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PREFACE

Founded by the botanist Jean Massart and landscape architect Jules Buyssens in 1922, the Botanic Garden Jean Massart mainly served to educate university students about plants and trees. Prof Jean Massart was an ecologist 'avant la lettre' and designed some kind of miniature botanical Belgium bringing together the major natural environments of the country in an area of 4.5 hectares. Despite the enormous urban stress, this tiny green space on the edge of the city of Brussels evolved into a highly diverse garden containing an unexpected and amazing fly fauna.

The editors are grateful to the many authors for commenting on the remarkable fly fauna as well as to the anonymous referees for their helpful comments.

The present fly survey was supported by Bruxelles-Environnement and we would particularly thank Barbara Dewulf, Frédéric Fontaine and Guy Rotsaert (Green Spaces Division, Biodiversity Department) as well as Olivier Beck (Project Director) for their encouragement and granting of collection permits.

It was a great pleasure to work with the staff of the Garden and we are much indebted to Thierry Bruffaerts (site manager, Bruxelles-Environnement), Jean Vermander, Youri Rouge and Hernando Silva Montenegro (Université Libre de Bruxelles - ULB), as well as to the entire technical team of gardeners for their continuous warm welcome and interest in our inventory. Last but not least the collaboration of the many Citizen Scientists was great fun. Thanks to their superb involvement, the project became winner of the #MonthOfTheProjects campaign of the EU-Citizen Science, a European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no. 824580.

Let's hope that the present survey will lead to more insights in the diversity and resilience of nature.

Patrick Grootaert & Alain Drumont

Editors

29 March 2023

IN MEMORIAM

This collection of papers is dedicated to the late Loïc Dahan (Metz, France, 24 May 1975 – Nethen, Belgium, 22 October 2022).

He was an enthusiastic citizen scientist and passionate about beetles.

He was involved in the Jardin Massart 'Objectif 1000' project nearly from the start and participated in the survey and set up of the Malaise traps.

His premature death deprived him of discovering the publication of this book.

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Abstract

A comprehensive three-year survey of the Diptera was done with Malaise traps in the Botanic Garden Jean Massart (Brussels-Capital Region) from spring 2015 till spring 2018. This tiny 4.5 ha centennial Botanic Garden is squeezed in between the eastern border of the city of Brussels and the Sonian forest. The Garden is composed of various biotopes like a marshland and ponds with Natura 2000 status, an orchard on dry grassland, a medicinal plants garden, an arboretum and an evolution garden. All is mixed with patches of semi natural woods. Nearly 2,000 plants species have been recorded here and more than 4,000 species of arthropods. Despite the small size and the location at the border of the city of Brussels under high environmental stress, the Garden has an amazing and unexpected high biodiversity with some very rare Diptera species, even on a European scale. Although, not all fly species were identified, no less than 1,191 Diptera species were found in 70 families. The species accumulation curves calculated for some of the families showed that more species are expected to be added in future. Among the flies, 129 species were reported for the first time in Belgium including three new species for science. The Diptera fauna is commented in 23 papers. A checklist covering all the Diptera species identified during the survey is provided at the end of the book.

Samenvatting

Een uitgebreid driejarig onderzoek van de Diptera in de 'Plantentuin Jean Massart' (Brussel Hoofdstedelijk Gewest) werd uitgevoerd aan de hand van Malaiseval staalnames vanaf de lente van 2015 tot de lente van 2018. Deze kleine honderdjarige tuin van amper 4,5 ha zit geprangd tussen de oostelijke rand van de stad Brussel en het Zoniënwoud. De plantentuin bestaat uit verscheidene biotopen zoals een moerasje en vijvers met Natura 2000 status, een boomgaard op een droge bloemenweide, een tuin met geneeskrachtige planten, een arboretum en een evolutietuin. Dit alles zit verweven in semi-natuurlijke bosjes. Bijna 2000 plantensoorten werden er vastgesteld en meer dan 4000 soorten geleedpotigen. Ondanks de kleine oppervlakte en de ligging aan de rand van Brussel onder een hoge milieustress, heeft de plantentuin een opmerkelijke en onverwachte biodiversiteit met een aantal zeer zeldzame Diptera, zelfs op een Europees niveau. Ondanks dat niet alle vliegen op naam werden gebracht, werden toch 1191 soorten Diptera aangetroffen behorende tot 70 families. De soorten-accumulatie curves die voor een aantal vliegenfamilies werden berekend, tonen aan dat nog veel meer soorten kunnen worden verwacht. Tijdens de survey werden 129 soorten voor het eerst in België vastgesteld waaronder ook drie nieuwe soorten voor de wetenschap. De Diptera fauna wordt uitgebreid besproken in 23 artikels. Een lijst van de soorten die tijdens de survey werden gevonden, wordt gegeven aan het einde van het boek.

Résumé

Une étude triennale des Diptera du Jardin botanique Jean Massart (Région de Bruxelles-Capitale) a été réalisée à l'aide de pièges Malaise du printemps 2015 au printemps 2018. Ce petit jardin botanique centenaire de 4,5 ha est enclavé entre la bordure est de la ville de Bruxelles et la forêt de Soignes. Le Jardin est composé de différents biotopes tels qu'un marais et des étangs avec un statut Natura 2000, un verger sur prairie sèche, un jardin de plantes médicinales, un arboretum et un jardin évolutif. Le tout est mélangé à des parcelles de bois semi-naturels. Près de 2.000 espèces de plantes y ont été recensées et plus de 4.000 espèces d'arthropodes. En dépit de sa petite taille et de sa situation à la limite de la ville de Bruxelles, dans un environnement sous pression, le jardin présente une biodiversité étonnante et inattendue, avec des espèces de diptères très rares, même à l'échelle européenne. Bien que toutes les espèces de diptères n'aient pas été identifiées, pas moins de 1.191 espèces ont été trouvées appartenant à 70 familles. Les courbes d'accumulation d'espèces calculées pour certaines de ces familles ont montré que d'autres espèces pourraient être ajoutées à l'avenir. Parmi les diptères identifiés, 129 espèces sont signalées pour la première fois en Belgique, dont trois nouvelles espèces pour la science. La faune des diptères présents sur le site est commentée dans 23 articles. Une liste comprenant toutes les espèces de Diptera recensées au cours de l'étude est fournie à la fin du livre.

An introduction to the survey of the diversity of the flies (Diptera) in the centennial Botanic Garden Jean Massart (Brussels-Capital Region, Belgium)

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Abstract

Annotated checklists, notes and a general checklist on nearly 70 families of mosquitoes, midges and flies (Diptera) are provided in the present study in order to highlight the centennial of the Botanic Garden Jean Massart in Brussels. The Botanic Garden Jean Massart is a tiny 4.5 ha site, squeezed in between the eastern border of the city of Brussels and the Sonian forest. Despite the small size and the location under high urban stress at the border of the city of Brussels, the Garden has an amazing and unexpected high biodiversity with some very rare species, even on a European scale. The Diptera have been identified by various experts, mainly citizen scientists. Their checklists show a remarkable high level of Diptera diversity and some prudent hypotheses are formulated to explain the noteworthy biodiversity of this small botanic garden.

Keywords: Faunistic survey, annotated checklists, Diptera, Belgium

Introduction

The main goal of the present survey was to get an idea of the general biodiversity of insects and spiders present in the centennial Botanic Garden Jean Massart situated at the outskirts of the city of Brussels. The project started under the name 'Objective 1000 @JardinMassart' aiming to inventory at least 1,000 species of insects and spiders during one single year. This goal was reached quite easily and a number of very rare species and even a new species for science were found (Grootaert, 2016). Hence, the survey was continued for another two years and at the moment more than 4,000 species of insects and spiders are recorded from this site.

The Botanic Garden Jean Massart is situated at the eastern side of the city of Brussels in the suburb town of Auderghem at the border of the Sonian forest. This large forest is more than 250 years old and can be considered as a mature forest. It is part of a vast forest complex called 'Kolenwoud'or 'Forêt Charbonnière'. The name *Silva Carbonaria* was given by Julius Caesar in his *de bello gallico*. It was a primeval forest extending in Gaul from Brabant to Picardie, comprising the actual Sonian forest, Hallerbos, Kravaalbos, Heverleebos, Neigembos,

Berchembos, Meerdaalwoud, Buggenhoutbos and the Bois de la Houssière (VANDER LINDEN, 1923).

The Garden is located in a valley and is surrounded by habitations in the west, a motorway in the south and, a small lake borders it in the north (Rouge Cloître). The east side opens towards the Sonian forest (Fig. 1). The Garden, also a Natura 2000 site, is nearly 4.5 ha, and was created in 1922 by Jean Massart, a botanist and ecologist "*avant la lettre*" (MARCHAL, 1927; DENAEYER *et al.*, 2006; DE BONT & HEYNICKX, 2012). Nearly 2,000 plant species have been recorded in this Natura 2000 site. The area comprises various small biotopes like woodlands, wetland with marshes and ponds as well as thematic collections such as medicinal and aromatic plants, a collection of cultivated plants, an old orchard, an arboretum, an evolutionary garden and experimental parcels for the students of the Université libre de Bruxelles (ULB). All is mixed with patches of semi-natural woods (TAMINIAUX, 2018). The Garden is now managed by the 'Brussels Environment' (BIM, IBGE).

At the time of the compilation of the present study the beetles in the garden are represented by 1,370 species which is about 30% of the actual known Belgian beetle fauna (BAUGNÉE *et al.*, 2021; DEKONINCK *et al.*, 2019; DELBOL *et al.*, 2013; DELBOL *et al.*, 2017; DRUMONT *et al.*, 2016; DRUMONT *et al.*, 2018; DRUMONT *et al.*, 2020; DRUMONT *et al.*, 2022; FAGOT *et al.*, 2021; MOUCHERON *et al.*, 2018; MOUCHERON *et al.*, 2019; SCHILTHUIZEN *et al.*, 2021; THOMAES *et al.*, 2016; THOMAES *et al.*, 2018; TROUKENS *et al.*, 2017a; TROUKENS *et al.*, 2017b; TROUKENS *et al.*, 2017c; TROUKENS *et al.*, 2019; TROUKENS & DRUMONT, 2019; TROUKENS *et al.*, 2019; TROUKENS *et al.*, 2020; TROUKENS & DRUMONT, 2020; TROUKENS *et al.*, 2020; TROUKENS, 2020). Inventory studies have been published for the Diptera (GROOTAERT, 2016; GROOTAERT *et al.*, 2020; KURINA & GROOTAERT, 2016), for the Hymenoptera (LIBERT, 2019; PAULY, 2019; RENNESON *et al.*, 2020) as well as for the Trichoptera (LOCK & DRUMONT, 2017).

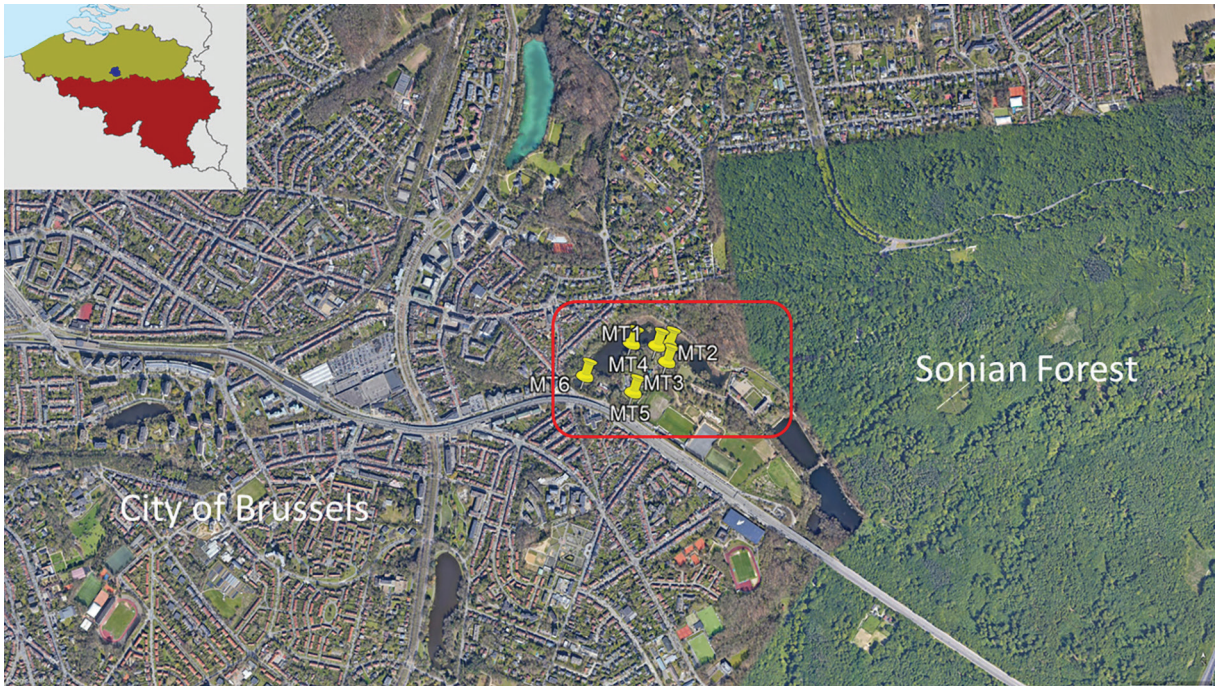

Fig. 1. Google Earth map of the eastern side of the city of Brussels with the outskirt of the city to the left side of the photo while the green area on the right side is the Sonian forest. The Botanic Garden Jean Massart is situated in the middle. The blue spot on the inset map of Belgium shows the position of Brussels-Capital Region in relation to Flanders (green) and Wallonia (red).

In the present work, nearly 70 families of Diptera were studied and an annotated checklist is provided for a number of families with data on distribution and rarity of the species. A general checklist of all the flies and mosquitoes found at the Botanic Garden Jean Massart is presented at the end of the book. Some prudent hypotheses are proposed to explain the remarkable species diversity of this small botanic garden of 4.5 ha, which is squeezed into the city of Brussels with dense habitations on one side, a large lake acting as giant insect trap, and a two-stories heavy traffic motorway. Only at the eastern side bordering to the old Sonian forest, the insect fauna seems less under stress.

Material and methods

Sampling methods

The Diptera in the present study were all collected with Malaise traps of the Townes type (2 m highest tip, 2 m long; van Achterberg *et al*., 2010). The survey covered three years and started on 7 May 2015 and ended on 23 March 2018.

The collecting jars were emptied at weekly intervals, except for the winter period from November to the end of February when they were collected every two weeks only (Annex 1). Over the course of three years, 307 samples were collected. All material was collected in 70% ethyl alcohol. After retrieval of the sample, part of the ethanol was replaced by fresh 70% ethanol to reduce effects of dilution of the ethanol by evaporation, to avoid maceration and acidification when large numbers of insects were collected. Hence, genetic barcoding of the specimens was possible.

Material studied

The identified material is preserved in glass tubes in 70% ethyl alcohol arranged per species per sample. The material is deposited at the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS) while voucher specimens are also deposited in the collections of the institutions of the various experts who identified the material as is indicated in the material and methods of the specific paper contributions.

All samples and identified specimens are labelled in French as shown in the example below.

Coll. I.R.Sc.N.B

BELGIQUE, Bruxelles, Auderghem, Jardin Massart, 30.VI-6.VII.2017, I.G: 33.400. Piège Malaise 2

Coll. I.R.Sc.N.B stands for Collection de l'Institut royal des Sciences naturelles de Belgique or Collections of the Royal Belgian Institute of Natural Sciences (RBINS). The locality is Auderghem (or Oudergem in Dutch), and the precise site is the Botanic Garden Jean Massart. 'Piège Malaise' stands for Malaise trap and is given in the text of the papers as MT1 to MT6 (Malaise trap 1 to 6 ; Figs 4 - 8). The precise position of the traps are indicated in Fig. 2.The precise number of samples that were sorted and studied for each fly family is given in the 'Material and methods' section of each treated family. For some families, almost all samples were sorted and specimens were identified as is the case in the Dolichopodidae, Hybotidae, Mycetophilidae s.l. and Syrphidae. But, due to the overwhelming numbers of specimens, for most other families only a limited number of samples could be sorted at present. For example, samples collected of four malaise traps during one single week in Spring 2017 contained 224 Hybotidae, 959 Phoridae, 763 Psychodidae and 427 Sphaeroceridae.

Study area

Sampling periods and site selection

Six sites have been sampled during at least one full year. Trap MT2 which contained the highest diversity of Diptera from the first year onwards, was sampled throughout the three years and thus serves as a reference site. Table 1 gives an overview of the sampling effort per site and a summary of the habitat characteristics. A detailed overview of the sampling is shown in Annex 1.

Table 1. Overview of the sampling effort per site and a summary of the habitat characteristics.

	MT1	MT2	MT3	MT4	MT5	MT6
	50°48'52.57" N 4°26'20.31" E	50°48'52.70" N 4°26'22.50" E	50°48'50.68" N 4°26'22.14" E	50°48'52.83" N 4°26'15.62" E	50°48'47.12" N 4°26'15.90" E	50°48'49.02" N 4°26'6.97" E
start	7.V.2015	7.V.2015	21.IV.2016	14.III.2017	14.III.2017	14.III.2017
end	14.III.2017	23.III.2018	14.III.2017	23.III.2018	23.III.2018	23.III.2018
years	2	3	1	1	1	1
soil	humid/ loamy	humid/ loamy	humid/ loamy	dry/ loamy	dry/ loamy	swampy loamy-sand
exposure	partly shaded	sun exposed	shaded	shaded	sun exposed	partly shaded
habitat	border of meadow, behind compost heap	border of flowerbeds, border of hedge	inside small wood; next to heap of decomposing wood	arboretum; no or short herbaceous layer	flowery meadow in old apple orchard	close to reed bed, above small ponds

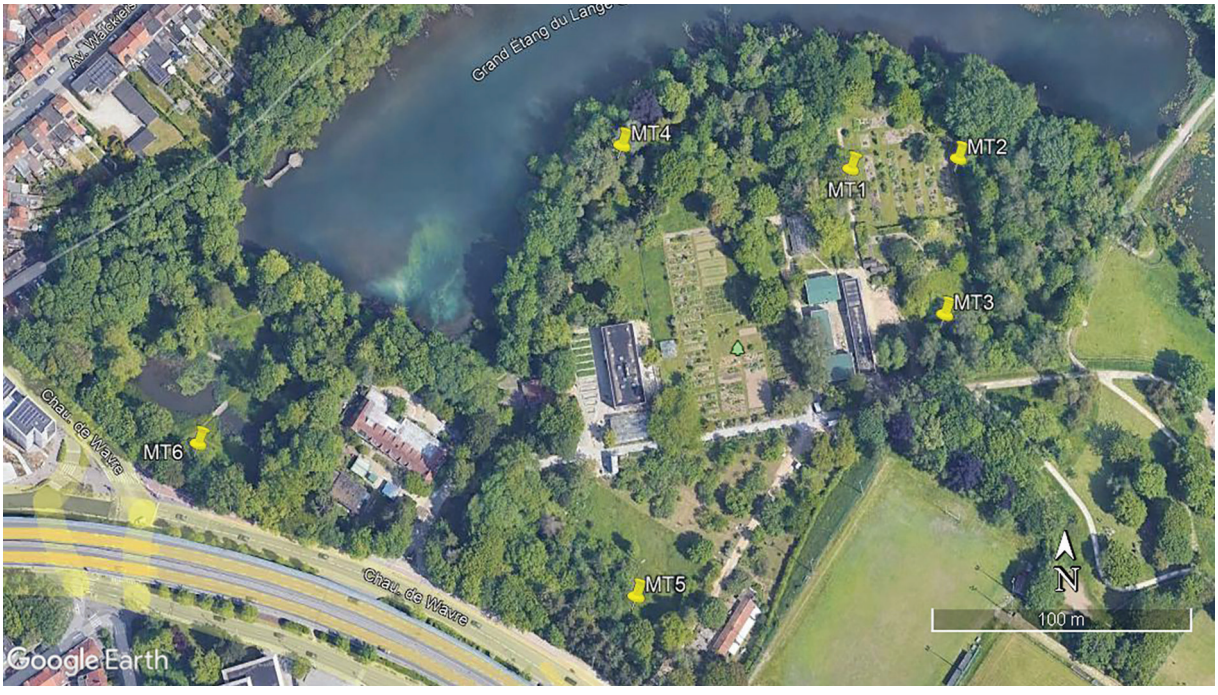

Fig. 2. Google Earth map of the Botanic Garden Jean Massart with indication of the six Malaise trap sampling stations. (MT1 to MT6).

Site 1 (MT1) 50°48'52.57" N 4°26'20.31" E

As can be seen on the map (Fig. 2) the Malaise trap was placed along a hedge of small trees with a large open space in front on the east side. The trap received full sunlight in the morning but from the afternoon to the evening it was shaded. Behind the Malaise trap and the screen of scrubs there is a compost heap, which is not visible on Fig. 3.

Site 2 (MT2) 50°48'52.70" N 4°26'22.50" E

As can be seen in Fig. 2, the trap was placed on the east side of a large open space with flower beds on the west side. The trap was mounted perpendicular on the border of a row of trees (Fig. 4A) with a large open space with flower beds on the west side (Fig. 4B). Early in the morning the trap was partly shaded but from the afternoon onwards until sunset, it received full sunlight.

Fig. 3. Site 1 (MT1), May 2015. © Alain Drumont.

Fig. 4. Site 2 (MT2). A. May 2015; B. June 2016. © Alain Drumont.

Site 3 (MT3) 50°48’50.68” N 4°26’22.14” E

The trap was placed in a small wooded area, continuously shaded (Fig. 5). A large pile of dead branches was situated behind the Malaise trap. This location was chosen to sample mycetophilid flies.

Site 4 (MT4) 50°48’52.83” N 4°26’15.62” E

The Malaise trap was placed in the arboretum (Fig. 2) and as can be seen on the photo taken in June 2017, the soil was bare or only covered by very small herbs. On the background (on the northern side) there is a large lake (Fig. 6A). During the whole day, the trap was located in the shade.

Fig. 5. Site 3 (MT3), 21 April 2016. © Isabelle Sauvage.

Fig. 6. Site 4 (MT4). A. March 2017; B. June 2017. © Alain Drumont.

Site 5 (MT5) 50°48’47.12” N 4°26’15.90” E

The trap was placed perpendicular on a screen of trees (Figs 2, 7) in front on the north side, situated in a large flower meadow (an ancient apple orchard) which receives sunlight during the whole day. The trap however, received only a little sunlight in the early morning and in the late afternoon.

Site 6 (MT6) 50°48’49.02” N 4°26’6.97” E

The open area on the north side of the trap, where the small ponds with reed beds are situated, received plenty of direct sunlight during the whole day (Figs 2, 8). The trap itself received little direct sunlight.

Fig. 7. Site 5 (MT5). A. March 2017; B. June 2017. © Alain Drumont.

Fig. 8. Site 6 (MT6). A, Swamp with ponds, March 2017; B, June 2017. © Alain Drumont.

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This publication results in part from the project to inventory the arthropod fauna of the Botanic garden Jean Massart, a project supported by Bruxelles-Environnement. Therefore, we would particularly like to thank Barbara Dewulf, Frédéric Fontaine and Guy Rotsaert (Green Spaces Division, Biodiversity Department) as well as Olivier Beck (Project Director) for their encouragement and the granting of collection permits. We are especially indebted to the staff of the Botanic garden: Thierry Bruffaerts (site manager, Bruxelles-Environnement), Jean Vermander, Youri Rouge and Hernando Silva Montenegro (Université Libre de Bruxelles - ULB), as well as to the entire technical team of gardeners for their always warm welcome and the constant interest in our inventory.

We sincerely appreciated the collaboration of the many Citizen Scientists. Thanks to their superb involvement the project became winner of the #MonthOfTheProjects campaign of the EU-Citizen.Science, a European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no. 824580.

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Annex 1. Overview of the 3-year sampling. The date when the collection started is given in column 'start' while the date when the sample was retrieved in column 'collection'. The cells marked with an X indicate that a sample was collected while no samples were taken in the grey shaded cells.

sample nr	start	collection	MT1	MT2	MT3	MT4	MT5	MT6
1	07.V.2015	13.V.2015	X	X				
2	13.V.2015	21.V.2015	X	X				
3	21.V.2015	28.V.2015	X	X				
4	28.V.2015	04.VI.2015	X	X				
5	04.VI.2015	10.VI.2015	X	X				
6	10.VI.2015	17.VI.2015	X	X				
7	17.VI.2015	26.VI.2015	X	X				
8	26.VI.2015	01.VII.2015	X	X				
9	01.VII.2015	08.VII.2015	X	X				
10	08.VII.2015	15.VII.2015	X	X				
11	15.VII.2015	22.VII.2015	X	X				
12	22.VII.2015	30.VII.2015	X	X				
13	30.VII.2015	06.VIII.2015	X	X				
14	06.VIII.2015	12.VIII.2015	X	X				
15	12.VIII.2015	20.VIII.2015	X	X				
16	20.VIII.2015	27.VIII.2015	X	X				
17	27.VIII.2015	04.IX.2015	X	X				
18	04.IX.2015	10.IX.2015	X	X				
19	10.IX.2015	17.IX.2015	X	X				
20	17.IX.2015	24.IX.2015	X	X				
21	24.IX.2015	01.X.2015	X	X				
22	01.X.2015	09.X.2015	X	X				
23	09.X.2015	20.X.2015	X	X				
24	20.X.2015	30.X.2015	X	X				
25	30.X.2015	12.XI.2015	X	X				
26	12.XI.2015	03.XII.2015	X	X				
27	03.XII.2015	17.XII.2015	X	X				
28	17.XII.2015	06.I.2016	X	X				
29	06.I.2016	21.I.2016	X	X				
30	21.I.2016	03.II.2016	X	X				
31	03.II.2016	17.II.2016	X	X				
32	17.II.2016	03.III.2016	X	X				
33	03.III.2016	11.III.2016	X	X				
34	11.III.2016	18.III.2016	X	X				
35	18.III.2016	25.III.2016	X	X				
36	25.III.2016	01.IV.2016	X	X				
37	01.IV.2016	08.IV.2016	X	X				
38	08.IV.2016	14.IV.2016	X	X				
39	14.IV.2016	21.IV.2016	X	X	X			
40	21.IV.2016	29.IV.2016	X	X	X			
41	29.IV.2016	06.V.2016	X	X	X			
42	06.V.2016	11.V.2016	X	X	X			
43	11.V.2016	19.V.2016	X	X	X			

sample nr	start	collection	MT1	MT2	MT3	MT4	MT5	MT6
44	19.V.2016	27.V.2016	X	X	X			
45	27.V.2016	03.VI.2016	X	X	X			
46	03.VI.2016	09.VI.2016	X	X	X			
47	09.VI.2016	16.VI.2016	X	X	X			
48	16.VI.2016	23.VI.2016	X	X	X			
49	23.VI.2016	01.VII.2016	X	X	X			
50	01.VII.2016	06.VII.2016	X	X	X			
51	06.VII.2016	14.VII.2016	X	X	X			
52	14.VII.2016	28.VII.2016	X	X	X			
53	28.VII.2016	04.VIII.2016	X	X	X			
54	04.VIII.2016	11.VIII.2016	X	X	X			
55	11.VIII.2016	17.VIII.2016	X	X	X			
56	17.VIII.2016	24.VIII.2016	X	X	X			
57	24.VIII.2016	01.IX.2016	X	X	X			
58	01.IX.2016	08.IX.2016	X	X	X			
59	08.IX.2016	15.IX.2016	X	X	X			
60	15.IX.2016	27.IX.2016	X	X	X			
61	27.IX.2016	13.X.2016	X	X	X			
62	13.X.2016	27.X.2016	X	X	X			
63	27.X.2016	09.XI.2016	X	X	X			
64	09.XI.2016	24.XI.2016	X	X	X			
65	24.XI.2016	20.XII.2016	X	X	X			
66	20.XII.2016	11.I.2017	X	X	X			
67	11.I.2017	01.II.2017	X	X	X			
68	01.II.2017	22.II.2017	X	X	X			
69	22.II.2017	14.III.2017	X	X	X			
1	14.III.2017	24.III.2017		X		X	X	X
2	24.III.2017	30.III.2017		X		X	X	X
3	30.III.2017	13.IV.2017		X		X	X	X
4	13.IV.2017	20.IV.2017		X		X	X	X
5	20.IV.2017	28.IV.2017		X		X	X	X
6	28.IV.2017	05.V.2017		X		X	X	X
7	05.V.2017	11.V.2017		X		X	X	X
8	11.V.2017	17.V.2017		X		X	X	X
9	17.V.2017	24.V.2017		X		X	X	X
10	24.V.2017	01.VI.2017		X		X	X	X
11	01.VI.2017	08.VI.2017		X		X	X	X
12	08.VI.2017	15.VI.2017		X		X	X	X
13	15.VI.2017	22.VI.2017		X		X	X	X
14	22.VI.2017	30.VI.2017		X		X	X	X
15	30.VI.2017	06.VII.2017		X		X	X	X
16	06.VII.2017	13.VII.2017		X		X	X	X
17	13.VII.2017	19.VII.2017		X		X	X	X
18	19.VII.2017	26.VII.2017		X		X	X	X
19	26.VII.2017	02.VIII.2017		X		X	X	X
20	02.VIII.2017	11.VIII.2017		X		X	X	X

sample nr	start	collection	MT1	MT2	MT3	MT4	MT5	MT6
21	11.VIII.2017	18.VIII.2017		X		X	X	X
22	18.VIII.2017	23.VIII.2017		X		X	X	X
23	23.VIII.2017	01.IX.2017		X		X	X	X
24	01.IX.2017	07.IX.2017		X		X	X	X
25	07.IX.2017	21.IX.2017		X		X	X	X
26	21.IX.2017	12.X.2017		X		X	X	X
27	12.X.2017	25.X.2017		X		X	X	X
28	25.X.2017	08.XI.2017		X		X	X	X
29	08.XI.2017	24.XI.2017		X		X	X	X
30	24.XI.2017	15.XII.2017		X		X	X	X
31	15.XII.2017	11.I.2018		X		X	X	X
32	11.I.2018	25.I.2018		X		X	X	X
33	25.I.2018	16.II.2018		X		X	X	X
34	16.II.2018	09.III.2018		X		X	X	X
35	09.III.2018	23.III.2018		X		X	X	X

The Botanic Garden Jean Massart (Brussels-Capital Region): a hotspot for long-legged flies (Diptera: Dolichopodidae) in Belgium or not?

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Abstract

Between May 2015 and January 2018, six Malaise traps were operational in the Botanic Garden Jean Massart at Oudergem (Brussels-Capital Region, Belgium) in an attempt to estimate the species richness of flying insects of this site. A total of 98 samples containing 6,016 Dolichopodidae (Diptera) were examined and produced 121 different species. The identity of 116 species could be established with complete certainty. Eleven species made up ¾ of the entire traps yield, whereas 44 species were collected as singletons or doubletons. Forest and marshland inhabiting species represented about ¾ of the species, and eurytopic species accounted for over ½ of the specimens. About 23% of the species can be termed rare to extremely rare in Flanders, including five species that were previously considered extinct in Flanders: *Liancalus virens* (Scopoli, 1763), *Neurigona pallida* (Fallén, 1823), *Rhaphium auctum* Loew, 1857, *R. quadrispinosum* (Strobl, 1898), and *Sybistroma crinipes* Staeger, 1842. Six species are formally reported as new to Belgium here: *Acropsilus niger* (Loew, 1869), *Medetera peloria* Negrobov, 1967, *Neurigona abdominalis* (Fallén, 1823), *Syntormon macula* Oldenberg, 1927, *Syntormon submonilis* Negrobov, 1975, and *Xanthochlorus galbanus* Chandler & Negrobov, 2008. A comparison with other Malaise trap surveys in Belgium revealed that the Botanic Garden Jean Massart produced the second highest species richness thus far observed, after Étang de Virelles (Virelles). Nevertheless, it is considered very likely that additional species might be discovered in the Botanic Garden when employing other collecting techniques.

Keywords: biodiversity survey, Malaise trap, ecoprofiles, rarity, new species to Belgium

Introduction

With over 8,000 described species worldwide (Bickel, 2009; Grichanov, 2017), long-legged flies (Diptera: Dolichopodidae) currently represent the fourth largest dipteran family, after Limoniidae, Tachinidae and Asilidae (Pape *et al*., 2009). The family consists of 17 subfamilies, including the basal Microphorinae and Parathalassiinae, and 15 other subfamilies, generally referred to as Dolichopodidae s. str. (Pollet & Brooks, 2008). Although long-legged flies occur in nearly every terrestrial and semi-aquatic habitat type, most species prefer humid to moist conditions. As a result, the highest species richness and numbers are found in humid forests, marshes and on banks of various waterbodies. More specialized communities are encountered in oligotrophic (heathlands, peat bogs) and saline biotopes (brackish and salt marshes) (Pollet, 2000). As many species exhibit a pronounced habitat affinity, the family as such serves well as bio-indicator in e.g., site quality assessments, in particular, of humid

biotopes (Pollet & Grootaert, 1999; Pollet, 2009). Apart from the plant mining larvae of *Thrypticus* Gerstäcker, 1864 (Dyte, 1959; Bickel & Hernandez, 2004), in general both adults and larvae are predatory and feed on small invertebrates (Ulrich, 2004). The family thus clearly contributes to the ecosystem service "crop protection".

In this paper, the results on the Dolichopodidae s. str. collected during the Malaise trap survey conducted from May 7, 2015 to January 11, 2018 in the Botanic Garden Jean Massart are presented. This implies that, although abundant and represented by four different species, the genus *Microphor* was not treated in the present study. Moreover, two cryptic morphs were discovered within *M. holosericeus* (Meigen, 1804) that could not yet be identified with certainty. Detailed information on this location, sampling methodologies and sites is included in Grootaert *et al*. (2023). The ecoprofile composition, rarity of the species and position of the fauna of this site in Flanders' dolichopodid landscape are discussed.

Material and methods

The Botanic Garden Jean Massart is a tiny 4.5 ha site, squeezed in between the eastern border of the city of Brussels and the Sonian forest (Belgium). Politically, it makes part of the Brussels-Capital Region, but geographically, it is situated in the southern border of Flanders. Nearly 2,000 plant species have been recorded in this Natura 2000 site. The area is composed of various biotopes such as humid areas with a swamp and ponds (site of Malaise trap 6, MT6), an old orchard in dry grassland (MT5), a medicinal plants garden, an experimental garden, an arboretum (MT4), and an evolution garden (MT1 & MT2). All those biotopes are mixed with patches of semi-natural woods (MT3).

Six sampling sites were investigated with a Malaise trap as described in detail in Grootaert *et al.* (2023):

- Site 1 (MT1) is a meadow margin, behind a compost heap (west of the evolution garden); the soil is humid and the area is partly shaded;
- Site 2 (MT2) is situated along the border of flowerbeds (evolution garden) and is sun exposed most of the time;
- Site 3 (MT3) lays amid a small forest patch, next to a pile of decaying wood and permanently shaded;
- Site 4 (MT4) makes part of the arboretum, is always shaded and has a dry soil with no or only a very short herbaceous layer;
- Site 5 (MT5) is a sun exposed flowering meadow in an old apple orchard on a rather dry soil; and
- Site 6 (MT6) is swampy, partly shaded, and borders a reed bed with small ponds.

A total of 98 or about 32% of the collected samples were examined, with 46 from 2015, 5 from 2016 and 47 from 2017-2018. These samples consisted of the dolichopodid fraction of the corresponding Malaise trap samples stored in 75% alcohol solution. Most identifications were carried out by the first author, the remaining part by the second author, on the basis of Parent (1938), d'Assis Fonseca (1978), and separate identification keys by e.g., Meuffels & Grootaert (1990), Pollet (1990, 1996) and Negrobov & Naglis (2016). Specimens of valuable species were pooled and stored separately in the reference collection of the first author (Marc Pollet private collection - MAPC), while the bulk of the ordinary species were combined in one single site jar.

The only published Red List of Dolichopodidae of Flanders (including the Brussels-Capital Region) dates back from over twenty years ago (Pollet, 2000) and included an estimate of the conservation value of the species. Ever since, there have been multiple attempts to update it which all failed due to an insufficient sampling coverage of each of the Flemish ecoregions (Pollet, 2011b; Pollet & Maes, 2014a, b). Nevertheless, the analyses encompassed data on nearly 643,000 specimens of more than 300 species from 354 UTM 5km squares in Flanders. In 2018 the most recent assessment of the current rarity of the species was conducted. Current rarity is expressed as the number of UTM 5km squares with the species / total number of investigated UTM 5 km squares since 1981. That year marks the onset of Malaise and pan trap use for the collection of flies in Belgium. Table 1 gives an overview of the recognized rarity categories.

Table 1. Number of dolichopodid species (Diptera: Dolichopodidae) and their specimens collected in the Botanic Garden Jean Massart between 2015 and 2018 as assigned to current rarity classes established for Dolichopodidae of Flanders and based on the EURODOL database (2018). Species of doubtful identity and *Argyra argentella* are not included (see Text).

Current rarity categories	Range (% of investigated UTM 5km squares with species)	No. species	No. specimens
R(eR) – extremely rare	< 1%	7	20
R(vR) – very rare	1 - < 2%	8	26
R(R) – rare	2 - < 5%	12	218
R(fR) – fairly rare	5 - < 10%	17	290
C(fC) – fairly common	10 - < 15%	19	379
C(C) – common	15 - < 30%	29	821
C(vC) – very common	30 - < 50%	20	1,733
C(eC) – extremely common	> 50%	4	2,035
Total numbers		116	5,522

The distribution of the species in Europe is based on Fauna Europaea (Pollet, 2011a) and more recently published papers.

Species were assigned to ecological groups or ecoprofiles on the basis of over 36 years of experience of the first author with this fly family and supported by the private database EURODOL. At present, the latter database encompasses data retrieved from nearly 17,000 samples collected in Belgium between 1852 and 2022 containing over 716,000 specimens of more than 340 species. It also includes the metadata associated with survey events and identifications, also from collecting trips and expeditions in other European countries.

Results

Species richness

Table 2 gives an overview of the species collected. A total of 6,016 specimens were examined, with 5,523 or nearly 92% identified with absolute certainly and 493 specimens of uncertain identity (mostly females). A total of 121 different species were recognized with five species whose identity remains to be confirmed: *Medetera bispinosa* Negrobov, 1967, *Medetera ravida* Negrobov, 1970, *Medetera veles* Loew, 1861, *Neurigona longipes* (Becker, 1918), and *Micromorphus albipes* (Zetterstedt, 1843). Of the four first species, only females were encountered in the samples. Until present, the true identity of most *Micromorphus* species remains doubtful due to the fact that the type of *M. albipes* proved to be a damaged female specimen (Pollet, unpubl. data) whereas the most recent identification key to species of this genus (Negrobov, 2000) most certainly contains errors. The identify of *M. veles* also needs to

Table 2. Overview of Dolichopodidae collected in the Botanic Garden Jean Massart with key information on Red list status, current rarity, ecoprofile, abundances and distribution over the different Malaise traps installed in this site (MT#: Malaise trap number). All samples of Malaise trap 3 were missing.

