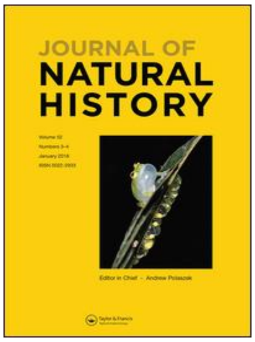

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New species of *Stenomacrus* (Hymenoptera: Ichneumonidae: Orthocentrinae) reared from *Bradysia impatiens* (Diptera: Sciaridae) in The Netherlands

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ABSTRACT

A new parasitoid wasp species, belonging to the genus *Stenomacrus* (Hymenoptera: Ichneumonidae: Orthocentrinae), was found in several Dutch plant nurseries. Here we describe, illustrate and discuss the biology, morphology and molecular characterisation of *Stenomacrus meijeri* sp. nov. It was reared from < 24 h old larvae of the fungus gnat *Bradysia impatiens* (Diptera: Sciaridae).

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Bradysia difformins; *Bradysia paupera*; fungus gnats; parasitoid; plant nursery; young plant root damage

Introduction

Bradysia spp. (Diptera: Sciaridae), also known as fungus gnats, are a ubiquitous pest in commercial greenhouses, especially in ornamentals (Hamlen and Mead 1979; Braun et al. 2012; Cloyd 2015). They inhabit shady moist places (Wilkinson and Daugherty 1970) as larvae mainly feed on decaying plant material and fungi in soil or soilless potting media (Kennedy 1974). However, larvae of some species, including *Bradysia impatiens* Johanssen, also known as *B. difformis* Frey or *B. paupera* Tuomikoski (Vilkamaa 2014), feed on healthy roots and root hairs, tunnel into stems or occasionally leaf tissues of young seedlings and cuttings (Wilkinson and Daugherty 1970). Larvae cause significant damage by feeding on the roots, disrupting the uptake of water and nutrients, which results in stunted growth or death of young seedlings and cuttings (Wilkinson and Daugherty 1970; Fawzi and Kelly 1982; Jarvis et al. 1993; Vaughan et al. 2011). Besides direct damage caused by larvae, they also play a role as vectors for various plant diseases. Wounds resulting from larval feeding allow soil-borne plant pathogens to enter plants (Gardiner et al. 1990; Jarvis et al. 1993). These insects, both larvae and adults, can transmit pathogenic fungi such as *Botrytis* spp., *Fusarium* spp., *Pythium* spp. and *Verticillium* spp. (Kalb and Millar 1986; Favrin et al. 1988; Gardiner et al. 1990; Gillespie and Menzies 1993; James et al. 1995; Braun et al. 2012).

In addition to the traditional use of pesticides, alternative pest control methods have recently become more attractive, including biological control using predatory or parasitic species that can suppress the number of pest populations in greenhouses. For these purposes, biological studies are required in order to find suitable natural enemies and evaluate their

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efficiency. Maintaining constant stable climate conditions (temperature, humidity, light) allows us to consider the greenhouse as an artificial simplified ecosystem, which makes it possible to observe biological interactions at three levels (plant–pest–parasitoid).

Recently, we reported the emergence of ichneumonid wasps (*Megastylus woelkei* Humala (Hymenoptera: Ichneumonidae: Orthocentrinae)) from larvae of Keroplatidae fungus gnats (Diptera) feeding on plant roots in Dutch orchid nurseries (Humala et al. 2017). A similar study was conducted in Japan in greenhouses where shiitake mushrooms (*Lentinula edodes* (Agaricales: Lentinula)) are grown (Mukai and Kitajima 2019; Watanabe et al. 2020). It was revealed that ichneumonid wasps, *Orthocentrus brachycerus* Humala et Lee and *Symplecis bicingulata* (Gravenhorst), parasitise larvae of *Neoempheria* fungus gnats (Diptera) which cause significant damage to these plantations.

Unfortunately, these examples revealing potential biological pest control agents are still scarce, and further studies are needed to obtain more information on the biology of ichneumonid wasps to allow the development of new progressive methods to reduce the harmful effects of insect pests.

During two experimental greenhouse trials, unknown ichneumonid wasps were found. The preliminary identification made by photo showed that these parasitoid wasp species belong to the genus *Stenomacrus* (Hymenoptera: Ichneumonidae: Orthocentrinae); however, species identification was impossible without detailed taxonomic study. The genus is rich in species and in need of taxonomic revision. Its taxonomy and the biology of the subfamily Orthocentrinae are poorly understood, and there is a lack of reliable rearing data. Most orthocentrines are known to be koinobiont endoparasitoids of primitive dipteran hosts of the superfamily Sciaroidea.

Here we describe and illustrate the morphology and biology of the newly described wasp species as well as the molecular identification.

