

# A genus new to Norway and the distribution of *Protaphidius wissmannii* (Ratzeburg, 1848) (Hymenoptera, Braconidae, Aphidiinae) in Scandinavia, a parasitoid of ant-attended aphids on tree trunks

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Staverløkk, A., Gärdenfors, U. & van Achterberg, K. 2022. A genus new to Norway and the distribution of *Protaphidius wissmannii* (Ratzeburg, 1848) (Hymenoptera, Braconidae; Aphidiinae) in Scandinavia, a parasitoid of ant-attended aphids on tree trunks. *Norwegian Journal of Entomology* 69, 304–312.

The genus *Protaphidius* Ashmead, 1900 and its only species in Europe, *P. wissmannii* (Ratzeburg, 1848) are here reported new to Norway. *Protaphidius wissmannii* is a parasitoid of giant aphids of the genus *Stomaphis* Linnaeus, 1758. The first records for Sweden, the Netherlands and Bulgaria are included and the distribution in Scandinavia is briefly discussed. A few additional European records belonging to the Naturalis collection in Leiden, are also reported. *Stomaphis longirostris* (Fabricius, 1787) is a new host record.

Key words: Hymenoptera, Braconidae, Aphidiinae, *Protaphidius wissmannii*, *Stomaphis*, parasitoid, Formicidae.

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## Introduction

The knowledge of Braconid wasps occurring in Norway is limited. The total of registered species of Braconidae in Norway is 449 and includes 30 species for the subfamily Aphidiinae (Artsnavnebasen 2022), which is much less than half of the expected number. According to Dyntaxa (2022) the number of Braconidae in Sweden is 1141 reproducing species and includes 116 species of Aphidiinae. Aphidiines are koinobiont endoparasitoids of aphids, meaning the host continues to feed and grow while the parasitoid

is feeding on the inside contents. It is one of the most studied groups of Braconidae because of the potential of several species to be effective agents in biological or integrated control of pest aphids (Quicke 2015). Some Aphidiinae species are especially associated with ant-attended aphids, e.g., *Paralipsis enervis* (Nees, 1834) is totally dependent on ants. Völk *et al.* (1996) found that in the colonies belonging to *Lasius niger* Linnaeus, 1758, the wasp survived compared to some other ant species. The wasp camouflages itself, both chemically and behaviorally, and the ant feeds them through trophallaxis, meaning the wasp get

liquid food directly mouth to mouth from the ant. Also, by having them in the colony, the ants give them access to their host aphid, *Anoecia eorni* (Fabricius, 1775), close to the nest. *Paralipsis enervis* was found in a *Lasius niger* colony in Horten, Norway in 2015 (Staverløkk & Ødegaard 2016).

Females of *Protaphidius wissmannii* parasitize the giant aphids in the genus *Stomaphis* Walker, 1870 (Aphididae, Lachninae, Stomaphidini) (Starý 1958, 1965, 1966, 1971, Takada 1968, Kierych 1980, Sanchis & Michelena 1994, Binazzi & Pennachio 2003, Kavallieratos *et al.* 2004, Kaliuzhna 2012, Hodgson *et al.* 2019). The host records by Fulmek (1957; *Pterocomma salicis* (Linnaeus, 1758) and Takada (1968; *Acyrtosiphon malvae* (Mosley, 1841)) have never been confirmed and are most likely erroneous. *Stomaphis* species are large aphids living on tree stems and roots. Their very long rostrum allows them to feed through the bark of trees. Starý (1958) was the first to report a host for *P. wissmannii*, viz., *Stomaphis quercus* (Linnaeus, 1758), and the most recent is by Hodgson *et al.* (2019) who found *P. wissmannii* associated with *Stomaphis wojciechowskii* Depa, 2012 in England. Oak (*Quercus* spp.) seems to be the preferred tree for both aphids, but *S. quercus* has also been collected on *Betula*, *Alnus* and *Acer* (Heie 1995) and *S. wojciechowskii* on *Tilia*, *Alnus*, *Salix* and *Juglans* (Depa *et al.*, 2017, Fjellberg 2022). It also seems that the aphid-species are associated with specific ant species. While *S. quercus* is attended by *Lasius fuliginosus* (Latreille, 1798), *S. wojciechowskii* seems to be preferred by *Lasius brunneus* (Latreille, 1798) (Hodgson *et al.* 2019). Very recently, both *Stomaphis* species were published new to Norway (Fjellberg 2022). Detailed drawings and morphological characters of the wasp are given in Figure 5. The wasp pupates inside the aphid and the mummified aphid skin is removed probably by the attending ants. The cocoon is round to spherical in shape, dark red in colour and the ventral part is securely fixed to the surface (Figure 7). When the adult wasp hatches, it cuts a round hole in the cocoon before emergence (Hodgson *et al.* 2019). The aphids hibernate as eggs, and the adults die in late fall