Dolichopodid species	Red List (Pollet, 2000) *	Current rarity (2018) §	Ecoprofile	Abundances (no. specimens per sampling site)					Total no. of specimens
				MT1	MT2	MT4	MT5	MT6	
Achalcus cinereus (Haliday, 1851)	vZ	C(fC)	swamps - marshlands	-	3	-	-	2	5
Achalcus flavicollis (Meigen, 1824)	vZ	C(fC)	reedmarshes	1	1	-	-	2	4
Achalcus phragmitidis Pollet, 1996	Z	R(vR)	reedmarshes	-	-	-	-	1	1
Acropsilus niger (Loew, 1869)		R(eR)	riparian habitats	-	-	-	-	2	2
Anepsiomyia flaviventris (Meigen, 1824)	N	C(C)	wooded habitats (incl. forests)	-	-	-	1	1	2
Argyra argentella (Zetterstedt, 1843)	-	-	-	-	-	-	1	-	1
Argyra argentina (Meigen, 1824)	vZ	C(fC)	swamps - marshlands	2	11	-	1	1	15
Argyra argyria (Meigen, 1824)	vZ	C(fC)	forest edges (incl. gardens)	-	3	-	-	-	3
Argyra atriceps Loew, 1857	Z	R(fR)	wooded habitats (incl. forests)	6	10	-	-	1	17
Argyra diaphana (Fabricius, 1775)	N	C(C)	wooded habitats (incl. forests)	1	-	-	-	1	2
Argyra grata Loew, 1857	3	R(fR)	wooded habitats (incl. forests)	15	34	-	3	-	52
Argyra ilonae Gosseries, 1988	Z	R(fR)	wooded habitats (incl. forests)	18	138	-	2	2	160
Argyra leucocephala (Meigen, 1824)	N	C(C)	eurytopic	1	12	-	1	1	15
Argyra perplexa Becker, 1918	N	C(fC)	wooded habitats (incl. forests)	-	-	-	-	3	3
Argyra vestita (Wiedemann, 1817)	vZ	C(fC)	reedmarshes	-	-	-	-	1	1
Australachalcus melanotrichus (Mik, 1878)	zZ	R(R)	rotholes / sapruns in trees	-	1	-	-	-	1
Campsicnemus curvipes (Fallén, 1823)	N	C(eC)	eurytopic	4	27	-	10	30	71
Campsicnemus lumbatus Loew, 1857	vZ	R(fR)	swamps - marshlands	-	1	-	-	-	1
Campsicnemus scambus (Fallén, 1823)	N	C(vC)	eurytopic	2	9	-	3	38	52
Chrysotimus flaviventris (von Roser, 1840)	Z	R(R)	wooded habitats (incl. forests)	9	10	22	3	-	44
Chrysotimus molliculus (Fallén, 1823)	N	C(vC)	eurytopic	93	248	3	26	21	391
Chrysotus blepharosceles Kowarz, 1874	N	C(C)	forest edges (incl. gardens)	8	76	-	9	-	93
Chrysotus cilipes Meigen, 1824	N	C(vC)	grasslands	28	233	1	11	3	276

Dolichopodid species	Red List (Pollet, 2000) *	Current rarity (2018) §	Ecoprofile	Abundances (no. specimens per sampling site)					Total no. of specimens
				MT1	MT2	MT4	MT5	MT6	
Chrysotus cupreus (Macquart, 1827)	1	R(vR)	forest edges (incl. gardens)	1	8	-	1	-	10
Chrysotus gramineus (Fallén, 1823)	N	C(eC)	eurytopic	86	1,542	3	87	55	1,773
Chrysotus neglectus (Wiedemann, 1817)	N	C(vC)	eurytopic	1	7	-	1	-	9
Chrysotus pulchellus Kowarz, 1874	N	C(C)	grasslands	1	5	-	2	3	11
Chrysotus suavis Loew, 1857	N	C(C)	riparian habitats	-	4	-	1	-	5
Diaphorus oculatus (Fallén, 1823)	3	C(fC)	wooded habitats (incl. forests)	-	12	-	-	-	12
Dolichophorus kerteszi Lichtwardt, 1902	?	R(R)	tree trunks	-	2	-	-	-	2
Dolichopus atripes Meigen, 1824	vZ	R(fR)	heathlands & moors	-	1	-	-	-	1
Dolichopus brevipennis Meigen, 1824	N	C(vC)	grasslands	-	1	-	-	-	1
Dolichopus claviger Stannius, 1831	N	C(vC)	wooded habitats (incl. forests)	1	-	-	-	1	2
Dolichopus excisus Loew, 1859	vZ	C(fC)	swamps - marshlands	1	-	-	-	-	1
Dolichopus festivus Haliday, 1832	N	C(C)	forests / marshlands	-	4	-	-	-	4
Dolichopus griseipennis Stannius, 1831	vZ	C(C)	eurytopic	-	10	-	-	1	11
Dolichopus latilimbatus Macquart, 1827	N	C(vC)	riparian habitats	12	62	-	3	4	81
Dolichopus linearis Meigen, 1824	N	C(fC)	reedmarshes	-	3	-	-	-	3
Dolichopus longicornis Stannius, 1831	N	C(vC)	eurytopic	-	1	-	-	-	1
Dolichopus nitidus Fallén, 1823	?	R(fR)	peatmoors	1	-	-	-	-	1
Dolichopus nubilus Meigen, 1824	N	C(C)	riparian habitats	4	6	-	-	1	11
Dolichopus plumipes (Scopoli, 1763)	N	C(eC)	eurytopic	19	74	-	5	27	125
Dolichopus popularis Wiedemann, 1817	N	C(vC)	wooded habitats (incl. forests)	-	1	-	1	-	2
Dolichopus signatus Meigen, 1824	N	C(C)	wooded habitats (incl. forests)	1	7	-	-	-	8
Dolichopus simplex Meigen, 1824	N	C(C)	heathlands & moors	-	1	-	1	-	2
Dolichopus subpennatus d'Assis Fonseca, 1976	N	C(C)	swamps - marshlands	29	46	-	2	6	83
Dolichopus trivialis Haliday, 1832	N	C(C)	forest edges (incl. gardens)	27	61	-	13	-	101
Dolichopus ungulatus (Linnaeus, 1758)	N	C(eC)	eurytopic	29	27	-	9	1	66

Dolichopodid species	Red List (Pollet, 2000) *	Current rarity (2018) §	Ecoprofile	Abundances (no. specimens per sampling site)					Total no. of specimens
				MT1	MT2	MT4	MT5	MT6	
Dolichopus urbanus Meigen, 1824	vZ	C(fC)	swamps - marshlands	-	-	-	-	1	1
Dolichopus wahlbergi Zetterstedt, 1843	N	C(C)	wooded habitats (incl. forests)	3	47	-	-	-	50
Gymnopternus aerosus (Fallén, 1823)	N	C(vC)	heathlands & moors	1	40	-	6	16	63
Gymnopternus blankaartensis (Pollet, 1990)	Z	R(fR)	swamps - marshlands	-	2	1	-	2	5
Gymnopternus celer (Meigen, 1824)	N	C(vC)	forests / riparian habitats	1	1	-	-	-	2
Gymnopternus cupreus (Fallén, 1823)	N	C(vC)	wooded habitats (incl. forests)	-	7	-	-	-	7
Gymnopternus metallicus (Stannius, 1831)	N	C(vC)	wooded habitats (incl. forests)	-	-	-	1	-	1
Gymnopternus silvestris (Pollet, 1990)	N	C(fC)	swamps - marshlands	-	4	-	3	4	11
Hercostomus nanus (Macquart, 1827)	N	C(C)	swamps - marshlands	3	2	-	-	5	10
Hercostomus nigripennis (Fallén, 1823)	2	R(fR)	heathlands & moors	-	1	-	-	-	1
Hercostomus nigriplantis (Stannius, 1831)	vZ	R(fR)	riparian habitats	-	1	-	1	2	4
Hercostomus plagiatus (Loew, 1857)	N	C(C)	swamps - marshlands	2	7	-	-	8	17
Hercostomus rusticus (Meigen, 1824)	3	R(eR)	forest edges (incl. gardens)	-	4	-	1	1	6
Liancalus virens (Scopoli, 1763)	0	R(eR)	springs / banks of rivers	-	2	-	1	1	4
Medetera abstrusa Thuneberg, 1955	vZ	C(fC)	tree trunks	-	5	-	-	-	5
Medetera belgica Parent, 1936		R(R)	tree trunks	6	1	9	-	2	18
Medetera dendrobaena Kowarz, 1877	N	C(C)	eurytopic	-	1	1	-	-	2
Medetera feminina Negrobov, 1967	?	R(fR)	tree trunks	-	2	-	-	2	4
Medetera impigra Collin, 1941	vZ	R(fR)	tree trunks	1	8	-	1	4	14
Medetera inspissata Collin, 1952	?	R(R)	tree trunks	-	1	-	-	-	1
Medetera jacula (Fallén, 1823)	N	C(vC)	eurytopic	-	8	-	3	-	11
Medetera jugalis Collin, 1941	vZ	R(fR)	tree trunks	-	1	-	-	1	2
Medetera pallipes (Zetterstedt, 1843)	N	C(C)	tree trunks	-	24	-	11	-	35
Medetera parenti Stackelberg, 1925	?	R(R)	tree trunks	-	2	-	-	-	2

Dolichopodid species	Red List (Pollet, 2000) *	Current rarity (2018) §	Ecoprofile	Abundances (no. specimens per sampling site)					Total no. of specimens
				MT1	MT2	MT4	MT5	MT6	
Medetera peloria Negrobov, 1967	-	R(vR)	tree trunks	-	4	1	-	1	6
Medetera pseudoapicalis Thuneberg, 1955	?	R(R)	tree trunks	-	1	-	-	-	1
Medetera saxatilis Collin, 1941	N	C(C)	eurytopic	-	-	-	1	-	1
Medetera striata Parent, 1927	?	R(eR)	tree trunks	3	1	-	-	-	4
Medetera takagii Negrobov, 1970	?	R(vR)	tree trunks	1	1	-	-	-	2
Medetera truncorum Meigen, 1824	N	C(vC)	eurytopic	4	29	6	11	7	57
Neurigona abdominalis (Fallén, 1823)	-	R(vR)	wooded habitats (incl. forests)	2	-	-	-	-	2
Neurigona pallida (Fallén, 1823)	0	R(R)	wooded habitats (incl. forests)	52	78	1	-	7	138
Neurigona quadrifasciata (Fabricius, 1781)	N	C(C)	wooded habitats (incl. forests)	20	39	3	-	1	63
Poecilobothrus nobilitatus (Linnaeus, 1767)	N	C(vC)	eurytopic	2	9	-	-	-	11
Rhaphium albifrons Zetterstedt, 1843	2	R(R)	swamps - marshlands	-	1	-	-	2	3
Rhaphium appendiculatum Zetterstedt, 1849	N	C(C)	wooded habitats (incl. forests)	32	167	-	6	7	212
Rhaphium auctum Loew, 1857	0	R(eR)	swamps - marshlands	-	-	-	-	2	2
Rhaphium caliginosum (Zetterstedt, 1843)	N	C(vC)	eurytopic	2	30	-	3	5	40
Rhaphium commune (Meigen, 1824)	3	C(fC)	wooded habitats (incl. forests)	71	170	-	16	6	263
Rhaphium crassipes (Meigen, 1824)	N	C(C)	wooded habitats (incl. forests)	2	-	-	-	-	2
Rhaphium fasciatum Meigen, 1824	vZ	C(fC)	reedmarshes	-	-	-	-	1	1
Rhaphium laticorne (Fallén, 1823)	N	C(fC)	riparian habitats	-	1	-	-	2	3
Rhaphium micans (Meigen, 1824)	zZ	R(fR)	swamps - marshlands	-	5	-	-	-	5
Rhaphium quadrispinosum (Strobl, 1898)	0	R(vR)	swamps - marshlands	-	1	-	-	-	1
Sciapus platypterus (Fabricius, 1805)	N	C(vC)	wooded habitats (incl. forests)	177	245	6	154	12	594
Sciapus wiedemanni (Fallén, 1823)	N	C(vC)	eurytopic	1	-	-	-	-	1
Sybistroma crinipes Staeger, 1842	0	R(eR)	swamps - marshlands	-	1	-	-	-	1
Sybistroma obscurellus (Fallén, 1823)	N	C(C)	wooded habitats (incl. forests)	-	1	-	-	-	1

Dolichopodid species	Red List (Pollet, 2000) *	Current rarity (2018) §	Ecoprofile	Abundances (no. specimens per sampling site)					Total no. of specimens
				MT1	MT2	MT4	MT5	MT6	
Sympycnus pulicarius (Fallén, 1823)	N	C(vC)	eurytopic	49	63	-	3	16	131
Syntormon bicolorellum (Zetterstedt, 1843)	N	C(fC)	forests / marshlands	-	-	-	-	1	1
Syntormon denticulatum (Zetterstedt, 1843)	N	C(C)	riparian habitats	1	5	-	4	11	21
Syntormon fuscipes (von Roser, 1840)	2	R(vR)	swamps - marshlands	-	1	-	1	1	3
Syntormon macula Oldenberg, 1927		R(vR)	swamps - marshlands	-	-	-	-	1	1
Syntormon metathesis (Loew, 1850)	zZ	R(fR)	swamps - marshlands	-	3	-	-	2	5
Syntormon pallipes (Fabricius, 1794)	N	C(C)	riparian habitats	-	-	-	1	1	2
Syntormon submonilis Negrobov, 1975	Z	R(R)	swamps - marshlands	-	1	-	-	5	6
Systenus bipartitus (Loew, 1850)	zZ	R(R)	rotholes / sapruns in trees	-	1	-	-	-	1
Systenus pallipes (von Roser, 1840)	zZ	R(R)	rotholes / sapruns in trees	-	1	-	-	-	1
Teuchophorus monacanthus Loew, 1859	vZ	C(fC)	riparian habitats	-	-	-	-	1	1
Teuchophorus nigricosta (von Roser, 1840)	vZ	C(fC)	wooded habitats (incl. forests)	1	26	-	1	-	28
Teuchophorus simplex Mik, 1880	Z	R(fR)	wooded habitats (incl. forests)	-	1	-	-	-	1
Teuchophorus spinigerellus (Zetterstedt, 1843)	N	C(C)	reedmarshes	-	2	-	-	7	9
Thrypticus smaragdinus Gerstäcker, 1864	zZ	R(eR)	reedmarshes	-	-	-	-	1	1
Thrypticus tarsalis Parent, 1932	Z	R(fR)	swamps - marshlands	-	1	-	-	1	2
Xanthochlorus galbanus Chandler & Negrobov, 2008	-	R(fR)	forest edges (incl. gardens)	-	10	-	2	3	15
Xanthochlorus ornatus (Haliday, 1832)	N	C(C)	eurytopic	1	10	-	3	1	15
Xanthochlorus tenellus (Wiedemann, 1817)	N	C(C)	eurytopic	3	8	1	6	2	20
Total no. species				53	94	13	47	65	117
Total no. specimens				845	3,818	58	437	365	5,523

* ?: insufficiently known; 0: locally extinct in the wild (Flanders); 1: critically endangered; 2: endangered; 3: vulnerable; N: safe/at low risk; vZ: fairly rare; Z: rare; zZ: very rare; -: not yet included.

§ C(C): common; C(eC): extremely common; C(fC): fairly common; C(vC): very common; R(eR): extremely rare; R(fR): fairly rare; R(R): rare; R(vR): very rare. Categories based on the number of UTM 5km squares in Flanders with the species to the total number of UTM 5km squares investigated for Dolichopodidae since 1981. For ranges, see Table 1.

be confirmed, as the main distribution range of *M. veles* is situated in the Nearctic region. This species is likely a non-native species in northwestern Europe that has been introduced by man (Pollet, unpubl. data).

The total number of species (n = 121) represents over 41% of the dolichopodid fauna of Belgium as documented by Pollet (2000). This Red List of Dolichopodidae of Flanders contains the only comprehensive treatment of the family in Belgium. Ever since, a fair number of species has been recorded for the first time from Belgium but has not yet been formally published. The Botanic Garden Jean Massart list includes six species that are formally recorded here for the first time from Belgium (see further). In addition, *Argyra argentella* (Zetterstedt, 1843) has been treated as a synonym of *Argyra argyria* (Meigen, 1824) since Meuffels *et al*. (1989) (see also Cole, 1990), but might be regarded as a valid species after all. And *Rhaphium albifrons* Zetterstedt, 1843 has been listed erroneously as *R. bilamellatum* (Becker, 1918) in Pollet (2000).

The following analyses are solely based on the 116 species with a certain identity (thus excluding *Argyra argentella*).

Ecoprofiles

Table 3 presents the number of species per ecoprofile and their abundances; Figure 1 gives the distribution of species and specimens over pooled ecoprofiles. The pooled ecoprofile "forests" includes all wooded habitats, forest edges, gardens, tree trunks and rotholes. Many species of the genera *Medetera* and *Neurigona* are nearly confined to tree trunks, while *Systenus* species breed in rotholes and sapruns and hardly leave these microhabitats. "Heathlands" represents all wet oligotrophic habitats such as heathlands and peatmoors, while "marshlands" includes reedmarshes, swamps, springs, banks of rivers and other riparian habitats. Finally, "eurytopic" suggests a lack of distinct habitat affinity; eurytopic species tend to feature a wide ecological amplitude and are found in multiple habitat types. Unfortunately, due to the fact that multiple samples from different Malaise traps were missing, a comparison of the dolichopodid fauna of the 6 sampling sites in the Botanic Garden Jean Massart was considered insufficiently supported by data. Indeed, only for a period of 6 sampling periods samples from all six Malaise traps were available.

On the species level, species of forests and marshlands are clearly dominant and represent ¾ of all species observed. Eurytopic species are the third most important ecological group with less than 20% of the species. When abundances are considered, however, eurytopic species take over the lead position with more than ½ of all specimens examined. Forest species retain an average abundance while marshland species appear to be collected in relatively far lower numbers (see Figure 1).

Rarity groups

Table 1 and Figure 2 give a summary of the species and their specimens as assigned to their current rarity classes. Of the 116 reliably identified species, about 23% (n=27) can be considered rare to extremely rare, and nearly 15% (n=17) fairly rare while the remaining 62% (n=72) are fairly to extremely common. As can be seen in Figure 2, a clear relationship is apparent between the current rarity estimate and the combined abundances of the species per estimate, with rarer species being less abundant and more common species increasingly abundant.

Chrysotus gramineus (Fallén, 1823) was by far the most numerous species observed and represented nearly 1/3 of the dolichopodid trap yields. *C. gramineus* is an eurytopic species of open sunny grassy biotopes. Another 10 species were collected with more than 100 specimens

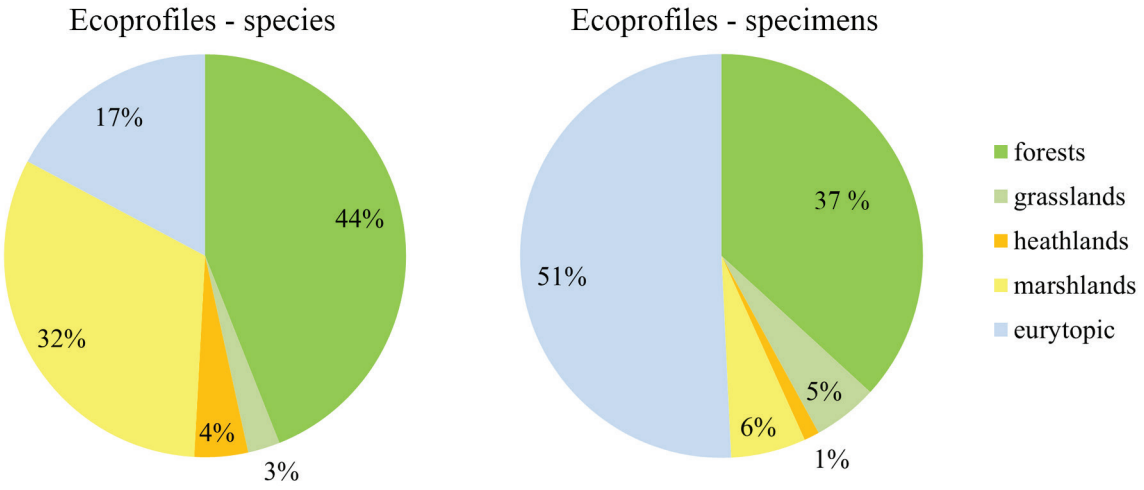

Fig. 1. Dolichopodid species and specimens collected in the Botanic Garden Jean Massart per pooled ecoprofile.

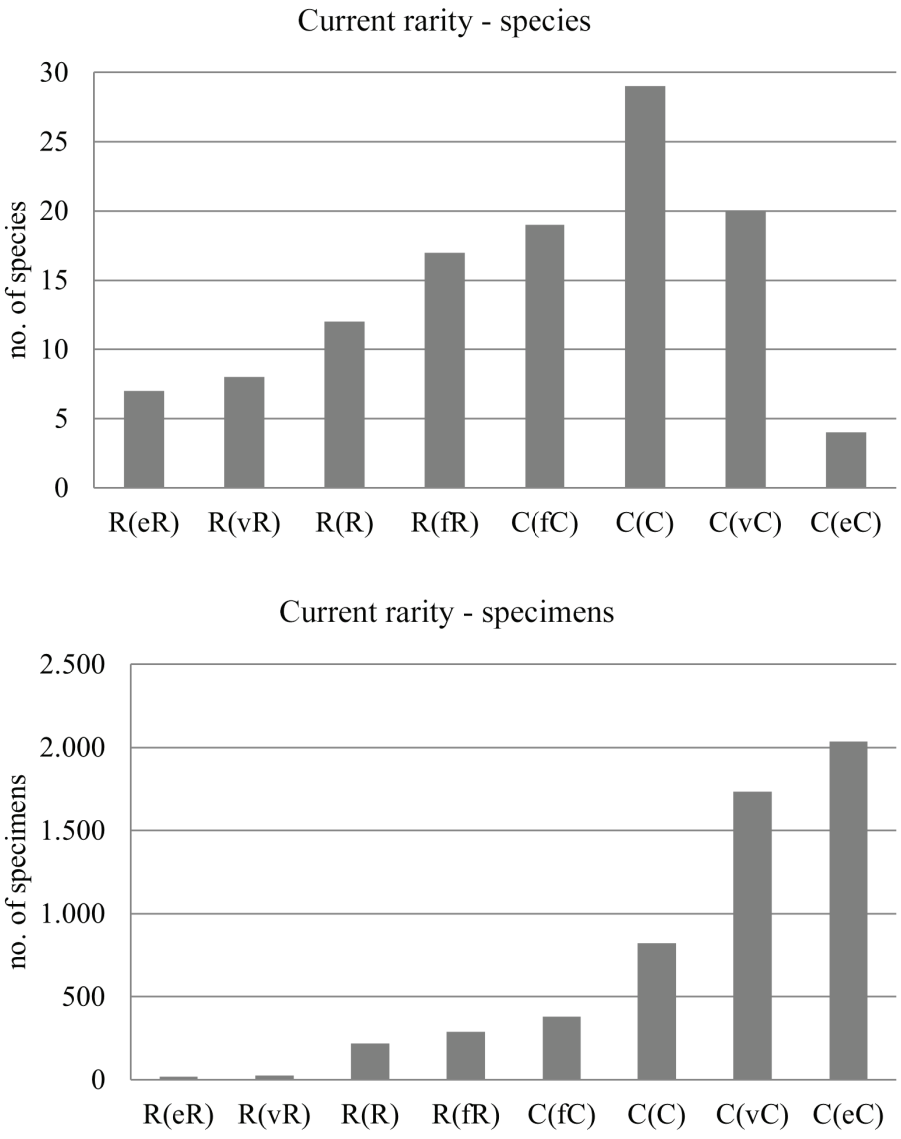

Fig. 2. Dolichopodid species and specimens collected in the Botanic Garden Jean Massart as assigned to current rarity classes. For information on the codes, see Table 1.

Table 3. Overview of Dolichopodidae and their specimens collected in the Botanic Garden Jean Massart as assigned to ecoprofiles.

Dolichopodid ecoprofiles	No. of species	No. of specimens
eurytopic	20	2,803
forest edges (incl. gardens)	7	246
forests / marshlands	2	5
forests / riparian habitats	1	2
rotholes / sapruns in trees	3	3
tree trunks	13	96
wooded habitats (incl. forests)	25	1,679
grasslands	3	288
heathlands & moors	4	67
peatmoors	1	1
reedmarshes	7	20
riparian habitats	9	130
springs / banks of rivers	1	4
swamps - marshlands	20	178
Total no.	116	5,522

and together contributed another 43% of the specimens. This group consists of species of wooded biotopes (*Sciapus platypterus* (Fabricius, 1805), *Rhaphium commune* (Meigen, 1824), *Rhaphium appendiculatum* Zetterstedt, 1849, *Argyra ilonae* Gosseries, 1988, *Neurigona pallida* (Fallén, 1823), *Dolichopus trivialis* Haliday, 1832), eurytopic species (*Chrysotimus molliculus* (Fallén, 1823), *Sympycnus pulicarius* (Fallén, 1823), *Dolichopus plumipes* (Scopoli, 1763)) and one grassland species (*Chrysotus cilipes* Meigen, 1824). Nine of these species are fairly to extremely common; only *A. ilonae* is considered fairly rare and *N. pallida* rare (see further). Twenty-seven species were collected as singletons, 17 as doubletons.

Species of special faunistic interest

A number of species deserves special attention. For each of these species, the following information is provided: Red List category by Pollet (2000), current rarity estimate, number and % of UTM 5km squares with this species since 1981, ecoprofile and noteworthy comments on its ecology, and its overall distribution in Flanders, Belgium and Europe.

List of species

Rhaphium auctum Loew, 1857

Red List category (Pollet, 2000): 0 (locally extinct in Flanders).

Current rarity (2018): extremely rare (R(eR)), 1 – 0.37%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut, Liège (Wallonia); Europe: widely distributed.

Ecology: swamps – marshlands, with an apparent preference for humid canopied sites with a well developed vegetation layer.

Acropsilus niger (Loew, 1869) – **Belg. sp. nov.**
Fig. 4 A

Red List category (Pollet, 2000): not included i.e., not observed in Flanders by 2000.

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: Flanders: Limburg (Flanders); Brussels; Namur (Wallonia); Europe: wide distribution (extending into Africa).

Ecology: riparian habitats; the species exhibits a distinct preference for open sunny sparsely vegetated, sandy or pebbly banks of both stagnant and running waters.

Hercostomus rusticus (Meigen, 1824)
Fig. 4 B

Red List category (Pollet, 2000): 3 (vulnerable).

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: West-Vlaanderen (Flanders); Brussels; Brabant wallon, Liège, Namur (Wallonia); Europe: widely distributed.

Ecology: forest edges (incl. gardens); the species prefers rather dry sunny sites with an open canopy (e.g. southern hill slopes). In Germany, *H. rusticus* appears rather abundant in heathlands, even in very small patches (Stark, pers. comm.)

Remarks: surprisingly, the species has recently showed up in backyards in Belgium and the Netherlands, which might be related to global warming (Pollet, unpubl. data).

Liancalus virens (Scopoli, 1763)
Fig. 4 C

Red List category (Pollet, 2000): 0 (locally extinct in Flanders).

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: Vlaams Brabant, Oost-Vlaanderen (Flanders); Brussels; Hainaut, Liège, Luxembourg, Namur; Europe: wide distribution.

Ecology: springs / banks of rivers; *L. virens* is most often encountered on vertical surfaces (e.g., bridges, fontains) in or along running waters. Unlike most other dolichopodid species, its activity period nearly spans about the entire year (d'Assis Fonseca, 1978; Germann & Bernasconi, 2010; Crossley, 2019).

Remarks: in the past two decades, the species has been observed with an increasing frequency in Flanders, often at fontains, even in the middle of large cities (see waarnemingen.be) (see also Pollet, 2012; Sivell, 2016; Pollet & Maes, 2019). Different factors might explain this phenomenon including an increased citizen science activity, combined with the species' conspicuous size and apparence, and/or an overall improved water quality.

Medetera striata Parent, 1927
Fig. 4 D

Red List category (Pollet, 2000): ? (insufficiently known).

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: Limburg, Oost-Vlaanderen (Flanders); Brussels; Europe: mainly northeastern

distribution as far as the Palaearctic Far East.

Ecology: tree trunks; like other members of the *M. pinicola – signaticornis* species group, it prefers trunks of coniferous trees.

Remarks: the species has recently been collected in Bos t'Ename (Ename, Oost-Vlaanderen) as well (Pollet, unpubl. data).

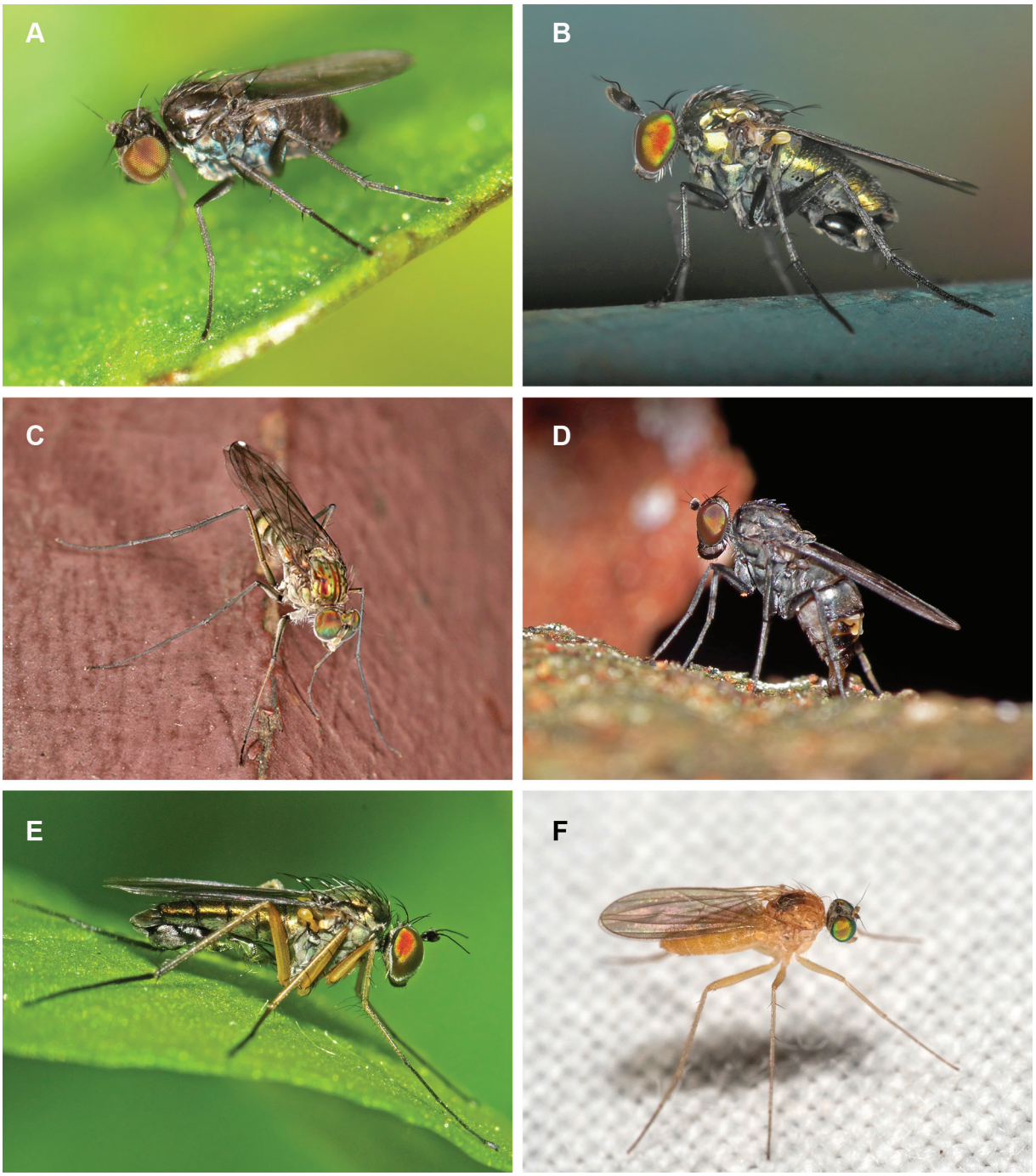

Fig. 4. Selected Dolichopodidae collected in the Botanic Garden Jean Massart. A, *Acropsilus niger*, Belg. sp. nov, ♂. © Jur Heijnen. B, *Hercostomus rusticus*, ♂. © Jur Heijnen. C, *Liancalus virens*, ♂. © Robert Heemskerk. D, *Medetera striata*, ♀. © Rui Andrade. E, *Sybistroma crinipes*, ♂. © Jur Heijnen. F, *Xanthochlorus galbanus*, Belg. sp. nov., ♀. © Arnold Wijker.

Sybistroma crinipes Staeger, 1842
Fig. 4 E

Red List category (Pollet, 2000): 0 (locally extinct in Flanders).

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut, Liège, Luxembourg, Namur (Wallonia); Europe: widely distributed except for the south.

Ecology: swamps – marshlands, in particular alder carrs.

Remarks: in Belgium, this species clearly exhibits a southern distribution; its only Flemish record originated from Bos t'Ename (Pollet, unpubl. data).

Thrypticus smaragdinus Gerstäcker, 1864

Red List category (Pollet, 2000): zZ (very rare).

Current rarity (2018): extremely rare (R(eR)), 2 – 0.74%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut (Wallonia); Europe: widely distributed, mainly in central and northeastern Europe.

Ecology: reedmarshes.

Remarks: *T. smaragdinus* larvae most presumably feed on common reed as leafminers, which explains its distribution. This species was encountered very abundantly in the reedmarshes of Étang de Virelles (Virelles, Hainaut) (Grootaert *et al*., 1988), which remains the only site of this species in Wallonia until present.

Chrysotus cupreus (Macquart, 1827)

Red List category (Pollet, 2000): 1 (critically endangered)

Current rarity (2018): very rare (R(vR)), 3 – 1.12%.

Distribution: Oost-Vlaanderen, Vlaams-Brabant, West-Vlaanderen (Flanders); Brussels; Brabant wallon, Hainaut, Liège, Luxembourg, Namur (Wallonia); Europe: widely distributed.

Ecology: forest edges (incl. gardens).

Remarks: *C. cupreus* exhibits a similar habitat affinity as *H. rusticus* (see also Stark & Meyer, 2016).

Syntormon fuscipes (von Roser, 1840)

Red List category (Pollet, 2000): 2 (endangered)

Current rarity (2018): very rare (R(vR)), 3 – 1.12%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut, Namur (Wallonia); Europe: widely distributed.

Ecology: swamps – marshlands, preferably with a wet, muddy soil, sparse herb vegetation and partly canopied by trees.

Remarks: Bos t'Ename is a real stronghold of this species and simultaneously the only site in Flanders where this species has been discovered thus far.

Syntormon macula Oldenberg, 1927 – **Belg. sp. nov.** (see also Pollet, 2012)

Red List category (Pollet, 2000): not included i.e., not observed in Flanders by 2000.

Current rarity (2018): very rare (R(vR)), 3 – 1.12%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Europe: thus far only recorded reliably from Great Britain, Germany, Switzerland, Hungary and Italy, and doubtfully from Romania (Pollet, 2011a).

Ecology: swamps – marshlands, often at seeps or muddy spots.

Remarks: females of *S. macula* are predominantly found in early spring which might in part explain the rarity of this species. Males are notoriously rare, both in Belgium and Britain, and rather peak in summer (Drake, 2021a, 2021b).

Medetera peloria Negrobov, 1967 – **Belg. sp. nov.** (see also Pollet, 2012)

Red List category (Pollet, 2000): not included i.e., not observed in Flanders by 2000.

Current rarity (2018): very rare (R(vR)), 4 – 1.49%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut (Wallonia); Europe: currently only recorded from the Near East, South European Russia (Pollet, 2011a) and Portugal (Pollet *et al*., 2019).

Ecology: largely unknown.

Remarks: females of this species cannot be separated from related species as *Medetera belgica* Parent, 1936 or *Medetera muralis* Meigen, 1824. The most decisive diagnostic feature in the male is the shape of the phallus in lateral view.

Neurigona abdominalis (Fallén, 1823) – **Belg. sp. nov.**

Red List category (Pollet, 2000): not included i.e., not observed in Flanders by 2000.

Current rarity (2018): very rare (R(vR)), 4 – 1.49%.

Distribution: Oost-Vlaanderen, Vlaams Brabant (Flanders); Brussels; Hainaut, Luxembourg (Wallonia); Europe: mainly northeastern distribution.

Ecology: wooded habitats (incl. forests).

Remarks: also this species has recently been collected in Bos t'Ename (Pollet, unpubl. data).

Achalcus phragmitidis Pollet, 1996

Red List category (Pollet, 2000): Z (rare)

Current rarity (2018): very rare (R(vR)), 4 – 1.49%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut (Wallonia); Europe: only reported from Belgium.

Ecology: reedmarshes, both in open landscapes and in swamps.

Remarks: this species has first been discovered in the Meetjeslandse Krekengebied with the Roeselarekreek (Sint Jan-in-Eremo) as type locality (Pollet, 1992, 1996). Ever since, it has been encountered in other reedmarshes across Oost-Vlaanderen and those along the Étang de Virelles (Hainaut). Its occurrence in the Botanic Garden Jean Masssart was quite surprising.

Medetera takagii Negrobov, 1970

Red List category (Pollet, 2000): ? (insufficiently known)

Current rarity (2018): very rare (R(vR)), 5 – 1.86%.

Distribution: Oost-Vlaanderen, West-Vlaanderen (Flanders); Brussels; Hainaut, Liège, Namur (Wallonia); Europe: currently only reported from Belgium, Germany (Meyer, 2005; Meyer & Stark, 2015), Switzerland and the East Palaearctic (Pollet, 2011a).

Ecology: tree trunks, most often on poplars in marshland habitats. This species has been reared from dead branches of several deciduous tree species in Germany (Meyer, 2005).

Remarks: *M. takagii* is one of the earliest *Medetera* species that emerges in early spring (April – May), which might contribute to its current rarity estimate, both in Flanders and the rest of Europe.

Rhaphium quadrispinosum (Strobl, 1898)

Red List category (Pollet, 2000): 0 (locally extinct in Flanders)

Current rarity (2018): very rare (R(vR)), 5 – 1.86%.

Distribution: Oost-Vlaanderen, Vlaams-Brabant (Flanders); Brussels; Hainaut (Wallonia); Europe: mainly western and central Europe.

Ecology: swamps – marshlands, mostly open or with a sparse canopy by trees or shrubs.

Syntormon submonilis Negrobov, 1975 – **Belg. sp. nov.** (see Pollet, 2000)

Red List category (Pollet, 2000): Z (rare).

Current rarity (2018): rare (R(R)), 6 – 2.23%.

Distribution: Oost-Vlaanderen (Flanders); Brussels; Hainaut, Liège, Luxembourg, Namur (Wallonia); Europe: only recorded from Great Britain, Romania, former Yugoslavia (Pollet, 2011a) and Croatia (Pollet & Ivkovic, 2018).