Materials and methods

Wasp collection and rearing

On 13 October 2016, in a greenhouse of Wageningen University & Research (WUR), Bleiswijk, The Netherlands, several Sciaridae adults were observed in a cage with young seedlings. Besides the sciarid adults, two unknown parasitoid wasps were collected in this cage (greenhouse settings 21°C, 60% relative humidity (RH)). As the host was yet unknown, a rearing was started in a BugDorm cage with *Bradysia impatiens* adults. Inside, a cup was placed with a mixture of soil and brown beans (*Phaseolus vulgaris* (Fabales: Fabaceae)) as a food source for *B. impatiens* larvae. Three times a week, the soil mix was moistened. A petri dish with cotton soaked in sugar water was provided as a food source for the parasitoid wasps. The rearing was started in a climate cabinet set at 25 ± 1°C, 70% RH and a 16:8 h light: dark period. On 14 October 2016, in the same greenhouse, four other parasitoid wasps were collected in cages with young seedlings and added to the rearing. On 4 November 2016, the first offspring of the collected parasitoid wasps were found in the rearing cage, confirming that *B. impatiens* is a host of the unknown parasitoid wasp species. Several offspring parasitoid wasps were put in alcohol for morphological identification (code ST).

During a pilot experiment on 25 September 2017 on the attractiveness of substrates for Sciaridae adults, at a plant breeding company in Hendrik ido Ambacht, The Netherlands, several parasitoid wasps were observed on a substrate that was attractive to sciarid adults. Unfortunately, only one parasitoid wasp was caught. This parasitoid wasp was brought to the entomology laboratory of WUR, Bleiswijk, The Netherlands. A separate rearing was started as described above, as it was not clear whether the collected parasitoid wasp belonged to the same species as those collected previously in WUR greenhouses. On 16 November 2017, the first offspring emerged, and it was confirmed that this parasitoid wasp also has *B. impatiens* as its host. Several offspring were put in alcohol for further species identification (code STF). Both ST and STF rearings were continued.

On 13 November 2017, 10 parasitoid wasps were collected in a greenhouse filled with *Poinsettia* species (Malpighiales: Euphorbiaceae) at WUR, Bleiswijk, The Netherlands. As these parasitoid wasps were very similar in appearance to the ones in the ST rearing, they were added to that rearing.

In the summer of 2018, the summer, autumn and winter of 2019 and the spring and summer of 2020, several parasitoid wasps of a species similar to ST and STF were found on sticky plates in several greenhouses with plants such as *Gerbera* (Asterales: Asteraceae) and Alstroemeria (Liliales: Alstroemeriaceae), suggesting that this species has established in WUR greenhouses.

Morphological species identification

The morphological terminology mostly follows Gauld (1991). Photographs shown in Figures 1–2 were taken at the Forest Research Institute, KRC RAS, with a DFC 290 digital camera attached to a Leica MZ9.5 stereomicroscope. Images were combined with Helicon Focus Pro (v. 5.3) software. Photographs shown in Figure 3 were taken at WUR with a Canon EOS 800D camera with a Canon MP-E 65 mm lens. Images were combined with Zerene Stacker (v. 1.04) software, except Figure 3(d,e) which were taken with a Zeiss AX10 LAB.A1 microscope using ZEN 2.5 lite software.

Molecular species identification

DNA isolation and polymerase chain reaction

Genomic DNA was extracted from five offspring specimens of ST and STF using the LGC Mag Plant Kit (Berlin, Germany) in combination with the KingFisher method (Waltham, MA, USA) according to the manufacturer protocol. Partial sequences of large-subunit ribosomal RNA gene (28S) and cytochrome oxidase subunit I gene (COI) loci were amplified by polymerase chain reaction (PCR) using the primers 28Sforward (5′- AGAGAGAGTTCAAGAGTACGTG-3′)/ 28Sreverse (5′- TAGTTCACCATCTTTCGGGTC-3′) (Belshaw et al. 2001) and MH-MF1 (5′- GCTTTCCCACGAATAAATAATA-3′)/LepR1 (5′- TAAACTTCTGGATGTCCAAAAAATCA-3′) (Hebert et al. 2004; Hajibabaei et al. 2005).

We performed standard 25 µL PCRs containing 12.5 µL of 2× PCR master mix (Cat. No. M7502, Promega), 1 µL of each primer (10 µM) synthesised by Biolegio (Nijmegen, The Netherlands), 5 µL DNA extract, and PCR-grade water to final volume. PCR conditions for COI were 95°C for 3 min, followed by 40 cycles of 95°C for 45 s, 52°C for 45 s and 72°C for 45 s, and a final extension at 72°C for 10 min. The same conditions were used for the amplification of 28S except annealing for 45 s at 56°C. The PCR products were visualised on a 1% agarose gel.

Sequence analysis

Sequencing was performed in both directions by BaseClear BV (Leiden, The Netherlands) using the same primers for the PCR reactions. Sequences of the two PCR products (ST and STF) were edited using BioEdit software.

