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Brachymeria tibialis (Walker, 1834) (Hymenoptera: Chalcididae), a parasitoid of *Zygaena* Fabricius, 1777, and other Lepidoptera

R. R. ASKEW

5 Beeston Hall Mews, Beeston, Tarporley, Cheshire CW6 9TZ

M. R. SHAW

National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF

Introduction

Brachymeria tibialis (Walker, 1834), frequently referred to in the literature under its junior synonym *Brachymeria intermedia* (Nees, 1834) (see Graham (1993) for discussion of priority), is reported to attack a variety of Lepidoptera. It is widely distributed in the Palaearctic region and ranges through Central Asia to central and southern Europe, being common in the Mediterranean region and extending as far north as Sweden. Its supposed occurrence in Britain (Bouček, 1952) has not, however, been confirmed.

Brachymeria tibialis is a solitary, primary or sometimes secondary, idiobiont parasitoid in Lepidoptera pupae. Oviposition is usually into fresh pupae (Dowden, 1935), and adults emerge directly from the host pupae. Occasionally the host is attacked as a prepupa, but we have seen just a single example of this with emergence from a cocooned prepupa of *Z. filipendulae* (L.).

Hosts most frequently cited are *Lymantria* and *Euproctis* and it has been repeatedly introduced into North America in attempts to control the Gypsy Moth, *Lymantria dispar* (L.) (Delvare & Bouček, 1992). In addition to Lymantriidae, species of Nymphalidae, Pieridae, Tortricidae and Zygaenidae feature prominently in host lists, and species of Arctiidae, Gelechiidae, Hesperiidae, Lasiocampidae, Noctuidae, Notodontidae, Oecophoridae, Papilionidae and Pyralidae are also recorded as primary hosts (Noyes, 1998).

We have seen quite a large number of *B. tibialis* reared from cocoons of *Zygaena* species (most of which are preserved in the National Museums of Scotland), and the importance of *Zygaena* as hosts appears to have been usually understated. In this paper we present several new host records involving *Zygaena* species (Table 1).

Populations of *Zygaena* species are often heavily parasitised, but their primary parasitoids are remarkable for their extreme specialisation to Zygaenidae. Although questionable records exist from non-zygaenid hosts for some of them, the following Hymenoptera are regular, often common and essentially specialist parasitoids of various *Zygaena* species over much of the range of the genus. (1) Koinobionts attacking the larval stage: *Cotesia zygaenarum* (Marshall), *Aleiodes assimilis* (Nees) and *Meteorus unicolor* (Wesmael) (all Braconidae), *Alcima orbitale* (Gravenhorst) and *Charops cantator* (DeGeer) (both Ichneumonidae – two others, *Barylypa helleni* Schnee and *Atrometus insignis* Förster, are much rarer but equally specialised); (2) Idiobionts attacking

Table 1. *Brachymeria tibialis* reared from cocoons of species of *Zygaena*; body lengths (mm) and depths of metatarsomere 5 (mtd, in arbitrary units with 60 = 1 mm) are shown, and new host and national records are asterisked.

