

THE SNAIL-KILLING FLY *SALTICELLA FASCIATA* NEW FOR THE NETHERLANDS, WITH AN UPDATE OF BELGIAN RECORDS (DIPTERA: SCIOMYZIDAE)

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The snail-killing fly *Salpicella fasciata* was discovered in Belgium in 2010. Since then, several new localities on the Belgian coast were discovered and in 2014, the first record for the Netherlands was found. This is the first representative of the genus and also of the subfamily Salticellinae in the Netherlands. In this paper, records from Belgium and the Netherlands are reviewed and information on biology and habitats is summarised.

INTRODUCTION

Flies of the family Sciomyzidae, commonly known as snail-killing or marsh flies, are found worldwide, with 543 described species in 63 genera (Knutson & Vala 2011). Larvae of most species attack aquatic, shoreline, or terrestrial species of snails and slugs, whereas larvae of *Renocera* Hendel, 1900 attack only fingernail clams, and early instars of *Anticheta* Haliday, 1838 feed within egg masses of pulmonate snails (Knutson & Vala 2011). Knutson & Vala (2011) analysed nearly all information known about the behaviour, ecology, life cycle, morphology and taxonomy of this family.

The family Sciomyzidae includes four subfamilies: Huttoniinae, Phaemyiinae, Salticellinae and Sciomyzinae. The subfamily Salticellinae contains only two species: *Salpicella fasciata* Meigen, 1830 in the Palearctic region and *S. stuckenbergi* Verbeke, 1962 in southern Africa. *Salpicella fasciata* adults are large (generally 9–12 mm) and conspicuous flies, easily recognized (fig. 1, 2). Their wing venation is diagnostic: anal cell with a triangular extension along the anal vein and with veins R₄₊₅ and M₁₊₂ converging near the apex of the wing. Further characteristics include the concave face and the conspicuously thickened femora. In the field, adult *S. fasciata* superficially resemble scathophagid flies.



Figure 1-2. Habitus of *Salpicella fasciata*.

Photo Christophe Lauriaut.

Figuur 1-2. Habitus van *Salpicella fasciata*.

Foto Christophe Lauriaut.



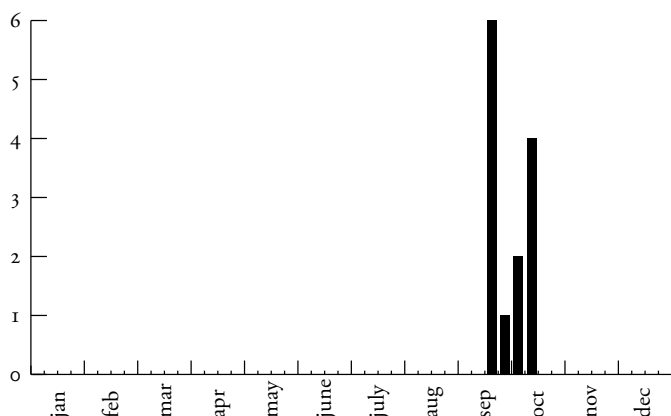


Figure 3. Phenology of *Salticella fasciata* in Belgium and the Netherlands.

Figuur 3. Fenologie van *Salticella fasciata* in België en Nederland.

From Belgium *S. fasciata* was known from one recent record (Mortelmans 2011). In this paper new data from Belgium and the Netherlands are presented. The species is currently known from the entire Belgian coastline and from one Dutch record, just across the border. The species is considered to be a true new arrival to both Belgium and the Netherlands, as it is unlikely to have been missed during historic and recent surveys. Information about the distribution, ecology (including host affinity), phenology, habitat affinity and general biology of *S. fasciata* is summarised.

DISTRIBUTION

Salticella fasciata has a wide distribution in the western Palaearctic. It is absent from Scandinavia but occurs in most southern and central European countries. It can be found from Ireland in the west to Iran in the east, and from the Netherlands in the north to Northern Africa in the south (Vala 1989). The European distribution is given in figure 4. We hereby correct Mortelmans (2011) who stated *Salticella* is present in Germany: *S. fasciata* is in fact not known from Germany.

