

# A social parasitic *Polistes* wasp parasitized by a twisted-wing insect (Hymenoptera: Vespidae, Strepsiptera: Xenidae)

Jan Smit  
John T. Smit

## KEY WORDS

Endoparasitism, social parasitism, *Polistes atrimandibularis*, *Xenos vesparum*

Entomologische Berichten 74 (3): 121-123

In October 2013, a female specimen of the social parasitic *Polistes atrimandibularis* was found with a pupa of a male twisted-wing insect in its abdomen. This turned out to be a new host for the genus *Xenos*, and is one of only few known cases of parasitism of a social parasite by Strepsiptera. Given the numbers of *Polistes dominula* present at the site, it is likely that *P. atrimandibularis*, as a parasite of that species, got infected by *Xenos* through this host.

## Introduction

Twisted-wing insects (Strepsiptera) are endoparasites that spend nearly all their life inside their host's body. With the exception of the family Mengerillidae, only the males and the first instar larvae are free-living. Most species are thus recorded through their hosts. The majority of the records are of male pupae protruding from their host's abdomen. Male pupae are more conspicuous because of they are thicker and darker than the females' cephalothorax, which also protrude from the abdomen (figure 1). A close inspection of the host is needed to find females, whereas male pupae are easily spotted in the field.

The species of the genus *Xenos* (Xenidae) are parasites of paper wasps of the genus *Polistes* (Hymenoptera: Vespidae). Two species have been recorded from Europe. *Xenos minor* Kinzelbach is only known from a few records and is said to have a limited range of rather rare *Polistes* hosts. It has only been recorded from three species of the (former) subgenus *Leptopolistes* (Batelka & Straka 2005b, Kinzelbach 1978, Neumayer et al. 2011). *Xenos vesparum* Rossius on the other hand, is more widespread and seems to be expanding its range in the past decade or so (Borowiec et al. 2012, Háva 2012, Henderickx 2008). This species has only recently been recorded for The Netherlands (Smit & Smit 2005) and has spread across the country since. It has been recorded from the common *P. dominula* (Christ) and two other species of *Polistes* s.str. as well as from the social parasitic *P. semenowi* Morawitz, which were formerly placed in the subgenus *Sulcopolistes*. Here we record a new social parasitic *Polistes* host for *Xenos*: *P. atrimandibularis* (Zimmerman).

## Polistes

The genus *Polistes* has a cosmopolitan distribution, with significantly more species in the tropics than in temperate areas. More than 200 species of *Polistes* have been described (Carpenter 1996), of which nine are indigenous to Europe (table 1). An additional introduced species from America has recently been recorded from Spain (Castro et al. 2013).

The European *Polistes* species were previously placed in two genera: *Polistes* and *Sulcopolistes*, the former containing eleven subgenera (Richards 1973). Carpenter (1996a) however, only recognises one genus worldwide, with a subgeneric division into four subgenera, placing all European species in the subgenus *Polistes*. Subsequently, Carpenter (1996b) states that although several of Richards' groups were paraphyletic, some of them turn out to be monophyletic, which still remain unnamed. This is corroborated by cladistic analyses of the



1. Female *Polistes dominula*, with four specimens of *Xenos vesparum*: a female underneath tergite 3 (arrow) and pupae of three males, two underneath tergite 4 and one under sternite 2. Bommel (The Netherlands), Het Hoog, 2010. Photo: Angela Mundi

1. *Polistes dominula*-vrouwje met vier exemplaren van *Xenos vesparum*: één vrouwje onder tergiet 3 (pijl) en de poppen van drie mannetjes, twee onder tergiet 4 en één onder sterniet 2. Bommel, Het Hoog, 2010.

**Table 1.** The European species of the genus *Polistes*, divided in social parasites and their hosts. Species indicated with an asterisk (\*) are known from The Netherlands.

**Tabel 1.** De Europese soorten van het genus *Polistes*, verdeeld in sociale parasieten en hun gastheren. Soorten aangegeven met een asterisk zijn bekend uit Nederland.

	Social parasite		
	<i>P. atrimandibularis</i> (Zimmerman)	<i>P. semenowi</i> Morawitz	<i>P. sulcifer</i> Zimmermann
<b>Host</b>			
<i>P. associus</i> Kohl	×		
<i>P. biglumis</i> (Linnaeus)*	×		
<i>P. bischoffi</i> Weyrauch			
<i>P. dominula</i> (Christ)*	×	×	×
<i>P. gallicus</i> (Linnaeus)	×		
<i>P. nimpha</i> (Christ)	×	×	

European species based on both morphological as well as molecular data (Carpenter 1997). The European species formerly placed in the (sub)genus *Sulcopolistes* and *Leptopolistes* both form monophyletic groups. These names are thus used in this paper to discuss the parasite-host relations among *Polistes* and *Xenos* species.