Host sp. & Locality	Year & Collector	No./sex.	Length (mtd)
Z. carniolica (Scopoli)			
Lebanon, Jabal Kesrouan	1973 T. B. Larsen	1♂	5.4 (7.0)
Z. angelicae elegans Burgeff*			
Germany, Bad.-Württem.	1996 A. Hofmann	1♀	5.2 (7.6)
Z. filipendulae (Linnaeus)			
France, Manche	1995 W. G. Tremewan	2♀	5.4 (8.0); 5.7 (7.9)
France, Provence	1987 M. R. Shaw	1♂	5.0 (6.4)
France, Hte-Pyrénées	1998 W. G. & S. M. Tremewan	1♀	6.2 (7.9)
France, Landes	1999 W. G. & M. A. Tremewan	5♀	4.7 (6.8); 5.4 (7.5); 5.4 (8.0); 5.6 (8.1); 5.7 (8.1)
Spain, Teruel	1979 W. G. Tremewan	1♀	5.2 (7.5)
Turkey	1996 A. Hofmann	1♀	5.3 (7.8)
Z. filipendulae via *?Charops cantator* (DeGeer)*			
France, Provence	1987 M. R. Shaw	1♂	4.5 (6.0)
Z. haberhaueri Lederer*			
Iran, Mazanderan	1997 W. G. Tremewan	1♀	5.7 (8.0)
Z. laeta (Hübner)*			
Turkey, Ankara	1969?	1♀	5.4 (7.7)
Turkey, Ankara	1999 W. G. Tremewan	1♀	5.5 (8.0)
Z. lydia Staudinger*			
Turkey, Ala Dagh	1995 A. Hofmann	1♂	5.3 (6.9)
Z. olivieri Boisduval*			
Lebanon, Cedar Mt.	1973 T. B. Larsen	1♀	5.6 (7.6)
Z. sarpedon (Hübner)*			
France, Provence	1996 A. Hofmann	1♀	6.2 (8.0)
Z. ?osterodensis Reiss* (= *?scabiosae* auctt. nec (Scheven))			
Switzerland*, Varen	1979 S. E. Whitebread	1♂	5.3 (6.4)
Z. transalpina (Esper)*			
France, Hte-Marne	1996 M. R. Shaw	5♂	4.7 (5.8); 4.7 (5.9); 4.7 (6.3); 5.0 (5.8); 5.3 (6.4)
		6♀	5.4 (6.5); 5.6(7.2); 5.7 (6.8); 5.7 (7.0); 5.7 (7.4); 5.8 (6.8)
France, Sarthe	1998 M. Nicolle	1♂	5.3 (5.8)
France, Issoire	1998 W. G. Tremewan	1♂	5.3 (6.8)
France, Dordogne	1996 M. R. Shaw	1♀	5.0 (6.6)
	1999 W. G. & M. A. Tremewan	1♂	4.9 (6.7)
France, Lot-et-Garonne	1998 W. G. & S. M. Tremewan	1♂	5.6 (7.9)
Z. trifolii (Esper)			
France, Manche	1998 W. G. & S. M. Tremewan	5♂	5.1 (6.0); 5.1 (6.6); 5.2 (5.8); 5.2 (6.0); 5.7 (6.0)
		5♀	5.4 (6.7); 5.5 (7.9); 5.6 (6.6); 5.6 (7.8); 5.6 (8.0)
Tunisia*, Kasserine	1981 W. G. Tremewan	2♀	5.2 (7.9); 5.3 (7.9)

cocoons: *Gambrus incubitor* (L.), several *Listrognathus* and *Agrothereutes* species, and the less common *Itoplectis viduata* (Gravenhorst) (all Ichneumonidae) and *Monodontomerus vicicellae* (Walker) (Torymidae). Less specialised hymenopterous parasitoids are completely absent except as hyperparasitoids, in which role several more generalist species (for example in Britain species of *Itoplectis*, *Gelis* and *Acrolyta* (all Ichneumonidae) and *Pteromalus* (*Habrocytus*) (Pteromalidae)) are typically abundant. Although Tachinidae (Diptera) generally tend to have more diffuse host ranges than koinobiont Hymenoptera, those that attack *Zygaena* are mostly rather specialised: the genera *Phryxe* and especially *Exorista* contain species with at least a strong leaning towards *Zygaena*, and the most abundant and polyphagous parasitoids of medium-sized, exposed Lepidoptera, such as *Compsilura concinnata* (Meigen) and *Pales pavida* (Meigen), are rather infrequently reared.