In Belgium, *S. fasciata* was discovered in 2010 (Mortelmans 2011). Since 2009, *S. fasciata* has been specifically searched in Belgium and the Netherlands. As a result, we can now present the

first record for the Netherlands and a rather complete distribution map of the species for Belgium (table 1, fig. 5). The Dutch specimen was caught on a hot, sunny autumn day in the dunes of Nieuwvliet (Zeeland). It is the first record of this species, genus and subfamily for the Netherlands.

All Sciomyzidae in the Royal Belgian Institute of Natural Sciences (RBINS) have been checked for *S. fasciata*. Because of the superficial similarities with dung flies the Scathophagidae collection of the RBINS was checked as well. Both collections did not contain *Salticella*.

LIFE HISTORY

Adult *S. fasciata* feed primarily on moribund snails, mainly species of the genera *Theba* Risso, 1826 (Gastropoda: Helicidae) and *Cernuella* Schlüter, 1838 (Gastropoda: Hygromiidae) as well as on other genera of terrestrial pulmonate snails such as *Cochlicella* Férussac, 1821 (Gastropoda: Cochlicellidae), *Helix* Linnaeus, 1758 (Gastropoda: Helicidae), *Helicella* Férussac, 1821 (Gastropoda: Hygromiidae) and *Monacha* Fitzinger, 1833 (Gastropoda: Hygromiidae) (Knutson et al. 1970, Rozkošný 2002, Vala 1989, Coupland et al. 1994). It is known to attack and feed on living snails of these genera (Coupland et al. 1994). Remarkably, they also attack and feed on some other inverte-

Tabel 1. Records of *Salpicella fasciata* in Belgium and the Netherlands. All records by the author and the voucher specimens are stored in the collection of the author.

Tabel 1. Vondsten van *Salpicella fasciata* in België en Nederland. De waarnemingen zijn allemaal gedaan door de auteur en de exemplaren zijn opgenomen in de collectie van de auteur.

Aantal	Land	Locatie	x	y	Date	Leg	Collection
1	Belgium	Raversijde - Duinen	2,839	51,198	22.IX.2010	J. Mortelmans	Mortelmans
1	Belgium	Oostende - Havengebied	2,938	51,223	22.IX.2010	J. Mortelmans	Mortelmans
2	Belgium	Zeebermduinen Oostduinkerke	2,69	51,138	18.IX.2011	K. Verhoeyen	
2	Belgium	Schipgatduinen	2,645	51,126	11.X.2012	J. Mortelmans	
2	Belgium	Bosjes Heist	3,252	51,341	20.IX.2013	F. Van de Meutter	Van de Meutter
1	Belgium	Halvemaandijk Oostende	2,926	51,237	4.X.2013	J. Mortelmans	
1	Belgium	Spanjaardduinen	2,953	51,247	30.IX.2014	J. Mortelmans	
1	Belgium	Halvemaandijk Oostende	2,926	51,237	2.X.2014	J. Mortelmans	
1	Belgium	Halvemaandijk Oostende	2,926	51,237	9.X.2014	J. Mortelmans	
1	Belgium	Halvemaandijk Oostende	2,926	51,237	13.X.2014	J. Mortelmans	
1	Netherlands	Nieuwvliet	3,445001	51,38938	16.IX.2014	J. Mortelmans	Mortelmans

brates, including *Oniscus asellus* Linnaeus, 1758 (Isopoda: Oniscidae), *Lumbricus terrestris* Linnaeus, 1758 (Oligochaeta: Lumbricidae) and *Deroceras reticulatum* (Müller 1774) (Gastropoda: Limacidae) (Knutson et al. 1970), indication of a wide range of prey.

Salpicella fasciata lays its eggs in the umbilicus (the cone-shaped cavity between the whorls on the underside of the shell) of living snails (Knutson et al. 1970, Coupland et al. 1994). Vala et al. (1999) showed in a laboratory experiment that eggs which were removed from the umbilicus withered after only 3-4 days. The umbilicus apparently protects the eggs from dessication (Vala et al. 1999). In the host, larvae feed on the snail tissue for 13-28 days (Vala 1989), often killing the snail. Pupation takes place outside the snail shell. In most cases the puparia are found on

or in the soil. The pupation stage lasts 21-33 days (Vala 1989).