Ecology: swamps – marshlands.

Remarks: in Bos t'Ename, this species shows the same habitat affinity as *S. fuscipes*. It had been separated from *Syntormon monilis* (Haliday, 1851) by Pârvu (1989) and described as *S. silvianum* Pârvu, 1989 which was subsequently questioned by Grichanov (2013). Recently, Drake (2021a) discovered that *S. silvianum* is actually a synonym of *S. submonilis* Negrobov, 1975. We currently consider *S. submonilis* a valid species of inland swamps while *S. monilis* mainly occurs in open coastal marshlands. *S. monilis* as listed by Pollet (2000), in fact, includes both species.

Neurigona pallida (Fallén, 1823)

Red List category (Pollet, 2000): 0 (locally extinct in Flanders).

Current rarity (2018): rare (R(R), 10 – 3.72%.

Distribution: Antwerpen, Limburg, Oost-Vlaanderen (Flanders); Brussels; Hainaut, Liège, Luxembourg, Namur (Wallonia); Europe: widely distributed.

Ecology: wooded habitats, incl. forests; *N. pallida* is mainly found on tree trunks, sometimes in large numbers, in park-like landscapes or clearings in mature deciduous forests on limestone soils.

Xanthochlorus galbanus Chandler & Negrobov, 2008 – **Belg. sp. nov.**
Fig. 4 F

Red List category (Pollet, 2000): not included i.e., not recognized in Flanders by 2000.

Current rarity (2018): fairly rare (R(fR), 14 – 5.20%.

Distribution: Limburg, Oost-Vlaanderen, West-Vlaanderen (Flanders); Brussels; Europe: most presumably widely distributed.

Ecology: forest edges (incl. gardens); like its congeners, *X. galbanus* is mainly found in sunny shrub rich forest edges where it can be found on foliages of shrubs and trees. In eastern Germany, on the contrary, it is considered characteristic for flood-plain forests along the river Saale (Stark, pers. comm.).

Remarks: a recent re-examination of MAPC-specimens previously identified as *X. tenellus* (Wiedemann, 1817) pointed out that several of them actually belonged to *X. galbanus*, and that the latter species is actually not so uncommon.

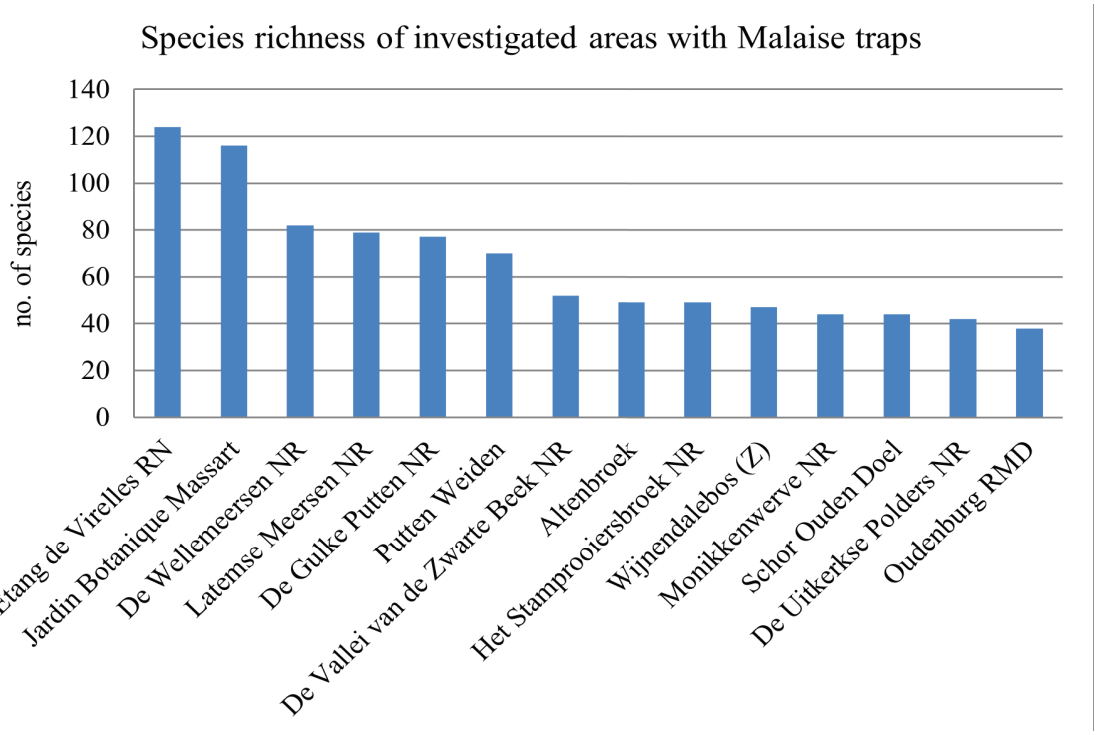

Fig. 3. Total number of Dolichopodid species collected during the 14 most species rich Malaise trap surveys in Belgium.

Table 4. Overview of Malaise trap sampling campaigns in Belgium with key results. NR: Natuurreservaat; RMD: Radio Maritieme Diensten; RN: Réserve Naturelle; Z: Zuid (south).

Selected Malaise trap sampling campaigns (sampling period)	No. species	No. specimens
Étang de Virelles RN (Virelles) - 1986, 2006	124	19.151
Jardin Botanique Massart (Oudergem) - 2015-2018	116	5.522
De Wellemeersen NR (Denderleeuw) - 2002-2003	82	5.678
Latemse Meersen NR (Sint-Martens-Latem) - 1999	79	9.080
De Gulke Putten NR (Wingene) - 1986-1987	77	5.256
Putten Weiden (Kieldrecht) - 2012	70	10.354
De Vallei van de Zwarte Beek NR (Beringen) - 1992	52	4.531
Altenbroek (Sint-Martens-Voeren) - 2003	49	6.025
Het Stamprooiersbroek NR (Kinrooi) - 1996	49	5.040
Wijnendalebos (Z) (Ichtegem-Torhout) - 1986-1987	47	4.222
Monikkenwerve NR (Lissewege) - 2012	44	5.435
Schor Ouden Doel (Kieldrecht) - 2014	44	4.860
De Uitkerkse Polders NR (Blankenberge) - 2013	42	8.222
Oudenburg RMD (Oudenburg) - 2012	38	8.934

Discussion

The dolichopodid fauna of the Botanic Garden Jean Massart is undeniably species rich and contains valuable species. Twenty-seven species or nearly ¼ of the entire community is termed rare to extremely rare, five species that were considered as extinct in Flanders in 2000 were rediscovered here, and 6 species are formally reported for the first time from Belgium. But how exceptional is the dolichopodid species richness of the garden?

To investigate this, results of previous dipterological surveys in Belgium were examined. In order to keep biases of different kinds to a minimum, we only included Malaise trap campaigns that yielded at least 4,000 specimens. In contrast, the number of traps nor the duration of the sampling period were considered as criteria for restriction. Data were retrieved from the EURODOL database that produced 62 surveys conducted between 1981 and 2015. Applying the restriction criteria reduced this list to only 14 surveys (see Table 4, Figure 4), with the Botanic Jardin Botanique Massart as the second most speciose survey. Only the Réserve Naturelle Étang de Virelles appeared more species rich, although both surveys differ in some characteristics. Surveys in the Étang de Virelles were carried out with an interval of twenty years, with only one Malaisetrap in 1986 and four in 2006, and all samples were examined. The other sampled areas invariably yielded less than 100 species, ranging from more than 80 in De Wellemeersen Nature Reserve (Denderleeuw) to Oudenburg RMD with more than 40 species less. Regardless of the fact that the use of multiple Malaise traps in different habitat types in the Botanic Garden Jean Massart most certainly contributed to the current species list, we may conclude that Jardin Botanique Massart is most likely more species rich than most other areas investigated.

Might some species be overlooked in the Botanic Garden? This also remains most likely. As has been demonstrated in several methodological studies, collecting methods for flying insects are largely complementary (Pollet & Grootaert, 1987, 1994). Especially lineages of soil-dwelling species like *Campsicnemus* and *Hydrophorus* are generally underrepresented in Malaise trap samples or even lack entirely. Also predominantly arboreal species like *Medetera* are only occasionally collected with Malaise traps. And species of rotholes and other moist

crevices in trees like *Systenus* sp. and some *Hercostomus* species (*H. nigrilamellatus* (Macquart, 1827)), and *H. argentifrons* Oldenberg, 1916 hardly end up in this type of traps. To collect or monitor these species groups, visual screening of tree trunks and crevices is much more reliable and productive (see Pollet, 2012).

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Fungus gnats in the Botanic Garden Jean Massart: an amazing diversity beyond the naked eye (Diptera: Diadocidiidae, Ditomyiidae, Bolitophilidae, Keroplatidae, Mycetophilidae)

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Abstract

A synopsis of the fungus gnat (Diptera: Diadocidiidae, Ditomyiidae, Bolitophilidae, Keroplatidae, Mycetophilidae) diversity in the Botanic Garden Jean Massart on Brussels outskirts is provided. We are summarising an earlier published study based on one-year sampling from May 2015 to May 2016 with two Malaise traps (Kurina & Grootaert, 2016) and subsequent collecting with six traps from June 2016 to November 2017. The studied material comprised altogether 5886 specimens identified to the species level, including 206 species. As a result, 78 species (52 published earlier + 26 here) were recorded from Belgium for the first time. Combined with earlier published data, the number of fungus gnats in Belgium is set at 332, of which 62% was recorded during this survey. Using different nonparametric methods, the estimated species richness of fungus gnats in the Botanic Garden Jean Massart is calculated to be 230 (by Bootstrap), 246 (by Chao 1 and Chao 2) or 276 (by Jacknife 2). The pictorial atlas representing variability of the fungus gnats' general facies as published by Kurina & Grootaert (2016) is supplemented by photos of five newly recorded genera: viz. *Monocentrota* Edwards, *Leptomorphus* Curtis, *Rondaniella* Johannsen, *Allodiopsis* Tuomikoski and *Pseudexechia* Tuomikoski.

Keywords: Sciaroidea, faunistics, species diversity, Europe, Belgium

Introduction

Fungus gnats constitute a diverse, speciose and mostly forest dwelling group of nematocerous flies. In Europe, the name covers members of five families (viz. Diadocidiidae, Ditomyiidae, Bolitophilidae, Keroplatidae and Mycetophilidae), with altogether more than 1200 species (e.g. Chandler, 2005). Adult fungus gnats are relatively small, coloured in yellow and brown to black, and preferring humid and shady habitats. As far as known, their larvae are mycophagous (including sporophagous), feeding in mycelium-penetrated litter or can be also predators (e.g. Ševčík, 2010; Jakovlev, 2012).

Prior the current inventory, the fungus gnat studies in Belgium, pioneered by Lameere (1907), resulted in 244 species as referred to in the Fauna Europaea Database (Chandler, 2005). Studies of fungus gnat diversity in the Botanic Garden Jean Massart on the outskirts of Brussels started in spring 2015 and so far resulted in a first account based on one-year sampling. That paper incorporated 148 species of which 52 were recorded as new to the Belgian fauna (Kurina & Grootaert, 2016). Meanwhile, Kurina & Chandler (2018) studied old collection material of *Ditomyia macroptera* (Winnertz, 1852) revealing exclusion of the species from the Belgian list. In addition, Kurina & Libert (2020) studied the composition of fungus gnats in Somal, a village of Belgian Famenne, and recorded 69 species including eleven species found

in Belgium for the first time. As a result, the number of Belgian fungus gnats prior the current communication was set at 306.

Here, we provide a synopsis of the faunistic survey of fungus gnats in the Botanic Garden Jean Massart based on material collected from 2015 to 2017. All discovered species are listed along with discussion of these recorded from Belgium for the first time and not covered by Kurina & Grootaert (2016). Moreover, an estimated species richness is calculated using several nonparametric methods.

Material and methods

The material was collected by six Townes type Malaise traps (abbreviated MT1–MT6 as follows) operated in the Botanic Garden Jean Massart. For details of traps localities and sampling periods see Grootaert *et al.* (2022). The study results of fungus gnats collected with MT1 and MT2 during the first year sampling period from 7th May 2015 to 11th May 2016 were published by Kurina & Grootaert (2016). In the current communication, that list of species is supplemented by outcome from subsequent collecting with additional traps. Whilst fungus gnats from all 84 samples of the first year collecting period with two traps were sorted out and studied, a selection of the samples were subjected to sorting and studying from the following period: 37 and 22 samples from the years 2016 and 2017, respectively.

All material was collected into 70% ethyl alcohol, within which it was thereafter sorted and finally identified using a stereomicroscope Leica S8APO. The identified material is preserved in glass tubes in 70% ethyl alcohol arranged per species per sample. In several cases when the detailed study of male terminalia was unavoidable, they were detached from the abdomen and treated in a solution of hot KOH for maceration. Thereafter, the remaining chitinous parts were washed with distilled water, neutralized in acetic acid and transferred into the glycerine. After examination, terminalia were stored in glycerine in a small plastic microvial together with the rest of body.

The habitus photos were combined using the software LAS V.4.1.0. from multiple gradually focused images taken in alcohol medium by a Leica DFC 450 camera attached to a stereomicroscope Leica 205C (see also Kurina *et al.*, 2017). Adobe Photoshop CS5 was used for editing the figures and compiling the plates. The material is deposited in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS) and in the Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences [former Institute of Zoology and Botany], Tartu, Estonia (IZBE).

Results

The list of fungus gnats of the Botanic Garden Jean Massart is based on the study of altogether 7036 specimens of which 5886 have been determined to the species level. The remaining female specimens were determined to genus level only and not included in the following list and neither in the diversity analysis. The first year of collecting with two Malaise traps during 2015–2016 yielded 2770 identified specimens including 148 species of 46 genera, with 52 species and 5 genera new to the Belgian fauna (Kurina & Grootaert, 2016). Subsequent collecting with six Malaise traps during 2016–2017 yielded an additional 3496 identified specimens belonging to 175 species of 51 genera, with 26 species and two genera new to the Belgium. Altogether 206 species of 51 genera were recorded, viz. 2 species (1 genus) of Diadocidiidae, 2 species (2 genera) of Ditomyiidae, 5 species (1 genus) of Bolitophilidae, 20 species (8 genera) of Keroplatidae and 177 species (39 genera) of Mycetophilidae. As a

result of subsequent collecting one keroplatid genus (*Monocentrota* Edwards, 1925) and four mycetophilid genera (*Leptomorphus* Curtis, 1831, *Rondaniella* Johannsen, 1909, *Allodiopsis* Tuomikoski, 1966 and *Pseudexechia* Tuomikoski, 1966) are recorded from the area for the first time and photographs of their habitus are provided (Figs 1, 2). In addition, the habitus of three *Keroplatus* Bosc, 1792 species, and a very rare and recently described species – *Grzegorzekia bushyae* Chandler, 2015 – are provided.

List of the species

In the following list, all fungus gnats species collected from the Botanic Garden Jean Massart during 2015–2017 are covered. An asterisk before the species number denotes a new, not yet published species from the garden and for these the studied material is listed in full details. For the species already included in Kurina & Grootaert (2016), only the total number of newly recorded specimens along with the reference to published material are provided. The species new to the Belgian fauna are indicated as "**Belg. sp. nov.**" [abbreviation for "Fauna belgica species nova"]. The distribution, biology and systematics of these as well as of the otherwise remarkable species are briefly discussed. The classification follows Fungus Gnats Online (https://sciaroidea.myspecies.info/) with changes resulting from Mantič *et al.* (2020) and Oliveira & Amorim (2021).

Bolitophilidae

1. *Bolitophila* (*Bolitophila*) *cinerea* Meigen, 1818

Kurina & Grootaert, 2016: 10

2. *Bolitophila* (*Bolitophila*) *saundersii* (Curtis, 1836)

Kurina & Grootaert, 2016: 10 (11♂♂ 3♀♀ identified as *B.* (*B.*) *saundersii* and 1♂ misidentified as *B.* (*C.*) *hybrida*; see remarks under the latter).

New material. 12♂♂ 6♀♀.

Remarks. All the studied specimens have flagellar segments with setae over twice as long as the diameter of the segments and wing without a central spot. The male terminalia including aedeagal apparatus match quite well with figures by Hutson *et al.* (1980) and Mayer (1951, figured as *B. plumicornis* Mayer) but differ somewhat from those figured by Zaitzev (1994). The studied females have the second and third segment of fore tarsus swollen and sternite 8 without spines on lower margin as noted by Hutson *et al.* (1980). Based on abovementioned characters, we consider our material to be conspecific with *B. saundersii*. However, *Bolitophila* s. str. species with long setae on flagellar segments require a future study, including geographically wider material and DNA sequencing, as there may be hidden undescribed diversity.

3. *Bolitophila* (*Cliopisa*) *hybrida* (Meigen, 1804)

Material examined**.** 1♂, MT2, 25.X–8.XI.2017; 3♂♂, MT5, 25.X–8.XI.2017. Total: 4♂♂.

Remarks. The only male specimen collected in 2015 turned out after double-checking to be *B.*(*B.*) *saundersii* (but see discussion above). However, four newly collected male specimens correspond well with interpretation of *B. hybrida* (e.g. Hutson *et al.*, 1980; Zaitzev, 1994; Kjaerandsen pers. comm.).

*4. *Bolitophila* (*Cliopisa*) *glabrata* Loew, 1869

Material examined. 1♂ 2♀♀, MT6, 25.X–8.XI.2017. Total: 1♂ 2♀♀.

5. *Bolitophila* (*Cliopisa*) sp.

Kurina & Grootaert, 2016: 10

Remarks. The single studied specimen is apparently not conspecific with any European species of the subgenus *Cliopisa* Enderlein and requires a future study.

Diadocidiidae

6. *Diadocidia* (*Diadocidia*) *ferruginosa* (Meigen, 1830)

Kurina & Grootaert, 2016: 8.

New material. 56♂♂ 22♀♀.

7. *Diadocidia* (*Diadocidia*) *spinosula* Tollet, 1948

Kurina & Grootaert, 2016: 8.

Ditomyiidae

8. *Ditomyia fasciata* (Meigen, 1818)

Kurina & Grootaert, 2016: 8.

New material. 2♂♂ 2♀♀.

9. *Symmerus annulatus* (Meigen, 1830)

Kurina & Grootaert, 2016: 8.

New material. 24♂♂ 11♀♀.

Keroplatidae

Macrocerinae

*10. *Macrocera fasciata* Meigen, 1804

Material examined. 1♀, MT5, 7–21.X.2017.

11. *Macrocera phalerata* Meigen, 1818

Kurina & Grootaert, 2016: 10.

New material. 1♂ 2♀♀.

*12. *Macrocera stigmoides* Edwards, 1925

Material examined. 1♂, MT1, 1–1.IX.2016; 1♀, MT2, 16–23.VI.2016; 1♂, MT2, 27.X–9.XI.2016; 1♂, MT3, 14–28.VII.2016; 1♂, MT2, 7–15.IX.2016; 1♀, MT2, 23.VIII–1.IX.2017; 1♀, MT2, 7–21.IX.2017; 1♀, MT6, 7–21.IX.2017. Total: 4♂♂ 4♀♀.

Remarks. Morphological differences between the *Macrocera* species are quite indistinct, especially in female specimens. The female specimen from MT 6 (7–21.ix. 2017) is slightly bigger and the macrotrichae in the anal sector of the wing are numerous that suggests to *M. stigma*. However, typically to *M. stigmoides*, the specimen has vein R_1 without a blackish mark before a pale tip and there is no sufficient basis to separate that specimen from others, which are fitting perfectly with the description of *M. stigmoides*.

Keroplatinae

*13. *Keroplatus reaumurii* Dufour, 1839 – **Belg. sp. nov.**

Fig. 1B

Material examined. 3♂♂, MT5, 21.IX–12.X.2017; 1♂, MT5, 12–25.X.2017. Total: 4♂♂.

Remarks. A widespread Western Palaearctic species with rather scattered and Southern distribution in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2020).

14. *Keroplatus testaceus* Dalman, 1818

Fig. 1C

Kurina & Grootaert, 2016: 10.

New material. 13♂ 3♀♀.

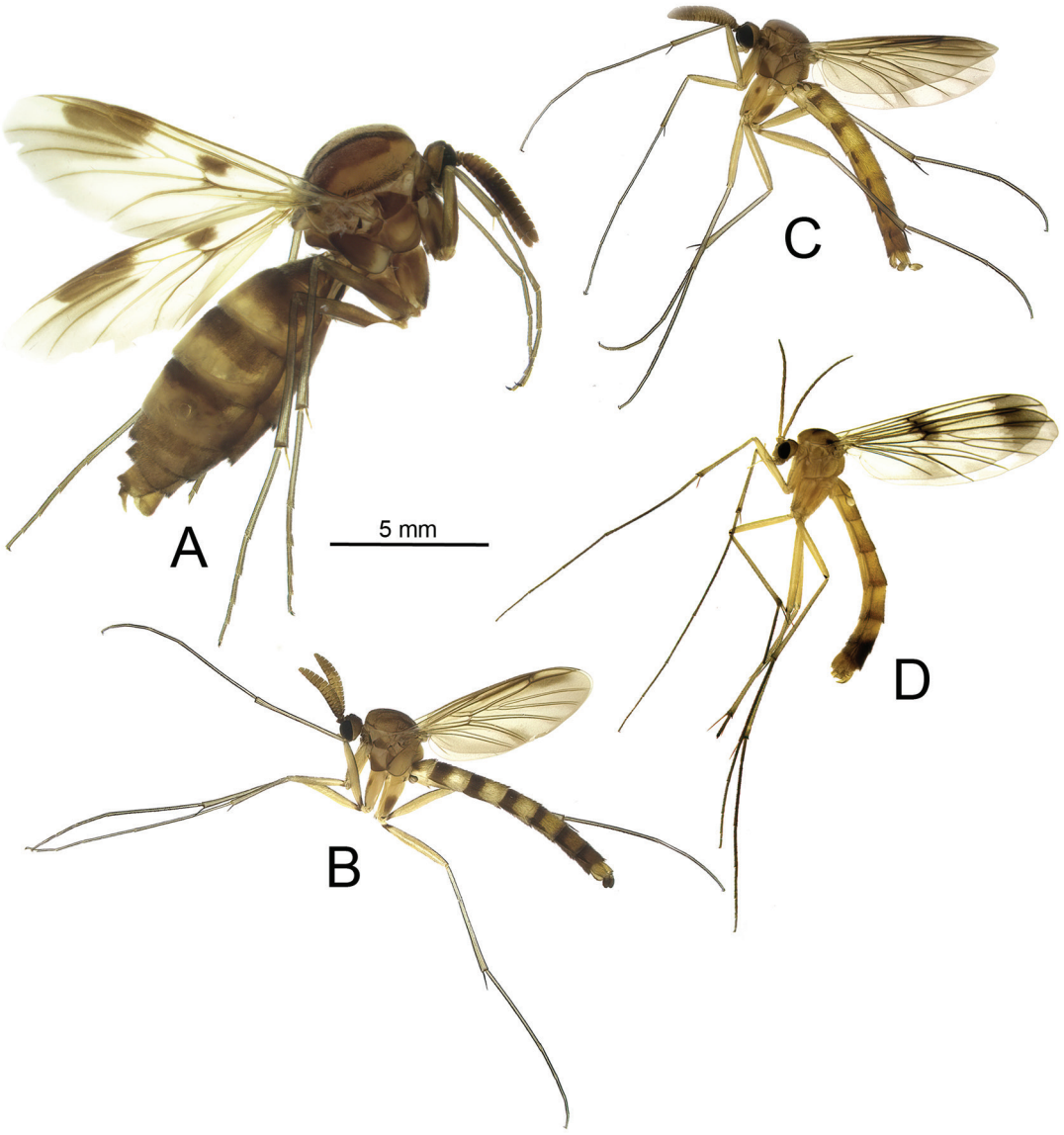

Fig. 1. Habitus of fungus gnats of the families Keroplatidae (A–C) and Mycetophilidae (D). A, *Keroplatus tipuloides* Bosc, 1792. B. *Keroplatus reaumurii* Dufour, 1839. C, *Keroplatus testaceus* Dalman 1818. D, *Leptomorphus walkeri* Curtis, 1831. © Oliva Kurina.

*15. *Keroplatus tipuloides* Bosc, 1792
Fig. 1A

Material examined. 1♀, MT1, 1–6.VII.2016; 1♀, MT2, 30.VI–6.VII.2017. Total: 2♀♀.

Remarks. A widespread but rare Palaearctic species. Recorded also from neighbouring countries: France, the Netherlands, Luxembourg (Cardew & Carrières, 2001; Chandler 2005) and Germany (iNaturalist contributors, 2022).The largest species in the genus and it is a wasp mimic. The larvae of *K. tipuloides* are fungus-spore feeders, are associated with the carpophores of *Fomes fomentarius* (Ståls & Kaila, 1990; Matile, 1990) and are reported to be luminous (Matile, 1990). The species is associated with old growth deciduous forests and is red-listed in several countries, e.g. Czech Republic (Farkac *et al.*, 2005), Sweden (Gärdenfors, 2005), Estonia (Kurina, 2020).

16. *Macrorrhyncha flava* Winnertz, 1846

Kurina & Grootaert, 2016: 10.

New material. 49♂♂ 6♀♀.

*17. *Monocentrota lundstroemi* Edwards, 1925 – **Belg. sp. nov.**
Fig. 2D

Material examined. 1♂, MT2, 3–9.VI.2016; 1♂, MT2, 14–28.VII.2016; 1♂, MT2, 28.VII–4.VIII.2016; 1♂, MT2, 4–11.VIII.2016; 1♂, MT2, 26.VII–2.VIII.2017.Total: 5♂♂.

Remarks. A European species with scattered distribution, recorded also from neighbouring countries except Luxembourg (Chandler 2005; Beuk, 2020).This is the first record of the genus *Monocentrota* Edwards, 1925 from Belgium.

18. *Neoplatyura modesta* (Winnertz, 1863)

Kurina & Grootaert, 2016: 10.

New material. 44♂♂ 9♀♀.

19. *Neoplatyura nigricauda* (Strobl, 1893)

Kurina & Grootaert, 2016: 10.

New material. 1♂ 1♀.

20. *Orfelia bicolor* (Macquart, 1826)

Kurina & Grootaert, 2016: 11.

New material. 13♂♂.

21. *Orfelia discoloria* (Meigen, 1818)

Kurina & Grootaert, 2016: 12.

New material. 2♂♂.

*22. *Orfelia fasciata* (Meigen, 1804)

Material examined. 2♂♂, MT1, 16–23.VI.2016; 1♂, MT3, 3–9.VI.2016. Total: 3♂♂.

23. *Orfelia lugubris* (Zetterstedt, 1851)

Kurina & Grootaert, 2016: 12.

New material. 12♂♂.

24. *Orfelia nemoralis* (Meigen, 1818)

Kurina & Grootaert, 2016: 12.

New material. 28♂♂.

25. *Orfelia nigricornis* (Fabricius, 1805)

Kurina & Grootaert, 2016: 12.

*26. *Orfelia pallida* (Staeger, 1840)

Material examined. 1♂, MT2, 3–9.VI.2016. Total: 1♂.

27. *Orfelia unicolor* (Staeger, 1840)

Kurina & Grootaert, 2016: 12.

28. *Pyratula zonata* (Zetterstedt, 1855)

Kurina & Grootaert, 2016: 12.

New material. 8♂♂ 1♀.

Platyurinae

29. *Platyura marginata* Meigen, 1804

Kurina & Grootaert, 2016: 12.

New material. 6♂♂.

Mycetophilidae

Mycomyinae

30. *Mycomya* (*Cymomya*) *circumdata* (Staeger, 1840)

Kurina & Grootaert, 2016: 12.

31. *Mycomya* (*Mycomya*) *annulata* (Meigen, 1818)

Kurina & Grootaert, 2016: 13.

*32. *Mycomya* (*Mycomya*) *britteni* Kidd, 1955 – **Belg. sp. nov.**

Material examined. 2♂♂, MT2, 21.IX–12.X.2017. Total: 2♂♂.

Remarks. A European species, known from Finland, Britain and Norway (Väisänen, 1984; Chandler, 2005; Kjærandsen & Søli, 2020). Also recorded from the Czech Republic, where Ševčík & Roháček (2008) obtained it from tussocks of *Carex remota* and *C. brizoides*.

33. *Mycomya* (*Mycomya*) *marginata* (Meigen, 1818)

Kurina & Grootaert, 2016: 13.

New material. 5♂♂.

34. *Mycomya* (*Mycomya*) *cinerascens* (Macquart, 1826)

Kurina & Grootaert, 2016: 13.

New material. 10♂♂.

35. *Mycomya* (*Mycomya*) *occultans* (Winnertz, 1863)

Kurina & Grootaert, 2016: 13.

New material. 17♂♂.

*36. *Mycomya* (*Mycomya*) *parva* (Dziedzicki, 1885) – **Belg. sp. nov.**

Material examined. 1♂, MT5, 7–21.IX.2017. Total: 1♂.

Remarks. A widespread Palaearctic species. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

37. *Mycomya* (*Mycomya*) *prominens* (Lundstrom, 1913)

Kurina & Grootaert, 2016: 13.

New material. 1♂.

38. *Mycomya* (*Mycomya*) *tenuis* (Walker, 1856)

Kurina & Grootaert, 2016: 13.

New material. 10♂♂.

39. *Mycomya* (*Mycomya*) *winnertzi* (Dziedzicki, 1885)

Kurina & Grootaert, 2016: 13.

New material. 14♂♂.

40. *Mycomya* (*Neomycomya*) *fimbriata* (Meigen, 1818)

Kurina & Grootaert, 2016: 13.

New material. 2♂♂.

*41. *Neoempheria bimaculata* (von Roser, 1840)

Kurina & Grootaert, 2016: 13 (as *Neoempheria pictipennis* (Haliday, 1833): misidentification).

Material examined. 1♂, MT2, 10-17.IX.2015 (*in* Kurina & Grootaert, 2016: 13 as *N. pictipennis*); 1♂, MT3, 23.VI–1.VII.2016; 1♂, MT3, 1–6.VII.2016; 1♂ 1♀, MT3, 1–8.IX.2016; 1♀, MT3, 8–15.IX.2016; 1♂, MT2, 26.VII–2.VIII.2017; 1♂, MT2, 12–25.X.2017; 1♂, MT4, 21.IX–12.X.2017. Total: 7♂♂ 2♀♀.

Remarks. The specimen erroneously listed as *N. pictipennis* in Kurina & Grootaert (2016: 13, Fig. 5J) is conspecific with *N. bimaculata*. In addition to structure of the male terminalia, the two species can reliably be distinguished by apical part of the wing that is entirely dark in *N. bimaculata* but with a preapical band in *N. pictipennis*.

42. *Neoempheria pictipennis* (Haliday, 1833)

Material examined. 1♂, MT3, 9–16.VI.2016. Total: 1♂.

*43. *Neoempheria striata* (Meigen, 1818)

Material examined. 1♂, MT1, 8–15.IX.2016; 1♂, MT2, 14–28.VII.2016; 1♂, MT3, 14–28.VII.2016; 2♂♂, MT2, 23.VIII–1.IX.2017; 1♂, MT2, 21.IX–12.X.2017; 3♂♂, MT5, 7–21.IX.2017; 1♂, MT5, 21.IX–12.X.2017; 1♂, MT5, 12–25.X.2017. Total: 11♂♂.

Sciophilinae

44. *Acnemia nitidicollis* (Meigen, 1818)

Kurina & Grootaert, 2016: 14.

New material. 61♂♂ 7♀♀.

*45. *Leptomorphus walkeri* Curtis, 1831
Fig. 1D

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

46. *Megalopelma nigroclavatum* (Strobl, 1910)

Kurina & Grootaert, 2016: 14.

New material. 29♂♂ 3♀♀.

47. *Monoclona rufilatera* (Walker, 1837)

Kurina & Grootaert, 2016: 14.

New material. 577♂♂ 57♀♀.

48. *Sciophila fenestella* Curtis, 1837

Kurina & Grootaert, 2016: 14.

New material. 10♂♂.

49. *Sciophila hirta* Meigen, 1818

Kurina & Grootaert, 2016: 14.

*50. *Sciophila lutea* Macquart, 1826

Material examined. 1♂, MT5, 7–21.IX.2017. Total: 1♂.

*51. *Sciophila nigronitida* Landrock, 1925 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 28.VII–4.VIII.2016. Total: 1♂.

Remarks. A Holarctic species, widespread in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005).

*52. *Sciophila pomacea* Chandler, 2006 – **Belg. sp. nov.**

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

Remarks. A Holarctic species, with rather Northern distribution in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

Gnoristinae

53. *Apolephthisa subincana* (Curtis, 1837)

Kurina & Grootaert, 2016: 15.

New material. 3♀♀.

*54. *Boletina dubia* (Meigen, 1804)

Material examined. 1♂, MT2, 1–6.VII.2016. Total: 1♂.

55. *Boletina gripha* Dziedzicki, 1885

Kurina & Grootaert, 2016: 15.

New material. 10♂♂.

56. *Boletina nitida* Grzegorzek, 1885

Kurina & Grootaert, 2016: 15.

New material. 85♂♂.

57. *Boletina sciarina* Staeger, 1840

Kurina & Grootaert, 2016: 15.

New material. 5♂♂.

58. *Boletina trispinosa* Edwards, 1913 – **Belg. sp. nov.**

Material examined. 1♂, MT1, 9–16.VI.2016; 1♂, MT1, 28.VII–4.VIII.2016; 1♂, MT2, 16–23.VI.2016. Total: 3♂♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

59. *Coelosia flava* (Staeger, 1840)

Kurina & Grootaert, 2016: 15.

New material. 1♂.

60. *Coelosia fusca* Bezzi, 1892

Kurina & Grootaert, 2016: 15.

61. *Coelophthinia thoracica* (Winnertz, 1863)

Kurina & Grootaert, 2016: 15.

New material. 1♀.

*62. *Grzegorzekia bushyae* Chandler, 2015 – **Belg. sp. nov.**

Fig. 2E

Material examined. 1♂, MT3, 23.VI–1.VII.2016; 1♂, MT6, 7–21.IX.2017. Total: 2♂♂.

Remarks. A recently described European species, so far known from south-east France and Britain only (Chandler, 2015; 2020). Notably, the first two known British specimens were collected from the Bushy Park on the outskirts of London. However, additional specimens were caught in 2019 in an ancient woodland in Gloucestershire, west of London (Chandler, 2020). Chandler (2015) discussed that biology of the species is probably similar to *G. collaris* (Meigen, 1818) and depending on damp rotten wood.

63. *Grzegorzekia collaris* (Meigen, 1818)

Kurina & Grootaert, 2016: 16.

New material. 1♀.

64. *Saigusaia flaviventris* (Strobl, 1894)

Kurina & Grootaert, 2016: 16.

New material. 3♂♂.

65. *Synapha fasciata* Meigen, 1818

Kurina & Grootaert, 2016: 16.

New material. 3♂♂.

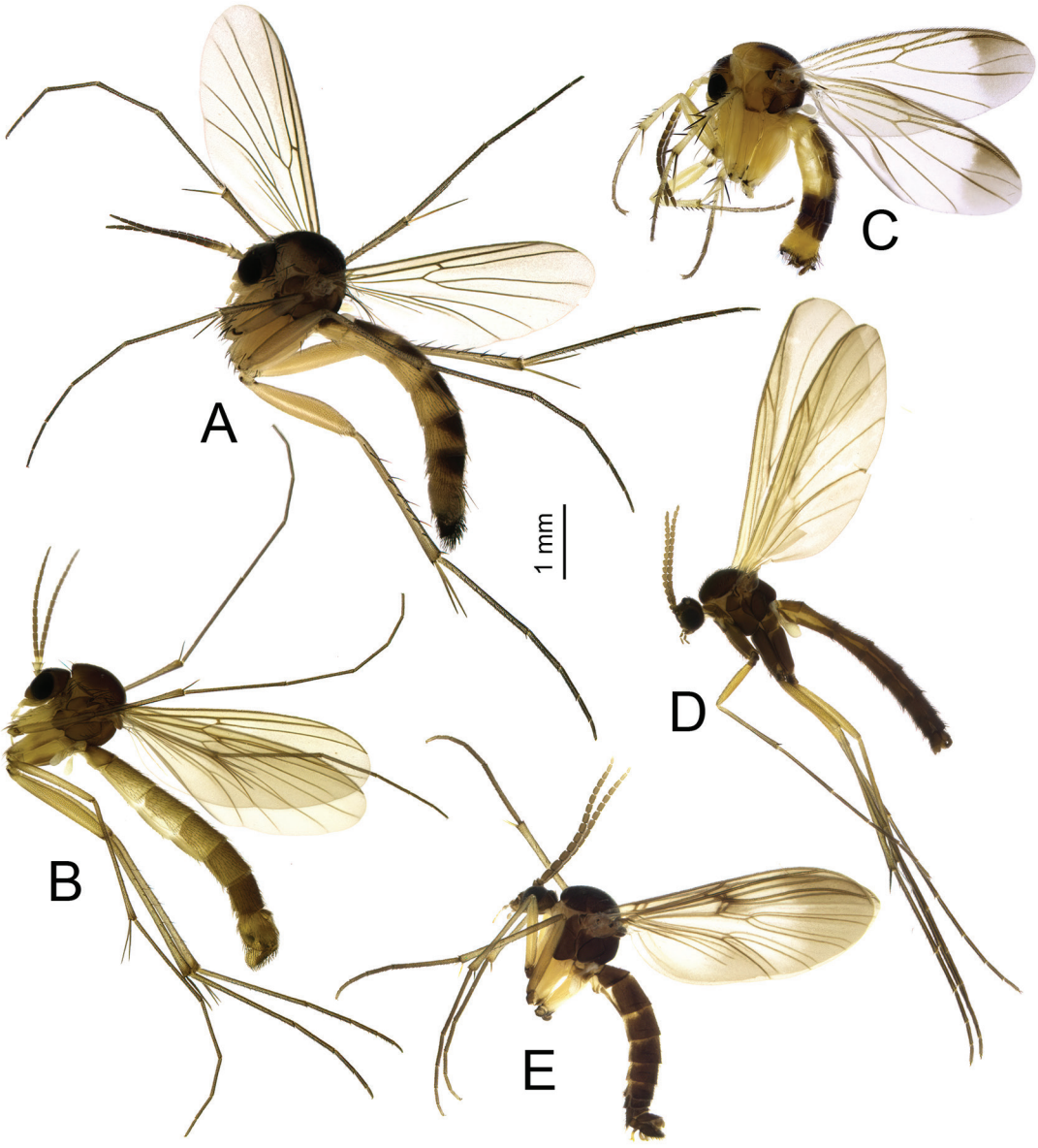

Fig. 2. Habitus of fungus gnats of the families Keroplatidae (D) and Mycetophilidae (A, B, C, E). A, *Allodiopsis domestica* (Meigen, 1830). B, *Pseudexechia tuomikoskii* Kjaerandsen, 2009. C, *Rondaniella dimidiata* (Meigen, 1804). D, *Monocentrota lundstroemi* Edwards, 1925. E, *Grzegorzekia bushyae* Chandler, 2015. © Oliva Kurina.