Specimen deposition

Holotype and paratype specimens of the newly described *Stenomacrus* species are deposited in the collection of the Natural History Museum, London, UK (NHMUK). Paratypes are deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZISP); Forest Research Institute, Karelian Research Centre of Russian Academy of Sciences, Petrozavodsk, Russia (FRI); and Naturalis Biodiversity Centre Leiden, The Netherlands (RMNH).

Results

Altogether, 17 individuals of ichneumonid wasp were collected in ornamental plant greenhouses (see Taxonomy: additional material section), and were used to start up a rearing. For morphological species identification, 92 ♀♀ and 27 ♂♂ offspring of ST and 34 ♀♀ and 28 ♂♂ offspring of STF were used (see Taxonomy: material examined section). For molecular species identification, 10 offspring specimens (5 of ST and 5 of STF) were used. Study of these materials revealed that this species belongs to the genus *Stenomacrus* and is new to science. Its description is given below.

Taxonomy

Family **ICHNEUMONIDAE** Latreille, 1802
Subfamily **ORTHOCENTRINAE** Förster, 1869
Genus ***Stenomacrus*** Förster, 1869

Stenomacrus is a large genus with 71 known extant species distributed worldwide, excluding the Afrotropical Region, where no species have been described yet (Yu et al. 2016). The majority of described species (52 spp.) are known from the Palaearctic. Taxonomy of the genus is poorly developed, and the revision of the Western Palaearctic species by Aubert (1981) cannot be considered satisfactory. The boundaries between this genus and related genera like *Neurateles* Ratzeburg, *Plectiscus* Gravenhorst and the tropical *Chilocyrtus* Townes are poorly defined. As noted by Broad (2010), *Stenomacrus* Förster species as currently defined do not possess any suite of apomorphies that effectively exclude other genera. The genus *Stenomacrus* is characterised by significant morphological variety, which can make it difficult to distinguish from *Neurateles* and *Plectiscus* species. Very little is known about the biology of *Stenomacrus*. Unfortunately, a large part of host records for the genus, referred for example to species of Lepidoptera or Coleoptera, is doubtful. Among the reliable observations of *Stenomacrus* hosts should be noted *S. curvulus* (Thomson) reared from *Trichosia sinuata* Menzel et Mohrig (Vilkamaa and Komonen 2001) and *S. laricis* (Haliday) reared from *Bradysia confinis* (Winn., Frey) (Deleporte 1986). Members of the genus *Stenomacrus*, and at least such closely allied genera as *Neurateles* and *Plectiscus*, seem to specialise on Sciaridae (Broad et al. 2018) and are presumed to be larval koinobiont endoparasitoids.

Diagnosis

Similar to other orthocentrines from the tribe Orthocentrini (*Orthocentrus* group), *Stenomacrus* has a strongly convex face fused with clypeus; long subcylindrical scapus, at least 2.0 times as long as wide (Figure 1(a,b)); mandibles strongly tapered with reduced lower tooth; spiracle of metasomal tergite 1 anterior to midlength, tergite not narrowed except at very anterior end; sternite 1 short, separated from tergite and not reaching the middle of tergite (Figure 1(a)).

The representatives of *Stenomacrus* are characterised by their small size (2–6 mm); lower edge of clypeus straight, labrum exposed unlike in *Orthocentrus* Gravenhorst; epicnemial carina developed laterally unlike in *Neurateles* and *Plectiscus*; ovipositor shorter than apical depth of metasoma (Figure 1(a)) and mandibles tapered and curved inwards with lower tooth small or sometimes reduced, not visible in anterior view, unlike in *Picrostigeus* Förster and *Batakomacrus* Kolarov. Notauli missing; nervellus (*cu-a*) reclivous, not broken (abscissa of vein 2 cu lacking). Females of some northern species are brachypterous, though the majority of species are fully winged. Fore wings as a rule without an areolet (Figure 1(a)), if present, quadrate or narrow pentagonal. Male antennae without tyloids, flagellomeres more or less uniform, gradually shortened to apex.

Stenomacrus meijeri Humala sp. nov.
(Figures 1–2)

Description

Female. Body length 2.5 mm, fore wing 2.0 mm (Figure 1).

Head. Head width 1.2 times its height; head nearly polished, sparsely punctate. Face at level of antennal sockets 0.55 times as wide as head width, inner orbits divergent ventrally (Figure 1(b)); eyes glabrous. Minimum distance between antennal sockets 0.55 times as long as diameter of socket. Scape slightly convex on inner surface, slightly concave on outer surface, 2.3 times as long as wide, obliquely truncate; antenna with 17–18 flagellomeres gradually shortening and slightly widened towards apex of antenna, first flagellomere about 3.2 times as long as wide, subapical flagellomere nearly quadrate. Frons smooth, polished; face nearly polished, scarcely punctate and covered with sparse long setae. Clypeus slightly convex, not separated from face, forming uniformly convex surface, its apical margin nearly truncate; labrum exposed. Malar space long, about 2.5 times as long as basal width of mandible, with distinct subocular sulcus between eye and base of mandible (Figure 1(a)) gently curved towards occiput; anterior tentorial pits large and open. Mandible slender, strongly tapered and twisted inwards; lower tooth reduced, much shorter than upper tooth; maxillary palp long, reaching back to fore coxa.