Salpicella fasciata has been proposed as a biocontrol agent in Australia, where European helicoid snails were imported and became pests. Despite its host specificity, *S. fasciata* proved inefficient as a biocontrol agent since its larvae are not capable of killing their host in these regions (Coupland et al. 1994).

PHENOLOGY

A recent field survey in southern France (Coupland et al. 1994) showed adult *S. fasciata* to be active from September to June. Population densities rose very fast, with a typical autumn peak in September. After this peak, population densities slowly declined. Vala (1989) recorded similar data

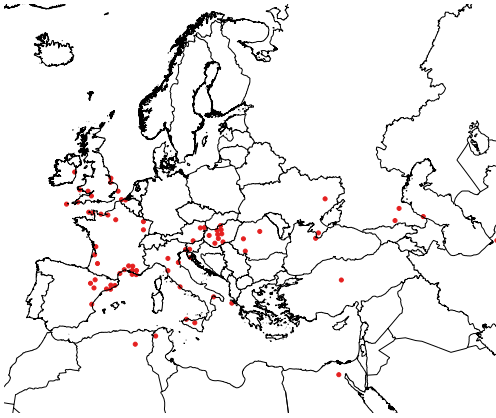


Figure 4. Distribution of *Salpicella fasciata*.

Sources: Knutson et al. 1970, Vala 1989, Kirk-Spriggs & McGregor 2009.

Figuur 4. Verspreiding van *Salpicella fasciata*.

Bronnen: Knutson et al. 1970, Vala 1989, Kirk-Spriggs & McGregor 2009.

from France, with *S. fasciata* found mainly from September to October, but also with isolated records from May, April and 'from June to the end of August'. This uncommon phenology is closely related to the life cycle of its main hosts, *Theba* and *Cernuella* (Coupland et al. 1994). They lay eggs in autumn (September–November). After oviposition the snails die and their population density drops quickly (Coupland et al. 1994). This suggests that first instars of *S. fasciata* can feed on live snails first and that second instars can feed on dead snails.

All reliable records indicate that *S. fasciata* is not found during the hot summer months, or only in very low densities. All Belgian and Dutch specimens of *S. fasciata* were found in September and October (fig. 3). In all these cases the adults were found on sunny days, when they were very active. Efforts to find specimens in winter and early spring were unsuccessful.

In Belgium and the Netherlands, the two most common genera of host snails, *Theba* and *Cernuella*, have only one or two generations per year

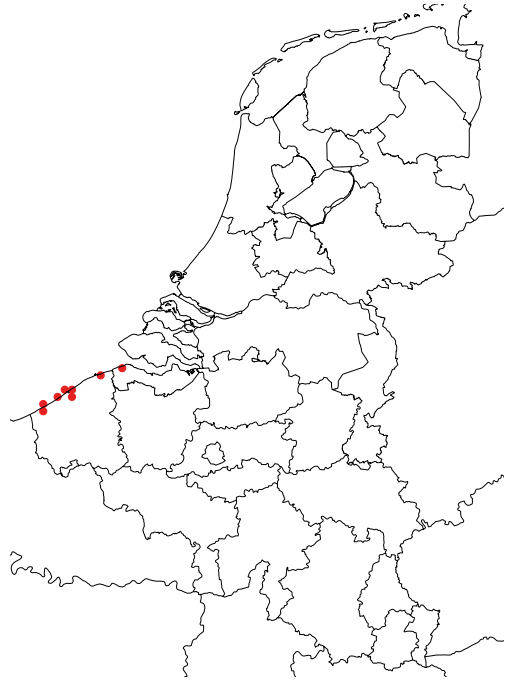


Figure 5. Records of *Salpicella fasciata* in Belgium and the Netherlands.

Figuur 5. Vindplaatsen van *Salpicella fasciata* in België en Nederland.

(Cowie 1984). Belgian and Dutch *S. fasciata* probably have a similar annual cycle, although the records indicate only one generation a year. Vala (1989) mentioned the possibility that *S. fasciata* has as many as four generations per year in more southern regions.

