A MILLIPEDE NEW TO THE UK: *OPHYIULUS GERMANICUS* (VERHOEFF, 1896) (DIPLOPODA, JULIDA: JULIDAE) FROM OXFORD

Steve J. Gregory

4 Mount Pleasant Cottages, Church Street, East Hendred, Oxfordshire, OX12 8LA, UK.
E-mail: stevejgregory@btopenworld.com

ABSTRACT

The millipede *Ophyiulus germanicus* Verhoeff is reported new for the UK from a site in Oxford city. A description with illustrations is provided, and comparison made with the common *O. pilosus* (Newport), to enable identification. Information about microsites inhabited and associated species is given. It is considered that *O. germanicus,* a millipede native to the Italian mainland, is an accidental introduction into the UK.

INTRODUCTION

The millipede genus *Ophyiulus* Berlese 1884 (Julida: Julidae) comprises 26 known species (Kime & Enghoff, 2017) with the centre of diversity occurring on the Italian peninsula, where 16 species, many endemic, are listed. Until now, just a single species, *Ophyiulus pilosus* (Newport, 1842), was known from the UK (Lee, 2006). Although ubiquitous in Britain (*ibid*), *O. pilosus* is thought to be an ancient introduction from its northern Italian stronghold and is scarce in much of neighbouring continental Europe, including France (Kime, 1999).

During a collecting trip to Trap Grounds, Oxford City (SP502081, VC 23) on 5th November 2015 the author collected a male and female specimen of what were thought in the field to be anomalous *Tachypodoiulus niger* (Leach). While viewing the specimens with a binocular microscope it was apparent that the traverse striae on the prozonites characteristic of *T. niger* (Blower, 1985, Fig.42A) were absent. In addition, the first pair of legs in the male were modified into elongated sickle-shaped structures, as seen in *Ophyiulus pilosus*. However, the specimens were much larger than expected for *O. pilosus* (as given in Blower, 1985) and lacked the characteristic deep metazonite sculpture. The specimens were sent to Henrik Enghoff who identified them as *Ophyiulus germanicus* (Verhoeff, 1896). Additional material, comprising two males and four females, was collected by Keith Lugg and the author on 27th April 2016. These are the first recorded occurrences of this species in the UK.

IDENTIFICATION

Specimens collected from Trap Grounds are described below, highlighting the key features that differentiate *O. germanicus* from the common *O. pilosus* (which was also recorded from Trap Grounds). Specimens of *O. germanicus* are deposited in the author's and BMIG's collections.

Taxonomy

ORDER Julida Brandt, 1833
FAMILY Julidae Leach, 1814
TRIBE Julini Lohmander, 1936
GENUS *Ophyiulus* Berlese, 1884
***Ophyiulus germanicus* (Verhoeff, 1896)**
syn. *Julus germanicus* Verhoeff, 1896
syn. *Ophyiulus strandi* Attems, 1927

Diagnosis

Ophyiulus germanicus is very similar to *O. pilosus* in general appearance (Fig. 1), but differs primarily its larger size and shallower metazonite striae. Males can be distinguished by the shape of the first legs, the structure of the coxae of the second legs and by the shape of the velum on the opisthomerite of the gonopods. These features are listed in Table 1 and considered in more detail below.

FIGURE 1: *Ophyiulus germanicus* (Verhoeff)
Habitus, live male from Trap Grounds, Oxford. Image © Keith Lugg

TABLE 1: Comparison of some characters of *Ophyiulus germanicus and O. pilosus.*

Character	*Ophyiulus germanicus* from Oxford city	*Ophyiulus pilosus* (*after Blower, 1985)
Male: length & diameter	21.0 x 1.4 and 23.0 x 1.6 mm	13.8-19.4 (21.0) x 1.03-1.14 mm*
Female: length & diameter	23.0-32.0 x 1.7-2.2 mm (4 specimens)	19.6-29.3 (30.0) x 1.50-2.17 mm*
Metazonite striae	Shallow 'scratches' (Fig. 1C)	Deeply fluted like 'Doric pillar'*
Male: distal article of first leg pair	Anterior margin with distinct bulge with 3+ long stout spines (Fig. 3C)	Anterior margin gently curved, with one long stout spine (Fig. 3F)
Male: coxae of second leg pair	Prominent finger-like processes on distal inner corner (Fig. 3D 'p')	Any process on distal inner corner considerably reduced (Fig. 3G 'p')
Male gonopods: velum of opisthomerite	Velum triangular, pointed, with 4-6 teeth on anterior margin (Figs. 3A-B)	Velum parallel sided with rounded tip bearing blunt tubercles (Fig. 3E)

FIGURE 2: *Ophyiulus germanicus* (Verhoeff) from Trap Grounds, Oxford.