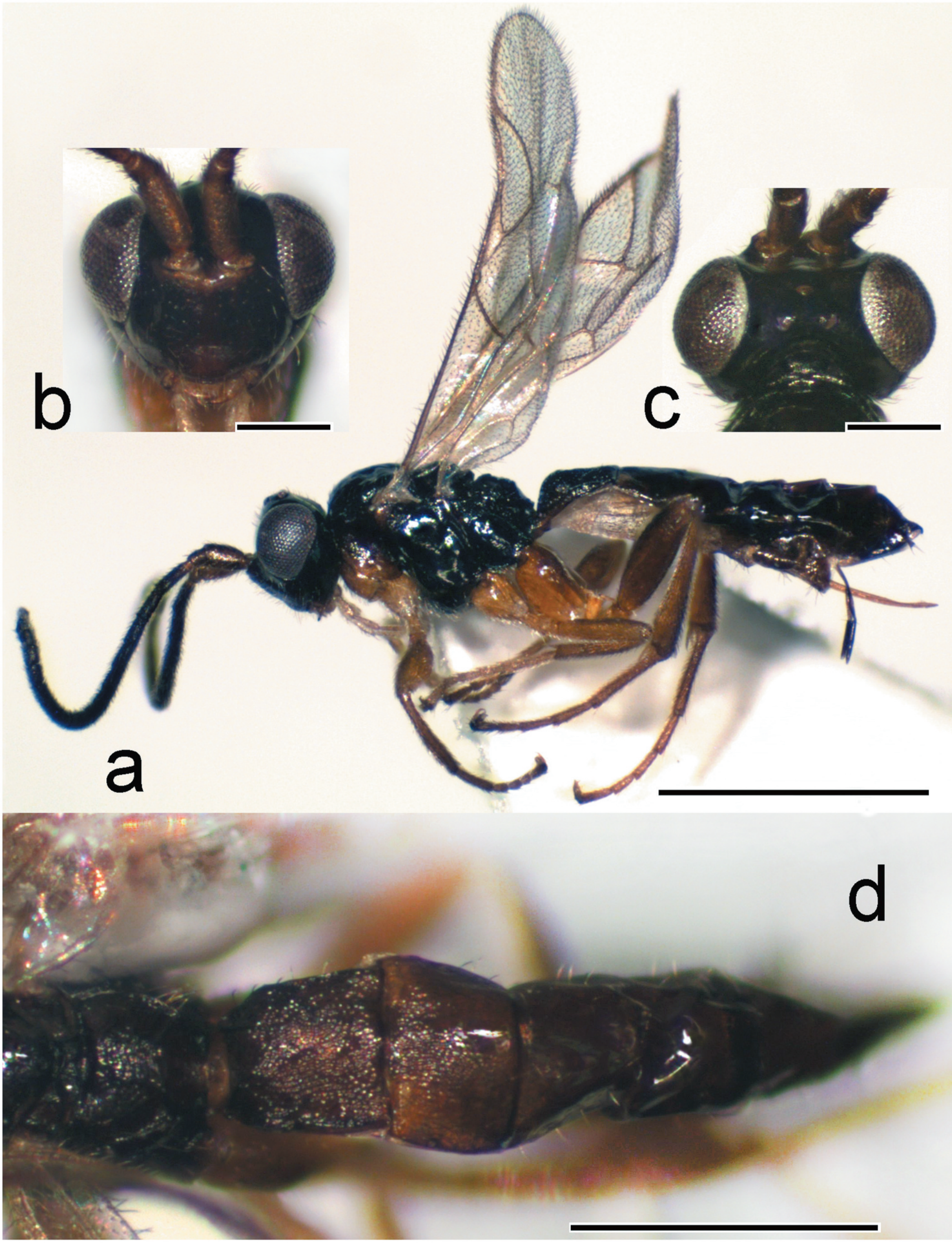

Figure 1. *Stenomacrus meijeri* sp. nov., holotype female: (a) whole insect, scale bar 1.0 mm; (b) head (anterior view), scale bar 0.2 mm; (c) head (dorsal view), scale bar 0.2 mm; (d) propodeum and base of metasoma (dorsal view), scale bar 0.5 mm.

In dorsal view, head posteriorly deeply concave, temples distinct, about 0.45 times transverse diameter of compound eye; occipital carina lacking. Ocelli of moderate size, ocular-ocellar line equal to postocellar line and about 1.5 times as long as maximum diameter of lateral ocellus (Figure 1(c)).