(Fjellberg 2022). The overwintering stadium of *Protaphidius wissmannii* is a bit unclear, but the cocoons can be found also during the winter months (Hodgson *et al.* 2019).

## Materials and Methods

The specimen from Norway was collected with a Malaise trap (MT). The Swedish records were all collected as mummies and put in vials for hatching and emergence. The illustrated female (Figure 5) from the Netherlands was reared in the province of Gelderland (Bennekom) by H. Evenhuis from *Stomaphis longirostris* (Fabricius, 1787) (the giant aspen aphid) taken from the bark of *Betula* sp., which is a new host record and a new record of both genus and species of *Protaphidius wissmannii* for the Netherlands. Later this species has been found in Amerongen (province of Utrecht) on the bark of an unidentified tree. For the stacking images (Figures 1–3, 7), several partially focused images were taken and then combined using Zerene Stacker 1.04 © (2009–2017) software. The coordinates for the locations are given in decimal degrees (Grid: Latitude/Longitude hddd. dddd; datum: WGS84). The faunistic division within Norway follows Endrestøl (2021) and are given in bold.

## Records

### ***Protaphidius wissmannii*** (Ratzeburg, 1848)

*Aphidius wissmannii* Ratzeburg, 1848: 59.

*Coelonotus wissmannii*; Fahringer 1937: 241.

*Menozaia formicaria*; Goidanich, 1934: 217–227

*Protaphidius wissmannii*; Starý 1958: 89–93.

**NORWAY, Aust-Agder (AAY), Risør:** Sønedeled, Trollåsen [N58.75087, E9.13608], 1♂ (Figure 1), MT, 2 August–13 September 2022, leg. Arnstein Staverløkk, coll. NINA. The trap site is a south-west facing slope dominated by deciduous trees (Figure 4).

**SWEDEN, Skåne, Dalby, Knivsåsen,** [N55.662742, E13.405165 ±250m], grassland with scattered birches, spherical mummies collected by Ulf Gårdenfors and put in rearing vials on stated date in colony of *Stomaphis*



**FIGURE 1.** Male of *Protaphidius wissmannii* (Ratzeburg) from Norway, Søndeled, Risør in Agder. Habitus (left), Mesosoma (posterior part) and first metasomal tergite, dorsal aspect (right). Photo: Arnstein Staverløkk.



**FIGURE 2.** *Protaphidius wissmannii* (Ratzeburg), female, Sweden, Skåne county. Habitus with retracted metasomal segments, lateral aspect (left); Mesosoma (posterior part) and first metasomal tergite, dorsal aspect (right). Photo: Arnstein Staverløkk.

*quercus*, attended by *Lasius fuliginosus* in bark crevices on lower trunk of rather large trees of *Betula pendula* var. *pendula* Roth (= *Betula*

*verrucosa*). Mummies collected 18 June 1983, 1 ♀ & 2 ♂ emerged, 1 mummy collected on 19 June 1983, 1 ♂ emerged, Mummies collected 28 July