### Social parasitism in *Polistes* species

Worldwide there are only three *Polistes* species with a social parasitic lifestyle: *P. atrimandibularis*, *P. semenowi* en *P. sulcifer* Zimmerman. All three species only occur in the western part of the Palearctic, around the Mediterranean Basin and the Caspian Basin. The females of these species overtake the nest of another *Polistes* species, having their offspring raised by workers of the host, much like a cuckoo among birds (Cervo 2006).

*Polistes atrimandibularis* has the broadest host range with records from five different *Polistes* species (Cervo 2006). Both other species are primarily known from *P. dominula*, though

*P. semenowi* has also been recorded from *P. nimpha* (Christ) (Cervo 2006). Table 1 gives an overview of the social parasites with their hosts.

### *Polistes* species as hosts of *Xenos*

Table 2 lists the known hosts of European *Xenos* species, showing a clear separation in the different former subgenera of the host.

*Xenos vesparum* has long been known as an endoparasite of four *Polistes* species, including a social parasite: *P. semenowi* (Kinzelbach 1978). On October 15th 2013, a female *P. atrimandibularis* was collected near the village of St. Jurs, dept. Alpes-de-Haute-Provence, France (figure 2). This specimen was parasitized by a *Xenos* species, presumably *X. vesparum*. In the course of one week, the only other *Polistes* species observed at that location was *P. dominula*, some of which were also parasitized by *X. vesparum*. *Polistes dominula* is the most common host of *P. atrimandibularis*, making it likely that this social parasite became infested with *X. vesparum*. In addition, the collected *Xenos* specimen had no median ocelli on the cephalotheca of the male puparium, suggesting it was *X. vesparum* because *X. minor* has three median ocelli (Kinzelbach 1971).

Only recently, the rare *Polistes* (*Leptopolistes*) *bischoffi* Weyrauch has been recorded as a host of *Xenos* (Batelka & Straka 2005a, 2005b, Neumayer et al. 2011). Batelka & Straka first published the parasite under *X. vesparum* (2005a) and Neumayer et al. (2011) also identified the parasite as *X. vesparum*, even though the host belongs to *Leptopolistes*. This is due to the use of Kinzelbach (1969), which was published two years before the description of *X. minor*. Later Batelka and Straka published the same specimens including additional material under *X. cf. minor* (2005b) because the host belongs to *Leptopolistes*. However, the character to distinguish male puparia of *X. minor* from *X. vesparum*, e.g. the three median ocelli on the cephalotheca, could not be determined by them. They further state that they found parasitized *P. (Leptopolistes) gallicus* and *P. (s.str.) dominula* syntopically, leading them to the suggestion that *X. vesparum* is also associated with the subgenus *Leptopolistes* or that *X. minor* could be a variety of *X. vesparum* (Batelka & Straka 2005b).

We tentatively consider *X. vesparum* and *X. minor* as separate species that can well be distinguished by the host species they use (Table 2). A similar case is noted in two other *Xenos* species (Nakase & Kato 2013) and in the species complex *Stylops melittae* Kirby s.l. (J. Smit personal observations).

**Table 2.** The European *Polistes* species with the associated *Xenos* parasites.

**Tabel 2.** De Europese *Polistes*-soorten met hun *Xenos*-parasieten.

Host	Parasite	
	<i>X. minor</i>	<i>X. vesparum</i>
<b>subg. Leptopolistes</b>		
<i>Polistes associus</i>	×	
<i>Polistes bischoffi</i>	×	
<i>Polistes gallicus</i>	×	
<b>subg. Polistes</b>		
<i>Polistes biglumis</i>		×
<i>Polistes dominula</i>		×
<i>Polistes nimpha</i>		×
<b>subg. Sulcopolistes</b>		
<i>Polistes atrimandibularis</i>		×
<i>Polistes semenowi</i>		×
<i>Polistes sulcifer</i>		



2. Female *Polistes atrimandibularis* with a male pupa of *Xenos vesparum* in the abdomen. Photo: Jan Smit

2. *Polistes atrimandibularis*-vrouwetje met een mannelijke pop van *Xenos vesparum* in het achterlijf.

## Parasitism of a social parasite

Social parasites in the genus *Polistes* cannot build their own nests and have no worker cast. They invade a colony of a host *Polistes* species and replace the queen to obtain workers to rear their brood (Carpenter 1997). If one of those *Polistes* workers is parasitized by a female *Xenos*, then her offspring are able to penetrate the brood of the social parasitic *Polistes*. Penetration of a new host specimen by a twisted-wing insect always occurs in the larval stage. In the particular case recorded here, *P. atrimandibularis* was likely associated with *P. dominula* and we therefore suggest that it was parasitized by *X. vesparum*. However, *P. atrimandibularis* is a social parasite of the subgenus *Polistes* and the former subgenus *Leptopolistes*. It is therefore possible that *P. atrimandibularis* can be parasitized by *X. minor* as well as *X. vesparum*, provided these are indeed separate species.