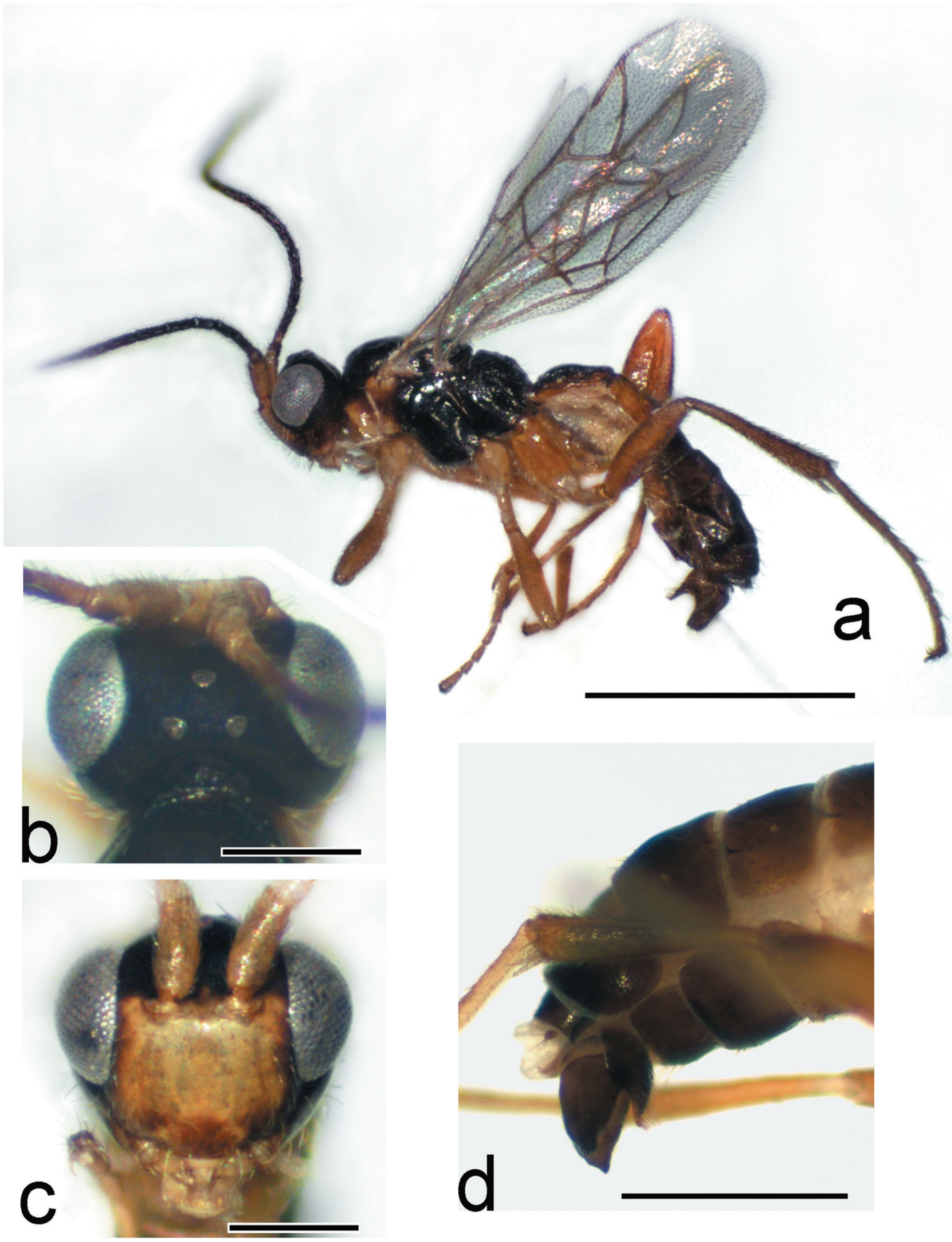

Figure 2. *Stenomacrus meijeri* sp. nov., paratype male: (a) whole insect, scale bar 1.0 mm; (b) head (dorsal view), scale bar 0.2 mm; (c) head (anterior view), scale bar 0.2 mm; (d) apex of metasoma and parameres (ventro-lateral view), scale bar 0.5 mm.

Mesosoma. Mesosoma mostly polished, its length 1.35 times height; epomia lacking. Epicnemial carina present, almost reaching hind margin of pronotum at its mid-height, reduced ventrally (Figure 1(a)). Mesoscutum convex, with sparse adpressed setae; notaulus not developed. Scutellum without lateral carinae; sternaulus lacking; metapleuron