66. *Synapha vitripennis* (Meigen, 1818)

Kurina & Grootaert, 2016: 16.

New material. 19♂♂ 1♀.

Tetragoneurinae

*67. *Ectrepesthoneura colyeri* Chandler, 1980 – **Belg. sp. nov.**

Material examined. 1♂, MT1, 1–8.IX.2016; 1♂, MT2, 8-15.IX.2016; 1♂, MT5, 7–21.IX.2017. Total: 3♂♂.

Remarks. A widely distributed species in western and northern Europe, recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

68. *Ectrepesthoneura hirta* (Winnertz, 1846)

Kurina & Grootaert, 2016: 18.

New material. 3♂♂.

69. *Docosia flavicoxa* Strobl, 1900

Kurina & Grootaert, 2016: 16.

New material. 6♂♂ 6♀♀.

*70. *Docosia fumosa* Edwards, 1925 – **Belg. sp. nov.**

Material examined. 1♂, MT3, 16–23.VI.2016. Total: 1♂.

Remarks. A widely distributed species in central and northern Europe, recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022). The species was reared from a blackbird's nest in Germany (Rulik & Kallweit, 2006).

71. *Docosia gilvipes* (Haliday in Walker 1856)

Kurina & Grootaert, 2016: 18.

New material. 19♂♂ 21♀♀.

72. *Docosia sciarina* (Meigen, 1830)

Kurina & Grootaert, 2016: 18.

73. *Tetragoneura sylvatica* (Curtis, 1837)

Kurina & Grootaert, 2016: 16.

New material. 13♂♂ 17♀♀.

Leiinae

74. *Clastobasis loici* Chandler, 2001

Kurina & Grootaert, 2016: 18.

New material. 5♂♂ 4♀♀.

75. *Greenomyia mongolica* Lastovka & Matile, 1974

Kurina & Grootaert, 2016: 18.

New material. 3♂♂ 4♀♀.

*76. *Leia arsona* Hutson, 1978 – **Belg. sp. nov.**

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

Remarks. A widely distributed species, recorded from the Afrotropical realm, Western Palaearctic but also from New Zealand (Toft & Chandler, 2004). Hutson (1978) suggested an Afrotropical origin and described *L. arsona* from the material from South Africa and Saint Helena Island but simultaneously discussed a morphological similarity with South American *Leia* species. The species has become widely distributed by the international trade of cultivated plants and plant products and was introduced to Europe on several occasions (Halstead 2004; Chandler & Pijnakker, 2009). Toft & Chandler (2004) considered the species synanthropic, being associated with cultivated areas. The species was recorded from the Czech Republic by Ševčík & Roháček (2008), who obtained it in numbers from tussocks of *Glyceria maxima* at a natural wetland site. In the neighbouring countries recorded from the Netherlands but also from Britain including the Channel Islands (Halstead 2004; Toft & Chandler, 2004; Beuk, 2022).

*77. *Leia bimaculata* (Meigen, 1804)

Material examined. 1♂, MT3, 9–24.IX.2016; 2♂♂, MT5, 7–21.IX.2017; 1♂, MT5, 25.X–8.XI.2017. Total: 4♂♂.

*78. *Leia cylindrica* (Winnertz, 1863) – **Belg. sp. nov.**

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005).

*79. *Leia fascipennis* Meigen, 1818

Material examined. 1♂, MT3, 9–24.XI.2016; 2♂♂ 3♀♀, MT5, 23.VIII–1.IX.2017; 1♂, MT5, 21.IX–12.X.2017; 1♂, MT5, 12–25.X.2017. Total: 4♂♂ 4♀♀.

*80. *Leia piffardi* Edwards, 1925 – **Belg. sp. nov.**

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

Remarks. A rarely collected European species with so far known scattered distribution. Recorded from Britain, Czech Republic, Hungary, Central European Russia but not from neighbouring countries (Chandler, 2005; Beuk, 2022). Well distinguishable by structure of the male terminalia including a perpendicular medial process of the gonostylus (cf. Hutson *et al.*, 1980: Fig 272).

81. *Leia winthemii* Lehmann, 1822

Kurina & Grootaert, 2016: 18.

New material. 4♂♂ 4♀♀.

82. *Megophthalmidia crassicornis* (Curtis, 1837)

Kurina & Grootaert, 2016: 19.

New material. 228♂♂ 50♀♀.

*83. *Rondaniella dimidiata* (Meigen, 1804) – **Belg. sp. nov.**
Fig. 2C

Material examined. 1♀, MT2, 3–9.VI.2016; 1♀, MT3, 4–11.VIII.2016; 1♂, MT2, 12–25.X.2017; 1♂, MT6, 23.VIII–1.IX.2017. Total: 2♂♂ 2♀♀.

Remarks. A Holarctic species, widespread in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2022). This is the first record of the genus *Rondaniella* Johannsen, 1909 from Belgium.

Mycetophilinae

84. *Allodia lugens* (Wiedemann, 1817)

Kurina & Grootaert, 2016: 19.

New material. 1♂.

85. *Allodia ornaticollis* (Meigen, 1818)

Kurina & Grootaert, 2016: 19.

New material. 9♂♂.

*86. *Allodiopsis domestica* (Meigen, 1830)
Fig. 2A

Material examined. 1♂, MT2, 21.IX–12.X.2017; 1♂, MT6, 12–25.X.2017. Total: 2♂♂.

*87. *Allodiopsis rustica* (Edwards, 1941)

Material examined. 1♂, MT5, 21.IX–12.X.2017. Total: 1♂.

88. *Anatella ciliata* Winnertz, 1863

Kurina & Grootaert, 2016: 19.

New material. 2♂♂.

89. *Anatella simpatica* Dziedzicki, 1923

Kurina & Grootaert, 2016: 19.

New material. 13♂♂.

*90. *Anatella turi* Dziedzicki, 1923 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 25.X–8.XI.2017; 1♂, MT5, 25.X–8.XI.2017. Total: 2♂♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

91. *Brachycampta barbata* (Lundstrom, 1909)

Kurina & Grootaert, 2016: 19.

92. *Brachycampta silvatica* (Landrock, 1912)

Kurina & Grootaert, 2016: 19.

93. *Brevicornu fissicauda* (Lundstrom, 1911)

Kurina & Grootaert, 2016: 20.

New material. 1♂.

*94. *Brevicornu fuscipenne* (Staeger, 1840)

Material examined. 1♂, MT2, 7–21.IX.2017. Total: 1♂.

95. *Brevicornu griseicolle* (Staeger, 1840)

Kurina & Grootaert, 2016: 20.

New material. 9♂♂.

96. *Brevicornu intermedium* (Santos Abreu, 1920)

Kurina & Grootaert, 2016: 20.

97. *Brevicornu proximum* (Staeger, 1840)

Kurina & Grootaert, 2016: 20.

New material. 3♂♂.

98. *Brevicornu sericoma* (Meigen, 1830)

Kurina & Grootaert, 2016: 20.

New material. 3♂♂.

99. *Cordyla brevicornis* (Staeger, 1840)

Kurina & Grootaert, 2016: 20.

New material. 3♂♂.

100. *Cordyla crassicornis* Meigen, 1818

Kurina & Grootaert, 2016: 20.

New material. 36♂♂.

101. *Cordyla fasciata* Meigen, 1830

Kurina & Grootaert, 2016: 20.

102. *Cordyla flaviceps* (Staeger, 1840)

Kurina & Grootaert, 2016: 20.

New material. 2♂♂.

103. *Cordyla fissa* Edwards, 1925

Kurina & Grootaert, 2016: 21.

New material. 2♂♂.

104. *Cordyla fusca* Meigen, 1804

Kurina & Grootaert, 2016: 21.

New material. 5♂♂.

105. *Cordyla murina* Winnertz, 1863

Kurina & Grootaert, 2016: 21.

New material. 2♂♂.

106. *Cordyla pusilla* Edwards, 1925

Kurina & Grootaert, 2016: 21.

New material. 29♂♂.

*107. *Exechia bicincta* (Staeger, 1840)

Material examined. 1♂, MT2, 21.IX–12.X.2017; 1♂, MT2, 25.X–8.XI.2017; 1♂, MT5, 12–25.X.2017; 1♂, MT6, 25.X–8.XI.2017. Total: 4♂♂.

108. *Exechia chandleri* Caspers, 1987

Kurina & Grootaert, 2016: 21.

New material. 1♂.

109. *Exechia cincta* Winnertz, 1863

Kurina & Grootaert, 2016: 21.

110. *Exechia contaminata* Winnertz, 1863

Kurina & Grootaert, 2016: 21.

*111. *Exechia dizona* Edwards, 1924

Material examined. 2♂♂, MT2, 12–25.X.2017. Total: 2♂♂.

112. *Exechia fusca* (Meigen, 1804)

Kurina & Grootaert, 2016: 22.

New material. 12♂♂.

*113. *Exechia neorepanda* Lindemann, 2021

Material examined. 1♂, MT2, 3–9.VI.2016; 2♂♂, MT2, 25.X–8.XI.2017. Total: 3♂♂.

Remarks. The species was recently described as different from the Nearctic *E. repanda* Johannsen, 1912 with a comment that all previous records of that species from the West-Palaearctic probably refer to *E. neorepanda* (Lindemann *et al.*, 2021). *Exechia repanda* was previously recorded from Belgium (Gosseries, 1991) but in accordance with the abovementioned comment, the record must be considered as *E. neorepanda*. The two species can distinguished by details in male terminalia and DNA barcodes.

114. *Exechia nigroscutellata* Landrock, 1912

Kurina & Grootaert, 2016: 22.

New material. 2♂♂.

115. *Exechia parva* Lundstrom, 1909

Kurina & Grootaert, 2016: 22.

116. *Exechia pseudofestiva* Lackschewitz, 1937

Kurina & Grootaert, 2016: 22.

New material. 2♂♂.

*117. *Exechia seriata* (Meigen, 1830)

Material examined. 1♂, MT6, 25.X–8.XI.2017. Total: 1♂.

118. *Exechia spinuligera* Lundstrom, 1912

Kurina & Grootaert, 2016: 22.

New material. 5♂♂.

119. *Exechiopsis* (*Exechiopsis*) *fimbriata* (Lundstrom, 1909)

Kurina & Grootaert, 2016: 22.

*120. *Exechiopsis* (*Exechiopsis*) *intersecta* (Meigen, 1818)

Material examined. 1♂, MT5, 21.IX–12.X.2017. Total: 1♂.

121. *Exechiopsis* (*Xenexechia*) *crucigera* (Lundstrom, 1909)

Kurina & Grootaert, 2016: 22.

122. *Exechiopsis* (*Xenexechia*) *leptura* (Meigen, 1830)

Kurina & Grootaert, 2016: 22.

New material. 2♂♂.

*123. *Pseudexechia tuomikoskii* Kjaerandsen, 2009
Fig. 2B

Material examined. 1♂, MT5, 25.X–8.XI.2017; 1♂, MT6, 12–25.X.2017. Total: 2♂♂.

124. *Rymosia bifida* Edwards, 1925

Kurina & Grootaert, 2016: 22.

New material. 4♂♂.

125. *Rymosia fasciata* (Meigen, 1804)

Kurina & Grootaert, 2016: 24.

New material. 87♂♂.

126. *Rymosia spinipes* Winnertz, 1863

Kurina & Grootaert, 2016: 24.

New material. 6♂♂.

*127. *Synplasta exclusa* (Dziedzicki, 1910) – **Belg. sp. nov.**

Material examined. 1♂, MT2, 9–16.VI.2016. Total: 1♂.

Remarks. A widespread European species (Ševčík, 2009; Chandler, pers. comm.). From neighbouring countries recorded from Germany (Chandler, 2005) and France (Chandler & Perry, 2011: as *S. sintenisi* (Lackschewitz, 1937)).

*128. *Synplasta gracilis* Winnertz, 1863 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 25.X–8.XI.2017. Total: 1♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2022).

129. *Tarnania fenestralis* (Meigen, 1838)

Kurina & Grootaert, 2016: 24.

New material. 10♂♂.

130. *Dynatosoma fuscicorne* (Meigen, 1818)

Kurina & Grootaert, 2016: 24.

New material. 7♂♂.

131. *Mycetophila alea* Laffoon, 1965

Kurina & Grootaert, 2016: 24.

New material. 16♂♂.

*132. *Mycetophila bialorussica* Dziedzicki, 1884 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 1–6.VII.2016; 1♂, MT2, 12–25.X.2017. Total: 2♂♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

133. *Mycetophila britannica* Lastovka & Kidd, 1975

Kurina & Grootaert, 2016: 24.

New material. 25♂♂.

134. *Mycetophila cingulum* Meigen, 1830

Kurina & Grootaert, 2016: 24.

New material. 8♂♂.

135. *Mycetophila curviseta* Lundstrom, 1911

Kurina & Grootaert, 2016: 24.

New material. 54♂♂.

136. *Mycetophila distigma* Meigen, 1830

Kurina & Grootaert, 2016: 25.

New material. 1♂.

*137. *Mycetophila dziedzickii* Chandler, 1977 – **Belg. sp. nov.**

Material examined. 1♂, MT6, 12–25.X.2017. Total: 1♂.

Remarks. A widespread species in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2022).

*138. *Mycetophila edwardsi* Lundstrom, 1913

Material examined. 1♂, MT2, 21.IX–12.X.2017. Total: 1♂.

139. *Mycetophila evanida* Lastovka, 1972

Kurina & Grootaert, 2016: 25.

New material. 2♂♂.

140. *Mycetophila formosa* Lundstrom, 1911

Kurina & Grootaert, 2016: 25.

New material. 3♂♂.

141. *Mycetophila fungorum* (De Geer, 1776)

Kurina & Grootaert, 2016: 25.

New material. 331♂♂ 442♀♀.

Remarks. This is the most common species with altogether 1279 specimens found from 101 samples. However, a very similar species – *M. perpallida* Chandler, 1993 – has been recorded from Belgium (Kurina & Libert, 2020) as well as from all neighbouring countries (Chandler, 2005). These two species can reliably be distinguished by details of the male terminalia only. During this study, several specimens were identified after study of preparations of male terminalia. All of these proved to be identical with *M. fungorum*. However, as vast majority of the specimens were identified without making any preparations, we cannot completely exclude a possibility that this material hides also the second species – *M. perpallida*.

142. *Mycetophila gibbula* Edwards, 1925

Kurina & Grootaert, 2016: 25.

*143. *Mycetophila hetschkoi* Landrock, 1918 – **Belg. sp. nov.**

Material examined. 2♂♂, MT5, 12–25.X.2017. Total: 2♂♂.

Remarks. A Palaearctic species, widespread in Europe. Recorded also from neighbouring countries except the Netherlands and Luxembourg (Chandler, 2005; Beuk, 2022).

144. *Mycetophila ichneumonea* Say, 1823

Kurina & Grootaert, 2016: 26.

New material. 3♂♂.

145. *Mycetophila idonea* Lastovka, 1972

Kurina & Grootaert, 2016: 26.

New material. 47♂♂.

146. *Mycetophila luctuosa* Meigen, 1830

Kurina & Grootaert, 2016: 26.

New material. 17♂♂.

147. *Mycetophila marginata* Winnertz, 1863

Kurina & Grootaert, 2016: 26.

New material. 3♂♂.

148. *Mycetophila nigrofusca* Dziedzicki, 1884

Kurina & Grootaert, 2016: 26.

149. *Mycetophila mitis* (Johannsen, 1912)

Kurina & Grootaert, 2016: 26.

150. *Mycetophila occultans* Lundstrom, 1913

Kurina & Grootaert, 2016: 26.

New material. 6♂♂.

151. *Mycetophila ocellus* Walker, 1848

Kurina & Grootaert, 2016: 26.

New material. 12♂♂.

152. *Mycetophila ornata* Stephens, 1846

Kurina & Grootaert, 2016: 27.

New material. 3♂♂.

153. *Mycetophila pictula* Meigen, 1830

Kurina & Grootaert, 2016: 27.

154. *Mycetophila pumila* Winnertz, 1863

Kurina & Grootaert, 2016: 27.

*155. *Mycetophila rudis* Winnertz, 1863

Material examined. 1♂, MT5, 12–25.X.2017. Total: 1♂.

156. *Mycetophila ruficollis* Meigen 1818

Kurina & Grootaert, 2016: 27.

New material. 21♂♂.

*157. *Mycetophila sigmoides* Loew, 1869 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 12–25.X.2017; 2♂♂, MT6, 21.IX–12.X.2017. Total: 3♂♂.

Remarks. A Holarctic species, with scattered distribution in Europe. According to Chandler (pers. comm.), the species has spread westwards in Europe during last 20 years. Found also in Georgia, Transcaucasia (Kurina 2021). From neighbouring countries recorded only from France (Chandler, 2005; Beuk, 2022).

158. *Mycetophila signatoides* Dziedzicki, 1884

Kurina & Grootaert, 2016: 27.

New material. 25♂♂.

*159. *Mycetophila sordida* van der Wulp, 1874 – **Belg. sp. nov.**

Material examined. 1♂, MT2, 25.X–8.XI.2017. Total: 1♂.

Remarks. A Holarctic species, widespread in Europe and found in North Africa. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2022).

160. *Mycetophila stolida* Walker, 1856

Kurina & Grootaert, 2016: 27.

New material. 4♂♂.

161. *Mycetophila strigata* Stæger, 1840

Kurina & Grootaert, 2016: 27.

New material. 1♂.

162. *Mycetophila strigatoides* Landrock, 1927

Kurina & Grootaert, 2016: 27.

New material. 2♂♂.

163. *Mycetophila subsigillata* Zaitzev, 1999

Kurina & Grootaert, 2016: 27.

164. *Mycetophila trinotata* Staeger, 1840

Kurina & Grootaert, 2016: 27.

New material. 6♂♂.

165. *Mycetophila unicolor* Stannius, 1831

Kurina & Grootaert, 2016: 27.

New material. 27♂♂.

166. *Mycetophila xanthopyga* Winnertz, 1863

Kurina & Grootaert, 2016: 27.

167. *Phronia basalis* Winnertz, 1863

Kurina & Grootaert, 2016: 28.

168. *Phronia biarcuata* (Becker, 1908)

Kurina & Grootaert, 2016: 28.

169. *Phronia conformis* (Walker, 1856)

Kurina & Grootaert, 2016: 28.

New material. 2♂♂.

170. *Phronia coritanica* Chandler, 1992

Kurina & Grootaert, 2016: 28.

New material. 1♂.

*171. *Phronia egregia* Dziedzicki, 1889 – **Belg. sp. nov.**

Material examined. 2♂♂, MT2, 12–25.X.2017; 1♂, MT2, 25.X–8.XI.2017. Total: 3♂♂.

Remarks. A Holarctic species, widespread in Europe. Recorded also from neighbouring countries except Luxembourg (Chandler, 2005; Beuk, 2022).

*172. *Phronia forcipata* Winnertz, 1863

Material examined. 1♂, MT2, 28.VII–4.VIII.2016. Total: 1♂.

173. *Phronia forcipula* Winnertz, 1863

Kurina & Grootaert, 2016: 28.

New material. 1♂.

174. *Phronia humeralis* Winnertz, 1863

Kurina & Grootaert, 2016: 28.

175. *Phronia nitidiventris* (van der Wulp, 1859)

Kurina & Grootaert, 2016: 28.

New material. 6♂♂.

*176. *Phronia nigricornis* (Zetterstedt, 1852)

Material examined. 1♂, MT2, 21.IX–12.X.2017. Total: 1♂.

77. *Phronia notata* Dziedzicki, 1889

Kurina & Grootaert, 2016: 29.

New material. 9♂♂.

178. *Phronia siebeckii* Dziedzicki, 1889

Kurina & Grootaert, 2016: 29.

New material. 1♂.

*179. *Phronia strenua* Winnertz, 1864

Material examined. 1♂, MT2, 4–11.VIII.2016. Total: 1♂.

180. *Phronia sylvatica* Dziedzicki, 1889

Kurina & Grootaert, 2016: 29.

New material. 1♂.

181. *Phronia tenuis* Winnertz, 1863

Kurina & Grootaert, 2016: 29.

New material. 2♂♂.

182. *Platurocypta punctum* (Stannius, 1831)

Kurina & Grootaert, 2016: 29.

New material. 13♂♂.

183. *Platurocypta testata* (Edwards, 1925)

Kurina & Grootaert, 2016: 29.

New material. 5♂♂.

*184. *Sceptonia costata* (van der Wulp, 1859)

Material examined. 1♂, MT2, 16–23.VI.2016. Total: 1♂.

185. *Sceptonia cryptocauda* Chandler, 1991

Kurina & Grootaert, 2016: 29.

New material. 23♂♂.

186. *Sceptonia flavipuncta* Edwards, 1925

Kurina & Grootaert, 2016: 29.

New material. 169♂♂.

187. *Sceptonia fumipes* Edwards, 1925

Kurina & Grootaert, 2016: 30.

New material. 7♂♂.

188. *Sceptonia hamata* Sevcik, 2004

Kurina & Grootaert, 2016: 30.

New material. 1♂.

*189. *Sceptonia humerella* Edwards, 1925 – **Belg. sp. nov.**

Material examined. 1♂, MT4, 21.IX–12.X.2017; 2♂♂, MT5, 21.IX–12.X.2017; 1♂, MT5, 12–25.X.2017; 1♂, MT6, 12–25.X.2017. Total: 5♂♂.

Remarks. A widespread European species. From neighbouring countries recorded only from Germany (Chandler, 2005).

*190. *Sceptonia membranacea* Edwards, 1925

Material examined. 1♂, MT5, 21.IX–12.X.2017. Total: 1♂.

191. *Sceptonia nigra* (Meigen, 1804)

Kurina & Grootaert, 2016: 30.

New material. 9♂♂.

*192. *Sceptonia pughi* Chandler, 1991 – **Belg. sp. nov.**

Material examined. 1♂, MT6, 23.VIII–1.IX.2017. Total: 1♂.

Remarks. A European species, recorded also from France but not found in the Netherlands, Germany and Luxembourg so far (Chandler, 2005; Beuk, 2022).

193. *Sceptonia tenuis* Edwards, 1925

Kurina & Grootaert, 2016: 30.

New material. 63♂♂.

194. *Trichonta foeda* Loew, 1869

Kurina & Grootaert, 2016: 30.

New material. 1♂.

195. *Trichonta fragilis* Gagne, 1981

Kurina & Grootaert, 2016: 30.

*196. *Trichonta melanura* (Staeger, 1840)

Material examined. 1♂, MT2, 9–24.IX.2016; 1♂, MT3, 24.XI–20.XII.2016; 1♂, MT5, 25.X–8.XI.2017; 1♂, MT6, 21.IX–12.X.2017. Total: 4♂♂.

*197. *Trichonta pulchra* Gagne, 1981 – **Belg. sp. nov.**

Material examined. 1♂, MT5, 7–21.IX.2017; 2♂♂, MT5, 21.IX–12.X.2017. Total: 3♂♂.

Remarks. A Holarctic species, widespread in Europe but not recorded from neighbouring countries (Chandler, 2005, pers. comm.; Beuk, 2022).

198. *Trichonta subterminalis* Zaitzev et Menzel, 1996

Kurina & Grootaert, 2016: 30.

New material. 11♂♂.

199. *Trichonta vitta* (Meigen, 1830)

Kurina & Grootaert, 2016: 31.

New material. 2♂♂.

200. *Zygomyia humeralis* (Wiedemann, 1817)

Kurina & Grootaert, 2016: 31.

New material. 1♂.

201. *Zygomyia matilei* Caspers, 1980

Kurina & Grootaert, 2016: 31.

New material. 16♂♂.

*202. *Zygomyia pictipennis* (Staeger, 1840)

Material examined. 1♂, MT2, 14–28.VII.2016; 1♂, MT2, 8–15.IX.2016; 1♂, MT5, 7–21.IX.2017; 1♂, MT6, 7–21.IX.2017. Total: 4♂♂.

*203. *Zygomyia pseudohumeralis* Caspers, 1980

Material examined. 1♂, MT1, 28.VII–4.VIII.2016; 1♂, MT2, 23.VI–1.VII.2016; 1♂, MT3, 16–23.VI.2016; 1♂, MT2, 23.VIII–1.IX.2017; 1♂, MT5, 7–21.IX.2017. Total: 5♂♂.

204. *Zygomyia semifusca* (Meigen, 1818)

Kurina & Grootaert, 2016: 31.

205. *Zygomyia valida* Winnertz, 1863

Kurina & Grootaert, 2016: 31.

New material. 10♂♂.

206. *Zygomyia vara* (Staeger, 1840)

Kurina & Grootaert, 2016: 31.

New material. 8♂♂.

Discussion

During the faunistic survey in the Botanic Garden Jean Massart 206 fungus gnat species were collected. 35% of the species (i.e. 73 out of 206) were collected by one trap only, emphasizing the importance of the microhabitat in fungus gnat diversity studies. When comparing the two species accumulation curves (Kurina & Grootaert, 2016: Fig. 8 and Fig. 3 in present publication), then the curve calculated from the full dataset (Fig. 3) has a decreased slope but is not yet reaching a plateau. Using several nonparametric methods, the estimated species richness can be calculated to be as high as 230 (by Bootstrap), 246 (by Chao 1 and Chao 2) or 276 (by Jacknife 2).

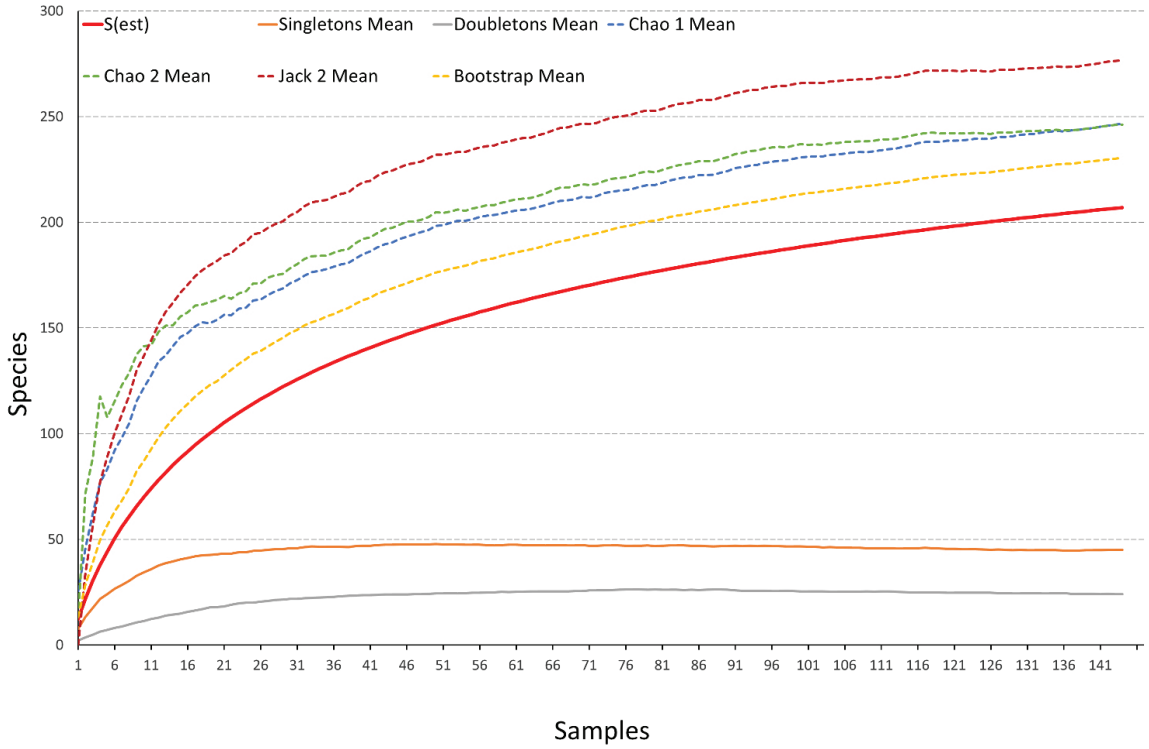

Fig. 3. Species accumulation curves (EstimateS, Version 9.1.0). Four nonparametric estimators (Chao 1, Chao 2, Jackknife 2 and Bootstrap) of total species richness are calculated. S(est) is the observed number of species.

The number of singletons (the species recorded only from one specimen) is still exceptional, being even higher (= 44) than in result of one year collecting (= 40, cf. Kurina & Grootaert, 2016). As a result of subsequent collecting, 25 previous singleton species were supplemented by additional specimens but at the same time, 29 new singletons were added. Accordingly, 21% of the 206 recorded fungus gnat species are represented by singletons only. That is a somewhat unexpected result of three years of thorough collecting in a considerably small area. Particularly, 20 out of 44 singletons were captured by MT2, a trap close to the Sonian forest, obviously maintaining such a high species diversity (cf. Kurina & Grootaert, 2016). Moreover, 44 out of 73 unique species (i.e. species collected by one trap only) were also captured by MT2. On the other hand, according to the Simpson's diversity index (D) that gives more weight to the more abundant species in a sample (Simpson, 1949; Keylock, 2005), MT1 appears to have the highest diversity (D=0.78), followed by the MT6 (D=0.82) (cf. Table 1).

Table 1. Summarised results of fungus gnats collected by different Malaise traps from the Botanic Garden Jean Massart during May 2015 until November 2017. The number of singeltons are provided separately for each trap and for the whole collecting project. The numbers of unique species represent these collected in terms of the particular trap only. The Simpson's diversity index is calculated according to the following equation: $D = 1 - \sum n(n-1) / N (N-1)$ where *n* is the number of individuals of each species in all samples of the particular trap and *N* is the total number of individuals of all species of all samples of the particular trap.

	MT 1	**MT 2**	**MT 3**	**MT 4**	**MT 5**	**MT 6**
Operating period	7.V.2015 to 20.XII.2016	7.V.2015 to 8.XI.2017	3.VI.2016 to 20.XII.2016	23.VIII.2017 to 25.X.2017	23.VIII.2017 to 8.XI.2017	23.VIII.2017 to 8.XI.2017
Samples	53	64	13	4	5	5
Collected specimens	1496	2468	719	37	815	351
Species	103	168	68	12	86	73
Singletons per MT	39	41	31	8	35	41
Singletons per project	7	20	2	0	7	8
Unique species per MT	8	44	2	0	10	9
Simpson's diversity index	0,78	0,94	0,84	0,86	0,87	0,82

By comparing with the first year sampling, the same two species (*Mycetophila fungorum* with 1279 specimens and *Monoclona rufilatera* with 1115 specimens, both from 101 samples) are still found to be the most abundant according to the full dataset (but see also remark under *M. fungorum* above). Notably, the high abundance of *Megophthalmidia crassicornis* (260 specimens from 20 samples), an otherwise uncommon species, was somewhat unexpected. As already stated by Kurina & Grootaert (2016), the majority of the collected species are widely distributed in Europe but still, a number of these deserve more attention. In addition to the species discussed already in our first paper, several others are commented on above. Most remarkable are three species of the genus *Keroplatus* (Fig. 1A–C), large species associated with mature and old growth forest and rarely encountered in MT samples. Finding the recently described *Grzegorzekia bushyae* is noteworthy, as the species is so far known only from a few localities in Britain and south-east France. Furthermore, a record of the probably introduced *Leia arsona* that has a supposed tropical origin shows its wider distribution in Europe.

The survey yielded altogether 78 fungus gnats species recorded as new to Belgium: 52 of them published by Kurina & Grootaert (2016) and 26 in this paper. To sum up, 332 species of fungus gnats are currently recorded from Belgium, 62% of them are present in the Botanic Garden Jean Massart. Such a high diversity is somewhat unexpected and suggests the importance of semi-natural habitats in diversity conservation of an urbanized environment. Besides, the actual number of fungus gnats in the whole of Belgium is obviously much higher but further collecting in various areas and habitats along with an additional study effort are necessary for a more complete picture.

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An annotated checklist of the Sphaeroceridae (Diptera) of the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium), including five species new to Belgium

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Abstract

Five new species of lesser dung flies (Diptera: Sphaeroceridae) are added to the Belgian checklist: *Crumomyia rohaceki* Norrbom & Kim, 1885, *Minilimosina secundaria* (Duda, 1918), *Paralimosina subcribrata* (Roháček, 1977), *Rachispoda opinata* (Roháček, 1991) and *Spelobia manicata* (Richards, 1927). A list of previously recorded species from Belgium, that have also been discovered in the Botanic Garden Jean Massart in Auderghem, is included. All specimens were collected from Malaise traps between 17 May 2017 and 25 October 2017. Apart from the five new species to Belgium, most of the species collected were relatively common, although as with many smaller flies, most are under recorded.

Keywords: faunistic survey, lesser dung flies, Malaise trap

Introduction

Sphaeroceridae can be difficult to identify, with many requiring dissection to arrive at a satisfactory conclusion as to species. In addition to this, they are in general, very small and either overlooked or 'put to one side' due to the assumed problems in identifying them. Thankfully, ongoing recording and descriptions of new species has been maintained within the European Diptera community; thus, allowing accurate identification in most cases for those prepared and able to invest the time to do so (Roháček *et al.*, 2001; Marshall *et al.*, 2011). Many species of Sphaeroceridae can be found in huge numbers when present, and as differences between some species cannot be ascertained satisfactorily by using external morphological features alone, this too means that on occasion, detailed checklists and determinations become hugely time consuming. Sphaeroceridae are divided into five different subfamilies (Roháček *et al*., 2001), three of which are found in Western/Central Europe, those being, Copromyzinae, Sphaerocerinae and Limosininae (Roháček *et al*., 2001). Each subfamily is distinct from the other in appearance and may on occasion have members present together in a single sample, the three subfamilies are all represented in Belgium and in the samples from Jardin Massart.

Material and methods

All Sphaeroceridae specimens identified came from 4 of 6 Malaise traps positioned within the Jardin Massart, between the 17 May 2017 and 25 October 2017. The positions of the traps varied between the border of flower beds and a hedge (Malaise trap 2), an old arboretum (Malaise trap 4) flower meadow in old apple orchard (Malaise trap 5) and wet areas close to reed beds, above small ponds (Malaise trap 6) (Grootaert *et al.*, 2022), with various numbers of specimens obtained from each.

All specimens were adults and identified using a variety of keys (Norrbom & Kim, 1985, Pitkin, 1988, Roháček, 1983, 1985, 1991, Roháček & Marshall, 1986). The material is deposited in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS), in the Maastricht Museum of Natural History, Maastricht, the Netherlands (NHMM) and in the private collection of the first author.

Results

Forty nine species of Sphaeroceridae that could be identified to species level were found during the collecting period with representatives of three subfamilies being present. Five species new to the Belgium were discovered, those being *Crumomyia rohaceki* Norrbom & Kim, 1985 (subfamily Copromyzinae), *Minilimosina secundaria* (Duda, 1918), *Paralimosina subcribrata* (Roháček, 1977), *Rachispoda opinata* (Roháček, 1991) and *Spelobia manicata* (Richards, 1927) (all subfamily Limosininae). Since all of the samples from mid to late spring: 17-24.V.2017, 1-8.VI.2017 and 8-15.VI.2017 and early autumn 21.IX-12.X.2017, 12-25.X.2017 were sorted and studied, the data of the four investigated sites can be compared as can be seen in Table 1.

Annotated checklist

New species for Belgium

Distribution throughout the species list is shown for records within the Palearctic zone; many of the species have much wider distributions that, if required, can be found within Marshall *et al.* (2011) and Roháček *et al.* (2001). All distribution data unless otherwise stated have been taken from Marshall *et al.* (2011).

Copromyzinae

Crumomyia rohaceki Norrbom & Kim, 1985 – **Belg. sp. nov.**

Material examined. MT 2: 17-24.V.2017, 1♀; MT 5: 17-24.V.2017, 1♂; MT 6: 17-24.V.2017, 1♂.

Distribution: Palaearctic: Austria, Czech Republic, Germany, France, Hungary, Israel, Italy, Moldavia, Poland, ?Romania, ?Serbia, Slovakia, Spain, Switzerland, Ukraine.

Discussion: This is a species belonging in the *Crumomyia notabilis* group of which the species were often confused in the past. This is part of the reason why its exact distribution is still unclear. It most closely resembles *C. notabilis* (Collin, 1902) but can be distinguished from this species by the shape of the male genitalia (surstyli and phallus), the shape and sclerotization of the sternites in the females and the pleura being less pruinose (Norrbom & Kim, 1985). Adults of *C. rohaceki* were collected on several kinds of decaying organic matter (fungi, moss, leaves; see Norrbom & Kim, 1985). This species is also classified as a hemitroglophilous species, meaning it is dependent on the outside world for completing its life cycle, but it can be found in the entrance zone of caves (Roháček & Papp, 2000), where it can spend time to evade unfavourable circumstances in the outside world (draught, cold, heat).

Table 1: Distribution and numbers of Sphaeroceridae species within the Botanic garden Jardin Massart.

Species	MT2	MT4	MT5	MT6	Total
Apteromyia claviventris (Strobl, 1909)	1				1
Bifronsina bifrons (Stenhammer, 1855)				1	1
Chaetopodella scutellaris (Haliday, 1836)				2	2
Coproica ferruginata (Stenhammer, 1855)				3	3
Coproica hirticula Collin, 1956				1	1
Coproica hirtula (Rondani, 1880)				1	1
Coproica vagans (Haliday, 1833)		1	1		2
Copromyza equina Fallén, 1820			1	1	2
Copromyza nigrina (Gimmerthal, 1847)	1				1
Copromyza stercoraria (Meigen, 1830)	5	1	1	3	10
Crumomyia fimetaria (Meigen, 1830)	11		9	5	25
Crumomyia glabrifrons (Meigen, 1830)	2			2	4
Crumomyia nitida (Meigen, 1830)			3		3
Crumomyia rohaceki Norrbom & Kim, 1985	1		1	1	3
Crumomyia roserii (Rondani, 1880)	2		5	3	10
Elachisoma aterrimum (Haliday, 1836)				1	1
Eulimosina ochripes (Meigen, 1830)	1				1
Ischiolepta denticulata (Meigen, 1830)				1	1
Ischiolepta pusilla (Fallén, 1820)	18		7	3	28
Leptocera caenosa (Rondani, 1880)	6		4	3	13
Leptocera fontinalis (Fallén, 1826)	4		3	11	18
Leptocera nigra (Olivier, 1813)	5	1	10	2	18
Limosina silvatica (Meigen, 1830)	28			22	50
Lotophila atra (Meigen, 1830)	4		1	1	6
Minilimosina fungicola (Haliday, 1836)	3		2	17	22
Minilimosina secundaria (Duda, 1918)		1		1	2
Minilimosina v-atrum (Villeneuve, 1917)	2				2
Minilimosina vitripennis (Zetterstedt, 1847)			2		2
Opacifrons coxata (Stenhammer, 1855)	8		16	91	115
Opalimosina liliputana (Rondani, 1880)	4			2	6
Opalimosina mirabilis (Collin, 1902)				2	2
Paralimosina subcribrata (Roháček, 1977)	1			2	3
Pseudocollinella humida (Haliday, 1833)				2	2
Pullimosina heteroneura (Haliday, 1836)	6	1	1	6	14
Pullimosina pullula (Zetterstedt, 1847)	1			2	3
Pullimosina vulgesta (Roháček, 2001)	6		45	80	131
Rachispoda lutosa (Stenhammer, 1855)	1		2	125	128
Rachispoda lutosoidea (Duda, 1938)				21	21
Rachispoda opinata (Roháček, 1991)	1		1		2
Spelobia clunipes (Meigen, 1830)	9		7	13	29
Spelobia luteilabris (Rondani, 1880)	1	1		5	7
Spelobia manicata (Richards, 1927)	2				2
Spelobia palmata (Richards, 1927)	23	2	10	8	43
Spelobia parapusio (Dahl, 1909)	11		5	1	17
Spelobia talparum (Richards, 1927)	8	2	1	1	12
Sphaerocera monilis (Haliday, 1836)	1				1
Terrilimosina schmitzi (Duda, 1918)	5		1		6
Trachyopella kuntzei (Duda, 1918)	1	3			4
Trachyopella leucoptera (Haliday, 1836)	1				1
number of specimens	**184**	**13**	**139**	**446**	**782**
number of species	**34**	**9**	**24**	**36**	**49**

Limosininae

Minilimosina secundaria (Duda, 1918) – **Belg. sp. nov.**

Material examined. MT 4: 8-15.VI.2017, 1♀; MT 6: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Czech Republic, Germany, Great Britain, Hungary, Lithuania, Spain, Sweden.