Zygaena species contain presumably protective cyanogenic glucosides (Davis & Nahrstedt, 1979, 1982), and Jones, Parsons & Rothschild (1962) showed that the parasitoids of *Zygaena* that they tested contained rhodanese, an enzyme capable of detoxifying cyanide by conversion to thiocyanate. The necessity to be so equipped – presumably at a cost – could explain why the parasitoid complex of *Zygaena* is comprised of specialists, while generalists are evidently easily able to enter only as hyperparasitoids. In this context the apparently broad host range of *Brachymeria tibialis* seemed anomalous, which prompted us to compare the morphology of specimens reared from *Zygaena* with that of specimens from other host Lepidoptera.

Comparison of *B. tibialis* from *Zygaena* and from other Lepidoptera

All reared specimens of *B. tibialis* available to us were microscopically scrutinised. This examination revealed only two small differences by which *Zygaena*-reared material appears to differ from specimens reared as parasitoids of other Lepidoptera.

1. In males from *Zygaena*, the groups of specialised sensillae on the underside of the antennal flagellum are restricted to the four basal funicle segments, with sometimes a few sensillae on the fifth funicle segment. Males reared from *Lymantria* have fully developed groups of sensillae beneath funicles 1–5, as has the male from a tortricid in Turkey (Table 2). However, the male from a tortricid in an oak gall has patches of sensillae only on funicles 1–3.
2. In both sexes, the hind tarsi of specimens reared from *Zygaena* are relatively more slender. Metatarsal thickness varies with overall body length, and females have stouter metatarsi than males. The width of the fifth metatarsomere (mtd) was measured just proximal to its apical narrowing (Fig. 1). In plots of mtd against body length (Tables 1, 2, Fig. 1), specimens reared from *Zygaena* cluster below those from other hosts, this segregation being more distinct in females than in males.

Conclusion

Slight morphological differences were found between *B. tibialis* reared from *Zygaena* and from other Lepidoptera. These were consistent over quite a broad

Table 2. *Brachymeria tibialis* reared from Lepidoptera other than Zygaenidae; body lengths (mm) and depths of metatarsomere 5 (mtd, in arbitrary units with 60 = 1 mm) are shown, and new host and national records are asterisked.

Host sp. & Locality	Year & Collector	No./sex.	Length (mtd)
Lymantria dispar (L.) (Lymantriidae)			
France, Hérault	1989 J. Feltwell	3♂	4.9 (7.1); 5.1 (7.4); 5.2 (6.8)
		1♀	5.8 (9.4)
Ocnerorgia amanda Staudinger* (Lymantriidae)			
Iraq*, Bagdad	1952 E. P. Wiltshire	4♀	5.1 (8.5); 5.8 (9.9); 6.2 (9.3); 6.5 (9.0)
Euproctis chrysorrhoea (L.) (Lymantriidae)			
Greece	1940? C. A. Isaakides	1♀	5.2(8.6)
Archips rosana (L.) (Tortricidae)			
Greece, Argolis	1994 V. Eastop	1♀	3.8 (7.0)
Cacoecia sp. (Tortricidae)			
Pakistan, Quetta	1938 Nazeer	1♀	5.1 (7.9)
Tortricidae in cynipid oak gall			
France, Bche-du-Rhône	1982 M. W. R. de V. Graham	1♂	4.5 (6.5)
Tortricidae on poplar			
Turkey, Ankara	1999 M. R. Shaw	1♂	4.5 (6.3)
Pleuroptya ruralis (Scopoli)* (Pyralidae)			
Spain, Zaragoza	1999 G. E. King	1♀	5.3 (9.0)

geographical range and might suggest that *B. tibialis* attacking *Zygaena* is a host-related genetic isolate. Intraspecific morphological variation linked to the host group attacked is, however, known in other Chalcidoidea and our present evidence is insufficient to justify a taxonomic splitting of *B. tibialis*. Nevertheless, the possibility of the existence of sibling species under this name must be considered when biological control programmes are planned, and we hope that by publishing our findings we will encourage others to investigate the host range of *B. tibialis* experimentally. It might be added that all the *B. tibialis* reared from *Zygaena* that we have seen emerged in the year that host cocoons were collected. The species is long-lived, however, and adult females at least can almost certainly overwinter as adults (Dowden, 1935), making it possible for the species to survive utilising only *Zygaena* as hosts.