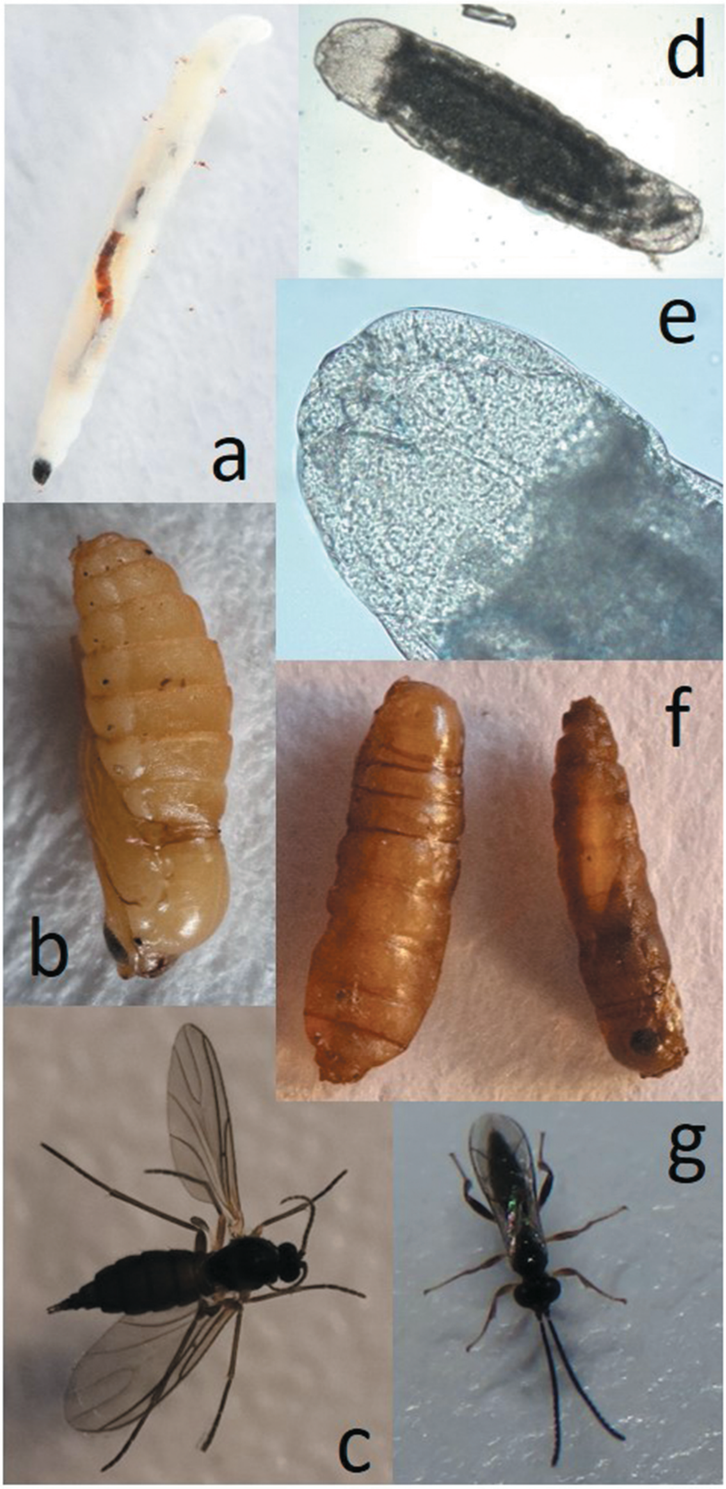

Figure 3. Biology of *Stenomacrus meijeri* sp. nov. and its host *Bradysia impatiens*: (a) fully grown *B. impatiens* larva; (b) *B. impatiens* pupa; (c) *B. impatiens* adult; (d) *S. meijeri* sp. nov. larva; (e) close-up of the larva head of *S. meijeri* sp. nov.; (f) parasitised *B. impatiens* pupae containing an *S. meijeri* sp. nov. larva (left) and an *S. meijeri* sp. nov. adult (right); (g) typical resting position of *S. meijeri* sp. nov.

polished. Propodeum coriaceous, with carinae considerably reduced; posterior transverse carina and pleural carinae present, area superomedia not defined, only stubs of median and longitudinal carinae present. Propodeal spiracle small, circular.

Wings. Wings somewhat narrow, fore wing without areolet; second recurrent vein (2 *m-cu*) with two bullae, vein 2*rs-m* disappeared due to veins *Rs* and *1 m-cu* meeting; pterostigma narrow, about 3.7 times as long as wide; vein *Rs* gently bent towards wing apex; nervulus (1 *cu-a*) oblique, slightly postfurcal; postnervulus strongly angulate, broken in upper third, its lower portion (2*cu-a*) reclivous; nervulus and lower portion of post-nervulus forming an angle of about 60°. Hind wing with nervellus (*cu-a*) strongly reclivous, not intercepted, discoidella (*Cu1*) lacking.

Legs. Legs moderately long; fore coxa with transverse basal carina on the rear side; hind coxa elongate, 2.2 times as long as broad, hind femur 3.5 times as long as broad and 0.9 times as long as hind tibia, hind basitarsus 0.54 times as long as hind tibia; spurs straight, tarsal claws slender and simple.