Discussion: *Minilimosina secundaria* is a rarely recorded, tiny sphaerocerid (Roháček, 1983) from the subfamily Limosininae. Currently there are European records of *M. secundaria* from the Czech Republic (Roháček, 2005), Germany (Duda, 1918), Great Britain (Richards, 1930), Hungary (Papp, 1976; 1990), Lithuania (Dumčius & Pakalniškis, 2006), Spain (Carles-Tolrá, 1990) and Sweden (Florén, 1989). The type specimen, a female, was caught on a window in Germany (Duda, 1918). The second record of this species, also a female, was from a soil trap in a boggy meadow in Hungary (Papp, 1976). Roháček (1993) examined females from Hungary which were collected in a valley of a brook and on a refuse heap. Six males and eight females were taken on human excrement in Spain by Carles-Tolrá in 1984 (Carles-Tolrá, 1990). Swedish records of two males were from a window and from a wet pasture and a potato field. (Florén, 1989; Roháček, 1993). The 3 male records in the Czech Republic were collected from Malaise traps (2 males) and a car-net (1 male) in warm deciduous forests (Roháček *et al.*, 2005) *M. secundaria* was also recorded in the UK in 1992 after a gap of 83 years, and then again in 2021 (Brice & Mitchell, 2021).

Paralimosina subcribrata (Roháček, 1977) – **Belg. sp. nov.**

Material examined**.** MT 2: 17-24.V.2017, 1♂; MT 6: 8-15.VI.2017, 1♀, 21.IX-12.X.2017, 1♂.

Distribution: Palaearctic: Austria, Czech Republic, France, Georgia (Brice *et al.*, in prep.) Hungary, Italy, Montenegro, Romania, Slovakia, Spain, Sweden.

Discussion: *Paralimosina subcribrata* has previously been described as a terricolous species that lives predominantly in leaf litter in warm temperate and Southern European areas (Roháček, 2009). *P. subcribrata* differs from related species having short wings, strongly punctate body, most noticeably on the abdomen and reduced thoracic and tibial setae (Roháček, 1983), suitable adaptations for their preferred habitat. As well specimens being caught in Malaise traps, they have also been caught in soil traps, further confirming their terricolous nature (Roháček, 1980 *in* Roháček, 1983). *P. subcribrata* is described as vulnerable *in* Roháček (2009), within the Czech Republic.

Rachispoda opinata (Roháček, 1991) – **Belg. sp. nov.**

Material examined. MT 2: 17-24.V.2017, 1♀; MT 5: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Czech Republic, Great Britain, Hungary, Italy, Slovakia.

Discussion: *Rachispoda opinata* is a hygrophilous (Gatt, 2010) lowland species (Roháček, 1991) with all of the type material, being collected in open marshy habitats (Roháček, 1991) although specimens have also been collected by sweeping undergrowth in lowland deciduous forests (Roháček, 1991).

Spelobia manicata (Richards, 1927) – **Belg. sp. nov.**

Material examined. MT 2: 8-15.VI.2017 2♀.

Distribution: Palaearctic: Austria, Czech Republic, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Norway, Slovakia, Spain, Sweden, Switzerland.

Discussion: Similar in appearance to the closely related *Spelobia clunipes*; but can be distinguished by several external morphological features although the differences are subtle. *Spelobia manicata* is a microcavernicolous species that develops in rotting material in the burrows of small mammals (Roháček, 2009). Along with Malaise traps, *S. manicata* has been collected by sifting leaf litter, decayed moss and grass, and by soil traps (Roháček, 1983) and sweeping.

Main Species list

Copromyzinae

Copromyza equina Fallén, 1820

Material examined. MT 5: 17-24.V.2017, 1♀; MT 6: 17-24.V.2017, 1♂.

Distribution: Palaearctic: Algeria, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), China, Czech Republic, Denmark, Estonia, Finland, France (incl. Corsica), Faeroe Is. (Denmark), Germany, Great Britain, Greece, Hungary, Iceland, Iran, Ireland, Israel, Italy (incl. Sardinia), Japan, Kirghizia, Latvia, Lithuania, Madeira (Portugal), Morocco, Netherlands, North Korea, Norway, Poland, Roumania, Russia, Slovakia, Spain, Sweden, Switzerland, Tadjikistan, Tunisia, Ukraine, former Yugoslavia.

Copromyza nigrina (Gimmerthal, 1847)

Material examined. MT 2: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bosnia and Herzegovina, Czech Republic, Denmark, Estonia, Faeroe Is. (Denmark), Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland.

Copromyza stercoraria (Meigen, 1830)

Material examined. MT 2: 17-24.V.2017, 4♀, 8-15.VI.2017, 1♀; MT 4: 17-24.V.2017, 1♀; MT 5: 17-24.V.2017, 1♀; MT 6: 17-24.V.2017, 2♀, 1-8.VI.2017, 1♂.

Distribution: Palaearctic: Andorra, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Italy, Latvia, Lithuania, Mongolia, Netherlands, Norway, Poland, Portugal, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland.

Crumomyia fimetaria (Meigen, 1830)

Material examined. MT 2: 8-15.VI.2017, 4♂, 21.IX-12.X.2017, 3♂, 4♀; MT 5: 17-24.V.2017, 2♂, 1♀, 8-15.VI.2017, 2♂, 1♀, 12-25.X.2017, 1♂, 2♀; MT 6: 21.IX-12.X.2017, 3♂, 2♀.

Distribution: Palaearctic: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, former Yugoslavia.

Crumomyia glabrifrons (Meigen, 1830)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀; MT 6: 17-24.V.2017, 2♀.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Finland, France, Germany, Greece, Hungary, Israel, Italy, Latvia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Tadjikistan, Turkey, Ukraine, former Yugoslavia.

Crumomyia nitida (Meigen, 1830)

Material examined. MT 5: 17-24.V.2017, 2♂, 1♀.

Distribution: Albania, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France (incl. Corsica), Faeroe Is. (Denmark), Great Britain, Hungary, Iceland, Ireland, Italy (incl. Sicily), Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland.

Crumomyia roserii (Rondani, 1880)

Material examined. MT 2: 21.IX-12.X.2017, 1♂, 1♀; MT 5: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 1♀, 12-25.X.2017, 1♂, 1♀; MT 6: 17-24.V.2017, 2♂, 1♀.

Distribution: Palaearctic: Andorra, Belgium, Bulgaria, Cyprus, Denmark, Portugal, Germany, Greece, Great Britain, Hungary, Ireland, Israel, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland.

Lotophila atra (Meigen, 1830)

Material examined. MT 2: 17-24.V.2017, 2♀, 8-15.VI.2017, 1♀, 21.IX-12.X.2017, 1♀; MT 5: 12-25.X.2017, 1♂; MT 6: 1-8.VI.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Algeria, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), China, Croatia, Czech Republic, Denmark, Estonia, Finland, France (incl. Corsica), Faeroe Is, Georgia, Germany, Great Britain, Greece (incl. Crete), Hungary, Kazakhstan, Ireland, Israel, Italy (incl. Sardinia), Japan, Latvia, Lebanon, Lithuania, Macedonia, Madeira (Portugal), Malta, Mongolia, Montenegro, Morocco, Netherlands, North Korea, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Ukraine, Uzbekistan.

Sphaerocerinae

Ischiolepta denticulata (Meigen, 1830)

Material examined. MT 6: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Andorra, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Norway, Poland, Russia, Sweden, Switzerland.

Ischiolepta pusilla (Fallén, 1820)

Material examined. MT 2: 8-15.VI.2017, 16♂, 21.IX-12.X.2017, 2♂; MT 5: 8-15.VI.2017, 5♂, 12-25.X.2017, 2♂; MT 6: 8-15.VI.2017, 2♂, 21.IX-12.X.2017, 1♂.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bulgaria, Canary Is. (Spain), Czech Republic, Denmark, Egypt, Faeroe Is. (Denmark), Finland, France, Germany, Great Britain, Hungary, Iceland, Iran, Ireland, Italy (incl. Sicily), Japan, Latvia, Madeira (Portugal), Malta,

Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Tunisia.

Ischiolepta cf. *pusilla* (Fallén, 1820)

[Note: Female *Ischiolepta pusilla* cannot be distinguished from the less common *Ischiolepta vaporariorum*]

Material examined. MT 2: 17-24.V.2017, 3♀, 8-15.VI.2017, 14♀, 21.IX-12.X.2017, 1♀; MT 4: 17-24.V.2017, 1♀; MT 5: 8-15.VI.2017, 2♀; MT 6: 1-8.VI.2017, 1♀, 8-15.VI.2017 4♀.

Distribution: As above.

Sphaerocera monilis (Haliday, 1836)

Material examined. MT 2: 8-15.VI.2017, 1♀.

Distribution: Palearctic: Belgium, Bulgaria, Czech Republic, Finland, Germany, Great Britain, Hungary, Ireland, Latvia, Norway, Poland, Romania, Slovakia, Sweden, Switzerland (Roháček *et al*., 2001).

Limosininae

Apteromyia claviventris (Strobl, 1909)

Material examined. MT 2: 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Italy (incl. Sicily), Latvia, Netherlands, Norway, Poland, Russia, Slovakia, Spain, Sweden, Switzerland.

Bifronsina bifrons (Stenhammer, 1855)

Material examined. MT 6: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Israel, Italy (incl. Sardinia, Sicily), Japan, Latvia, Madeira (Portugal), Malta, Montenegro, Morocco, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, United Arab Emirates.

Chaetopodella scutellaris (Haliday, 1836)

Material examined. MT 6: 12-25.X.2017, 2♀.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy (incl. Sicily), Japan, Kazakhstan, Latvia, Lithuania, Macedonia, Netherlands, North Korea, Norway, Poland, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland.

Coproica ferruginata (Stenhammer, 1855)

Material examined. MT 6: 17-24.V.2017, 1♀, 1-8.VI.2017, 1♂, 12-25.X.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Algeria, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), China, Cyprus, Czech Republic, Denmark, Egypt, Finland, France (incl. Corsica), Germany, Great Britain, Greece (incl. Crete), Hungary, Ireland, Italy,

Israel, Japan, Latvia, Lebanon, Madeira (Portugal), Malta, Mongolia, Montenegro, Morocco, Netherlands, North Korea, Norway, Poland, Romania, Russia, Serbia, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Turkey, United Arab Emirates.

Coproica hirticula Collin, 1956

Material examined. MT 6: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Germany, Great Britain, Greece (incl. Crete), Finland, France, Hungary, Israel, Italy, Japan, Latvia, Madeira (Portugal), Malta, Norway, Poland, Romania, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, United Arab Emirates.

Coproica hirtula (Rondani, 1880)

Material examined. MT 6: 1-8.VI.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Egypt, Finland, Germany, Great Britain, Greece, Hungary, Italy, Israel, Japan, Latvia, Madeira (Portugal), Malta, Montenegro, Netherlands, North Korea, Norway, Poland, Romania, Russia, Serbia, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tunisia, United Arab Emirates, Uzbekistan.

Coproica vagans (Haliday, 1833)

Material examined. MT 4: 8-15.VI.2017, 1♀; MT 5: 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Algeria, Andorra, Austria, Azerbaijan, Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Egypt, Finland, France (incl. Corsica), Georgia, Germany, Great Britain, Greece (incl. Crete), Hungary, Iceland, Ireland, Israel, Italy (incl. Sardinia, Sicily), Japan, Latvia, Macedonia, Malta, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Saudi Arabia, Serbia, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Turkey, United Arab Emirates.

Elachisoma aterrimum (Haliday, 1836)

Material examined. MT 6: 17-24.V.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Egypt, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy (incl. Sicily), Latvia, Madeira (Portugal), Malta, Netherlands, Poland, Romania, Russia (NET: Northern European Territories), Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan.

Eulimosina ochripes (Meigen, 1830)

Material examined. MT 2: 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France (incl. Corsica), Germany, Great Britain, Greece, Hungary, Ireland, Italy (incl. Sicily), Kazakhstan, Kirghizia, Latvia, Lebanon, Lithuania, Macedonia, Mongolia, Montenegro, Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tadjikistan, Tunisia.

Leptocera caenosa (Rondani, 1880)

Material examined. MT 2: 17-24.V.2017, 1♂, 3♀, 8-15.VI.2017, 1♂, 21.IX-12.X.2017, 1♀; MT 5: 17-24.V.2017, 2♂, 8-15.VI.2017, 1♀, 12-25.X.2017, 1♂; MT 6: 17-24.V.2017, 2♀, 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Finland, France, Georgia, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Israel, Italy (incl. Sardinia), Japan, Latvia, Madeira (Portugal), Malta, Mongolia, Montenegro, Netherlands, North Korea, Norway, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Uzbekistan; South Atlantic: Gough I., Tristan da Cunha.

Leptocera fontinalis (Fallén, 1826)

Material examined. MT 2: 8-15.VI.2017, 4♀; MT 5: 17-24.V.2017, 1♀, 8-15.VI.2017, 1♂, 1♀; MT 6: 1-8.VI.2017, 3♂, 5♀, 8-15.VI.2017, 2♂, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Faeroe Is. (Denmark), Finland, France, Georgia, Germany, Great Britain, Greece (incl. Crete), Hungary, Iceland, Ireland, Israel, Italy (incl. Sardinia, Sicily), Latvia, Lebanon, Lithuania, Kazakhstan, Macedonia, Malta, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Turkey, Ukraine, Uzbekistan.

Leptocera nigra (Olivier, 1813)

Material examined. MT 2: 17-24.V.2017, 3♂, 8-15.VI.2017, 2♂; MT 4: 17-24.V.2017, 1♀; MT 5: 17-24.V.2017, 3♀, 8-15.VI.2017, 3♂, 3♀, 12-25.X.2017, 1♂; MT 6: 1-8.VI.2017, 1♀, 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Algeria, Afghanistan, Andorra, Armenia, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Croatia, Cyprus, Czech Republic, Denmark, Egypt, Finland, France, Georgia, Germany, Great Britain, Greece (incl. Crete), Hungary, Iran, Ireland, Israel, Italy (incl. Pantelleria I., Sardinia, Sicily), Japan, Jordan, Latvia, Lebanon, Lithuania, Macedonia, Madeira (Portugal), Malta, Montenegro, Morocco, Netherlands, North Korea, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Turkey, Uzbekistan.

Limosina silvatica (Meigen, 1830)

Material examined. MT 2: 17-24.V.2017, 4♂, 7♀, 8-15.VI.2017, 11♂, 6♀; MT 6: 17-24.V.2017, 2♀, 1-8.VI.2017, 7♂, 8♀, 8-15.VI.2017, 1♂, 4♀.

Distribution: Palaearctic: Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Israel, Italy (incl. Sicily), Latvia, Netherlands, Norway, Poland, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Tunisia, Ukraine.

Minilimosina fungicola (Haliday, 1836)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 1♂; MT 5: 8-15.VI.2017, 1♂, 1♀; MT 6: 1-8.VI.2017, 1♀, 8-15.VI.2017, 8♂, 7♀, 21.IX-12.X.2017, 1♀.

Distribution: Palaearctic: Andorra, Azores (Portugal), Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Lithuania, Madeira (Portugal), Netherlands, Norway, Poland, Slovakia, Spain, Sweden, Switzerland.

Minilimosina v-atrum (Villeneuve, 1917)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀.

Distribution: Palaearctic: Belgium, Czech Republic, France, Germany, Great Britain, Hungary, Italy, Poland, Russia, Slovakia, Sweden, Switzerland.

Minilimosina vitripennis (Zetterstedt, 1847)

Material examined. MT 5: 8-15.VI.2017, 2♂.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Estonia, Faeroe Is. (Denmark), Finland, France, Germany, Great Britain, Greece (incl. Crete), Hungary, Iceland, Ireland, Italy, Latvia, Macedonia, Madeira (Portugal), Mongolia, Netherlands, North Korea, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland.

Opacifrons coxata (Stenhammer, 1855)

Material examined. MT 2: 17-24.V.2017, 2♀, 8-15.VI.2017, 8♂, 1♀; MT 5: 17-24.V.2017, 1♂, 7♀, 8-15.VI.2017, 3♂, 5♀; MT 6: 17-24.V.2017, 3♂, 5♀, 1-8.VI.2017, 10♂, 11♀, 8-15.VI.2017, 29♂, 32♀, 21.IX-12.X.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Armenia, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France (incl. Corsica), Germany, Great Britain, Greece (incl. Crete), Hungary, Iran, Ireland, Israel, Italy (incl. Sardinia), Latvia, Lithuania, Lebanon, Macedonia, Madeira (Portugal), Malta, Mongolia, Montenegro Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, Turkey.

Opalimosina liliputana (Rondani, 1880)

Material examined. MT 2: 17-24.V.2017, 2♂, 8-15.VI.2017, 1♂, 1♀; MT 6: 8-15.VI.2017, 1♂, 12-25.X.2017, 1♂.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Italy, Latvia, Lebanon, Madeira (Portugal), Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland.

Opalimosina mirabilis (Collin, 1902)

Material examined. MT 6: 1-8.VI.2017, 1♀, 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Cyprus, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Iran, Ireland, Italy, Japan, Latvia, Lebanon, Madeira (Portugal), Malta, Mongolia, Morocco, Netherlands, North Korea, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Tunisia, Turkey.

Pseudocollinella humida (Haliday, 1836)

Material examined. MT 6: 17-24.V.2017, 1♂, 8-15.VI.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Algeria, Andorra, Armenia, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Faeroe Is. (Denmark), Finland, France (incl. Corsica), Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy (incl. Pantelleria I., Sardinia), Kazakhstan, Latvia, Lebanon, Lithuania, Malta, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia.

Pullimosina heteroneura (Haliday, 1836)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 1♀, 21.IX-12.X.2017, 1♂, 2♀; MT 4: 17-24.V.2017, 1♂; MT 5: 17-24.V.2017, 1♂; MT 6: 21.IX-12.X.2017, 1♀, 12-25.X.2017, 3♂, 2♀.

Distribution: Palaearctic: Afghanistan, Algeria, Andorra, Austria, Azores (Portugal), Belgium, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Greece (incl. Crete), Hungary, Iceland, Ireland, Israel, Italy (incl. Pantelleria I., Sardinia, Sicily), Japan, Latvia, Lebanon, Lithuania, Macedonia, Madeira (Portugal), Malta, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tadjikistan, Tunisia, United Arab Emirates; South Atlantic: Gough I. Bulgaria, Canary Is. (Spain).

Pullimosina pullula (Zetterstedt, 1847)

Material examined. MT 2: 8-15.VI.2017, 1♀; MT 6: 1-8.VI.2017, 1♀, 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Austria, Belgium, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Great Britain, Hungary, Italy, Japan, Latvia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland.

Pullimosina vulgesta (Roháček, 2001)

Material examined. MT 2: 17-24.V.2017, 2♂, 8-15.VI.2017, 2♂; MT 5: 17-24.V.2017, 1♂, 8-15.VI.2017, 1♂, 21.IX-12.X.2017, 2♂, 12-25.X.2017, 21♂, 22♀, MT 6: 17-24.V.2017, 1♀, 1-8.VI.2017, 3♂, 3♀, 8-15.VI.2017, 24♂, 26♀, 21.IX-12.X.2017, 1♂, 1♀, 12-25.X.2017, 10♂, 11♀.

Distribution: Palaearctic: Andorra, Austria, Azores (Portugal), Belgium, Czech Republic, Denmark, Finland, France (incl. Corsica), Germany, Great Britain, Hungary, Ireland, Italy, Japan, Latvia, Madeira (Portugal), Montenegro, Netherlands, Norway, Poland, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland.

Rachispoda lutosa (Stenhammer, 1855)

Material examined. MT 2: 8-15.VI.2017, 1♂; MT 5: 17-24.V.2017, 1♂, 8-15.VI.2017, 1♂; MT 6: 17-24.V.2017, 17♂, 21♀, 1-8.VI.2017, 16♂, 9♀, 8-15.VI.2017, 48♂, 5♀.

Distribution: Palaearctic: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Montenegro, Netherlands, North Korea, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey.

Females of *R. lutosa* and *R. lutosoidea* are morphologically alike making it difficult to distinguish between them accurately without dissection. Due to time constraints, it has not been possible to carry out this process for this many specimens. Both species are represented on the site; male *R. lutosa* far outnumber male *R. lutosoidea*, thus *R. lutosa* has been accepted as the predominant species in females too. All specimens will be examined in detail in due course and data adapted whenever necessary, but all females of the MT 6 sample dated 17-24.V.2017 were examined and shown to be *R. lutosa*.

Material examined. MT 6: 1-8.VI.2017, 9♀, 8-15.VI.2017, 42♀.

Rachispoda lutosoidea (Duda, 1938)

Material examined. MT 6: 17-24.V.2017, 5♂, 1-8.VI.2017, 2♂, 8-15.VI.2017, 11♂, 3♀.

Distribution: Palaearctic: Afghanistan, Algeria, Austria, Belgium, Bulgaria, Canary Is. (Spain), Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Iran, Ireland, Israel, Italy (incl. Sardinia, Sicily), Latvia, Lebanon, Lithuania, Malta, Montenegro, Morocco, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Tunisia, Turkey.

Spelobia clunipes (Meigen, 1830)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 2♂, 2♀, 21.IX-12.X.2017, 1♂, 2♀, MT 5: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 1♂, 3♀, 12-25.X.2017, 1♂, MT 6: 17-24.V.2017, 2♂, 1♀, 1-8.VI.2017, 5♂, 1♀, 8-15.VI.2017, 1♂, 2♀, 21.IX-12.X.2017, 1♂.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, China, Cyprus, Czech Republic, Denmark, Estonia, Faeroe Is. (Denmark), Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Italy (incl. Sicily), Latvia, Lithuania, Macedonia, Mongolia, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tadjikistan, Tunisia, Ukraine, Uzbekistan.

Spelobia luteilabris (Rondani, 1880)

Material examined. MT 2: 17-24.V.2017, 1♂, 8-15.VI.2017, 1♂; MT 4: 17-24.V.2017, 1♂; MT 6: 17-24.V.2017, 1♂, 2♀, 8-15.VI.2017, 2♂.

Distribution: Palaearctic: Andorra, Austria, Azores (Portugal), Belgium, Bulgaria, Canary Is. (Spain), Croatia, Czech Republic, Denmark, Faeroe Is. (Denmark), Finland, France (incl. Corsica), Germany, Great Britain, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Macedonia, Madeira (Portugal), Montenegro, Netherlands, North Korea, Norway, Poland, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland.

Spelobia palmata (Richards, 1927)

Material examined. MT 2: 17-24.V.2017, 8♂, 10♀, 8-15.VI.2017, 4♂, 21.IX-12.X.2017, 1♂; MT 4: 17-24.V.2017, 1♂, 1♀; MT 5: 17-24.V.2017, 3♂, 8-15.VI.2017, 3♂, 12-25.X.2017, 1♂, 3♀; MT 6: 17-24.V.2017, 2♂, 1-8.VI.2017, 2♂, 8-15.VI.2017, 1♂, 12-25.X.2017, 2♂, 1♀.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Faeroe Is. (Denmark), Finland, France, Germany, Great Britain, Greece (incl. Crete), Hungary, Ireland, Israel, Italy, Latvia, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain (incl. Balearic Is.), Sweden, Switzerland, Tunisia.

Spelobia parapusio (Dahl, 1909)

Material examined. MT 2: 17-24.V.2017, 6♂, 4♀, 21.IX-12.X.2017, 1♀; MT 5: 17-24.V.2017, 3♂, 1♀, 12-25.X.2017, 1♀; MT 6: 12-25.X.2017, 1♀.

Distribution: Palaearctic: Andorra, Austria, Belgium, Bulgaria, Canary Is. (Spain), Croatia, Cyprus, Czech Republic, Denmark, Finland, France (incl. Corsica), Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Madeira (Portugal), Montenegro, Netherlands, North Korea, Norway, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, Tunisia.

Spelobia talparum (Richards, 1927)

Material examined. MT 2: 17-24.V.2017, 1♂, 1♀, 8-15.VI.2017, 1♂, 21.IX-12.X.2017, 3♂, 2♀; MT 4: 17-24.V.2017, 2♂; MT 5: 8-15.VI.2017, 1♂; MT 6: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Lithuania, Norway, Portugal, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine.

Terrilimosina schmitzi (Duda, 1918)

Material examined. MT 2: 8-15.VI.2017, 4♂, 1♀; MT 5: 17-24.V.2017, 1♂.

Distribution: Palaearctic: Austria, Belgium, China, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Mongolia, Netherlands, North Korea, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland.

Trachyopella kuntzei (Duda, 1918)

Material examined. MT 2: 17-24.V.2017, 1♀; MT 4: 17-24.V.2017, 1♂, 2♀.

Distribution: Palaearctic: Belgium, Czech Republic, France, Germany, Hungary, Latvia, Poland, Slovakia, Sweden, Switzerland.

Trachyopella leucoptera (Haliday, 1836)

Material examined. MT 2: 8-15.VI.2017, 1♀.

Distribution: Palaearctic: Afghanistan, Andorra, Azores (Portugal), Belgium, Canary Is. (Spain), Czech Republic, Denmark, Finland, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Madeira (Portugal), Malta, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland.

Discussion

A total number of 782 specimens were collected at the four sites (MT2, MT4, MT5 and MT6) and identified belonging to 49 named species (Table 1). The marshland MT6 had, with 446 specimens, the largest number of specimens and with 36 species recorded, also the largest number of species. The dominant species here were *Rachispoda lutosa* (including *Rachispoda* cf. *lutosa*), *Pullimosina vulgesta*, and *Opacifrons coxata*. Apart from *P. vulgesta* at MT5, these species were much less represented in the other sites. *P. vulgesta* is commonly found on decaying vegetation, often in woods and in garden compost heaps, but it has also been collected in soil traps (Roháček, 1983) and is very common in grassland habitats in central Europe (Roháček, 2011). This would explain its proportionally large populations in the two areas where grass, and potentially, rotting vegetation would be present.

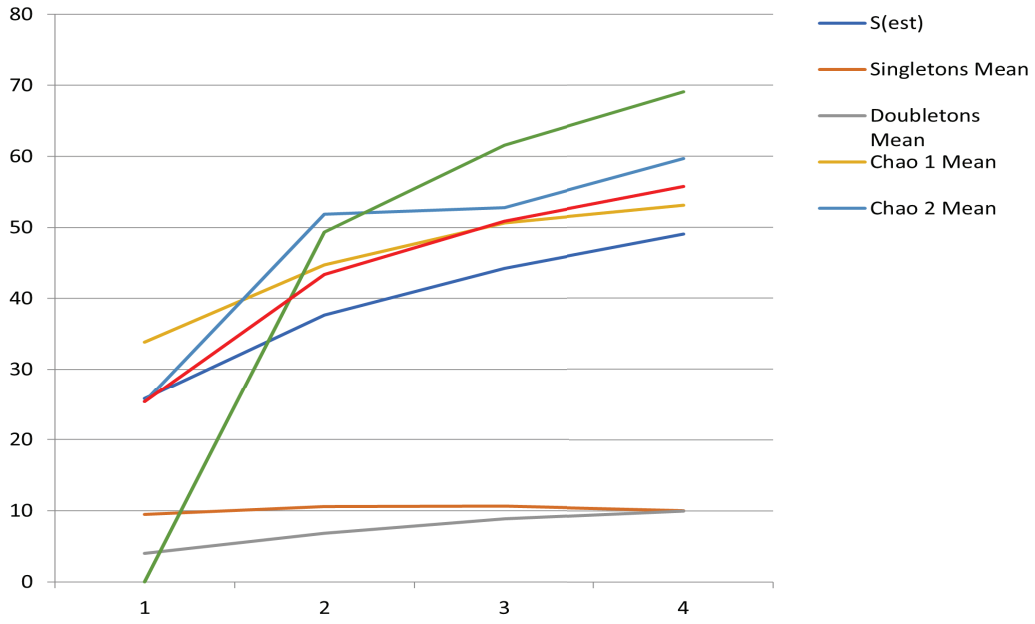

Fig. 1. Species accumulation curves (EstimateS, Version 9.1.0). Four nonparametric estimators (Chao 1, Chao 2, Jackknife 2 and Bootstrap) of total species richness are calculated. S(est) is the observed number of species.

Both *R. lutosa* and *O. coxata* can be numerous in wet, muddy areas. Larvae of *R. lutosa* develop in mud and the adults colonise marshy areas and water margins of numerous types, as long as the areas are open, or vegetation is sparse; *R. lutosa* can occur in large numbers on bare mud (Roháček, 1991). *O. coxata* is a commonly reported species, found beside ponds, streams amongst vegetation and on dried river-beds, (Pitkin, 1988) it can also be found on wet mud/sand at river edges (pers. obs. DB). The larvae, as with *R. lutosa* develop in mud (Pitkin, 1988).

The experimental garden MT2, had a much lower number of specimens than MT6 (184/446), but, with 34 species, also a greater diversity in relation to specimens collected (34:184 vs. 36:446). The old apple orchard on a flower meadow (MT5) had only 24 species with *P. vulgesta* being dominant. In the arboretum (MT4) with its almost continuously shaded, bare soil, only 13 specimens were found belonging to 9 species, it seems clear that this site was not favourable for sphaerocerid activity, although it should be noted that one species (*Minilimosina secundaria*) was new to Belgium.

Of the 49 species found here during this short period of survey, 10 were singletons and 10 represented by only two specimens; overall, these totalled about 40% of all species found. The high number of species represented by only one or two specimens in itself suggests that many more species are likely to be found in the Botanic Garden Jean Massart, than is shown in the current analysis. Using several nonparametric methods, the estimated species richness can be calculated to be as high as 69 (by Jackknife 2), 65 (by Bootstrap) or 53 or 60 (by Chao 1 and Chao 2, respectively) (Fig. 1).

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Atelestidae (Diptera: Empidoidea) from the Botanic Garden Jean Massart with a first record from Belgium of the very rare *Meghyperus sudeticus* Loew, 1850 and an update on the Belgian Atelestidae

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Abstract

A survey on Atelestidae was done as part of a comprehensive Diptera study of the Botanic Garden Jean Massart, Brussels. *Atelestus pulicarius* (Fallén, 1816) was relatively common in the Garden. Its sibling species, *Atelestus dissonans* Collin, 1961 was not found. *Meghyperus sudeticus* Loew, 1850, a very rare species throughout Europe, is recorded here for the first time in Belgium, represented by a male and four females. The Belgian records of the Atelestidae are updated.

Keywords: Atelestidae, *Meghyperus*, first record, Jardin Botanique Jean Massart, Belgium.

Introduction

The Atelestidae is a very small family in the superfamily Empidoidea that were formerly included in the Empididae s. l. (Chvála, 1983). There are three genera known in Western Europe: *Atelestus* Walker, 1837, *Meghyperus* Loew, 1850 and *Nemedina* Chandler, 1981. The genus *Atelestus* is represented in Belgium with two species: *Atelestus pulicarius* (Fallén, 1816) and *A. dissonans* Collin, 1961. Recently, two new *Atelestus* species have been described by Kanavalová *et al*. (2020) respectively from Spain and Turkey and a key to the four western Palaearctic species is provided.

The genus *Meghyperus* Loew, 1850 is still represented in Europe by a single species, *Meghyperus sudeticus* Loew, 1850 which is reported here for the first time in Belgium.

The genus *Nemedina* has not been recorded yet in Belgium. In the western Palaearctic, there are three species known of this very rare genus (*N. alamirabilis* Chandler, 1981, *N. acutiformis* Carles-Tolrá, 2008 and *N. zaitsevi* Sinclair & Shamshev, 2003). A re-description of the type species *N. alamirabilis* Chandler, 1981 is given by Sinclair & Papp (2004).

The present report is based on a three-year survey of the Diptera in the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium). This Botanic Garden is a tiny 4.5 ha site, squeezed in between the eastern border of the city of Brussels and the Sonian forest. Nearly 2,000 plant species have been recorded in this Natura 2000 site. The area is composed of various biotopes such as humid areas with a swamp and ponds, an old orchard on dry grassland, a medicinal plants garden, an arboretum and an evolution garden. All is mixed with patches of semi natural woods.

Material and methods

Six sites in the Garden were sampled during different periods from spring 2017 to spring 2018 with Malaise traps (abbr. MT) only. Details on trapping and the sites are described in Grootaert *et al*., 2023.

All the samples from the survey have been screened for empidoid flies including the Atelestidae. The material is conserved in the collections of the Royal Belgian Institute of Natural Sciences in Brussels (RBINS). The position of the specimens in the collection from the Botanic Garden is given as ref. followed by a number.

Observations

Atelestus pulicarius (Fallén, 1816)

Empis pulicaria Fallén, 1816: 33.
Atelestus sylvicola Walker, 1837: 229.
Platycnema tibiella Zetterstedt, 1842: 333.
Atelestus pulicarius (Fallén, 1816) *in* Collin, 1961: 231.
Atelestus pulicarius (Fallén, 1816) *in* Chvála, 1983: 235; re-description (Figs 53, 557, 561, 563-579).

Material examined. Oudergem, Botanic Garden Jean Massart: MT1: 1♀, 28.V- 4.VI.2015; 1♂, 4-10.VI.2015; MT2: 1♀, 24.v-1.VI.2017 (ref. 1074); 1♂, 8-15.VI.2017 (ref. 1378); MT5: 11♂♂, 3♀♀, 24.V-1.VI.2017 (ref. 1082); 2♂♂, 1♀, 1-8.VI.2017 (ref. 1285); MT5: 1♀, 8-15. VI.2017; MT6: 1♂, 24.V-1.VI.2017 (ref. 1169); 1♂, 2♀♀, 1-8.VI.2017 (ref. 1088).

Previous Belgian records: 1♂, Durbuy (31UFR78), 18.VI.1962 (M. Bequaert, RBINS); 1♂, Herbeumont (31UFR61), 26.VI.1952 (M. Bequaert, RBINS); 1♂, Lixhe (31UFS82), 1.VI.1947 (M. Bequaert, RBINS); 2♂♂, Logne (31UFR88), 2.VII.1986 (J. Berteau, RBINS); 1♂, Mirwart (31UFR64), 12.VI.1946 (M. Bequaert, RBINS); 1♀, Nismes (31UFR14), 24.VI.1981 (P. Grootaert, RBINS); 1♀, Ottignies (31UFS11), 5.VI.1982 (P. Dessart, RBINS); 2♂♂, Ottignies (31UFS11), 12.VI.1981 (M. Bequaert, RBINS); 1♂, Steenbergse bossen (st. 16), 2013 (J. Mortelmans); 1♂, Treignes (31UFR15), 7.VIII.1984 (K. Hofmans, RBINS).

Comments. As can be seen, almost all records, except the record from Steenbergse bossen, are from the southern part of Belgium. Apparently, the species is only active from early summer onward.

Distribution**.** Belgium, British Isles, Central European Russia, Croatia, Czech Republic, Danish mainland, Finland, Germany, Ireland, Slovakia, Slovenia, Sweden and Switzerland [according to Chvála (1983), Fauna Europaea, 2022].

Atelestus dissonans Collin, 1961

Atelestus dissonans Collin, 1961: 233; description female.
Atelestus dissonans Collin, 1961 *in* Chvála, 1983: 237; description male and female (Fig. 580 male genitalia).

Material examined. 1♂, Houyet (UTM: 31UFR46), 6.VII.1928 (RBINS); 1♂, Ethe (31UFQ89), 28.VIII.1981 (RBINS).

Distribution**.** Belgium, British I., Czech Republic, Germany and Switzerland (Fauna Europaea, 2022). According to Chvála (1983), its occurrence is expected in Fennoscandia.

There are only two records from Belgium and they are from the south of Belgium.

Key to the west Palaearctic *Atelestus* species after Kanavalová *et al.*, 2020.

1. Mesonotum with all bristles pale (white to yellow).....*A. turcicus* Barták
– Mesonotum with most bristles black 2

2. Abdomen with many pale bristles (white to yellow) .....*A. ibericus* Barták
– Abdomen with all bristles black.....3

3. Female frons with microtrichia. Male mid tibia usually with at least one longer dorsal bristle near middle; apex of epandrial lamella broadly ovate and microtrichose; hypandrium longer than wide in ventral view, with posterior lobes pointed posteriorly (L- to C- shaped in lateral view); wing usually longer than 2.4 mm ..... *A. pulicarius* (Fallén)
– Female frons shiny. Male mid tibia with all dorsal bristles shorter and equally long; apex of epandrial lamella narrowly ovate and shiny; hypandrium short (about as long as wide in ventral view), with posterior lobes pointed dorsally (U-shaped in lateral view); wing usually shorter than 2.2 mm ..... *A. dissonans* Collin

Meghyperus sudeticus Loew, 1850 – **Belg. sp. nov.**
Fig. 1.

Meghyperus sudeticus Loew, 1850: 303.

Meghyperus sudeticus Loew, 1850 *in* Chvála, 1983: 241; re-description (Figs 54, 558, 559,562, 581-588, 592-594).

Material examined. Oudergem, Botanic Garden Jean Massart: MT1: 1♂, 10-17.VI.2015; 1♀, 17-26.VI.2015 (ref. 761); MT2: 2♀♀, 24.V-1.VI.2017 (ref. 1069); MT5: 1♀, 24.V-1. VI.2017 (ref. 1081); MT6: 1♀, 17-24.V.2017 (det. P. Beuk; in coll. Natuurhistorisch Museum, Maastricht).

Distribution. Austria, Belgium (new record), Finland, Germany, Hungary, Slovakia, Slovenia, The Netherlands, Russia (NW European Russia & Russian Far East) and former Yugoslavia (according to Fauna Europaea, 2022).

Comments. According to Chvála (1983), the species is rare everywhere and males are even more rare. In Fennoscandia, *Meghyperus* is present in June and July while in Central Europe from May to August.

Meghyperus sudeticus was found in four sites in the Botanic Garden Jean Massart (MT1, MT2, MT5 and MT6). It was present only in late Spring from 17 May to 17 June.