HABITAT

Because of its strict association with *Theba* and *Cernuella*, *S. fasciata* prefers dry dune habitats. In Belgium, *S. fasciata* is restricted to coastal dunes, where it is always found on dry, exposed areas, most often on *Senecio*, or resting on low scrubs such as *Eryngium* and *Ammophila*. In seasonally inundated areas (e.g., IJzermunding, Zwin), no *S. fasciata* were found, despite extensive research by the author. Because inundation most likely affects the pulmonate snails living in

those areas, it would affect *Salpicella* in the same manner. In other regions, habitats in which *S. fasciata* is found include rivers and even forest edges (Vala 1989). In Ireland, Britain, France and Spain, *S. fasciata* is a true coastal species, with few exceptions. Because of its affinity for coastal dunes, and because the habitat is so limited in Belgium and the Netherlands, activities such as habitat alteration/destruction and tourism (destruction of coastal vegetation) pose a serious threat to *S. fasciata*.

HOST SNAILS

In southern France, the two main host species of *S. fasciata* are *Theba pisana* (Müller, 1774) and *Cerņuella virgata* (Da Costa, 1778) (Coupland et al. 1994). Other *Cerņuella* species (e.g., *C. acuta* (Müller, 1774), *C. barbara* (Linnaeus, 1758) are used as hosts only when *Theba pisana* or *C. virgata* are absent (Coupland et al. 1994). In Belgium, *Theba* and *Cerņuella* are represented by four species: *T. pisana*, *C. virgata*, *C. aginnica* (Locard, 1882) and *C. jonica* (Mousson, 1854) (Bank, 2013). In the Netherlands, *T. pisana*, *C. virgata*, *C. aginnica*, *C. virgata* and *C. neglecta* (Draparnaud, 1805) are known (Bank 2013).

It is interesting to consider the historical records of these species: whereas *Theba pisana* has been present in Belgium for a very long time, *C. virgata* and *C. aginnica* appear to be 'recent' arrivals in Belgium (1935 and 1945 respectively) (Devriese et al. 2004). The forth species, *C. jonica*, is very rare and restricted in distribution (Devriese et al. 2004). The number of records of *Theba* was equal before and since 1950, whereas the number of records of *C. virgata* has doubled since 1950, indication of a positive trend (Devriese et al. 2004). For the Netherlands, unfortunately, such data are lacking.

Both *Theba pisana* and *C. virgata* have a similar shell morphology, with *C. virgata* having a larger umbilicus than *Theba pisana*. In laboratory experiments, *S. fasciata* showed no preference between

the species (Coupland et al. 1994), although one might expect *S. fasciata* to prefer species with a larger umbilicus in which the eggs can be deposited deeper, protected against desiccation. *Theba pisana* has a worldwide distribution, occurring along nearly all coasts. *Cerņuella virgata* occurs only along European coasts, similar to the distribution of *S. fasciata*. The positive trend of *S. fasciata* might be linked to that of *C. virgata*. Based on these three considerations, it seems likely that *S. fasciata* is more closely associated with *C. virgata* than with *Theba pisana*. It would be interesting to further investigate the host preferences of *S. fasciata* in Belgium and the Netherlands.

Nearly all western European records of *S. fasciata* are from coastal locations, so it seems plausible that *S. fasciata* is indeed linked with the coastal snail genera *Theba* and *Cerņuella*. Interestingly, in eastern Europe *S. fasciata* can be found at more inland locations, so in those areas *S. fasciata* might have a preference for other snail taxa. It is not known in which habitats the species lives in eastern Europe.

DISCUSSION

The suggestion by Mortelmans (2011) that *S. fasciata* could be very common in the proper habitat appears to have been correct. How long this species has been present in Belgium is hard to tell. Several historic and more recent collecting campaigns have been conducted during the proper season without result (e.g. Goetghebuer M.E.L., who collected for seven consecutive days in September 1931; or Speybroek (2005) who performed extensive sampling in Belgian coastal dunes). Since a fly this striking is unlikely to have been ignored in these thorough campaigns, it is assumed here *S. fasciata* is a very recent arrival for both countries. It is expected *S. fasciata* can be found in more northern locations in the Netherlands.