A) Anterior body rings (swollen gnathochilarial stipes and sickle-shaped first leg pair arrowed) Image © Keith Lugg; B) Posterior body rings and telson; C) Central body rings showing metazonite striae; D) Size comparison of *O. germanicus* (top) and *O. pilosus* (bottom). E) Male, gonopod, mesal view; F) and G) Female, vulva, posterior and lateral view (E-G cleared in euparal).

Description

This description is based on three males and five females collected from Trap Grounds.

Colour

The first specimens collected were grey/brown in colour (Gregory, 2016), but subsequent specimens were more heavily pigmented, being a dark brown-black, with pale brown legs (Figs. 1, 2A-D). The prozonites are lightened ventro-laterally due to the absence of dermal pigment over the muscle attachments and therefore very similar in appearance to *O. pilosus*.

Size

The two males measured were 21 and 23 mm in length by 1.4 and 1.6 mm in diameter, respectively. The five females ranged between 23-32 mm by 1.6-2.2 mm in diameter. Thus, for a given stadium this species is noticeably larger than *O. pilosus* (as given in Blower, 1985) (Fig. 2D).

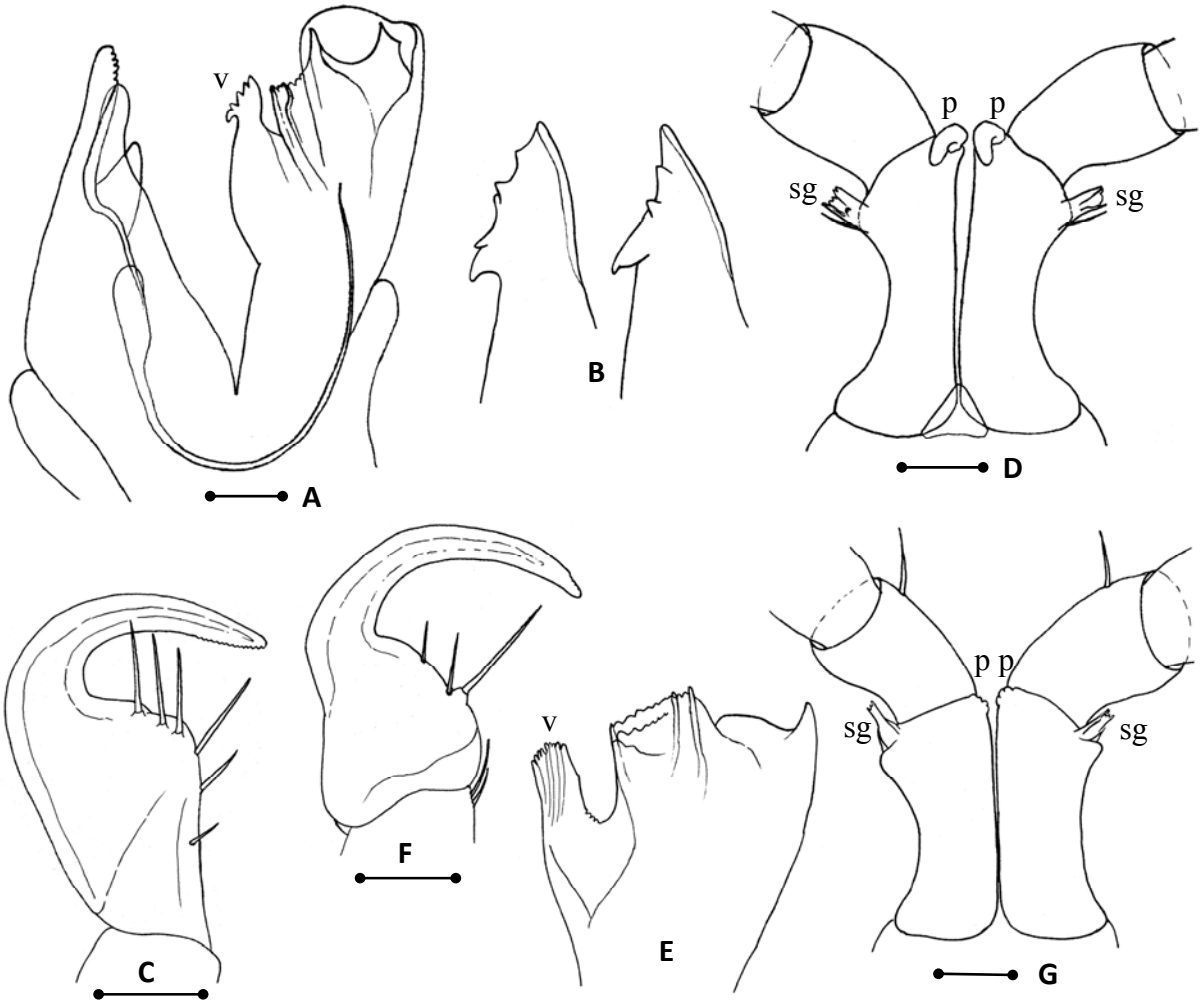

FIGURE 3: A-D) *Ophyiulus germanicus* (Verhoeff), male, Trap Grounds, Oxford.
A) gonopod, mesal view (v = velum); B) velum, two examples; C) distal article of first leg, lateral view; D) coxae of second leg, anterior view.
E-G) *Ophyiulus pilosus* (Newport), male, Trap Grounds, Oxford.
E) opisthomerite of gonopod, mesal view (v = velum); F) distal article of first leg, lateral view; G) coxae of second leg. All scale bars 0.1 mm.

Body rings

Metazonites bear shallow longitudinal striae (Fig. 2C), which is quite different from the deep fluting "like a Doric pillar" (Blower, 1985) seen in *O. pilosus.* Metazonites are fringed along their posterior edge with distinct setae. These are typically only about half the length of the metazonites, but becoming distinctly longer towards the anterior and posterior of the animal (Fig. 2A). Overall the setae are shorter and less conspicuous, than seen in *O. pilosus*, where they typically exceed the full width of the metazonites (Blower, 1985).

Telson (Fig. 2B) is produced into a long pointed caudal projection, ending in a straight hyaline tip. This is essentially identical to that seen in *O. pilosus*.