Metasoma. First tergite of metasoma strongly angulate in lateral view, about as long as posteriorly broad, coriaceous with irregular longitudinal striae, with median longitudinal carinae weak and indistinct; glymmae undeveloped; spiracles at anterior 0.4 of tergite (Figure 1(a,d)). First sternite separated from tergite, 0.2 times as long as tergite length. Second tergite 0.6 times as long as posteriorly broad, coriaceous in anterior half, more finely sculptured posteriorly; anterior thyridium large, oval/rectangular; spiracles at anterior 1/3 of segment on its lateral edge; third tergite with anterior thyridium. Remaining tergites transverse, unsculptured; metasoma compressed to apex from third tergite; tergites covered with scattered setae. Sternites membranous with sparse dark setiferous punctures, sclerotised patches on third and fourth sternites yellowish brown; seventh tergite with deep longitudinal apical incision medially. Ovipositor slightly upcurved, as long as apical depth of metasoma, with shallow subapical incision on dorsal valve (Figure 1(a)); its sheaths uneven, with hairless proximal stalk and widened in apical 0.4, where margins are covered with sparse setae.

Colour. Fuscous; scape and pedicel ventrally and first flagellomere basally yellowish, rest of flagellum fuscous; clypeus reddish brown; mouthparts and lower malar space yellowish. Propleuron, lower pronotum reddish brown; tegula and base of wings yellowish. Legs yellowish, hind coxa dorsally, hind femur and hind tibia somewhat infuscate.

Metasoma brown, except for yellowish brown anterior thyridia of second and third tergites and sclerotised patches on second and third sternites. Wings hyaline, pterostigma and veins light brown.

Male. Similar to female. Body length 2.5 mm, fore wing 1.8 mm (Figure 2).

Head. Head width 1.1 times its height; head matt, sparsely punctate. Face at level of antennal sockets 0.6 times as wide as head width, inner orbits divergent ventrally (Figure 2(c)). Scape obliquely truncate, about 2.5 times as long as wide; antenna long with 18 flagellomeres, all flagellomeres longer than wide; anterior flagellomere about 3.6 times as long as wide. Frons nearly polished, almost impunctate; face smooth, scarcely punctate. Clypeus fused with face, its apical margin somewhat truncate; anterior tentorial pits large and open. Malar space long, 2.5 times as long as basal width of mandible, with distinct impressed subocular sulcus between eye and base of mandible (Figure 2(a)). Mandible slender, strongly tapered and turned inwards, lower tooth small, much shorter than upper tooth; maxillary palp long, reaching back to fore coxa; temples wide, somewhat inflated; ocelli of moderate size, ocular-ocellar line 1.6 times as long as maximum diameter of lateral ocellus, postocellar line 1.4 times as long as maximum diameter of lateral ocellus (Figure 2(b)). In dorsal view, head posteriorly strongly concave, occipital carina reduced. Temple distinctly inflated, 0.6 times as wide as compound eye.

Mesosoma. Mesosoma length 1.4 times height; epomia lacking. Epicnemial carina present, almost reaching hind margin of pronotum at its mid-height. Mesoscutum convex, nearly polished; notaulus not developed. Scutellum without lateral longitudinal carinae. Sternaulus weak and indistinct. Propodeum coriaceous, both transverse carinae indistinct, lateral and lateromedian longitudinal carinae lacking.

Wings. Fore wing with nervulus oblique, slightly postfurcal; vein 2*rs-m* completely reduced, areolet absent, vein 2 *m-cu* with two bullae, *Cu1* lacking.

Legs. Legs long, slenderer than in females (Figure 2(a)).

Metasoma. First tergite of metasoma 1.2 times as long as posteriorly broad, coriaceous; somewhat widened in anterior third and subparallel in posterior 2/3; glymma lacking; spiracles at anterior 0.4 of tergite (Figure 2(a)); median longitudinal carinae weak, convergent posteriorly, not reaching posterior edge; first sternite separated from tergite, 0.2 times as long as tergite length; second tergite 0.6 times as long as posteriorly broad. Remaining tergites more finely sculptured. Metasomal tergites covered with sparse setae. Anterior sternites membranous with sparse dark setiferous punctures; apical sternites from fifth sternite well sclerotised, not divided medially by membrane, eighth sternite with median protrusion bearing dense long setae. Parameres as in Figure 2(d).

Colour. Fuscous; face and lower frons, lower gena, malar space, scape, pedicel and first flagellomere basally yellowish, rest of flagellum fuscous; mouthparts and tegulae pale. Propleuron, pronotum excluding upper anterior part, subtegular ridge and anterior mesopleuron yellowish. Legs yellowish, fore coxae and all trochanters and tarsi pale.

Metasoma brown, except for posterior halves of first and second tergites, and posterior 2/3 of third tergite yellowish; anterior half of second tergite, anterior third of third tergite and narrow posterior bands of second, third and fourth tergites pale; sclerotised patches on second, third and fourth sternites yellowish brown; wings hyaline, pterostigma and veins light brown.