## Acknowledgements

We thank Angela Mundi for the permission to use her photograph. We thank Wijnand Heitmans for his valuable comments on an earlier version of this paper.

## References

- Batelka J & Straka J 2005a. Occurrence of *Xenos vesparum* and *Pseudoxenos heydeni* (Strepsiptera: Xenidae) in the Czech Republic. *Klapalekiana* 41: 1-9.
- Batelka J & Straka J 2005b. Several records of Xenidae and Stylopidae from the West Palaearctic region (Strepsiptera). *Bulletin de la Société entomologique de France* 110: 403-406.
- Borowiec ML, Wisniowski B & Zyla W 2012. *Xenos vesparum* Rossius, 1793 (Strepsiptera: Xenidae) – first records in Poland with review of the species' biology. *Acta Musei Moraviae, Scientiae Biologicae* 97: 7-12.
- Carpenter JM 1996a. Phylogeny and biogeography of *Polistes*. In *Natural History and Evolution of Paper-Wasps* (Turillazzi S & West-Eberhard MJ eds): 18-57. Oxford University Press.
- Carpenter JM 1996b. Distributional checklist of species of the genus *Polistes* (Hymenoptera: Vespidae; Polistinae, Polistini). *American Museum Novitates* 3188: 1-39.
- Carpenter JM 1997. Phylogenetic relationships among European *Polistes* and the evolution of social parasitism (Hymenoptera: Vespidae, Polistinae). In: *The origin of biodiversity in fusescts: phylogenetic tests of evolutionary scenarios* (Grandcolas P ed). *Mémoires du Muséum National d'Histoire Naturelle* 173: 135-161.
- Cervo R 2006. *Polistes* wasps and their social parasites: an overview. *Annales Zoologici Fennici* 43: 531-549.
- Háva J 2012. Notes of the occurrence of *Xenos vesparum* (Strepsiptera, Xenidae) in Bohemia. *Elateridarium* 6: 58-60.
- Henderickx H 2008. Faunistische bemerkungen over Strepsiptera met onderzoek van een populatie *Halictophagus silwoodensis* (Halictophagidae) in het Nationaal Park Hoge Kempen (Maasmechelen). *Phegea* 36: 103-107.
- Kinzelbach R 1969. 78. Familie: Stylopidae, Fächerflügler (= Ordnung: Strepsiptera). In: *Die Käfer Mitteleuropas, Band 8(78)* (Freude H, Harde W & Lohse GA eds): 139-159. Goecke & Evers.
- Kinzelbach RK 1978. *Die Tierwelt Deutschlands*. 65. Teil. Strepsiptera. Gustav Fischer Verlag.
- Nakase Y & Kato M 2013. Cryptic diversity and host specificity in giant *Xenos* strepsipterans parasitic in large *Vespa* hornets. *Zoological Science* 30: 331-336.
- Neumeyer R, Gigon A & Dobler Gross C 2011. Eine neue Feldwespe am Greifensee: Farbmorphe, Hybrid oder *Polistes gallicus* (Linnaeus, 1767)? *Entomo Hevetica* 4: 7-22.
- Richards OW 1973. The subgenera of *Polistes Latreille* (Hymenoptera, Vespidae). *Revista Brasileira de Entomologia* 17: 85-104.
- Smit JT & Smit J 2005. De waaivleugeligen (Strepsiptera) van Nederland. *Entomologische Berichten* 65: 43-51.

Geaccepteerd: 26 maart 2014

## Samenvatting

### Een sociaalparasitaire *Polistes* geparasiteerd door een waaivleugelige (Hymenoptera: Vespidae, Strepsiptera: Xenidae)

In oktober 2013 werd in Frankrijk een exemplaar van de sociaalparasitaire wesp *Polistes atrimandibularis* aangetroffen die was geparasiteerd door de waaivleugelige *Xenos* aangetroffen. Dit is een van de weinige waarnemingen van deze bijzondere combinatie. *Polistes atrimandibularis* parasiteert op onder andere *P. dominula*, waarbij de werksters van deze gastheer gebruikt worden voor het verzorgen van haar larven. Gezien het grote aantal *Polistes dominula* dat aanwezig was op de betreffende plek, waarvan een aantal zelf geparasiteerd door *Xenos vesparum*, is het waarschijnlijk dat *P. atrimandibularis* de waaivleugelige heeft opgelopen via deze gastheer.