As in other members of the genus, including *O. pilosus*, the distal part of the gnathochilarial stipes is conspicuously swollen in the male (Fig. 2A).

Male: first leg pair

Males bear elongated sickle-shaped first legs (Figs. 2A, 3C) that are characteristic of many species in this genus. In lateral view, the anterior margin has a prominent bulge which bears a row of at least three elongated stout spines and a few smaller ones. In *O. pilosus* (Fig. 3F) the anterior edge lacks this bulge, and bears just one elongated stout spine (and a few smaller ones).

Male: second leg pair

The distal inner corner of the coxae of the second pair of legs is extended into a small triangular projection which bears a fleshy finger-like curved process that projects anteriorly (Fig. 3D 'p'). The outer edge of the coxae bear prominent secretory glands located on a bulge (Fig. 3D 'sg'). *O. pilosus* bears similar secretory glands on the outer edge of the coxae (Fig. 3G 'sg'), but the triangular projection on the distal inner corner is absent and the finger-like process is more or less absent (Fig. 3G 'p').

Male: gonopods (leg pairs 8 & 9)

The gonopods of *O. germanicus* (Figs. 2E & 3A) are very similar in general appearance to those of *O. pilosus* (Fig. 3E). The diagnostic character is the shape of the velum on the anterior margin of the opisthomerite. In *O. germanicus* (Fig. 3B), the velum is triangular with a pointed tip and bears a number of stout teeth along the anterior edge (between four and six in the three specimens examined). Some of these teeth may be directed laterally and therefore not immediately obvious in lateral view. In contrast, the velum in *O. pilosus* (Fig. 3E) is more or less parallel sided with a rounded apex bearing blunt tubercles.

Female: vulvae

The female vulvae are very similar to those of *O. pilosus* (as figured in Blower, 1985, Fig. 54C-E), but differ subtly in shape. In posterior view the apical margin is less deeply incised (Fig. 2F) and in lateral view is slightly more swollen posteriorly (Fig. 2G) relative to *O. pilosus*. However, these differences are possibly not sufficient to enable reliable species determination.