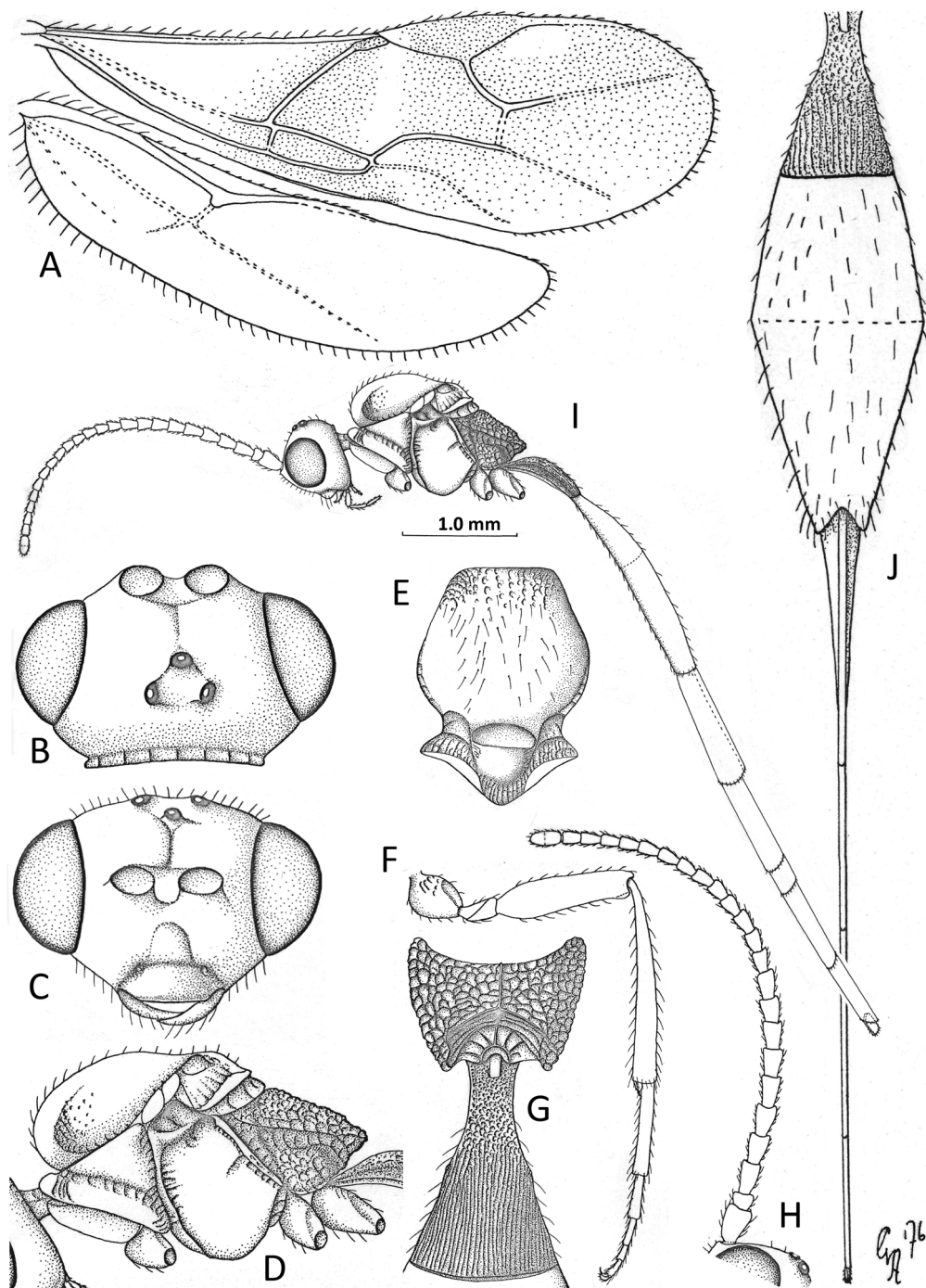


**FIGURE 3.** *Protaphidius wissmannii* (Ratzeburg), male, Sweden, Skåne county. Habitus, lateral aspect (left); Mesosoma (posterior part) and first metasomal tergite, dorsal aspect (right). Photo: Arnstein Staverløkk.