Biology. According to Chvála, 1983 nothing is known about the immature stages, nor are there observations on the feeding behaviour of the adults. Nevertheless, the mouthparts suggest that they are predacious. The habitat of the adult flies is also unclear, though adults have been frequently collected along riverbanks in forest in Finland (Finnish database, leg. J. Kahanpää). Moreover, swarming behaviour was observed by Frey (1933, 1956), also along a riverbank. The record in the Netherlands was apparently also from a swarm when Bob van Aartsen (*in* litt. Paul Beuk) collected 1♂ and 29♀♀ in early June 1998 in ‘t Harde (Gelderland). Unfortunately, the precise habitat is not known. The observations in the Botanic Garden Jean Massart do not elucidate its habitat preferences since specimens were found in four different habitats.

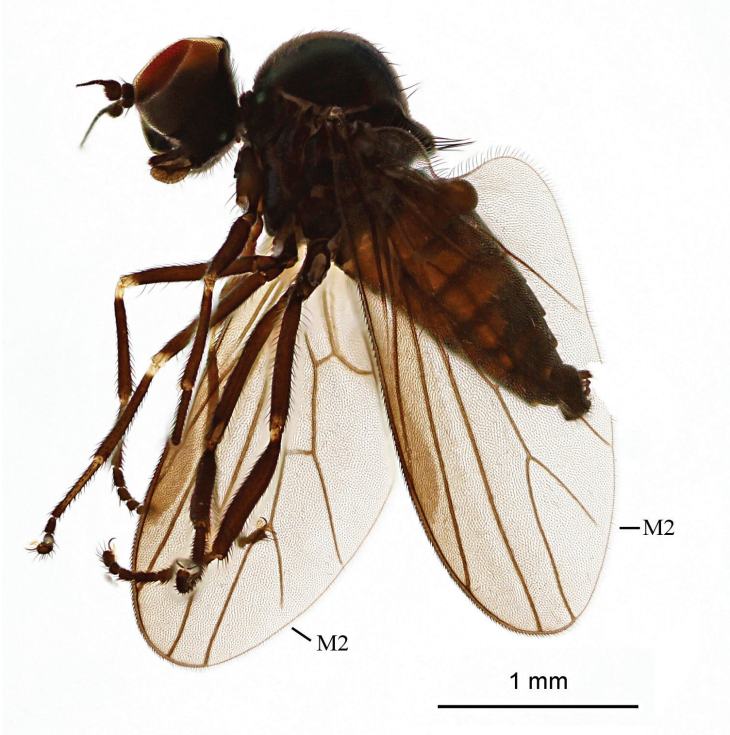

Fig. 1. *Meghyperus sudeticus* Loew, 1850, Botanic Garden Jean Massart. Habitus male, Vein M_2 is abbreviated. © Camille Locatelli.

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An annotated checklist of the Scatopsidae (Diptera) of the Botanic Garden Jean Massart at the outskirts of Brussels (Belgium)

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Abstract

Sixteen species of Scatopsidae are recorded from the Botanic Garden Jean Massart. Four species are reported for the first time for the Belgian fauna: *Holoplagia lucifuga* (Loew, 1870), *Holoplagia richardsi* (Edwards, 1934), *Swammerdamella acuta* Cook, 1956 and *Swammerdamella adercotris* Cook, 1972. A revised checklist of the Scatopsidae of Belgium is given.

Keywords: Scatopsidae, new species fauna, Belgium

Introduction

The main goal of the present survey was to get an idea of the general diversity of the insects and spiders present in the old Botanic Garden Jean Massart. This centennial Garden is situated at the outskirts of the city of Brussels at the border of the old Sonian forest. The tiny garden of 4.5 ha was created in 1922 by Jean Massart, a botanist and ecologist *avant la lettre*; the present study thus attributes to the 2022 centennial anniversary. The garden is composed of various small biotopes like woodlands, a wetland with marshes and ponds as well as thematic collections such as medicinal and aromatic plants, a collection of cultivated plants, an old orchard, an arboretum, an evolutionary garden and experimental parcels for the students of the Université libre de Bruxelles (ULB).

The order Diptera was proven to be surprisingly interesting by for example the high diversity of fungus gnats (Kurina & Grootaert, 2016), snipe flies (Rhagionidae) (Grootaert *et al*., 2020) and even a new hybotid fly which was described from this Garden (Grootaert, 2016). A detailed description of the Garden and the survey can be found in Grootaert *et al.* (2023).

Scatopsidae are a rather poorly known small family of nematoceran Diptera with about 380 species arranged in 36 genera described worldwide (Haenni & Amorim, 2017). About 100 species are recorded from Europe (Haenni, 2013a). Scatopsids are minute (1-4 mm), rather sturdily built, dark coloured midges with shortened antennae with only the anterior veins of the wings pigmented, contrasting with the membrane (except in some genera). They can be found in all types of terrestrial environments, with slight preference for moist open or semi-open habitats. Most known larvae are saprophagous, developing in various kinds of decaying organic material, mainly vegetal, in soil, forest litter, under bark of trees, but also in animal excrements and fungi (Haenni &Vaillant, 1994), with myrmecophily known or suspected in some genera. Scatopsidae have been given very little attention in Belgium so far, with a single comprehensive study by Goetghebuer (1945) enumerating 20 species based on the material present in the collection of the Royal Belgian Institute of Natural Sciences (RBINS) and from his own collecting activity. The present survey is thus the first in this country to deal with

the scatopsid fauna of one locality, which appears to harbour an important part of the species recorded in the national list.

Material and methods

The material was collected in the Botanic Garden Jean Massart near Brussels, Belgium (community Oudergem, leg. A. Drumont & H. Raemdonck), as described in Grootaert *et al*. (2023). For the study of the Scatopsidae, all the samples collected from May to December 2017 in four sites (MT2, MT4, MT5 and MT6) at the Garden were sorted. The characteristics of the sites are summarized in Table 1.

The material is preserved in 70% ethanol in the collections of the RBINS, Brussels, and the Maastricht Museum of Natural History, Maastricht, the Netherlands (NHMM), except for a few duplicates in the collection of the first author (JPH).

Table 1. Summary of the sites sampled in 2017.

Site	MT2	MT4	MT5	MT6
coord.	50°48’52.70”N 4°26’22.50”E	50°48’52.83”N 4°26’15.62”E	50°48’47.12”N 4°26’15.90”E	50°48’49.02”N 4°26’6.97”E
soil	humid/ loamy	dry/ loamy	dry/ loamy	swampy loamy-sand
exposure	sun exposed	shaded	sun exposed	partly shaded
habitat	border of flowerbeds, along a hedge	arboretum; no or short herbaceous layer	flowery meadow in old apple orchard	close to reed bed, above small ponds

Results

The survey in 2017, carried out in four sites, yielded 107 specimens belonging to 16 species (Table 2). The abundance of Scatopsidae in the Malaise trap samples was low and only half of the samples contained Scatopsidae, generally in very low numbers, ranging from 1 or 2 specimens per sample. The dominant species *Apiloscatopse flavicollis* (Meigen, 1804) was represented exceptionally by up to 17 specimens in a single sample.

Apiloscatopse flavicollis, the dominant species in the Garden, is the only species represented by more than 20 specimens. These overall low numbers exclude a statistical analysis of the habitat preferences of the species. From the species that are usually common and abundant in samples, e.g. in France [Haenni & Withers, 2007], only *Thripomorpha coxendix* (Verrall, 1912) was represented by more than 10 specimens, while other frequent species, e.g. *Swammerdamella brevicornis* (Meigen, 1830), *Coboldia fuscipes* (Meigen, 1830), *Scatopse notata* (Linnaeus, 1758) or *Apiloscatopse scutellata* (Loew, 1846) were all poorly represented in the captures.

MT2 with 11 species is the site with the highest diversity, followed by MT5 (8 species), MT4 (6 species) while only 4 species were found in MT6, the swampy area. Apparently, the Scatopsidae do not thrive in these very humid conditions.

Table 2. Summary of the number of specimens per species per site in 2017.

Species / sites	MT2	MT4	MT5	MT6	Total
Apiloscatopse flavicollis (Meigen, 1804)	30	10	9	8	57
Apiloscatopse picea (Meigen, 1818)	1	1			2
Apiloscatopse scutellata (Loew, 1846)		1			1
Coboldia fuscipes (Meigen, 1830)			1		1
Colobostema nigripenne (Meigen, 1830)	1	1			2
Colobostema triste (Zetterstedt, 1850)	5		3		8
Ectaetia clavipes (Loew, 1846)	4		1		5
Holoplagia lucifuga (Loew, 1870)			1	1	2
Holoplagia richardsi (Edwards, 1934)		1			1
Reichertella pulicaria (Loew, 1846)	1				1
Rhexoza subnitens (Verrall, 1886)	3	1			4
Scatopse notata (Linnaeus, 1758)	1		1	1	3
Swammerdamella acuta Cook, 1956	2				2
Swammerdamella adercotris Cook, 1972	3				3
Swammerdamella brevicornis (Meigen, 1830)			1		1
Thripomorpha coxendix (Verrall, 1912)	8		2	4	14
Total number of specimens	59	15	19	14	107
Number of species	**11**	**6**	**8**	**4**	**16**

Annotated checklist of the findings in the Botanic Garden in 2017

In the following list, the species new to the Belgian fauna are indicated as "**Belg. sp. nov.**". Systematics and nomenclature according to Haenni (2013a). In addition to the survey in 2017, a few occasional data from 2016 are added to the records listed below.

Ectaetiinae

Ectaetia clavipes (Loew, 1846)

Material examined. MT2: 17-24.V.2017, 1♂, 1♀; 24.VI-1.VII.2017, 1♂; 23.VIII-1.IX.2017, 1♂; MT5, 15-22.VI.2017, 1♀.

A widespread European species, reared from rotting wood in Britain (Freeman, 1986).

Scatopsinae

Rhegmoclematini

Thripomorpha coxendix (Verrall, 1912)

Material examined. MT2: 7-11.V.2017, 1♀; 17-24.V.2017, 3♀♀; 24.V-1.VI.2017, 2♀♀; 8-15.VI.2017, 1♀; 23.VIII-1.IX.2017, 1♀; MT5: 24.V-1.VI.2017, 1♀; 1-7.IX.2017, 1♂; MT6: 1-8.VI.2017, 4♀♀.

Widespread species in temperate Europe.

Colobostematini

Colobostema nigripenne (Meigen, 1830)

Material examined. MT2: 2-11.VIII.2017, 1♀; MT4: 17-24.V.2017, 1♀.

The commonest species of the genus, recorded from various habitats all over Europe.

Colobostema triste (Zetterstedt, 1850)

Material examined. MT2: 8-15.VI.2017, 2♂♂; 15.22.VI.2017, 1♂; 13-19.VII.2017, 1♂; 23.VIII-1.IX.2017, 1♂; MT5: 7-11.V.2017, 1♂; 24.V-1.VI.2017, 1♂; 21.IX-12.X.2017, 1♂.

A common European species. Both *Colobostema* species are myrmecophilous and are apparently associated with ant nests for their development.

Holoplagia lucifuga (Loew, 1870) – **Belg. sp. nov.**

Fig. 1

Material examined. MT5: 19-26.VII.2017, 1♂; MT6: 8-15.VI.2017, 1♂.

A rarely collected species, recorded from several countries of temperate Europe. The immature stages have recently been described from accumulations of rotten wood caused by the activity of the arboreal ant *Lasius brunneus* (Latreille, 1798) (Köhler, 2011).

Fig. 1. *Holoplagia lucifuga* Loew, 1870, Belg. sp. nov. Habitus male. © Julien Lalanne.

Holoplagia richardsi (Edwards, 1934) – **Belg. sp. nov.**

Material examined. MT4: 17-24.V.2017, 1♀.

A rare species, only known from a few localities in England, France, Switzerland, Czech Republic and Slovakia. The larva has been reared from rotten beech wood in England (Edwards, 1934) and from wood debris in tree-holes in France (Haenni & Vaillant, 1994).

Scatopsini

Apiloscatopse flavicollis (Meigen, 1818)

Material examined. MT1: 13-27.X.2016, 5♀♀; MT2: 21.IX-12.X.2017, 1♂, 14♀♀; 12-25.X.2017, 2♂♂, 13♀♀; MT3: 27.IX-9.X.2016, 4♀♀; MT4: 21.IX-12.X.2017, 1♂, 2♀♀; 12-25.X.2017, 6♀♀; 25.X-8.XI.2017, 1♀; MT5: 21.IX-12.X.2017, 4♂♂, 1♀; 12-25.X.2017, 6♀♀; MT6: 12-25.X.2017, 2 ♂♂, 6♀♀.

A very common and widespread species in forested areas throughout Europe, with autumnal flight period as is the case in the following two species. All three of them are commonly found to be numerous visiting ivy *Hedera helix* flowers.

Apiloscatopse picea (Meigen, 1818)

Material examined. MT1: 13-27.X.2016, 1♀; MT2: 21.IX-12.X.2017, 1♀; MT4: 21.IX-12.X.2017, 1♀.

A common species in lowland forests of temperate Europe.

Apiloscatopse scutellata (Loew, 1846)

Material examined. MT4: 21.IX-12.X.2017, 1♂.

A widespread and very common species in all types of forests of Europe. Immature stages have been described from leaf litter in Switzerland (Haenni, 1981).

Reichertella pulicaria (Loew, 1846)

Material examined. MT2: 17-24.V.2017, 1♀.

A temperate European species, apparently restricted to lowlands.

Scatopse notata (Linnaeus, 1758)

Material examined. MT2: 21.IX-12.X.2017, 1♀; MT5: 21.IX-12.X.2017, 1♀; MT6: 14-24. III.2017, 1♀.

Widespread and common species, cosmopolitan in distribution, spread by man in most parts of the world (except for tropical regions). In Europe occurring in anthropogenic as well as in natural conditions. A frequent inhabitant of compost heaps.

Swammerdamellini

Coboldia fuscipes (Meigen, 1830)

Material examined. MT5: 15-22.VI.2017, 1♀.

A cosmopolitan species, very common and widespread, both in anthropogenic or natural environments in Europe. The larvae can develop in all kind of decaying material.

Rhexoza subnitens (Verrall, 1886)

Material examined. MT1: 23.VI-1.VII.2016, 1♀; MT2: 28.IV-5.V.2017, 1♀; 15-22.VI.2017, 1♀; 2-11.VIII.2017, 1♀; MT4, 15-22.VI.2017, 1♀.

Widespread, but local species in temperate and boreal Europe. The larvae were found under decaying bark of poplar trees in Belgium (Tonnoir, 1927).

Swammerdamella acuta Cook, 1956 – **Belg. sp. nov.**
Fig. 2

Material examined. MT2: 7-11.V.2017, 1♂, 1♀

Widespread species through temperate and boreal Europe, reaching southwards to France, Italy and Slovakia. Biology and immatures stages unknown.

Fig. 2. *Swammerdamella acuta* Cook, 1956, Belg. sp. nov. Habitus male. © Paul Beuk.

Swammerdamella adercotris Cook, 1972 – **Belg. sp. nov.**

Fig. 3.

Material examined. MT2: 7-11.V.2017, 1♂, 1♀; 17-24.V.2017, 1♂.

This small species is known from scattered localities in some countries of boreal and temperate Europe, reaching southwards to France, northern Italy and Slovakia. Nothing is known about its biology and immature stages.

Swammerdamella brevicornis (Meigen, 1830)

Material examined. MT5: 23.VIII-1.IX.2017, 1♀.

A common and widespread West Palaearctic species, occurring in all kind of habitats, but immature stages still unknown.

Swammerdamella sp.

Material examined. MT1: 23.VI-1.VII.2016, 1♀; MT4, 24.V-1.VI.2017, 1♀.

These two specimens belong either to *S. adercotris* or to *S. acuta* Cook, 1956, two related species which are presently undiscernible in the female sex.

Fig. 3. *Swammerdamella adercotris* Cook, 1972, Belg. sp. nov. Habitus male. © Julien Lalanne.

Discussion

The Botanic Garden Jean Massart appears to be a hotspot of biodiversity for the family Scatopsidae in Belgium. Indeed, the Garden hosts a very high percentage (59%) of the Belgian fauna of the family, more than half of the species presently known with certainty from the country. No less than 16 species (out of 27) have been recorded in the Malaise traps operating in the year 2017 only (the few sorted samples of 2016 did not yield additional species). Moreover, four species are recorded for the first time from Belgium. These are rarely encountered European species, two of them being most probably dependent on old or senescent trees and the associated ants.

The actual observed number of species is 16 and the species curve (Fig. 4) is still distinctly rising (Sest) while Chao1 predicts 18 species, Jackknife 21 species and Bootstrap 18 species.

Nine species are represented by singletons and doubletons which is more than half of the species observed. This high number of singletons and doubletons suggests that the present sampling effort is not large enough to get a good idea of the real diversity.

It is probable, but remains to be proved, that this very high proportion of the Belgian fauna in the Botanic Garden Jean Massart is biased by the poor state of our knowledge of the Belgian fauna. Indeed, the family Scatopsidae has never been studied extensively in Belgium, with only one comprehensive paper giving information on 20 species (Goetghebuer, 1945) including *Anapausis inermis* (Ruthé, 1831) being obviously an erroneous identification (see Appendix, notes). There is no doubt that with further surveys the number of species in Belgium can be increased with 10-20%.

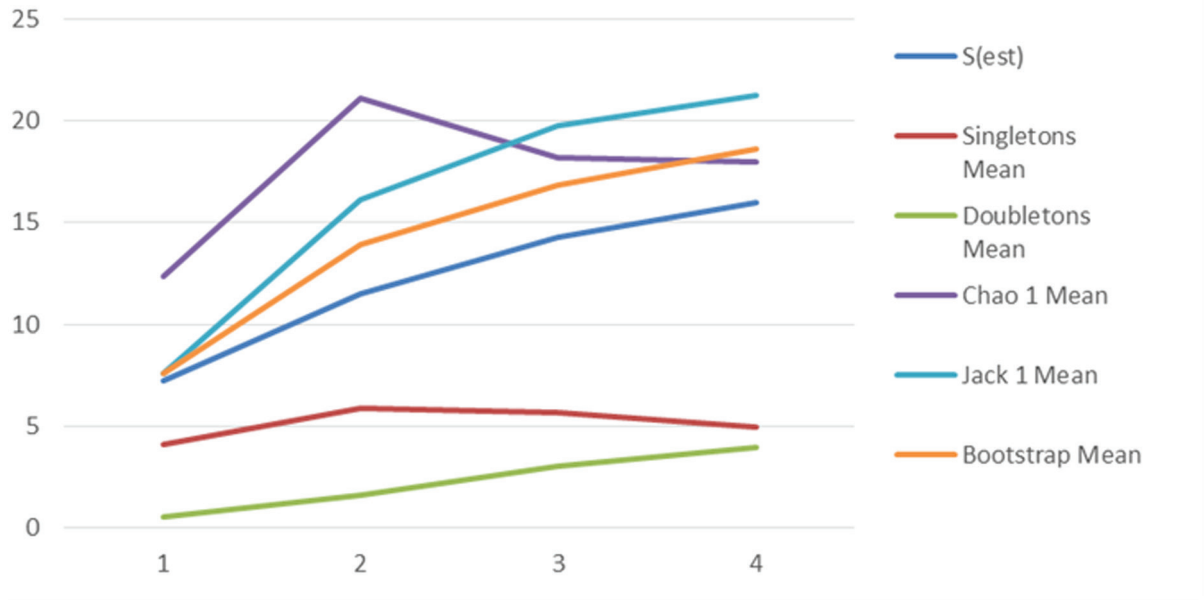

Fig. 4. Species accumulation curve calculated with the programme EstimateS (Colwell, 2013). Relation between number of sampling sites and number of species.

Appendix

Revised checklist of the Scatopsidae of Belgium

Several lists of the Scatopsidae present in Belgium are available: Goetghebuer (1945), Gosseries (1991) and Belgian Species List (2022). On the other hand, lists of Belgian species can also be obtained by checking more general works like *Catalogue of Palaearctic Diptera* (Krivosheina & Haenni 1986) and *Fauna Europaea* database (Haenni, 2013a). However, when comparing these lists, important discrepancies can be found between them, not only in the number of species included but also in the composition of the lists, with species present in some and omitted in others and *vice versa*. The present publication gave the opportunity of a critical examination of these and allowed the production of the revised checklist below. Sources of the first records are given in brackets.

Aspistinae

Aspistes berolinensis Meigen, 1818 [Goetghebuer, 1945]

Ectaetiinae

Ectaetia clavipes (Loew, 1846) [Goetghebuer,1945]

Psectrosciarinae

Anapausis talpae (Verrall, 1912) [Goetghebuer, 1945]

Scatopsinae

Apiloscatopse flavicollis (Meigen, 1818) [Goetghebuer, 1945]
Apiloscatopse picea (Meigen, 1818) [Goetghebuer, 1945]
Apiloscatopse scutellata (Loew, 1846) [Goetghebuer, 1945]
Coboldia fuscipes (Meigen, 1830) [Goetghebuer, 1945]
Colobostema nigripenne (Meigen, 1830) [Goetghebuer, 1945] – N1
Colobostema triste (Zetterstedt, 1850) [Goetghebuer, 1945] – N1
Efcookella albitarsis (Zetterstedt, 1850) [Goetghebuer, 1945]
Ferneiella brevifurca (Enderlein, 1912) [Goetghebuer, 1945]
Ferneiella incompleta (Verrall, 1886) [Goetghebuer, 1945]
Holoplagia lucifuga (Loew, 1870) [present paper]
Holoplagia richardsi (Edwards, 1934) [present paper]
Holoplagia transversalis (Loew, 1846) [Goetghebuer, 1945]
Parascatopse litorea (Edwards, 1925) [Gosseries, 1991]
Reichertella geniculata (Zetterstedt, 1850) [Goetghebuer, 1945]
Reichertella nigra (Meigen, 1804) [Gosseries, 1991]
Reichertella pulicaria (Loew, 1846) [Goetghebuer, 1945]
Rhexoza subnitens (Verrall, 1886) [Goetghebuer, 1945]
Scatopse lapponica Duda, 1928 [Goetghebuer, 1945]
Scatopse notata (Linnaeus, 1758) [Goetghebuer, 1945]
Swammerdamella acuta Cook, 1956 [present paper]

Swammerdamella adercotris Cook, 1972 [present paper]
Swammerdamella brevicornis (Meigen, 1830) [Goetghebuer, 1945]
Thripomorpha coxendix (Verrall, 1912) [Goetghebuer, 1945]
Thripomorpha halterata (Meigen, 1838) [Goetghebuer, 1945]

Deleted species

Psectrosciarinae

Anapausis inermis (Ruthé, 1831) [Goetghebuer, 1945] – N2

Doubtful species

Ectaetiinae

Ectatetia lignicola Edwards, 1925 [Belgian Species List, 2022] – N3
Ectatetia platyscelis (Loew, 1869) [Belgian Species List, 2022] – N3

Psectrosciarinae

Anapausis albohalterata Duda, 1928 [Belgian Species List, 2022] – N3
Anapausis haemorrhoidalis Duda, 1928 [Belgian Species List, 2022] – N3
Anapausis rectinervis Duda, 1928 [Belgian Species List, 2022] – N3

Scatopsinae

Apiloscatopse flavocincta (Duda, 1928) [Belgian Species List, 2022] – N3
Thripomorpha bifida (Zilahi-Sebess, 1956) [Belgian Species List, 2022] – N3
Thripomorpha cooki (Hutson, 1970) [Belgian Species List, 2022] – N3
Thripomorpha paludicola Enderlein, 1905 [Belgian Species List, 2022] – N3
Thripomorpha verralli (Edwards, 1934) [Belgian Species List, 2022] – N3

Notes

N1: Identifications incorrect in Goetghebuer (1945), but both species are nevertheless present in the Material examined by Goetghebuer (Haenni 2013b).

N2: Although an easily recognizable species among European species thanks to the rufous coloration of pleura, legs and last two abdominal segments, this species was characterized in the key by Goetghebuer (1945) by the following characters "abdomen d'un noir un peu luisant; balanciers blanchâtres" [abdomen slightly shining black; halters whitish], both characters do not apply to *A. inermis*. Accordingly, this species is deleted from the list.

N3: This species was only mentioned in the Belgian Species List (2022) but no record of it is traceable and no material is present in the collections of RBINS. Its inclusion in the Belgian Species List (2022) was probably inferred from the fact that it may have been recorded from at least one of the three neighbouring countries (the Netherlands, Germany and France). It most probably occurs in Belgium, but in absence of material or credible reference, it is listed as doubtful.

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We are very grateful to Mr Alain Drumont and Mr Hugo Raemdonck for the weekly, meticulous sampling at the Botanic Garden Jean Massart from Spring 2015 to Spring 2018. Many thanks to Dr Peter J. Chandler for his important suggestions of improvements of the manuscript of this paper. We thank Julien Lalanne for providing pictures.

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The Heleomyzidae (Diptera) of the Botanic Garden Jean Massart

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Abstract

Twenty six species of the fly family Heleomyzidae were recorded in the Botanic Garden Jean Massart, being nearly 60% of the species ever recorded in Belgium. This large number is probably due to the fact that most Heleomyzidae have a wide distribution with little ecological differences between the species. *Schroederella bifida* Papp & Carles-Tolrá, 1994, described from Spain is recorded here for the first time since its description. *Suillia fuscicornis* (Zetterstedt, 1847), *Suillia oxyphora* (Mik, 1900) and *Trixoscelis frontalis* (Fallén, 1823) are also species recorded from Belgium for the first time, bringing the total amount of the reported heleomyzid fly species in Belgium to 48.

Keywords: New for the Belgian fauna, Malaise trap

Introduction

Heleomyzidae are small to medium-sized flies (about 2-12 mm) which vary in body colour from yellowish to dark greyish or brownish, sometimes reddish. The third antennal segment is generally rounded, the arista is bare to plumose and the vibrissae are present. The postocellar setae converge. The wing membrane is hyaline or has darker zones, sometimes patterns. The costa has a subcostal break and usually the costa bears a number of conspicuous interspaced spine-like setae (Beuk, 2022).

The larvae of most Heleomyzidae develop in all kinds of decomposing animal or vegetable matter (Papp, 1981). Larvae of the subfamily Suillinae occur in various mushroom species and generally do not show a preference for specific fungus species. In autumn many males of *Suillia* Robineua-Desvoidy, 1830, may be seen on fungi, while they are on guard for females which are ready to mate and lay eggs (Colyer & Hammond, 1968; own observations).

Many species of Heleomyzidae are recorded from late autumn to early spring. Especially on and around recently dead mammals and birds, it is possible to observe Heleomyzinae. Yet, some species, like *Eccoptomera microps* (Meigen, 1830), are rarely observed in nature since they live in tunnels and nests of moles (*Talpa europaea* Linnaeus, 1758).

Species of *Tephrochlamys* Loew, 1862, can be seen throughout the year, when it is not too warm, in gardens and in sheds, where for example, rabbits are kept.

The Belgian catalogue of Diptera (Gosseries, 1991a, b) mentions 44 species (as Heleomyzidae and Trixoscelididae), but in fact little attention was paid to this family of flies. In the Netherlands 50 species are recorded (Beuk, 2022) while 61 species are known from the United Kingdom (Chandler, 2021; also as Heleomyzidae and Trixoscelididae).

The present study deals with the identification of the heleomyzids found in four sites sampled in 2017 in the Botanic Garden Jean Massart in Brussels.

Material and methods

All material was collected with Malaise traps as described by Grootaert *et al.* (2023). Only the heleomyzids collected in the four sites sampled in 2017 (MT2, MT4, MT5 and MT6) were available for the present study. Voucher specimens of all species are deposited in the collections of the Royal Belgian Institute of Natural Sciences in Brussels (RBINS) and in the collections of Natuurhistorisch Museum Maastricht, Maastricht, the Netherlands (NHMM).

Results

887 specimens were collected belonging to 26 species (Table1). Ten species, less than half the total number of species, were represented by 20 specimens or more which may allow a statistical comparison between the four sites.

Site MT5, the old orchard in a dry flowered meadow had the highest number of specimens (402) and with 24 species also the highest diversity. Site MT2 with 307 specimens belonging to 20 species was the second most diverse site. The marshland site MT6 had only 155 specimens belonging to 16 species and the arboretum (MT4), a permanently shaded site with no or only very short ground vegetation had the lowest number of specimens (60) but still 12 species. Here, *Suillia affinis* was the dominant species with 38 specimens, while the other 11 species were represented with six specimens at the most. It seems that the area was accidentally used as a passage way.

Twenty six species were found and the species curve (Sest) is still rising after collecting in four sites and hence not reaching the asymptote (Colwell, 2013). The number of species calculated with Chao1 and Bootstrap is 29 for both, while estimated 32 with Jackknife (Fig. 1).

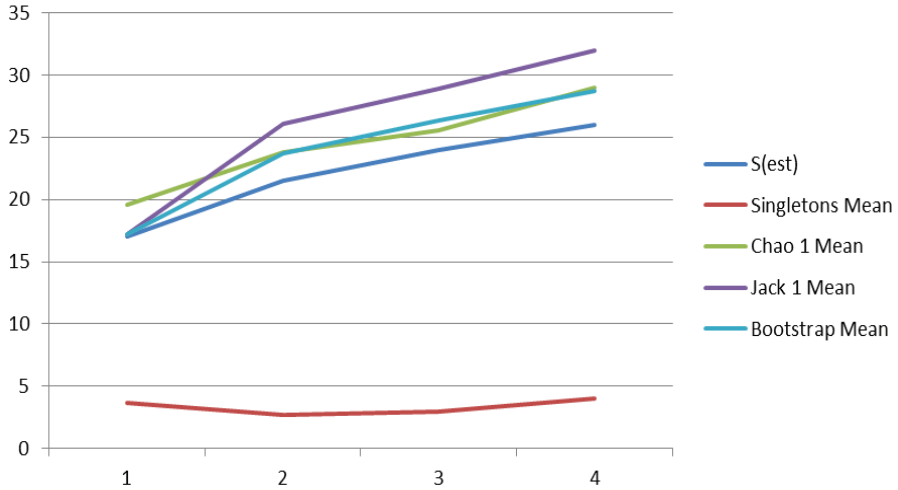

Fig. 1. Species accumulation curve (Colwell, 2012). Species number in relation to the number of samples sites.

Annotated checklist

The general species distribution for the species discussed below are derived from Fauna Europaea (Woznica *et al.*, 2013). Since no recent additions were made to Fauna Europaea it was not deemed appropriate to list the exact distribution as given by this resource. Data on the biology are generally extracted from Colyer & Hammond (1968) and Papp (1981) unless otherwise stated.

Table 1. List of species of Heleomyzidae found at the Botanic garden.

Species	MT2	MT4	MT5	MT6	Total
Suillia affinis (Meigen, 1830)	94	38	100	46	278
Suillia variegata (Loew, 1862)	24	6	74	16	120
Tephrochlamys rufiventris (Meigen, 1830)	39		26	27	92
Suillia pallida (Fallén, 1820)	19	1	33	24	77
Tephrochlamys flavipes (Zetterstedt, 1838)	27		14	18	59
Suillia similis (Meigen, 1838)	24	1	31	2	58
Oecothea fenestralis (Fallén, 1820)	18	2	34	3	57
Suillia bicolor (Zetterstedt, 1838)	15	5	26	4	50
Heteromyza rotundicornis (Zetterstedt, 1846)	13	1	10	1	25
Suillia notata (Meigen, 1830)	4	2	12	2	20
Suillia laevifrons (Loew, 1862)	9		6		15
Tephrochlamys tarsalis (Zetterstedt, 1847)	1		6	4	11
Suillia humilis (Meigen, 1830)	1	1	5	3	10
Eccoptomera longiseta Loew, 1862	3		5		8
Suillia atricornis (Meigen, 1830)	1	1	4	2	8
Morpholeria ruficornis (Meigen, 1830)	3		3	1	7
Eccoptomera filata Loew, 1862	4		2	1	7
Suillia fuscicornis (Zetterstedt, 1847)	2		3		5
Neoleria ruficauda (Zetterstedt, 1847)	3				3
Suillia sp.	3				3
Neoleria ruficeps (Zetterstedt, 1838)			3		3
Trixoscelis frontalis (Fallén, 1823)		1	1	1	3
Eccoptomera pallescens (Meigen, 1830)			2		2
Suillia oxyphora (Mik, 1900)		1			1
Schroederella bifida Papp & Carles-Tolrá, 1994			1		1
Suillia imberbis Czerny, 1924			1		1
number of specimens	**307**	**60**	**402**	**155**	**924**
number of species	**20**	**12**	**23**	**16**	**26**

Heleomyzinae

Eccoptomera filata Loew, 1862

This species has been recorded from Southern Europe to Western Europe. Larvae have been found in nests and burrows of small mammals.

Eccoptomera longiseta Loew, 1862

Like the previous species it is often found in burrows and nests of small mammals. Because of its hidden way of life, it is not often recorded just like the other species of *Eccoptomera*.

It has been recorded from all over Europe

Eccoptomera pallescens (Meigen, 1830)

This species also has been recorded from caves, but also again in burrows. It seems to prefer somewhat colder conditions. It has been recorded especially in the beginning of spring and end of autumn.

Morpholeria ruficornis (Meigen, 1830)

This Western Palaearctic species has never been collected in long series. Very little is known about its biology.

Neoleria ruficauda (Zetterstedt, 1847)

Neoleria sp. can especially be found in the colder seasons. The first author always collected them on dead mammals. *N. ruficauda* is known from all over Europe

Neoleria ruficeps (Zetterstedt, 1838)

Little is known about this species. It has been recorded from the north of Scandinavia to Northern Africa.

Oecothea fenestralis (Fallén, 1820)

This Holarctic species has spread into a much bigger territory. It has also been recorded from the Neotropics and even in New Zealand. Unlike other species of *Oecothea* it has not been recorded from caves. It is a typical synanthropical species. It is not unusual to find in homes during the entire year, though there seems to be a peak in spring and late autumn.

Schroederella bifida Papp & Carles- Tolrá, 1994 – **Belg. nov. sp.**
Fig. 2

Material examined: 1♀, MT5, 25.X–8.XI.2017.

An interesting record as the species was described only fairly recently and was hitherto only known from Spain. The single specimen was a female, but it was still easy to recognize by the typical bristles on the hind metatarsus.

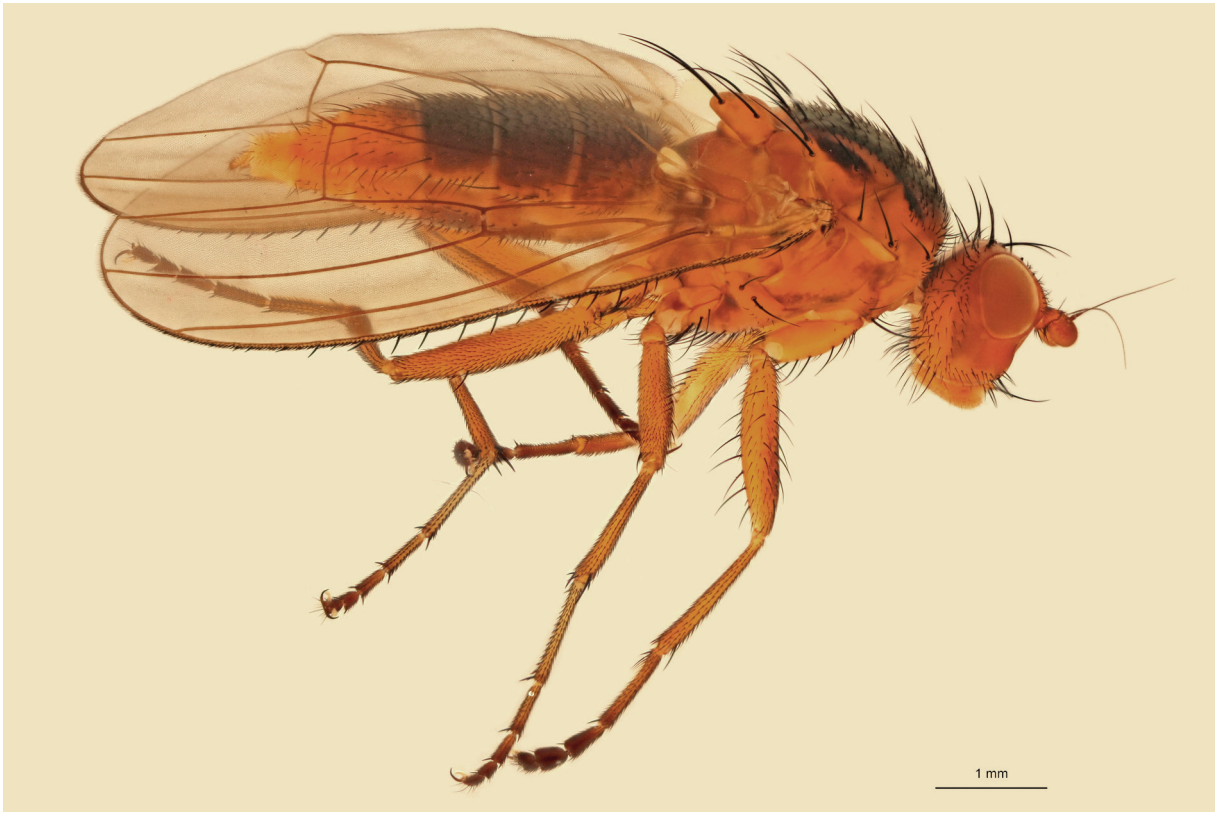

Fig. 2. *Schroederella bifida* Papp & Carles-Tolra, 1994, female, **Belg. sp. nov**. The typical spine-like bristle on the hind metatarsus is obscured by the overlaying wing. © Julien Lalanne.

Heteromyzinae

Heteromyza rotundicornis (Zetterstedt, 1846)

Females of *H. rotundicornis* and *H. commixta* cannot be separated with certainty. As we did not find males of *H. commixta* during this study, all females were attributed to *H. rotundicornis* although the occurrence *H. commixta* in the Botanic Garden Jean Massart is quite well possible.

Tephrochlamys flavipes (Zetterstedt, 1838)

This is the least common of the *Tephrochlamys* species but by no means rare. It is typically more frequent in the colder season than the other species.

Tephrochlamys rufiventris (Meigen, 1830)

Common all over the Holarctic region. Very common in urban areas.

Tephrochlamys tarsalis (Zetterstedt, 1847)

Somewhat less common than *T. rufiventris*. The first author (RvdW) reared the flies in large numbers from decaying willow wood.

Suilliinae

Suillia affinis (Meigen, 1830)

Very common species and found all over Europe except above the Arctic circle.

Suillia atricornis (Meigen, 1830)

A Holarctic species, which can be found everywhere in parks and forests, but it mostly occurs in low numbers.

Suillia bicolor (Zetterstedt, 1838)

This species can be found all over the Palaearctic area and is, in Western Europe, perhaps more common than *S. affinis*. However, it has a smaller size and therefore not as easy to observe as *S. affinis*. Often in large numbers on all kind of fungi.

Suillia fuscicornis (Zetterstedt, 1847) – **Belg. nov. sp.**

Material examined: 1♀, MT5, 25.X–8.XI.2017.

This species is not rare in our part of Europe and can be found all over the Palaearctic.