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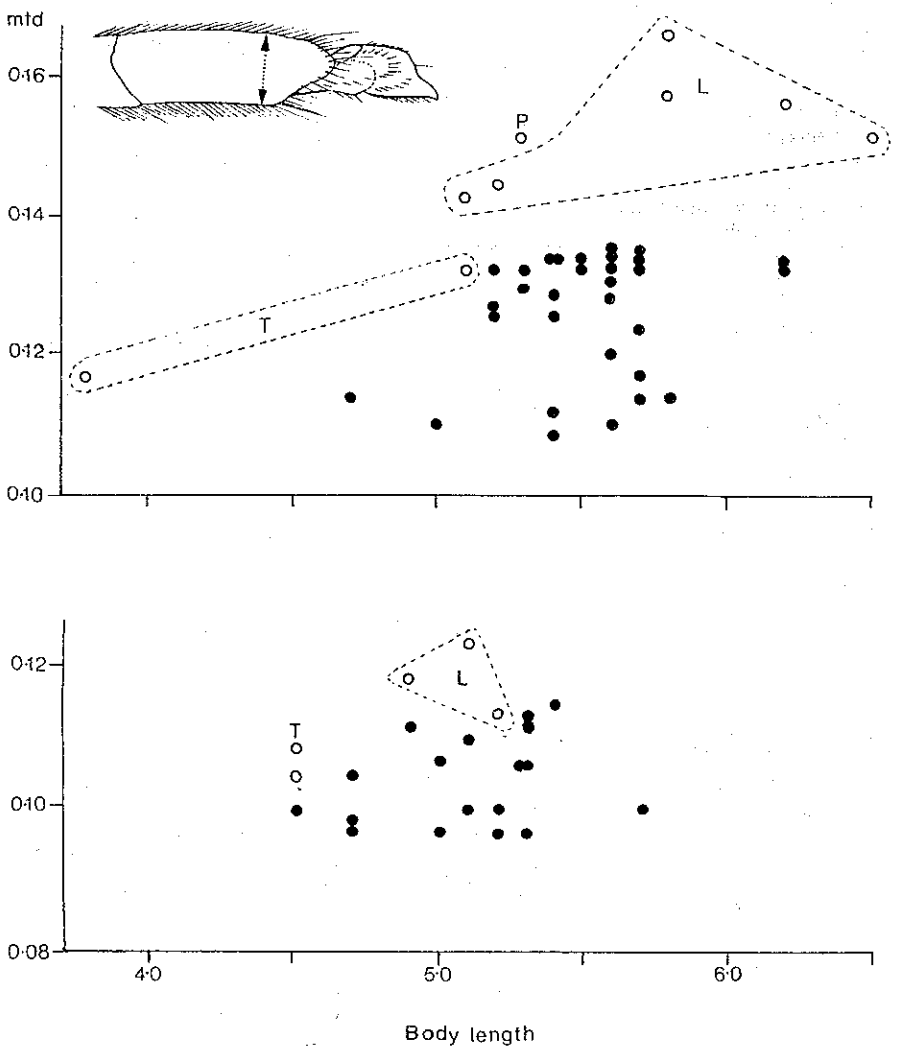

Fig. 1. *Brachymeria tibialis*, plots of the relationship between depth of fifth metatarsomere (mtd) and body length, females above and males below. Axes are marked in millimetres. Specimens reared from *Zygaena* are shown as solid circles, those from other hosts as open circles (L = Lymantriidae, P = Pyralidae, T = Tortricidae). The inset diagram of metatarsomere 5 in profile shows where mtd was measured.

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