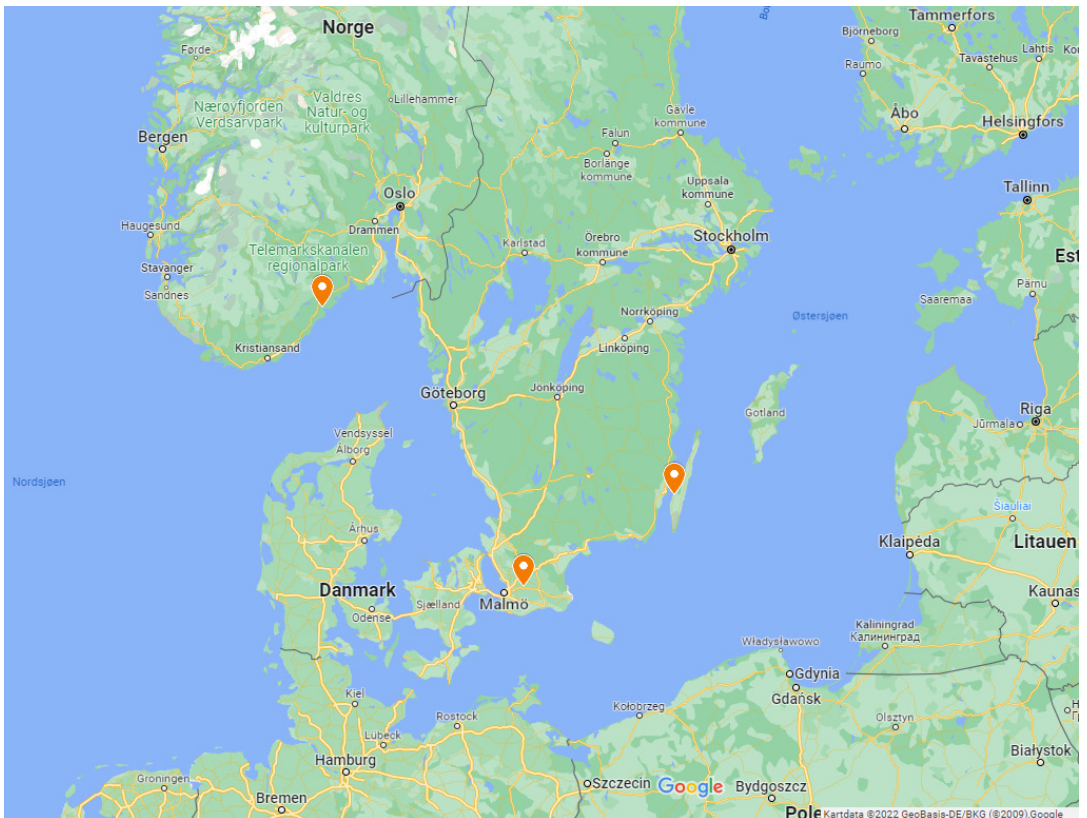


**FIGURES 4.** Location of the Malaise trap at Søndeled, Risør in Agder, 10 May 2022. Photo: Arnstein Staverløkk..





**FIGURE 5.** *Protaphidius wissmannii* (Ratzeburg), female, Netherlands, Bennekom. The scale-line is for the habitus in lateral view. **A.** Wings, **B.** Head, dorsal aspect, **C.** Head, anterior aspect, **D.** Mesosoma, lateral aspect, **E.** Mesoscutum and scutellum, dorsal aspect, **F.** Hind leg, **G.** Propodeum and first metasomal tergite, dorsal aspect, **H.** Antenna, **I.** Habitus with exserted metasomal segments, dorsal aspect, **J.** Metasoma, dorsal aspect. Drawings by Kees van Achterberg.



**FIGURE 6.** Map showing the records of *Protaphidius wissmannii* (Ratzeburg, 1848) in the Nordic countries. Map: Google Maps.

1991 (Figure 7), 1♀ (Figure 2) and 1♂ hatched (Figure 3). Mummies collected 27 July 1985 and 6 August 1996 did not hatch. Emerged specimens currently in private collection but will be deposited in Lund Zoological Museum. Live *Stomaphis quercus* aphids, with no signs of mummification, all attended by *Lasius fuliginosus*, were also collected at 6 occasions at other locations in the province of Skåne, between 26 June and 4 August in 1981 and 1982, from *B. pendula* var. *pendula* and put in rearing vials. From none of these *Protaphidius* specimens emerged. **SWEDEN**, **Öland**, Torslunda, Skogsby Lund Nature reserve [N56.624126, E16.497332 ±234m] 1♂, collected with sweep netting on 7 July 2018, leg. Robert Ennerfelt, private collection. **NETHERLANDS**, **Bennekom**, ex. mummy of *Stomaphis longirostris* on *Betula* sp., [N52.000000, E5.683333 +300m], 1♀, coll. 26 June 1973, emerged 12 July 1973, leg. D. Hille Ris Lambers, coll. Naturalis (RMNH,