Suillia humilis (Meigen, 1830)

A species which can be found especially in the colder parts of the Palaearctic area. It is not rare, but not found in large numbers either.

Suillia imberbis Czerny, 1924

This species is closely related to *S. similis*, but it is clearly less often found.

Suillia laevifrons (Loew, 1862)

This species also belongs to the *similis*-group. It is easy to mix up the species in this group. It will be very interesting to revise this group.

Suillia notata (Meigen, 1830)

S. notata belongs to the more common species and it should be possible to find everywhere in Western Europe.

Suillia oxyphora Mik), 1900) – **Belg. nov. sp.**

Material examined: 1♂, MT4, 21.IX-12.X.2017.

While observing *S. bicolor* it is interesting to check whether there are no *S. oxyphora* specimens among them. It is certainly not a common species, but it is not a surprise that the species occurs in Jardin Massart. They are easily recognized by their scutellar projection.

Suillia pallida (Fallén, 1820)

This species is almost as common as *S. affinis* and *S. notata*.

Suillia similis (Meigen, 1838)

Not an uncommon species, but easily mixed up with the other species within the *similis* group: *laevifrons*, *villeneuvei* Czerny, 1924, and *imberbis*.

Suillia variegata (Loew, 1862)

Very common species, which can be found all over Europe, the Middle East and Africa. In the Botanic Garden Jean Massart it also occurs in large numbers.

Suillia (nov.?) sp.

Three females do not seem to belong to any of the known species and need further study. These specimens have longer hairs on mid tibiae and mid metatarsi. The bare strip on the scutellum is narrow. The postabdomen is similar to that of *S. similis*.

Trixoscelidinae

Trixoscelis frontalis (Fallén, 1823) – **Belg. nov. sp.**

Fig. 3.

Material examined: 1♀, MT4, 17–24.V.2017; 1♀, MT5, 17–24.V.2017; 1♀, MT6, 17–24.V.2017.

Trixoscelis frontalis is one of three species in northwestern Europe that has its wings (almost) completely hyaline. The identity of these three species (*T. frontalis*, *T. canescens* Loew, 1865 and *T. similis* Hackman, 1970) has only recently been elucidated (Chandler & Drake, 2016) so the general distribution of the species is unclear. In the United Kingdom it is considered to be a common species and is found in a diversity of habitats, ranging from rather dry (even near dunes) to somewhat wet. The larvae have not been described but adults have been reared from bird nests (Chandler & Drake, 2006).

Discussion

In the past very little attention was paid to the faunistics of the family Heleomyzidae in Belgium. To our knowledge no new records were published after the general inventory by Gosseries (1991a, b). In total we record 25 named species of Heleomyzidae from the Botanic Garden Jean Massart. This is nearly 60% of the species ever recorded in Belgium, including the four new species found in this study. This large number of species in the Garden on such a small surface is probably due to the fact that most Heleomyzidae have a wide distribution with little

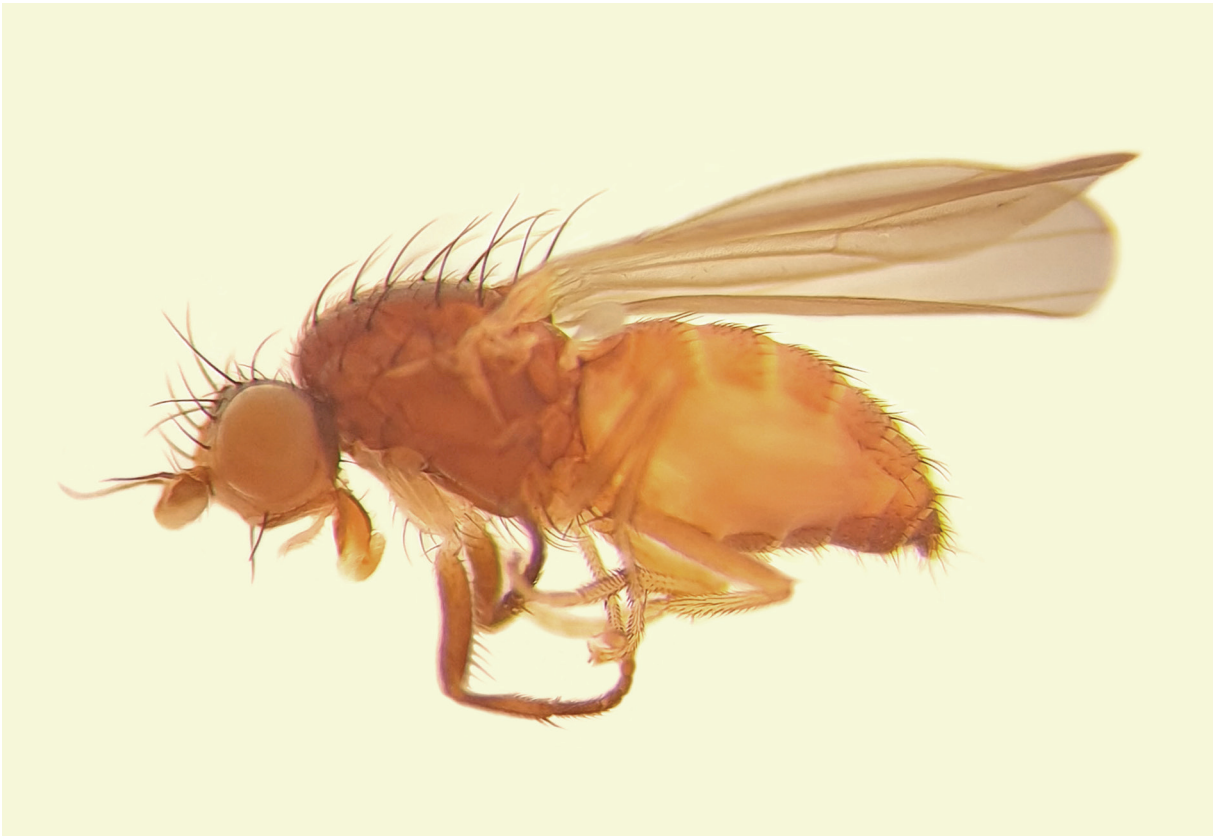

Fig. 3. *Trixoscelis frontalis* (Fallén, 1823) habitus female, another species new for the Belgian fauna. © Paul Beuk.

ecological differences between the species. Indeed the larvae of most species are saprophagous and feed on decaying fungi, carrion and faeces. Nevertheless, some of the recorded species are quite notable. *Schroederella bifida*, described from Spain is recorded here for the first time since its description. *Suillia fuscicornis*, *Suillia oxyphora* and *Trixoscelis frontalis* are also recorded from Belgium for the first time, but each has a considerably wider distribution in Europe.

Acknowledgements

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The Pipunculidae (Diptera) of the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) with a new species record for the Belgian fauna

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Abstract

In a survey of four sites with Malaise traps during 2017 in the Botanic Garden Jean Massart, 199 specimens of Pipunculidae were found belonging to 34 species. *Semicephalops ultimus* (Becker, 1900) was the dominant species. More than half of the species were represented by singletons and doubletons suggesting that the sampling was poor and many more species are to be expected. Associations with hosts are discussed and the checklist of Belgian Pipunculidae is updated. *Chalarus immanis* Kehlmaier *in* Kehlmaier & Assmann, 2008 is recorded for the first time from Belgium.

Keywords: Belgium, big-headed fly, checklist, new species, host, Auchenorrhyncha, *Tipula*.

Résumé

Lors d'une étude avec quatre pièges Malaise au cours de l'année 2017 dans le Jardin botanique Jean Massart, 199 spécimens de Pipunculidae, appartenant à 34 espèces, ont été trouvés. *Semicephalops ultimus* (Becker, 1900) était l'espèce dominante. Plus de la moitié des espèces étaient représentées par des singletons et des doubletons, ce qui suggère que l'échantillonnage était insuffisant et que de nombreuses autres espèces sont à prévoir. Les associations avec les hôtes sont discutées et la liste des Pipunculidae belges est mise à jour. *Chalarus immanis* Kehlmaier *in* Kehlmaier & Assmann, 2008 est signalée pour la première fois en Belgique.

Introduction

Among the Diptera Brachycera, the family Pipunculidae is characterised by its large compound eyes, occupying almost the entire globular head. Their small size (2-12 mm), uniform dark appearance and rather cryptic behaviour allow Pipunculidae to remain unnoticed.

Adults are non-flower visitors and can be found in a wide variety of habitats (wetlands, forests, meadows, lawns...). In the larval stage, Pipunculidae are almost exclusively endoparasitoids of Auchenorrhyncha (Table 1), notably of the families Cixiidae, Cercopidae, Flatidae, Fulgoridae, Delphacidae and Membracidae (Freytag, 1985; Ferrar, 1987; Kapoor *et al*., 1987; Skevington & Marshall, 1997). This highly specialised developmental strategy is unique to this family of Diptera. The overdevelopment of the eyes by the enlarged ommatidia occupying the whole face of the head (Fig. 1), as well as the ovipositor of females, strongly sclerotized like a sting, are a direct consequence of their behaviour. Only representatives of the genus *Nephrocerus* Zetterstedt, 1838, an exception in the Pipunculidae, parasitizes the Diptera Tipulidae (Koenig & Young, 2007; Kehlmaier & Floren, 2010).

Currently 1,484 species of Pipunculidae are known worldwide (Skevington, 2021), divided into four subfamilies and 25 genera (and 3 fossils in Motamedinia *et al*., 2021), but the fauna is still considered poorly known and an estimate of over 2,000 species is given by Skevington & Yeates (2001). In Europe, 213 species are known (Kehlmaier, 2014; Kehlmaier *et al*., 2019; Withers & Claude, 2021) of which 80 were reported from Belgium before the present study (De Meyer & De Bruyn, 1985; Grootaert & De Meyer, 1986; De Meyer, 1989; Albrecht, 1990; De Meyer, 1991; Jervis, 1992; Ackland, 1993; Kehlmaier, 2005).

Table 1. Systematics of European Pipunculidae with known host subfamily (Dempewolf, 1996; Motamedinia *et al*. 2021).

Nephrocerinae	**Host subfamily**
Nephrocerus Zetterstedt, 1838	Diptera: *Tipula*
Chalarinae	
Chalarus Walker, 1834	Typhlocybinae
Verrallia Mik, 1899	Aphrophorinae, Macropsinae
Pipunculinae	
Microcephalopsini	
Microcephalops De Meyer, 1989	Deltocephalinae
Pipunculini	
Beckerias Aczél, 1939	Stenocraninae
Cephalops Fallén, 1810	no data
Cephalosphaera Enderlein, 1936	Cixciinae
Parabeckerias De Meyer, 1994	Delphacinae, Deltocephalinae
Semicephalops De Meyer, 1994	Delphacinae, Deltocephalinae
Pipunculus Latreille, 1802	Deltocephalinae
Tomosvaryellini	
Claraeola Aczél, 1940	no data
Clistoabdominalis Skevington, 2001	Deltocephalinae
Dasydorylas Skevington, 2001	Deltocephalinae
Dorylomorpha Aczél, 1939	Deltocephalinae
Eudorylas Aczél, 1940	Deltocephalinae
Tomosvaryella Aczél, 1939	Deltocephalinae

Material and methods

255 pipunculid specimens were sorted by the second author, from Malaise traps between 2015 and 2017 (but especially the last year) in the Botanic Garden Jean Massart. Details of the trapping and the sites can be found in Grootaert *et al*. (2023). In addition to the 199 specimens identified from 2017 in MT2, MT4, MT5 and MT6, four specimens collected in MT1 in 2016 were included in the calculation of the species accumulation curve.

The identification of Pipunculidae largely requires the study of the genital characteristics of the males, with a high magnification of at least 50 times (80 times for species of the genus *Chalarus* Walker, 1834 in particular). With a few exceptions, females are more difficult to identify, the criteria being based on external anatomical characteristics that sometimes vary.

For the identification of the samples, the following references were used for the different taxa:

Chalarus: Kehlmaier & Assmann; 2008, Kehlmaier, 2010a

Verrallia: Kuznetzov, 1992; Kehlmaier, 2006

Nephrocerus: Grootaert & De Meyer, 1986

Microcephalops: De Meyer, 1989; Dunk & Lauterer, 1998

Beckerias, *Cephalops*, *Parabeckerias*, *Semicephalops*: De Meyer, 1989; Ackland, 1993; Kehlmaier & De Meyer, 2005; Kehlmaier, 2008a; Kehlmaier, 2010b; Kehlmaier & Andrade, 2016

Clareola, *Clistoabdominalis*, *Eudorylas*: Kuznetzov, 1990; Kehlmaier, 2005

Pipunculus: Kehlmaier, 2008a; Kehlmaier, 2010b; Kehlmaier *et al*., 2019; Kozánek *et al*., 2021

Dorylomorpha: Albrecht, 1990; Kehlmaier, 2008b

Tomosvaryella: Földvári & De Meyer, 2000; Kehlmaier, 2008a; Withers & Claude, 2021.

The nomenclature used follows Motamedinia *et al*. (2021).

The specimens were identified by the first author, who has his own reference collection (in 70% ethanol), built up over the course of the determinations, validated by double determination (morphological) and then by molecular confirmation by Christian Kehlmaier for the most problematic specimens.

A reference collection of the identified specimens of the Botanic Garden Jean Massart was built up (at least one specimen per species and sex, stored separately) and, unless otherwise indicated, was deposited together with all the specimen material at the Royal Belgian Institute of Natural Sciences (IRScNB) in 70% ethanol.

Abbreviations

MT: Malaise Trap
Coll: collection
IRScNB: Royal Belgian Institute of Natural Sciences
JC: Jocelyn Claude

Fig. 1. *Tomosvaryella palliditarsis* (Collin, 1931), male and female in copula, a species expected to occur in the Botanic Garden Jean Massart. © Jessica Joachim.

Results

Of the 255 specimens studied, 199 could be identified to species level, representing 34 species (Table 2).

In addition to the above species list, 4 specimens from 2016 (MT1) were identified: *Eudorylas* sp. Aczél, 1940, 2♀♀, 6-14.VIII.2016, *Chalarus longicaudis* Jervis, 1992, 1♂, 6-14.VIII.2016, Coll. JC, *Nephrocerus flavicornis* Zetterstedt, 1844, 1♀, 3-9.VI.2016, Coll. IRScNB.

A total of 34 species were found in the four sites that were sampled in 2017. There are only three species represented by more than 20 specimens as shown in Table 2.

Table 2. List of the 34 species identified of the Botanic Garden Jean Massart ordered by abundance collected in the four sites in 2017.

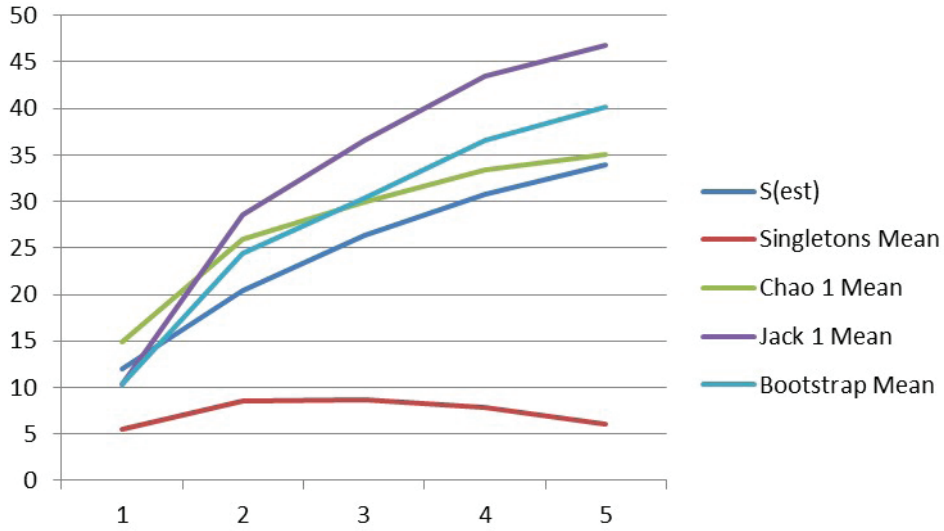
Species / sites	**MT2**	**MT4**	**MT5**	**MT6**	**Total**
Semicephalops ultimus (Becker, 1900)	25	1	24	4	54
Chalarus indistinctus Jervis, 1992	17	1	2	1	21
Semicephalops varipes (Meigen, 1824)	16		5		21
Pipunculus lenis Kuznetzov, 1991	7	1	3		11
Emicephalops varius (Cresson, 1911)	9	1	1		11
Chalarus spurius (Fallén, 1816)	7		1		8
Eudorylas fuscipes (Zetterstedt, 1844)	8				8
Dorylomorpha extricata (Collin, 1937)	4		2		6
Microcephalops opacus (Fallén, 1816)	3	1	2		6
Pipunculus campestris Latreille, 1802	5		1		6
Cephalops vittipes (Zetterstedt, 1844)	2	2			4
Chalarus longicaudis Jervis, 1992	3	1			4
Eudorylas montium (Becker, 1897)	3				3
Verrallia fasciata (Roser, 1840)	2		1		3
Chalarus holosericeus (Meigen, 1824)	2				2
Chalarus latifrons Hardy, 1943	2				2
Chalarus pughi Coe, 1966			2		2
Clistoabdominalis fusculus (Zetterstedt, 1844)	1		1		2
Eudorylas jenkinsoni Coe, 1966	2				2
Eudorylas obscurus Coe, 1966	1	1			2
Eudorylas ruralis (Meigen, 1824)	2				2
Eudorylas zermattensis (Becker, 1897)	2				2
Eudorylas zonellus Collin, 1956	1	1			2
Nephrocerus scutellatus (Macquart, 1834)	2				2
Tomosvaryella sylvatica (Meigen, 1824)	2				2
Verrallia beatricis (Coe, 1966)	1			1	2
Verrallia pilosa (Zetterstedt, 1838)	1		1		2
Beckerias pannonicus (Aczél, 1939)	1				1
Chalarus fimbriatus Coe, 1966	1				1
Chalarus immanis Kehlmaier *in* Kehlmaier & Assmann, 2008	1				1
Dorylomorpha xanthopus (Thomson, 1870)	1				1
Eudorylas subterminalis Collin, 1956	1				1
Nephrocerus flavicornis Zetterstedt, 1844	1				1
Verrallia aucta (Fallén, 1817)			1		1
Total number of specimens	**136**	**10**	**47**	**6**	**199**
Total number of species	**32**	**9**	**14**	**3**	**34**

Discussion

Pipunculidae assemblage

Seven singletons and 13 doubletons were observed. This large number of singletons and doubletons represents more than half of the species that were observed in 2017. This suggests that the sampling is quite poor and that with a larger sample many more species will be found.

Fig. 2. Species accumulation curves calculated according to Colwell (2013) based on 5 sampling periods. S(est) represents the actual number of species (34) recorded in the Botanic Garden, while Chao1 predicts 35 species, Bootstrap 40 species and Jackknife1 47 species. The number of singletons is declining although the actual number of species is still rising and not reaching an asymptote.



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The evolution garden (MT2) has by far the highest diversity (n=32 species). The old orchard with the flower meadow (MT5) has the second highest diversity (n=14 species). The marshland (MT6) has the lowest diversity with only 3 species. The arboretum (MT4), continuously shaded and with very low ground vegetation (Grootaert *et al*. 2023), is mostly very poor in number of species and abundance for other Diptera, whereas here 6 species were observed.

Among the 34 species identified during this work, 8 species of *Chalarus* were found, which is remarkable. *Semicephalops ultimus* (Becker, 1900) is the dominant species. *S. ultimus* is however abundant in MT5 and not in MT6. The other two dominant species in MT2, *Chalarus indistinctus* Jervis, 1992 and *Semicephalops varipes* (Meigen, 1824) are present in low numbers in the other sites.

Link to host species

Based on Table 3 of Dempewolf's (1996) thesis, and consolidated by the few new elements in the literature (Kehlmaier & Assmann, 2008; Kehlmaier & Floren, 2010; Kolcsár, 2018), the associations between the 34 identified Pipunculidae species and their hosts are shown

in Annex 1. Information on the host of 26 species is available, being more than 75% of the species inventoried. The presence of *Cephalops vittipes*, *Chalarus holosericeus*, *Chalarus immanis*, *Chalarus longicaudis*, *Dorylomorpha extricata*, *Eudorylas zermattensis*, *E. zonellus* and *Semicephalops varius* cannot be explained from existing information.

Among the Auchenorrhynch species (identified by Koen Lock) and from the pipunculid species present, (Annex 2) and through literature, the presence of the following Pipunculiae can be logically explained:

Chalarus fimbriatus: *Alnetoidia alneti* (Dahlbom, 1850) and *Eupteryx urticae* (Fabricius, 1803). Eight species of *Edwardsiana* are also listed (Annex 2), and one or more of these could be potential hosts.

Chalarus indistinctus: is logically explained by the presence of *Edwardsiana lethierryi* (Edwards, 1881), *Edwardsiana rosae* (Linnaeus, 1758), *Fagocyba cruenta* (Herrich-Schäffer, 1838), *Ribautiana tenerrima* (Herrich-Schäffer, 1834), *Ribautiana ulmi* (Linnaeus, 1758) and *Typhlocyba quercus* (Fabricius, 1777).

Chalarus pughi: Among the 8 potentially known *Edwardsiana*, no species corresponding to those listed in the literature is present. However, among the *Eupteryx*, *E. aurata* (Linnaeus, 1758) and *E. urticae* (Fabricius, 1803) are present and logically explain the registration of *C. pughi* in the Botanic Garden.

Chalarus spurius: *Eupteryx aurata* (Linnaeus, 1758), *E. cyclops* Matsumura, 1906 and *E. urticae* (Fabricius, 1803).

Clistoabdominalis fusculus: *Balclutha punctata* (Fabricius, 1775)

Dorylomorpha xanthopus: *Arthaldeus pascuellus* (Fallén, 1826), *Euscelis incisus* (Kirschbaum, 1858) and *Psammotettix confinis* (Dahlbom, 1850)

Eudorylas fuscipes: *Macrosteles laevis* (Ribaut, 1927) and *M. sexnotatus* (Fallén, 1806)

Eudorylas jenkinsoni: *Arthaldeus pascuellus* (Fallén, 1826)

Eudorylas montium: *Cicadula quadrinotata* (Fabricius, 1794)

Eudorylas obscurus: *Arthaldeus pascuellus* (Fallén, 1826) and *Psammotettix confinis* (Dahlbom, 1850)

Eudorylas ruralis: *Arthaldeus pascuellus* (Fallén, 1826) and *Psammotettix confinis* (Dahlbom, 1850)

Eudorylas subterminalis: *Arthaldeus pascuellus* (Fallén, 1826), *Cicadula quadrinotata* (Fabricius, 1794), *Euscelis incisus* (Kirschbaum, 1858), *Jassargus pseudocellaris* (Flor, 1861) and *Psammotettix confinis* (Dahlbom, 1850)

Microcephalus opacus: *Balclutha punctata* (Fabricius, 1775)

Pipunculus campestris: *Arthaldeus pascuellus* (Fallén, 1826), *Cicadula quadrinotata* (Fabricius, 1794), *Euscelis incisus* (Kirschbaum, 1858), *Macrosteles laevis* (Ribaut, 1927), *M. sexnotatus* (Fallén, 1806) and *Psammotettix confinis* (Dahlbom, 1850)

Semicephalops ultimus: *Javesella pellucida* (Fabricius, 1794)

Semicephalops varipes: *Javesella pellucida* (Fabricius, 1794)

Tomosvaryella sylvatica: *Arthaldeus pascuellus* (Fallén, 1826), *Jassargus pseudocellaris* (Flor, 1861) and *Psammotettix confinis* (Dahlbom, 1850)

Table 3. List of Pipunculidae of Belgium, based on the work of De Meyer & De Bruyn, 1985 (+2); Grootaert & De Meyer, 1986 (+3); De Meyer, 1989 (+13); Albrecht, 1990 (+7); De Meyer, 1991 (+44); Jervis, 1992 (+8); Ackland, 1993 (+1); Kehlmaier, 2005 (+1), and our present work (+2), according to the current nomenclature (Motamedinia *et al*., 2021) and using the synonymy from the first checklist of De Meyer (1991).

Checklist of Belgian Pipunculidae	**First mention and other data since (or confirmation following taxonomic revision)**
NEPHROCERINAE Carpenter & Hull, 1939	
Nephrocerus flavicornis Zetterstedt, 1844	Grootaert & De Meyer (1986); present study
Nephrocerus lapponicus Zetterstedt, 1838	Grootaert & De Meyer (1986)
Nephrocerus scutellatus (Macquart, 1834)	Grootaert & De Meyer (1986); present study
CHALARINAE Aczél, 1939	
Chalarus brevicaudis Jervis, 1992	Jervis (1992)
Chalarus decorus Jervis, 1992	Jervis (1992)
Chalarus fimbriatus Coe, 1966	Jervis (1992); present study
Chalarus holosericeus (Meigen, 1824)	Jervis (1992); Kehlmaier & Assmann (2008); present study
= *Chalarus perplexus* Jervis, 1992	
Chalarus immanis Kehlmaier, 2008 *in* Kehlmaier & Assmann, 2008	This study
Chalarus indistinctus Jervis, 1992	Jervis (1992); present study
Chalarus latifrons Hardy1943	Jervis (1992); present study
Chalarus longicaudis Jervis, 1992	Jervis (1992); present study
Chalarus pughi Coe, 1966	Jervis (1992); present study
Chalarus spurius (Fallén, 1816)	De Meyer (1991); Jervis (1992); present study
Verrallia aucta (Fallén, 1817)	De Meyer (1991); present study
Verrallia beatricis (Coe, 1966)	De Meyer (1991); Kehlmaier (2006); present study
= *Jassidophaga beatricis* (Coe, 1966)	
Verrallia fasciata (Roser, 1840)	De Meyer (1991); Kehlmaier (2006); present study
= *Jassidophaga fasciata* (Roser, 1840)	
= *Verrallia setosa* Verrall, 1901	
Verrallia pilosa (Zetterstedt, 1838)	De Meyer (1991); Kehlmaier (2006); present study
= *Jassidophaga pilosa* (Zetterstedt, 1838)	
Verrallia villosa (Roser, 1840)	De Meyer (1991)
= *Jassidophaga villosa* (Roser, 1840)	
PIPUNCULINAE Walker, 1834	
MICROCEPHALOPSINI, Aczél, 1940	
Microcephalops opacus (Fallén, 1816)	De Meyer (1989); present study
= *Microcephalops vestitus* (Becker, 1900)	
PIPUNCULINI Walker, 1834	
Beckerias pannonicus Aczél, 1939	De Meyer (1989); present study
Cephalops aeneus Fallén, 1810	De Meyer (1989)
Cephalops vittipes (Zetterstedt, 1844)	De Meyer (1989); present study
Cephalosphaera furcate (Egger, 1860)	De Meyer (1989)
= *Cephalops furcatus* (Egger, 1860)	
Cephalosphaera germanica (Aczél, 1940)	De Meyer (1989)
= *Cephalops* Germanicus (Aczél, 1940)	
Parabeckerias obtusinervis (Zetterstedt, 1884)	De Meyer (1989)
= *Cephalops obtusinervis* (Zetterstedt, 1884)	
= *Cephalops chlorionae* (Frey, 1945)	
Semicephalops carinatus (Verrall, 1901)	De Meyer (1989)
= *Cephalops carinatus* (Verrall, 1901)	
Semicephalops penultimus (Ackland, 1993)	Ackland (1993)
Semicephalops perspicuous (de Meijere, 1905)	De Meyer (1989)

Checklist of Belgian Pipunculidae	**First mention and other data since (or confirmation following taxonomic revision)**
Semicephalops signatus (Becker, 1900)	De Meyer (1989)
= *Cephalops signatus* (Becker, 1900)	
Semicephalops subultimus Collin, 1956	De Meyer (1989)
= *Cephalops subultimus* Collin, 1956	
Semicephalops ultimus (Becker, 1900)	De Meyer (1989); present study
= *Cephalops ultimus* (Becker, 1900)	
Semicephalops varius (Cresson, 1911)	present study
Semicephalops varipes (Meigen, 1824)	De Meyer (1989); present study
= *Cephalops semifumosus* (Kowarz, 1887)	
Pipunculus calceatus von Roser, 1840	De Meyer (1991)
Pipunculus campestris Latreille, 1802	De Meyer (1991); present study
Pipunculus elegans Egger, 1860	De Meyer (1991)
= *Pipunculus spinipes* auct. nec Meigen, 1830	
Pipunculus fonsecai Coe, 1966	De Meyer (1991)
Pipunculus lenis Kuznetzov, 1991	De Meyer (1991); present study
= *Pipunculus thomsoni* auct. nec Becker, 1897	
Pipunculus oldenbergi Collin, 1956	De Meyer (1991)
Pipunculus omissinervis Becker, 1889	De Meyer (1991)
= *Pipunculus phaeton C*oe, 1966	
Pipunculus tenuirostris Kozánek, 1981	De Meyer (1991)
Pipunculus violovitshi Kuznetzov, 1991	De Meyer (1991)
= *Pipunculus varipes* auct. nec Meigen, 1824	
Pipunculus zugmayeriae Kowarz, 1887	De Meyer (1991)
TOMOSVARYELLINI, Hardi, 1943	
Claraeola halterata (Meigen, 1838)	De Meyer (1991)
= *Eudorylas halteratus* (Meigen, 1838)	
Claraeola melanostola (Becker, 1897)	De Meyer (1991)
= *Eudorylas melanostolus* (Becker, 1898)	
Clistoabdominalis fusculus (Zetterstedt, 1844)	De Meyer (1991); present study
= *Eudorylas fusculus* (Zetterstedt, 1844)	
Dasydorylas horridus (Becker, 1897)	De Meyer (1991)
= *Eudorylas horridus* (Becker, 1897)	
Dorylomorpha (*Dorylomorpha*) *confusa* (Verrall, 1901)	Albrecht (1990)
Dorylomorpha (*Dorylomorpha*) *extricata* (Collin, 1937)	De Meyer & De Bruyn (1985); present study
Dorylomorpha (*Dorylomorpha*) *imparata* (Collin, 1937)	Albrecht (1990)
Dorylomorpha (*Dorylomorpha*) *rufipes* (Meigen, 1824)	De Meyer & De Bruyn (1985)
Dorylomorpha (*Dorylomyia*) *incognita* (Verrall, 1901)	De Meyer (1991)
Dorylomorpha (*Dorylomyia*) *xanthocera* (Kowarz, 1887)	Albrecht (1990)
Dorylomorpha (*Dorylomyza*) *albitarsis* (Zetterstedt, 1844)	Albrecht (1990)
Dorylomorpha (*Dorylomyza*) *hungarica* (Aczél, 1939)	Albrecht (1990)
Dorylomorpha (*Dorylomyza*) *infirmata* (Collin, 1937)	Albrecht (1990)
Dorylomorpha (*Dorylomyza*) *xanthopus* (Thomson, 1870)	Albrecht (1990); present study
Dorylomorpha (*Pipunculina*) *maculata* (Walker, 1834)	De Meyer (1991)
Eudorylas coloratus (Becker, 1897)	Kehlmaier (2005)
Eudorylas fascipes (Zetterstedt, 1844)	De Meyer (1991)
Eudorylas fuscipes (Zetterstedt, 1844)	De Meyer (1991); present study
Eudorylas inferus Collin, 1956	De Meyer (1991)
Eudorylas jenkinsoni Coe, 1966	De Meyer (1991); present study
Eudorylas kowarzi (Becker, 1897)	De Meyer (1991); Kehlmaier (2005)
Eudorylas longifrons Coe, 1966	De Meyer (1991)

Checklist of Belgian Pipunculidae	First mention and other data since (or confirmation following taxonomic revision)
Eudorylas montium (Becker, 1897)	De Meyer (1991); Kehlmaier (2005); present study
Eudorylas obliquus Coe, 1966	De Meyer (1991)
Eudorylas obscurus Coe, 1966	De Meyer (1991); Kehlmaier (2005); present study
Eudorylas ruralis (Meigen, 1824) = *Clistoabdominalis ruralis* (Meigen, 1824)	De Meyer (1991); present study
Eudorylas subfascipes Collin, 1956	De Meyer (1991)
Eudorylas subterminalis Collin, 1956	De Meyer (1991); present study
Eudorylas terminalis (Thomson, 1870)	De Meyer (1991)
Eudorylas zermattensis (Becker, 1897)	De Meyer (1991); present study
Eudorylas zonatus (Zetterstedt, 1849)	De Meyer (1991)
Eudorylas zonellus Collin, 1956	De Meyer (1991); present study
Tomosvaryella cilitarsis (Strobl, 1910)	De Meyer (1991)
Tomosvaryella geniculata (Meigen, 1824)	De Meyer (1991)
Tomosvaryella kuthyi Aczel, 1944	De Meyer (1991)
Tomosvaryella littoralis (Becker, 1897)	De Meyer (1991)
Tomosvaryella minima (Becker, 1897)	De Meyer (1991)
Tomosvaryella palliditarsis (Collin, 1931)	De Meyer (1991)
Tomosvaryella sylvatica (Meigen, 1824)	De Meyer (1991); present study

For three other pipunculid species, their hosts are not identified nor present. Some elements of discussion can be arised:

Beckerias pannonicus: its host, *Stenocranus minutus* (Fabricius, 1787), is not present, but a closely related species is listed: *S. major* (Kirschbaum, 1868).

Chalarus latifrons is known to parasitize Cicadellidae of the genus *Kybos*. Two species are recorded in the literature: *K. butleri* (Edwards, 1908) and *K. smaragdulus* (Fallén, 1806) but are not present here. Four other *Kybos* species are listed (Annex 2) and could potentially be parasitized by *Chalarus latifrons* [*K. lindbergi* (Linnavuori, 1951), *K. mucronatus* (Ribaut, 1933), *K. populi* (Edwards, 1908) and *K. virgator* (Ribaut, 1933)].

Pipunculus lenis: only *Elymana sulphurella* (Zetterstedt, 1828) is known to be its host. This cicadellid is not mentioned locally. It is therefore possible that *P. lenis* uses one or more other species of Deltocephalinae to complete its cycle.

Among the *Verralia* species, *V. aucta* is a bit of a standout among this genus and parasitizes the Aphrophoridae of which *Philaenus spumarius* is shown here. All other *Verralia* species, belonging to the ex-genus *Jassidophaga*, are known to parasitise Cicadellidae Macropsinae of the genus *Oncopsis*. In the studied site, *O. flavicollis* (Linnaeus, 1761) and *O. tristis* (Zetterstedt, 1840) are reported and explain the presence of *V. fasciata*. It is likely that other *Oncopsis* species present are potential hosts (present in the site are *O. alni* (Schrank, 1801 and *O. subangulata* (Sahlberg, 1871)) or that *V. beatricis* and *V. pilosa* also parasitise *O. flavicollis*.

Concerning the genus *Nephrocerus*, whose species parasitise Tipulidae Diptera - and more particularly those of the genus *Tipula*, two species out of the three present in Europe and Belgium were identified: *Nephrocerus flavicornis* Zetterstedt, 1844 and *N. scutellatus* (Macquart, 1834). In the Botanic Garden Jean Massart, the Tipulidae were identified by Kris Peeters, using the same study material as for the Pipunculidae. The number of species obtained is important (n=17), logically explained by the presence of wetlands and associated environments. Among the 17 species reported (Peeters, 2023), *Tipula helvola* (Loew, 1873) and *T. unca* (Wiedemann, 1817), are known hosts of *Nephrocerus* recorded during this study (Annex 2). On the other hand, the absence of *Nephrocerus lapponicus* Zetterstedt, 1838, a pipunculid that is nevertheless

frequent (and present in Belgium), in this study raises questions. Its absence may be linked to an insufficient sampling effort and/or the lack of its host tipules (no species reported in the literature to date). In the nature reserve of Côte de Mancy (Jura, France), all three species of *Nephrocerus* are present, whereas only *Tipula vernalis* Meigen, 1804, a species with a wide ecological range, is recorded (Malécot & Claude, in press).

Contribution to Pipunculidae knowledge and Belgian checklist

Chalarus immanis Kehlmaier *in* Kehlmaier & Assmann, 2008 is to our knowledge (Table 3), not reported to date in Belgium. MT2, 1♂, 30.VI.- 6.VII.2017, Coll. IRScNB.

Note: *Eudorylas sulcatus* (Becker, 1897) cited by De Meyer (1991) but was de-listed by Kehlmaier (2005). *Chalarus basalis* Loew, 1873 is cited by De Meyer (1991) but published citings should be reviewed as females are very similar to *Ch. Pughi* (Kehlmaier & Assmann, 2008). The presence of *Verrallia villosa* (Roser, 1840) in De Meyer (1991) is to be confirmed. According to the European revision of the genus (Kehlmaier 2006), Belgium is not mentioned in the distribution. *Eudorylas inferus* Collin, 1956, is also to be verified (Kehlmaier, 2005). Finally, *Eudorylas zonatus* (Zetterstedt, 1849) is widely distributed in Europe but the Belgian specimens from 2005 onward need verification (Kehlmaier, 2005). Old male records need to be confirmed due to a possible confusion with *E. inferus* Collin, 1956 and *E. zonellus* Collin, 1956.

Perspectives

From the list of Belgian Pipunculidae consolidated in the present study (Table 3) and the Auchenorrhyncha and Tipulidae species recorded (Annex 2), 10 species can be potentially expected in the Botanic Garden Jean Massart (Table 4). These pipunculids could be found by using additional Malaise traps, by sight hunting with nets, or by rearing from infested leafhoppers.

Table 4. List of other potential Pipunculids, predicted from the presence of the host Auchenorrhyncha and Tipulidae recorded in the Botanic Garden Jean Massart. Other species not yet recorded in Belgium, such as *Chalarus juliae* Jervis, 1992 (host *Empoasca vitis* (Goethe, 1875), could also be added in the future.

Potential Pipunculidae species	**Registered host species in the Botanic Garden Jean Massart**	**References**
Cephalosphaera furcata (Egger, 1860)	*Tachycixius pilosus* (Olivier, 1791)	Waloff & Jervis (1987)
Chalarus brevicaudis Jervis, 1992	*Empoasca vitis* (Goethe, 1875)	Jervis (1992)
Dasydorylas horridus (Becker, 1897)	*Euscelis incisus* (Kirschbaum, 1858)	Sander (1985)
Dorylomorpha hungarica Aczél, 1939	*Cicadula flori* Sahlberg, 1871 *Cicadula quadrinotata* (Fabricius, 1794)	Waloff & Jervis (1987)
Dorylomorpha rufipes (Meigen, 1824)	*Cicadula quadrinotata* (Fabricius, 1794)	Waloff (1975), Huq (1982)
Eudorylas fascipes (Zetterstedt, 1844)	*Arthaldeus pascuellus* (Fallén, 1826) *Cicadula quadrinotata* (Fabricius, 1794) *Deltocephalus pulicaris* (Fallen, 1806) *Psammotettix confinis* (Dahlbom, 1850)	Waloff & Jervis (1987)
Eudorylas longifrons Coe, 1966	*Euscelis incisus* (Kirschbaum, 1858) *Arthaldeus pascuellus* (Fallén, 1826)	Sander (1985)
Eudorylas obliquus Coe, 1966	*Cicadula quadrinotata* (Fabricius, 1794) *Psammotettix confinis* (Dahlbom, 1850)	Waloff & Jervis (1987)
Eudorylas subfascipes Collin, 1956	*Euscelis incisus* (Kirschbaum, 1858) *Psammotettix confinis* (Dahlbom, 1850) *Jassargus pseudocellaris* (Flor, 1861)	Sander (1985) Waloff & Jervis (1987) Waloff (1975), Huq (1982)
Tomosvaryella kuthyi Aczél, 1944	*Psammotettix confinis* (Dahlbom, 1850)	Waloff & Jervis (1987)

The list of potential species is certainly not limited to 10 species, as for many European species the hosts are still unknown. The prospects for future studies on pipunculids and their hosts are promising and exciting.