Comments. *Stenomacrus meijeri* sp. nov. differs from other congeners by the following combination of characteristics: female antenna with 17–18 flagellomeres; first flagellomere comparatively long, about 3.2 times as long as wide (Figure 1(a)); lack of areolet in fore wing, pterostigma narrow (Figure 1(a)); propodeum with area superomedia limited by longitudinal carinae; first tergite as long as posteriorly broad without developed dorsal carinae (Figure 1(d)); metasoma not compressed from tergite 3; ovipositor as long as apical depth of metasoma, slightly upcurved posteriorly; ovipositor sheaths with basal hairless flexible stalk and widened apical part covered by hairs (Figure 1(a)). From the related Holarctic *S. vafer* Holmgren, where the new species runs by the Aubert's key (Aubert 1981), it can easily be distinguished by its small size, wide face, long flagellum and proximal flagellomeres, long malar space, narrow pterostigma; fine sculpture of head and mesosoma; metasoma not compressed from tergite 3; and first tergite strongly convex from a lateral view, forming almost a right angle in profile (Figure 1(a)). The new species differs from the similar *S. affinitor* Aubert in fewer flagellomeres in antenna, longer ovipositor, absence of dorsal longitudinal carinae and more roughly sculptured first tergite (Figure 1(d)); *Stenomacrus palustris* Holmgren differs from *S. meijeri* sp. nov. by cubic head, shorter first flagellomere and mostly brown legs.

Material examined

Holotype female (NHMUK), The Netherlands, Bleiswijk, 52.032632°N, 4.531056°E ornamental plant greenhouse; emerged and collected 17 March 2017 (it is an offspring of the collected ST wasps of 13 and 14 October 2016) ex *Bradysia impatiens* larvae (Diptera, Sciaridae) reared in a mixture of soil and brown beans (leg. J.B. Woelke).

Paratypes: 41 ♀♀ and 5 ♂♂ same data as holotype (ST1); 23 ♀♀ and 2 ♂♂ (ST2) same data as holotype; 24 ♀♀ and 1♂ same data as holotype except 20 March 2017 (ST3); 3 ♀♀ and 19 ♂♂ same data as holotype except 16 October 2017 (ST4). All wasps are offspring of the wasps collected 13 and 14 October 2016 (ST).

The Netherlands, Hendrik-Ido-Ambacht, 51.836396°N, 4.612118°E, greenhouse of breeder and young plant supplier, 11 ♀♀ and 22 ♂♂ 20 October 2017 (STF1); 23 ♀♀ and 6 ♂♂ 20 October 2017 (STF3) ex *Bradysia impatiens* larvae (Diptera: Sciaridae) reared in a mixture of soil and brown beans (leg. J.B. Woelke). All wasps are offspring of the female wasp collected 25 September 2017 (STF).

Additional material

The Netherlands, Bleiswijk, 52.032632°N, 4.531056°E, two specimens (sexes unknown, ST) collected 13 October 2016 in greenhouse with cage with young seedlings and sciarid adults (leg. J.B. Woelke); same place, four specimens (sexes unknown, ST) collected 14 October 2016 in greenhouse with cage with young seedlings and sciarid adults (leg. J.B. Woelke); The Netherlands, Bleiswijk, 52.032632°N, 4.531056°E, 10 specimens (sexes unknown, ST) collected 13 November 2017 in greenhouse with *Poinsetia* species (Malpighiales: Euphorbiaceae) (leg. J.B. Woelke).

The Netherlands, Hendrik-Ido-Ambacht, 51.836396°N, 4.612118°E, 1 female specimen (STF) collected 25 September 2017 in greenhouse of breeder and young plant supplier (leg. J.B. Woelke).

Biology

Wasps were collected alive. In the rearing, they were offered $<$ 24 h old larvae of *Bradysia impatiens*. We observed an *S. meijeri* sp. nov. female putting her antennae on the soil. When a larva was located, she put her metasoma between her legs and let her ovipositor oscillate over the soil until a larva was detected, then quickly the larva was parasitised. Because *B. impatiens* larvae (Figure 3(a)) feed in the soil, they pupate at or close to the surface (Figure 3(b)), as adults (Figure 3(c)) than can emerge easily. Development of *S. meijeri sp. nov*. is solitary; that is, only one larva develops per host individual (Figure 3(d,e)). The parasitoid pupates within the host's pupa and does not spin a cocoon (Figure 3(f)). So, our observations confirm that *S. meijeri* sp. nov. is a koinobiont, solitary larval–pupal endoparasitoid of *B. impatiens*. It was also observed in the rearing that *S. meijeri* sp. nov. adults were resting in a typical position as shown in Figure 3(g).

Distribution

The Netherlands, ornamental plant greenhouses. This species is probably widely spread through ornamental plant greenhouses because this species was also found in a greenhouse of a breeder and young plant supplier.

Etymology

The new species is named in honour of Mr Henk Meijer, grandfather of J.B. Woelke.

Sequence analysis

MegaBLAST analysis revealed that the 28S and COI sequences of *Stenomacrus meijeri* sp. nov. matched with 92–100% identity to 28S and COI sequences of several *Stenomacrus* spp. and unclassified *Orthocentrinae* sp. in GenBank. Sequence ID of *S. meijeri* sp. nov.: MN709059-MN709060 (28S) and MN650845-MN650846 (COI).

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Disclosure statement

No potential conflict of interest was reported.

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