Leiden). **Amerongen**, [N52.000000, E5.466667 +300m], 1♀, 29 May–11 June 1999, in cone trap, from trunks in managed forest, leg. L. Moraal, coll. Naturalis (RMNH, Leiden). **BULGARIA**, **Sofia**, Experimental university farm, Malaise trap, [N42.700000, E23.250000 +600m], 1♀, 21 July–7 August 1997, 1♀, leg. P.V. Atanassova. In addition, in RMNH specimens from **GERMANY**, **Bayern**, Grafenrheinfeld near Schweinfurt (Unterfranken), [N50.000000, E10.200000], 23 June 1984 and 27 May 1985, from trunk of *Quercus robur*, leg. W. Büchs, coll. Naturalis (RMNH, Leiden), **FRANCE**, **Vaucluse** (trail 84), Mt. Ventoux (Z), Jas de Perrache, [N44.116667, E5.183333], 18 September 1997, leg. M.J. Gijswijt, coll. Naturalis (RMNH, Leiden).

**Distribution:** *Protaphidius wissmannii* (Ratzeburg, 1848) is the only species in its genus in the Western Palearctic and is probably restricted to Europe. It is officially reported from Czech



**FIGURE 7.** Mummie of *Stomaphis quercus* (Linnaeus, 1758) (left) and empty cocoon of *Protaphidius wissmannii* (Ratzeburg, 1848) from Skåne, Sweden. Photo: Arnstein Staverløkk.

Republic, England, France, Germany, Hungary, Italy, Latvia, Poland, Serbia, Slovakia, Spain, and Ukraine (Yu *et al.* 2016, Hodgson *et al.* 2019). The records of *Protaphidius wissmannii* of the East Palaearctic region most likely concern very similar species (Yamamoto *et al.* 2020). Figure 6 shows the records from the Nordic countries.

## Discussion

While ovipositing, the aphidiines bring their telescopic metasoma under the mesosoma so that the ovipositor is pointing forwards between the wasp's middle or fore legs. *Protaphidius* have an extra-long telescopic metasoma (Figure 4, 5I) to reach into the semi-concealed *Stomaphis*-aphids in the crevices of the bark (Quicke 2015). A closer study needs to be done at Trollåsen (the Norwegian locality) to uncover what aphid species is associated with *P. wissmannii* in Norway. What is clear, is that there were several workers of *Lasius brunneus* in the trap material

but no specimens of *Lasius fuliginosus*. Based on the assumption that the ants are species specific on the *Stomaphis* aphids, this could indicate that the aphid host is *Stomaphis wojciechowskii* (see Hodgson *et al.* 2019). To look for ant trails on oak trees that are minimum 60 cm in diameter, and in the height of 0.5–3.0 m above ground would be the right approach in the search for more data, but also the tree trunk near soil or below soil level should be checked for aphids (Hodgson *et al.* 2019). It seems likely that cocoons can be found all year round in the colonies of these aphids (Hodgson *et al.* 2019). This species is rare in entomological collections, meaning that the species is more easily found by specific search than in trap material. Considering the distribution of the giant aphids in Scandinavia (listed in Naturbasen (DK), Artskart (NO), Artportalen (S)), it is likely that *Protaphidius wissmannii* can be found at more sites in Scandinavia. It should occur in Denmark but is still not found or officially reported. Considering the variability in the shape and colour of the femora, the sculpture of the



mesosoma (especially of the propodeum) and the first tergite, it would be worth to look for cryptic species among *P. wissmannii sensu lato* (see also Yamamoto *et al.* (2020)).

**Acknowledgements.** We would like to thank landowner Svein Stamsø for his kindness and for the permission to conduct our studies in his forest. Thanks to Robert Ennerfelt for allowing us to include his record from Öland, and thanks to Frederique Bakker at RMNH for providing us with data on the specimens in the iNaturalis collection in Leiden. Also, a huge thanks to Frode Ødegaard for cooperation and companionship during fieldwork. Part of this study was funded through the Norwegian Taxonomy Initiative by the Norwegian Biodiversity Centre, project 9-20 (NOCER).

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*Received: 29 November 2022*

*Accepted: 8 December 2022*