	HQ263845
<i>Meteorus</i>	<i>cespitor</i>	female		136	000005161	HQ264017	HQ263846
<i>Meteorus</i>	<i>cespitor</i>	female		137	000005162	HQ264018	HQ263847
<i>Meteorus</i>	<i>filator</i>	female		138	000005156	HQ264019	HQ263848
<i>Meteorus</i>	<i>filator</i>	female		139	000005160	HQ264020	HQ263849
<i>Meteorus</i>	<i>cis</i>	female		140	000005157	HQ264021	HQ263850
<i>Meteorus</i> *	<i>obfuscatus</i>	female		141	000005158	HQ264022	HQ263851
<i>Meteorus</i>	<i>pendulus</i>	female		142	000005159	HQ264023	HQ263852
<i>Meteorus</i>	<i>colon</i>	female		143	000005163	HQ264024	HQ263853
<i>Meteorus</i>	<i>longipilosus</i>	female	Paratype	144	000004977	n.a	HQ263854
<i>Meteorus</i>	<i>abdominator</i>	female		145	000005184	n.a	HQ263855
<i>Meteorus</i>	<i>abdominator</i>	female		146	000005185	n.a	HQ263856
<i>Meteorus</i>	<i>abdominator</i>	female		147	000005186	n.a	HQ263857
<i>Meteorus</i>	<i>abdominator</i>	female		148	000005187	n.a	HQ263858
<i>Meteorus</i>	<i>abdominator</i>	female		149	000005188	n.a	HQ263859

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**Appendix II** (continued)

Genus	Species	Sex	Type	DNA Nr	NHRS HYME ID	GenBank COI	GenBank 28S
<i>Meteorus</i>	<i>affinis</i>	female		150	000005189	n.a	HQ263860
<i>Meteorus</i>	<i>affinis</i>	female		151	000005190	n.a	HQ263861
<i>Meteorus</i>	<i>affinis</i>	male		152	000005191	n.a	HQ263862
<i>Meteorus</i>	<i>affinis</i>	female		153	000005192	HQ264025	HQ263863
<i>Meteorus</i>	<i>affinis</i>	female		154	000005193	HQ264026	HQ263864
<i>Meteorus</i>	<i>affinis</i>	female		155	000005194	HQ264027	HQ263865
<i>Meteorus</i>	<i>affinis</i>	female		156	000005195	HQ264029	HQ263867
<i>Meteorus</i>	<i>cis</i>	female		157	000005196	HQ264030	HQ263868
<i>Meteorus</i>	<i>cis</i>	female		158	000005197	HQ264031	HQ263869
<i>Meteorus</i>	<i>consimilis</i>	female		159	000005198	HQ264032	HQ263870
<i>Meteorus</i>	<i>consimilis</i>	female		160	000005199	n.a.	HQ263871
<i>Meteorus</i>	<i>consimilis</i>	female		161	*	HQ264033	HQ263872
<i>Meteorus</i> *	<i>abscissus</i>	female		162	000005216	HQ264048	HQ263887
<i>Meteorus</i> *	<i>rubens</i>	female		163	000005212	HQ264044	HQ263883
<i>Meteorus</i>	<i>consimilis</i>	female		164	000005201	HQ264028	HQ263866
<i>Meteorus</i>	<i>consimilis</i>	male		165	000005200	HQ264034	HQ263873
<i>Meteorus</i>	<i>filator</i>	male		166	000005202	HQ264035	HQ263874
<i>Meteorus</i>	<i>filator</i>	male		167	000005203	HQ264036	HQ263875
<i>Meteorus</i>	<i>cis</i>	female		168	000005204	HQ264037	HQ263876
<i>Meteorus</i>	<i>sibyllae</i>	female	Paratype	169	000005205	HQ264038	HQ263877
<i>Meteorus</i>	<i>cis</i>	female		171	000005207	HQ264039	HQ263878
<i>Meteorus</i>	<i>sibyllae</i>	female	Holotype	172	000005208	HQ264040	HQ263879
<i>Meteorus</i> *	<i>stenomastax</i>	female		173	000005213	HQ264045	HQ263884
<i>Meteorus</i>	<i>pendulus</i>	female		174	000005209	HQ264041	HQ263880
<i>Meteorus</i>	<i>pendulus</i>	female		175	000005210	HQ264042	HQ263881
<i>Meteorus</i>	<i>pendulus</i>	female		176	000005211	HQ264043	HQ263882
<i>Meteorus</i> *	<i>abscissus</i>	female		177	000005214	HQ264046	HQ263885
<i>Meteorus</i> *	<i>rubens</i>	male		178	000005215	HQ264047	HQ263886
<i>Meteorus</i> *	<i>acerbiavorus</i>	female	Paratype	179	000005223	HQ264049	HQ263888
<i>Meteorus</i> *	<i>acerbiavorus</i>	male	Paratype	180	000005222	HQ264050	HQ263889
<i>Meteorus</i>	<i>vexator</i>	female		181	*	HQ264051	HQ263890
<i>Meteorus</i> *	<i>acerbiavorus</i>	female	Paratype	183	000005246	n.a	HQ263891
<i>Meteorus</i> *	<i>acerbiavorus</i>	female	Paratype	185	000005241	HQ264052	HQ263892
<i>Meteorus</i>	<i>abscissus</i>	female		186	Ribes coll.	HQ264053	HQ263893
<i>Meteorus</i> *	<i>acerbiavorus</i>	male	Paratype	187	000005247	HQ264054	HQ263894
<i>Meteorus</i> *	<i>acerbiavorus</i>	male	Paratype	188	000005245	n.a	HQ263895
<i>Meteorus</i>	<i>corax</i>	-			*	AY935418	AY935488
<i>Centistes</i>		-			AB071	n.a	n.a
<i>Leiophron</i>		-			AB022	n.a	n.a
<i>Mannokeria</i>		-			AB086	n.a	n.a
<i>Peristenus</i>		-			AB016	n.a	n.a
<i>Streblocera</i>		-			AB073	n.a	n.a
<i>Syntretus</i>		-			JS111	n.a	n.a