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LITERATURE

- Bank, R.A. 2013. Fauna Europaea: Pulmonata, Helicidae. – Fauna Europaea version 2.6, www.faunaeur.org.
- Coupland J.B., A. Espiau & G. Baker 1994. Seasonality, longevity, host choice, and infection efficiency of *Salpicella fasciata* (Diptera: Sciomyzidae), a candidate for the biological control of pest helicid snails. – Biological Control 4: 32-37.
- Cowie, R. H. 1984. Ecogenetics of *Theba pisana* (Pulmonata: Helicidae) at the northern edge of its range. – Malacologia 25: 361-380.
- Devriese, H. B. Vercoutere & H. van Loen 2004. Landslakken. – In: S. Provoost & D. Bonte (red.), Levende duinen: een overzicht van de biodiversiteit aan de Vlaamse kust. Instituut voor Natuurbehoud, Brussel: 344-365.
- Kirk-Spriggs, A.H. & G. McGregor 2009. Disjunctions in the Diptera (Insecta) fauna of the Mediterranean Province and southern Africa and a discussion of biogeographical considerations. – Transactions of the Royal Society of South Africa 64: 32-52.
- Knutson L. V. & J.-C. Vala 2011. Biology of snail-killing Sciomyzidae flies. – Cambridge University Press, Cambridge.
- Knutson L. V., J. W. Stephenson & C. O. Berg 1970. Biosystematic studies of *Salpicella fasciata* (Meigen), a snail-killing fly (Diptera: Sciomyzidae). – Transactions of the Royal Entomological Society of London 122: 81-100.
- Mortelmans J. 2011. Three new additions to the Belgian fauna: *Salpicella fasciata* Meigen 1830 (Diptera - Sciomyzidae), *Tephritis divisa* Rondani 1871 (Diptera - Tephritidae) and *Conops ceriaeformis* Meigen 1824 (Diptera - Conopidae). – Bulletin de la Société royale belge d'Entomologie 147: 46-47.
- Speybroeck, J., D. Bonte, R. Dasseville, T. Gheskiere, P. Grootaert, M. Lionard, J.-P. Maelfait, K. Sabbe, E.W.M. Stienen, K. Van den Broeck, M. Van de walle, W. Van Landuyt, E. Vercruysse, W. Vyverman, M. Vincx & S. Degraer S. 2005. Biologische evaluatie van elf strandzones langs de Vlaamse kust. – Instituut voor Natuurbehoud/KBIN/Universiteit Gent, Gent.
- Rozkošný, R. 2002. Insecta: Diptera: Sciomyzidae. – In: J. Schwoerbel & P. Zwick (red.), Süßwasserfauna von Mitteleuropa. Spektrum, Heidelberg & Berlin: 15-122.
- Vala, J.-C. 1989. Diptères Sciomyzidae Euro-méditerranéens. – Faune de France 72: 1-300.
- Vala, J.-C., L. V. Knutson, & C. Gasc 1999. Stereoscan studies with descriptions of new characters of the egg and larval instars of *Salpicella fasciata* (Meigen) (Diptera: Sciomyzidae). – Journal of Zoology 247: 531-536.

SAMENVATTING

De slakkendodende vlieg *Salpicella fasciata* nieuw voor Nederland, met nieuwe Belgische waarnemingen (Diptera: Sciomyzidae)

De slakkendodende vlieg *Salpicella fasciata* werd in 2010 ontdekt in België. Sinds die tijd werden diverse nieuwe locaties gevonden en de soort blijkt inmiddels langs de hele Belgische kust voor te komen. Ook werd de soort in Zeeuws-Vlaanderen gevonden. Dit is de eerste waarneming voor Nederland. Dit is de tevens de eerste vondst van dit genus en de subfamilie Salticellinae in Nederland. Het lijkt erop dat *S. fasciata* zich aan het uitbreiden is en de verwachting is dan ook dat deze vlieg op noordelijkere locaties langs de Nederlandse kust gevonden kan worden.

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