OCCURRENCE AT TRAP GROUNDS

Location

Trap Grounds is a designated Local Wildlife Site is one of the last remaining un-built spaces along the Oxford Canal between the city centre and the northern suburbs. It lies on the flood plain of the river Thames at about 55m asl. Although only six acres (2.4 ha) in size, it supports a rich mosaic of habitats,

including reed bed, grassland and mature secondary deciduous woodland (Jackson-Houlston, 2009). The site was formerly much larger in size but modern housing has encroached on three sides. The site continues to support a diverse invertebrate fauna including Nationally Scarce species such as the spider *Theridiosoma gemmosum* and the bee *Hylaeus signatus* (Gregory, 2013). Until the 1990s Trap Grounds was used as an unofficial rubbish tip and consequently the invertebrate fauna (and flora) shows a strong synanthropic element, including the second British record for the introduced millipede *Anamastigona pulchella* (Gregory *et al*, 2015), and now *O. germanicus*.

Habitat and associated species

Despite searches across the entire site, all specimens of *O. germanicus* collected so far (data presented herein and M.G. Telfer pers. comm.) have been collected from a discrete area of secondary woodland known as Sparrowhawk Wood. This is mainly composed of Sycamore, *Acer pseudoplatanus,* and Hawthorn, *Crataegus monogyna,* that has developed over made up ground strewn with rubble and other debris. This is in keeping with the typical woodland habitat favoured by this species (see heading *Occurrence elsewhere in Europe* below).

At Trap Grounds specimens of *O. germanicus* were found associated with the Chordeumatidans *Anamastigona pulchellum* (Sivestri) and *Brachychaeteuma melanops* Brade-Birks & Brade-Birks; the Julids *Brachyiulus pusillus* (Leach)*, Cylindroiulus britannicus* (Verhoeff)*, Cylindroiulus punctatus* (Leach), *Tachypodoiulus niger* (Leach) and *Ophyiulus pilosus* (Newport); and the Polydesmid *Polydesmus coriaceus* Porat.

Ophyiulus germanicus has been collected from the Trap Grounds on 5th November, 18th April (M.G. Telfer, pers. comm.) and 27th April. The German observation (Decker & Hannig, 2011) was made on 23rd September. This may be a species that is mature all year, or possibly mature only during the winter months.

OCCURRENCE ELSEWHERE IN EUROPE

Ophyiulus germanicus was described from northern Italy (South Tyrol) and its distribution is centred of the Apennine Mountains of Italy (Foddai, *et al*, 1995), where it is mainly associated with deciduous woodland, including Sweet Chestnut *Castanea,* Oak *Quercus,* Hornbeam *Carpinus,* Ash *Fraxinus* and Hazel *Corylus* (Kime & Enghoff, 2107). Despite its name, this species has only very recently been recorded from Germany (in 2006), where it is considered to be introduced (Decker & Hannig, 2011; Reip *et al*, 2016). It has also been collected from Mt Turbon, Huesca, in Spain at an altitude of 1400-1600m (Kime & Enghoff, 2107). The Italian and Spanish records are from mountainous regions, which contrasts strongly with the Trap Grounds which lies on the lowland floodplain of the River Thames at about 55m asl.

CONCLUSION

Ophyiulus germanicus appears to be established in a fairly discrete area of Trap Grounds (Sparrowhawk Wood). Given the suburban location and its historical use of as an unofficial rubbish tip then it is most likely that this species has been unintentionally introduced to this site. Woodland seems to be a key feature in its occurrence, and it may be found at other similar sites within Oxford city or elsewhere in the UK. However, fifteen tubes of voucher specimens of *Ophyiulus pilosus* that are held in the author's personal collection, all collected from the county of Oxfordshire (VC 23 & 22 in part), have been examined and all have proved to have been correctly determined as *O. pilosus*.

ACKNOWLEDGEMENTS

My thanks go to Henrik Enghoff for identification of the original specimens and subsequent advice; Desmond Kime for additional information; and to Hans Reip for providing relevant literature. Keith Lugg allowed me to examine his specimens collected in April 2016 and gave permission to use his images of the live animal in this paper.

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