Conclusion

The valorisation of pipunculids captured in the Malaise traps of the Jean Massart garden in Brussels allows us to advance local entomological knowledge by adding 34 species to the inventory, only *Nephrocerus flavicornis* (Zetterstedt, 1844) being known before this work. It is very likely that more species will be discovered in the coming years.

As done by Hollier *et al*. (2016) and Malécot & Claude (in press), information between Auchenorrhyncha and Diptera Tipulidae hosts was cross-referenced with the identified Pipunculidae parasites. But unlike them, this work establishes host relationships for more than 75% of the Pipunculidae identified here. Several species are however poorly or not explained, showing a clearly insufficient level of knowledge. This observation of fragility is also deepened by the evolution of taxonomy since the first work on the ecology of Pipunculidae in the 1970s and 1980s and the absence of contemporary studies on the subject.

The knowledge on the Pipunculidae of Belgium (80 species recorded before the present study), based on 8 studies (Table 3) can be judged as quite good. The present identification study of the material originating from the Botanic Garden Jean Massart consolidates this list with one species new to the Belgian fauna. In comparison, 140 species are listed in France (Withers & Claude, 2021), 107 in Finland (Kehlmaier, 2014) and Switzerland (Claude *et al*., 2021; Claude *et al*., in prep.), 101 in Spain and 106 in Italy (Kehlmaier *et al*. 2019; Withers & Claude, 2021) and 82 in the Netherlands (De Meyer & Beuk, 2021).

In the future, by intensifying the surveys at the Botanic Garden Jean Massart and examination of more samples collected elsewhere in the country (e.g. peat bogs of the Hautes Fagnes), as well as by studying the relationship with hosts, there are still important and interesting perspectives for improving our knowledge of the Pipunculidae of Belgium.

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Annex 1. The 34 species of Pipunculidae recorded in the Botanic Garden Jean Massart, with their known European hosts. Host species in bold are present in the Botanic Garden Jean Massart: Hemiptera, Auchenorrhyncha (det. K. Lock) and Diptera: Tipulidae *Tipula* (det. K. Peeters).

Pipunculid parasitoid	Host family	Host species	References
Beckerias pannonicus	Delphacidae	*Stenocranus minutus* (Fabricius, 1787)	Waloff & Jervis (1987)
Cephalops vittipes	no data		
Chalarus fimbriatus	Cicadellidae	***Alnetoidia alneti* (Dahlbom, 1850)**	Jervis (1992)
		Edwardsiana Zachvatkin, 1929	Kehlmaier & Assmann (2008)
		***Eupteryx urticae* (Fabricius, 1803)**	Kehlmaier & Assmann (2008)
Chalarus holosericeus	no data		
Chalarus immanis	no data		
Chalarus indistinctus	Cicadellidae	*Edwardsiana bergmanni* (Tullgren, 1916)	Jervis (1992)
		Edwardsiana geometrica (Schrank, 1801)	Jervis (1992)
		***Edwardsiana lethierryi* (Edwards, 1881)**	Jervis (1992)
		***Edwardsiana rosae* (Linnaeus, 1758)**	Jervis (1992)
		***Fagocyba cruenta* (Herrich-Schäffer, 1838)**	Jervis (1992)
		Fagocyba Dlabola, 1958	Jervis (1992)
		***Ribautiana tenerrima* (Herrich-Schäffer, 1834)**	Jervis (1992)
		***Ribautiana ulmi* (Linnaeus, 1758)**	Jervis (1992)
		***Typhlocyba quercus* (Fabricius, 1777)**	Jervis (1992)
Chalarus latifrons	Cicadellidae	*Kybos butleri* (Edwards, 1908)	Jervis (1992)
		Kybos smaragdulus (Fallén, 1806)	Jervis (1992)
Chalarus longicaudis	no data		
Chalarus pughi	Cicadellidae	*Edwardsiana geometrica* (Schrank, 1801)	Kehlmaier & Assmann (2008)
		Edwardsiana Zachvatkin, 1929	Kehlmaier & Assmann (2008)
		***Eupteryx aurata* (Linnaeus, 1758)**	Kehlmaier & Assmann (2008)
		***Eupteryx urticae* (Fabricius, 1803)**	Kehlmaier & Assmann (2008)
Chalarus spurius	Cicadellidae	***Eupteryx aurata* (Linnaeus, 1758)**	Jervis (1992)
		***Eupteryx cyclops* Matsumura, 1906**	Jervis (1992)
		Eupteryx melissae Curtis, 1837	Jervis (1992)
		***Eupteryx urticae* (Fabricius, 1803)**	Jervis (1992)
Clistoabdominalis fusculus	Cicadellidae	***Balclutha punctata* (Fabricius, 1775)**	Waloff & Jervis (1987)
Dorylomorpha extricata	no data		
Dorylomorpha xanthopus	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Conosanus obsoletus (Kirschbaum, 1858)	Waloff & Jervis (1987)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		***Euscelis incisus* (Kirschbaum, 1858)**	Waloff & Jervis (1987)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff & Jervis (1987)
Eudorylas fuscipes	Cicadellidae	*Arocephalus punctum* (Flor, 1861)	Sander (1985)
		Elymana sulphurella (Zetterstedt, 1828)	Waloff & Jervis (1987)
		***Macrosteles laevis* (Ribaut, 1927)**	Waloff & Jervis (1987)
		***Macrosteles sexnotatus* (Fallén, 1806)**	Waloff & Jervis (1987)
		Macrosteles variatus (Fallén, 1806)	Waloff & Jervis (1987)
Eudorylas jenkinsoni	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
Eudorylas montium	Cicadellidae	*Cicadula albingensis* Wagner, 1940	Sander (1985)
		***Cicadula quadrinotata* (Fabricius, 1794)**	Waloff & Jervis (1987)
		Mocydia crocea (Herrich-Schäffer, 1837)	Huq (1982)

Pipunculid parasitoid	Host family	Host species	References
Eudorylas obscurus	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
		Mocydia crocea (Herrich-Schäffer, 1837)	Sander (1985)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff & Jervis (1987)
Eudorylas ruralis	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
		Mocydia crocea (Herrich-Schäffer, 1837)	Sander (1985)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff & Jervis (1987)
Eudorylas subterminalis	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		***Cicadula quadrinotata* (Fabricius, 1794)**	Hu (1982)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
		***Euscelis incisus* (Kirschbaum, 1858)**	Waloff & Jervis (1987)
		Jassargus distinguendus (Flor, 1861)	Waloff & Jervis (1987)
		Jassargus flori (Fieber, 1869)	Waloff & Jervis (1987)
		***Jassargus pseudocellaris* (Flor, 1861)**	Waloff (1975)
		Mocuellus collinus (Boheman, 1850)	Waloff & Jervis (1987)
		Mocydia crocea (Herrich-Schäffer, 1837)	Sander (1985)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff (1975)
		Psammotettix helvolus (Kirschbaum, 1868)	Sander (1985)
		Psammotettix kolosvarensis (Matsumura, 1908)	Waloff & Jervis (1987)
		Psammotettix nodosus (Ribaut, 1925)	Waloff & Jervis (1987)
		Turrutus socialis (Flor, 1861)	Waloff & Jervis (1987)
Eudorylas zermattensis	no data		
Eudorylas zonellus	no data		
Microcephalus opacus	Cicadellidae	***Balclutha punctata* (Fabricius, 1775)**	Waloff & Jervis (1987)
Nephrocerus flavicornis	Tipulidae	***Tipula helvola* Loew, 1873**	Kolcsár (2018)
		***Tipula unca* Wiedemann, 1817**	Kehlmaier & Floren (2010)
Nephrocerus scutellatus	Tipulidae	***Tipula helvola* Loew, 1873**	Kehlmaier & Floren (2010)
Pipunculus campestris	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Cicadula flori (Sahlberg, 1871)	Waloff & Jervis (1987)
		Cicadula frontalis (Herrich-Schäffer, 1835)	Sander (1985)
		***Cicadula quadrinotata* (Fabricius, 1794)**	Waloff & Jervis (1987)
		Conosanus obsoletus (Kirschbaum, 1858)	Waloff & Jervis (1987)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		Elymana kozhevnikovi (Zachvatkin, 1938)	Sander (1985)
		Elymana sulphurella (Zetterstedt, 1828)	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
		***Euscelis incisus* (Kirschbaum, 1858)**	Waloff & Jervis (1987)
		***Macrosteles laevis* (Ribaut, 1927)**	Waloff & Jervis (1987)
		***Macrosteles sexnotatus* (Fallén, 1806)**	Waloff & Jervis (1987)
		Mocydia crocea (Herrich-Schäffer, 1837)	Sander (1985)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff & Jervis (1987)
		Psammotettix helvolus (Kirschbaum, 1868)	Sander (1985)
Pipunculus lenis	Cicadellidae	*Elymana sulphurella* (Zetterstedt, 1828)	Waloff & Jervis (1987)

Pipunculid parasitoid	**Host family**	**Host species**	**References**
Semicephalops ultimus	Cicadellidae	*Speudotettix subfusculus* (Fallén, 1806)	Huq (1982)
	Delphacidae	*Conomelus anceps* (Germar, 1821)	Waloff & Jervis (1987)
		Criomorphus williamsi China, 1939	Waloff & Jervis (1987)
		Delphacodes venosus (Germar, 1830)	Waloff & Jervis (1987)
		Dicranotropis hamata (Boheman, 1847)	Waloff & Jervis (1987)
		Eurysa lineata (Perris, 1857)	Waloff & Jervis (1987)
		***Javesella pellucida* (Fabricius, 1794)**	Sander (1985)
Semicephalops varipes	Delphacidae	*Conomelus anceps* (Germar, 1821)	Waloff & Jervis (1987)
		Criomorphus williamsi China, 1939	Waloff & Jervis (1987)
		Delphacodes venosus (Germar, 1830)	Waloff & Jervis (1987)
		Dicranotropis hamata (Boheman, 1847)	Waloff & Jervis (1987)
		Ditropis pteridis (Spinola, 1839)	Waloff & Jervis (1987)
		Hyledelphax elegantulus (Boheman, 1847)	Waloff & Jervis (1987)
		Javesella discolor (Boheman, 1847)	Waloff & Jervis (1987)
		***Javesella pellucida* (Fabricius, 1794)**	Waloff & Jervis (1987)
Semicephalops varius	no data		
Tomosvaryella sylvatica	Cicadellidae	***Arthaldeus pascuellus* (Fallén, 1826)**	Waloff & Jervis (1987)
		Diplocolenus abdominalis (Fabricius, 1803)	Waloff & Jervis (1987)
		Errastunus ocellaris (Fallén, 1806)	Waloff & Jervis (1987)
		Jassargus distinguendus (Flor, 1861)	Waloff & Jervis (1987)
		***Jassargus pseudocellaris* (Flor, 1861)**	Waloff (1975), Huq (1982)
		Mocuellus collinus (Boheman, 1850)	Huq (1982)
		Ophiola ocellaris (Lethierry, 1880)	Waloff (1975)
		***Psammotettix confinis* (Dahlbom, 1850)**	Waloff & Jervis (1987)
		Psammotettix kolosvarensis (Matsumura, 1908)	Huq (1982)
		Turrutus socialis (Flor, 1861)	Huq (1982)
Verrallia aucta	Aphrophoridae	*Neophilaenus lineatus* (Linnaeus, 1758)	Waloff & Jervis (1987)
		***Philaenus spumarius* (Linnaeus, 1758)**	Waloff & Jervis (1987)
Verrallia beatricis	Cicadellidae	*Oncopsis alni* (Schrank, 1801)	Waloff & Jervis (1987)
Verrallia fasciata	Cicadellidae	***Oncopsis flavicollis* (Linnaeus, 1761)**	Waloff & Jervis (1987)
		Oncopsis subangulata (Sahlberg, 1871)	Waloff & Jervis (1987)
Verrallia pilosa	Cicadellidae	*Oncopsis* Burmeister, 1838	Waloff & Jervis (1987)
		Oncopsis subangulata (Sahlberg, 1871)	Waloff & Jervis (1987)

Results of a Malaise trap sampling campaign at the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) *partim* Syrphidae (Diptera)

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Abstract

The Botanic Garden Jean Massart in Oudergem (Brussels-Capital Region, Belgium) is part of a unique area with meadows, seepage areas and ponds at the outskirts of the Sonian forest. A Malaise trap survey in 2015 and 2017 yielded 114 species of Syrphidae, with a good representation of saproxylic species and species of wet meadows and marshlands. Rarefaction indicates that the sampling is still far from complete, which is corroborated by existing data from the surrounding area where >175 hover fly species have been recorded, including a regionally unique mixture of saproxylic species (*Callicera*, *Mallota*, *Myolepta* and *Pocota* spp., etc.) not found in the present sampling, possibly because they are canopy species that are underrepresented in Malaise traps. In addition to forest species, a diverse assemblage of species of wet meadows and marshlands is found, indicative of its relatively good habitat quality. More (and scarcer) species of this ecological group are found at similar places in the Sonian forest indicating the importance of these ecosystems within the Brussels area. Overall, the Botanic Garden Jean Massart and its environs are a highly diverse area for syrphid flies, and because of its high floral abundance, probably constitutes an essential piece in the ecological network at the west side of the Sonian forest.

Keywords: biodiversity survey, saproxylic species, seepages

Introduction

Members of the hover flies (Syrphidae) are generally medium-sized, attractive flies with conspicuous colours mimicking bees or wasps. They are frequent flower visitors that make an important contribution to pollination and aphid control in crops and natural ecosystems (van Rijn & Smit, 2007; Inouye *et al.*, 2015). Recent studies have indicated strong declines of Syrphidae in North-western Europe (Doyle *et al.*, 2020; Hallmann *et al.*, 2021; Barendregt *et al*, 2022) and a recent Red List for the Flanders region in Belgium indicates that 44% is threatened to some extent or has gone extinct (Van de Meutter *et al*., 2021). Monitoring initiatives need to be launched with the aid of standard trapping methods to document the current trends of insects (https://wikis.ec.europa.eu/display/EUPKH/EU+Pollinator+monitoring+framework) to feed and evaluate conservation initiatives. Identifying hotspots of specific groups, such as Syrphidae, will be part of effective protection of our fauna.

In the present paper, the results on the Syrphidae collected during the Malaise trap survey conducted between 2015 and 2017 in the Botanic Garden Jean Massart are presented. The results will be discussed and put into context relative to available data for the area.

Material and methods

A description of the Botanic Garden Jean Massart, the sample sites, the sample methodology and sample processing is given in Grootaert *et al*. (2023).

A total of 63 samples containing Syrphidae were processed for this project. They came from two different Malaise traps in 2015 (MT1 & MT2) and four Malaise traps in 2017 (MT2, MT4, MT5, MT6). Syrphidae were identified using Bot & Van de Meutter (2019). Nomenclature also follows Bot & Van de Meutter (2019) except for *Cheilosia ruffipes* (Preyssler, 1793) that is used for *Cheilosia soror* (Zetterstedt, 1843). Species habitat affinity traits are taken from Speight, 2015. This publication presents species affinity scores (ranging 1-3) to different habitat types for all European hover flies. For this study we have only retained habitat affinities >1 as indicative of a strong habitat link. Species can have a strong habitat link to different habitats. For simplicity we have only retained the four overarching habitat groups [aquatic habitats, forest, cultural habitats and open habitats, for more details and background see Speight (2015)]. A sample-based species rarefaction curve was made using the specaccum function in Vegan (Oksanen *et al.*, 2018). The data of this study at the Botanic Garden Jean Massart are put into a larger context of the area using data of the Belgian Syrphidae database (BELSYRPHDAT) hosted by Frank Van de Meutter at INBO (Research Institute for Nature and Forest).

Results

Table 1 gives an overview of the species collected. A total of 2,271 specimens were examined, with 2,238 identified with absolute certainty. The specimens of uncertain identity are females of the genera *Eumerus*, *Neocnemodon*, *Pipizella* and *Platycheirus* that most likely belong to some species recorded with certainty (i.e. they are not extra species). A total of 114 different species were recognized. The rarefaction curve of all samples combined indicates that species richness still moderately increases and has not reached the asymptote of local α-diversity yet (Fig. 1).

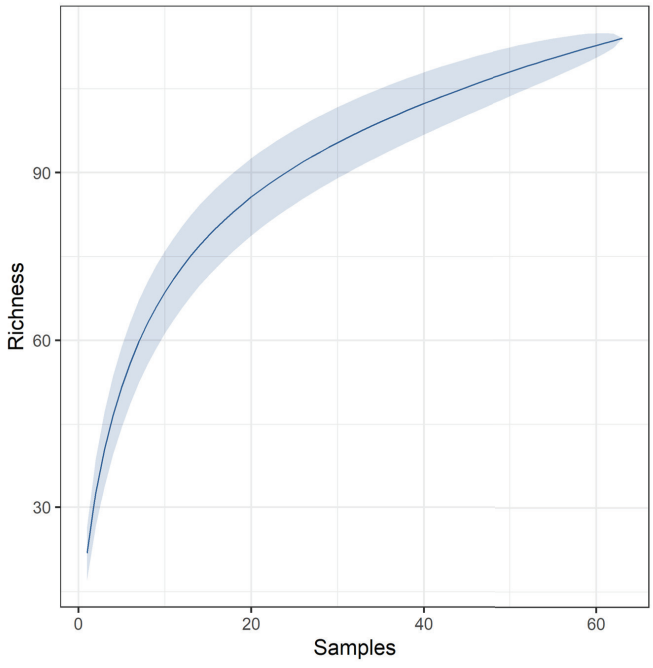

Fig. 1. Rarefaction curve of all samples in the Botanic Garden Jean Massart (combining years and different Malaise traps). Richness refers to species richness i.e. the number of species.

Table 1. List of species and numbers recorded for the different Malaise traps at the Botanic Garden Jean Massart, Oudergem, Brussels-Capital Region, Belgium.

Species	**MT1**	**MT2**	**MT3**	**MT5**	**MT6**	**Total**
Anasimyia contracta		2				2
Baccha elongata	12	12		2		26
Brachyopa pilosa	1	2			1	4
Brachyopa scutellaris	2	7				9
Brachypalpoides lentus	3					3
Brachypalpus laphriformis		2				2
Caliprobola speciosa	3	5		1		9
Ceriana conopsoides		1				1
Chalcosyrphus nemorum	13	68	1	3	11	96
Cheilosia albipila		1				1
Cheilosia albitarsis	23	57	5	61	4	150
Cheilosia chloris		1				1
Cheilosia himantopus		1				1
Cheilosia lasiopa	1	4				5
Cheilosia pagana	4	18		1		23
Cheilosia ruffipes		1				1
Cheilosia scutellata	5	5			1	11
Cheilosia semifasciata	1	3		2		6
Cheilosia uviformis	1	1				2
Cheilosia variabilis				1		1
Chrysogaster solstitialis	3	2		1	1	7
Chrysotoxum bicinctum		5				5
Criorhina asilica		5			1	6
Criorhina berberina	14	8				22
Criorhina ranunculi		2				2
Dasysyrphus albostriatus	2	5				7
Dasysyrphus tricinctus					1	1
Dasysyrphus venustus	1	4		2		7
Didea fasciata	2	3		1		6
Didea intermedia				1		1
Epistrophe eligans	11	7		3	1	22
Epistrophe flava	1					1
Epistrophe grossulariae	1					1
Epistrophe melanostoma	1	5				6
Epistrophe nitidicollis	2	8		2		12
Epistrophe olgae		2				2
Epistrophella euchroma		1				1
Episyrphus balteatus	23	119		10	7	159
Eristalinus sepulchralis		3				3
Eristalis nemorum	1	5				6
Eristalis pertinax	4	1		1	1	7
Eumerus funeralis		68	2		13	83
Eumerus ornatus		2				2

Species	MT1	MT2	MT3	MT5	MT6	Total
Eumerus sp.		2				2
Eumerus strigatus		3				3
Eupeodes bucculatus					2	2
Eupeodes corollae	8	14			2	24
Eupeodes latifasciatus	10	117		3	3	133
Eupeodes luniger	15	15		3	2	35
Fagisyrphus cinctus		11	1	12	11	35
Ferdinandea cuprea	83	27	1	15	1	127
Helophilus pendulus	14	21		2	3	40
Lejogaster metallina		1				1
Matsumyia berberina		7		4	2	13
Melangyna cincta	1					1
Melangyna lasiophthalma		1				1
Melanogaster hirtella	3	56	1	11	1	72
Melanogaster nuda	1	9		1	7	18
Melanostoma mellinum	9	160		12	1	182
Melanostoma scalare	20	66		18	4	108
Meligramma triangulifera	2	6				8
Meliscaeva auricollis		5		8	3	16
Merodon equestris	2	28		2	5	37
Myathropa florea	2	7				9
Neoascia interrupta		1				1
Neoascia meticulosa	1	7		2	1	11
Neoascia obliqua		1				1
Neoascia podagrica		4		1		5
Neocnemodon pubescens		1				1
Neocnemodon sp.		8				8
Neocnemodon vitripennis		1				1
Orthonevra brevicornis		3	1		1	5
Paragus haemorrhous	1	6				7
Paragus pecchiolii		9	1			10
Parasyrphus punctulatus	1	1	1	1		4
Parhelophilus frutetorum		3			5	8
Parhelophilus versicolor		1			1	2
Pipiza festiva		2				2
Pipiza luteitarsis		2				2
Pipiza noctiluca	1					1
Pipiza notata		1				1
Pipizella sp.	2	15				17
Pipizella viduata		18		3	3	24
Pipizella virens		3				3
Platycheirus albimanus	31	18	2	2	6	59
Platycheirus angustatus	4	12		2	1	19
Platycheirus clypeatus		5				5
Platycheirus europaeus	1	9				10

Species	MT1	MT2	MT3	MT5	MT6	Total
Platycheirus fulviventris	1	9		1	4	15
Platycheirus occultus	5	10		5		20
Platycheirus peltatus		2				2
Platycheirus scutatus	3	10	1	11	1	26
Platycheirus sp.	2	4				6
Pyrophaena rosarum		9		1	2	12
Rhingia campestris	4	1			1	6
Rhingia rostrata				1		1
Riponnensia splendens		2				2
Scaeva pyrastri		2				2
Scaeva selenitica		2		9	1	12
Sericomyia silentis	2	7			1	10
Sphaerophoria scripta		41		6	1	48
Sphaerophoria taeniata		1		4		5
Sphiximorpha subsessilis	1					1
Syritta pipiens	2					2
Syrphus nitidifrons		1				1
Syrphus ribesii	28	47	6	29	57	167
Syrphus torvus				1	7	8
Syrphus vitripennis	3	11	1	5	2	22
Temnostoma bombylans		8			1	9
Temnostoma vespiforme	6	7		1	5	19
Volucella bombylans	1	5		2	2	10
Volucella pellucens	3	4				7
Volucella zonaria					1	1
Xanthogramma pedissequum		6		1		7
Xanthogramma stackelbergi					1	1
Xylota segnis	8	6		3	10	27
Xylota sylvarum	4	16		2	2	24
Xylota xanthocnema		1				1
Total	420	1345	24	276	206	2271

The species *Cheilosia uviformis* Becker, 1894 is critically endangered while *Epistrophe flava* Doczkal & Schmid, 1994 (Fig. 2), *Eupeodes bucculatus* (Rondani, 1857) and *Lejogaster metallina* (Fabricius, 1781) (Fig. 3) are endangered according to the recent Flemish Red list (Van de Meutter *et al*., 2021).

The distribution of the recovered species over the different habitat groups is presented and compared to the Belgian situation in Table 2. Forest species are the dominant ecological group (55%) closely followed by species of open habitats (an aggregate of meadows, heathlands, marshes, etc.). Species of aquatic habitats and cultural habitats present nearly a quarter of all species. Compared to the full community of Belgian species, the Botanic Garden Jean Massart has very similar proportions of most habitat groups, except a clearly higher percentage of cultural species. Cultural species are species associated with agricultural land, park land, urban areas, brownfields, and alike.

Fig. 2. *Epistrophe flava* Doczkal & Schmid, 1994, an endangered species. © Rachel Poppe.

Fig. 3. *Lejogaster metallina* (Fabricius, 1781), an endangered species. © Floris Walraet.

Table 2. Percentage of species belonging to 4 habitat groups for the Botanic Garden Jean Massart and all Belgian species [only habitat affinities >1 are retained from Speight (2015)].

Habitat	Jardin Massart	Belgium
Aquatic habitats	23	24
Forest	55	56
Cultural habitats	25	13
Open habitats	54	50

Discussion

The Botanic Garden Jean Massart is part of a larger half-open park-like landscape around the "Rood Klooster" ("Rouge Cloître"), an old monastery with orchards, ponds and a park. The area is a geological depression with seepage areas that feed the ponds. This open landscape penetrates into the westside of the Sonian forest, one of the largest old-growth forests in Belgium. This area is famous for its high number of saproxyilic hover fly species (e.g. genera *Callicera*, *Mallota*, *Myolepta*, *Pocota*), some of which occur here in abundances nowhere else encountered in Belgium (e.g. *Callicera spinolae* Rondani, 1844 and *Mallota fuciformis* (Fabricius, 1794), Wakkie & Van de Meutter, in prep.). More than 175 species of hover flies have been recorded in an area of ca. 25ha neighbouring the Botanic Garden Jean Massart (data from the BELSYRPHDAT, database) and most of them probably also visit the Botanic Garden Jean Massart to feed. The Sonian forest has large closed stands of Beech and Oak of the same age class (some over 250 years old), in which little light can reach the forest floor and with little flowers in the understory. Its specialized fauna, which relies on pollen and nectar, ventures into forest margins and forest glades with flowers and blossoms to feed, such as the Rood Klooster and Botanic Garden Jean Massart. Many of these species remain high in the forest canopy for most of their lives, and when coming down to feed, also show a strong preference for flowers high above the ground (flowering trees and bushes, ivy, Reemer *et al*. (2009)). As such they may be found by experienced collectors, but rarely end up in Malaise traps. This may partly explain the moderate representation of these specialized forest species in the catches at the Botanic Garden Jean Massart. Further, this could also be a reason why species richness still increases fairly strongly with each extra sample, even after running 6 Malaise traps for a whole year (see rarefaction curve). Specific trap location may also play a role, as setting up a Malaise trap specifically for syrphid flies may differ somewhat from a more general approach. A Malaise trap campaign in the Hageland region yielded 112 species with 7 traps (pers. obs., unpublished document), in less diverse habitats compared to the Botanic Garden Jean Massart, but had similar richness and a higher percentage of saproxylic species, which may be due to more optimal trap location for syrphids in general and for attracting canopy species (under a flowering *Crataegus*, southeast oriented forest margins that are used for warming up, etc.).

Of high importance in a Flemish and Brussels context are the species from wet meadows and marshes (genera *Cheilosia*, *Lejogaster*, *Neoascia*, *Orthonevra*, *Platycheirus*, *Riponnensia*). *Cheilosia* is a genus of hover flies that tunnels plant tissue of specific genera or species (Speight, 2020). A good diversity of *Cheilosia* indicates good floral diversity and good management for larvae to develop. *Cheilosia himantopus* (Panzer, 1798) lives in leaf stems of *Petasites hybridus* and *C. uviformis* has been observed ovipositing on *Eupatorium cannabinum* (pers. comm. Leendert-Jan van der Ent). Whereas both these plants are not rare in our region, its associated species occur (very) locally within the range of the food plants (Van de Meutter,

Opdekamp & Maes, 2021) suggesting some additional requirements or dispersal limitation. The presence of base-rich seepages in the area is reflected in the presence of *Orthonevra brevicornis* (Loew, 1843), *Lejogaster metallina* (Fabricius, 1777) and especially *Riponnensia splendens* (Meigen, 1822), a species that largely lacks in water-rich the Netherlands, but is widespread in the Belgian silt region ("leemstreek"). Other seepage areas in the Sonian forest (mainly in Hoeilaart, a few km south of the Botanic Garden Jean Massart) also harbour the regionally very scarce *Sericomyia lappona* (Linnaeus, 1758) and *Chrysogaster virescens* Loew, 1854 (data from BELSYRPHDAT and waarnemingen.be), indicating the unique character of these seepage areas within broad-leaved forest, even if they are now largely surrounded by urban land. The high contribution of cultural species to the Botanic Garden Jean Massart hover fly fauna typically follows from the fact that it is a botanical garden with a large variety of traditional garden plants. Several are food for syrphid larvae, such as bulbs (e.g. *Narcissu*s, *Tulipa*) that are the food of *Eumerus* and *Merodon* or *Sedum telephium* of which the leaves are tunneled by *Cheilosia semifasciata* Becker, 1894 (Bot & Van de Meutter, 2019).

The Botanic Garden Jean Massart and its near environment within an open wedge within the Sonian forest is extremely rich in Syrphidae. Despite high human pressure bordering to the Brussels urbanized centre and high numbers of visitors to the area, the presence of senescent trees in the parks and the Sonian forest and of diverse biotic conditions on a small area (seepages, ponds, wet meadows, park land and botanical garden, dry heathlands on exposed sand, etc.) sets the stage for a diverse syrphid community. Areas with high floral diversity and mild human pressure such as found within the Botanic Garden Jean Massart are essential pieces of the ecological network found here.

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First checklist of Cylindrotomidae and Limoniidae (Diptera) from the Botanic Garden Jean Massart in Brussels-Capital Region, Belgium

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Abstract

A first list of the families Cylindrotomidae and Limoniidae from the Botanic Garden Jean Massart in Auderghem is presented based on sampling with Malaise traps. One species of Cylindrotomidae and 41 species of Limoniidae were recorded, including the presence of several very rare species.

Keywords: crane flies, Tipuloidea, aquatic habitat

Introduction

The family Cylindrotomidae is a small family of crane flies with only four species in Belgium. They are quite large, measuring around 11-16 mm, and they have remarkable larvae. The larvae have outstanding processes on their body. Adults can be found especially in marshy habitats. Worldwide, 66 species are known (Oosterbroek, 2019).

The family Limoniidae is one of the 'crane fly families', together with the Tipulidae and the small families of Cylindrotomidae and Pediciidae. In winter times, the superficially similar Trichoceridae or 'winter crane flies' can swarm in big groups, but they are not closely related to the 'real' crane flies. Within the crane flies, Limoniidae are the family with the highest amount of species. 10746 species of Limoniidae are known worldwide (Oosterbroek, 2019).

Limoniidae are mostly found in moist, damp habitats close to water. The larvae are usually (semi-)aquatic and feed on rotten organic material. Some species can be associated with mushrooms, other species do favour reed beds or damp woods. The wings can have very nice patterns of spots and stripes or be transparent. There are also species, like *Dicranomyia ornata* (Meigen, 1818), which are associated with one plant species, in this case butterbur *Petasites hybridus*. Flight times do vary, some species have their flight period in spring, others in more seasons or just in autumn. Some specimens form swarms, in contrast to Tipulidae. In some cases, male and female are different. For example in the females of *Idioptera pulchella* (Meigen, 1830) and *Molophilus niger* (Goetghebuer, 1920), the wings are reduced. The males have fully developed wings.

A good introductory book for people interested in Limoniidae and Cylindrotomidae would be Boardman (2016). The book is full of colour photographs and keys for most of the species. Another book every cranefly-loving person should have on his or her bookshelf, is Stubbs (2021). It contains information about the habitats, flight times, characters *et cetera* of all British species. Both books are about the British species, but the majority of it can be applied to the Belgian situation.

Material and methods

The Cylindrotomidae and Limoniidae were identified based on material caught in Malaise traps (Grootaert *et al.,* 2023). Identification of the Cylindrotomidae can be done with Peeters & Oosterbroek (2013a, 2016).

Identification of the Limoniidae can be done with Podenas *et. al.* (2016) or the test keys from Stubbs (1994-2001). It is good to know that all these test keys are summarized in a book published last year (Stubbs, 2021). One should always take care that these keys are not covering all the species.

Results

One species of Cylindrotomidae and forty-one species of Limoniidae were found to date in the Botanic Garden Jean Massart. Six females of *Paradelphomyia cf. fuscula* (Loew, 1873) were collected, but because they were all females their identification could not be confirmed with certainty. Five females were found in Malaise trap 5, 50°48'47.12"N 4°26'15.90"E, from 21.IX-12X.2017 and one female in Malaise trap 6, 50°48'49.02"N 4°26'6.97"E, also from 21.IX-12.X.2017.

The above-mentioned *Paradelphomyia fuscula* is not yet recorded for Belgium. Females cannot be identified to species level however. A male specimen is needed for examination. This is the reason why it is not submitted on the species list, but because it obviously is a *Paradelphomyia* species, with a very pale brown appearance and yellow scutellum, it is very likely this species.

The list of recorded species of Limoniidae is very nice, as many species which demand critical requirements for their habitats were found. *Dicranomyia affinis* (Schummel, 1829) is recorded for the first time for Belgium and for *Atypophthalmus inustus*, *Dicranomyia lucida*, *Lipsothrix nervosa*, *Pilaria fuscipennis*, *Rhipidia uniseriata* and *Thaumastoptera calceata* there are only one or very few recent records in Belgium. Two of these species were added just in 2021 to the Belgian fauna.

Species like *Eloeophila maculata*, *Ellipteroides lateralis* and *Limonia trivittata* have more recent records, but are also rare and only found locally.

The species *Cheilotrichia imbuta*, with its yellow colour and black rings on the femora is recorded, two females and one male. Despite its beautiful appearance, it is not recorded much.

Four species of Cylindrotomidae were mentioned in Grootaert, De Bruyn & De Meyer, 1991. No other species have since been added to this list.

For the Limoniidae, 159 species were mentioned in Grootaert, De Bruyn & De Meyer, 1991. In this number, Pediciinae are not included, because they are now in a separate family, Pediciidae. Oosterbroek *et al*. (2005) also mentions 159 species. Peeters & Oosterbroek again mention 159 species (Peeters & Oosterbroek, 2013b). In Martens *et al.* (2014), *Erioptera fusculenta* Edwards, 1938 is recorded for Belgium, this brings the total of species to 160. Kolcsar *et al*. (2021) record *Atypophthalmus umbratus*, *Helius flavus*, *Helius pallirostris*, *Ilisia occoecata* and *Lipsothrix nervosa* as new for Belgium. So at the moment, 165 species are officially recorded. Some information is given about the records, the biology and distribution are discussed. Part of the observations are also shared at https://waarnemingen.be.

Cylindrotomidae

Diogma glabrata (Meigen, 1818)

Records: 17.VI-20.VIII.2015, 3 ♂♂, 14 ♀♀; MT1, but almost exclusively MT2 (16 specimens)

Biology: Moist and wet woodland; larvae in mosses

Distribution: Europe; rather common in the eastern half of Belgium

Limoniidae

Atypophthalmus inustus (Meigen, 1818)

Records: 22-30.VI.2017, 1 ♀; MT6

Biology: Wet woodland, larvae fungivorous

Distribution: Europe, very rare in Belgium, this being only the second recent record of the species. First recorded in the Netherlands in 2008 (Dek *et al.*, 2014)

Austrolimnophila ochracea (Meigen, 1804)

Records: 4.VI-24.IX.2015, 9 ♀♀; 5.VI-1.IX.2017, 4 ♀♀; MT1, MT2, MT6

Biology: Variety of woodland

Distribution: Europe, common in Belgium

Cheilotrichia cinerascens (Meigen, 1804)

Records: 7-13.V.2015, 2 ♀♀; 10.IX-12.XI.2015, 1 ♂, 7 ♀♀; 8.IV-11.V.2016, 1 ♂, 17 ♀♀; MT1

Biology: Shade places on dry soils

Distribution: Europe, common in Belgium

Cheilotrichia imbuta (Meigen, 1818)

Records: 1-8.VI.2017, 2 ♀♀, 1 ♂, MT6

Biology: Found at edges of streams, ditched and other wetlands (Boardman, 2016)

Distribution: Europe, local; also in Belgium

Dicranomyia affinis (Schummel, 1829) – **Belg. sp. nov.**

Records: 29.IV-11.V.2016, 2 ♂♂; 17-21.V.2017, 1 ♂; MT1, MT2

Biology: Acid soils

Distribution: Europe; new species for Belgium, also recently new to the Netherlands (Dek, 2021)

Dicranomyia chorea (Meigen, 1818)

Records: 21-28.V.2015, 1 ♀; MT1

Biology: Variety of habitats

Distribution: Europe; very common in Belgium

Dicranomyia lucida (de Meijere, 1918)

Records: 26.VI-1.VII.2015, 1 ♀;

Biology: Wet woodland with permanent wet mud or water margins

Distribution: Europe; very rare in Belgium, this specimen being the only recent one. In their Catalogue of Belgian Tipulids, Goetghebuer and Tonnoir (1920) mention for the whole of the country only two localities, Melsbroek and Bosvoorde, both around Brussels. After 100 years the only recent specimen of this species was found at 1 kilometer from Bosvoorde!

Dicranomyia mitis (Meigen, 1830)

Records: Several records: in May-June and October

Biology: Variety of habitats.

Distribution: Europe, widely distributed; common in Belgium

Dicranomyia modesta (Meigen, 1818)

Records: Several records: from April till November

Biology: All kinds of wet soils in grassland, marsh, water margins and et cetera.

Distribution: Europe, widely distributed; common in Belgium

Dicranophragma adjunctum (Walker, 1848)

Records: 29.IV-4.V.2015, 2 ♂♂; MT1

Biology: Wet meadows and marshes

Distribution: Europe; common in Belgium

Dicranophragma nemorale (Meigen, 1818)

Records: 4-26.VI.2015, 2 ♂♂; MT1

Biology: Variety of wet woodland

Distribution: Europe; uncommon in Belgium

Ellipteroides lateralis (Macquart, 1835)

Records: 26.VI-1.VII.2015, 1 ♀; 15.-30.VI.2017, 2 ♀♀; MT1, MT2, MT6.

Biology: Marsh and wet woodland

Distribution: Europe; rare in Belgium

Eloeophila maculata (Meigen, 1804)

Records: 21-28.V.2015, 1 ♂; 23.VIII-1.IX.2017, 1 ♀; MT1, MT6.

Biology: Shaded ditches, woodland streams and more open situations

Distribution: Europe; rare in Belgium, in the eastern and southern part of the country.

Epiphragma ocellare (Linnaeus, 1760)

Records: 13.V-8.VII.2015, 23 ♂♂, 8 ♀♀; 17.V-30.VI.2017, 13 ♂♂, 5 ♀♀; MT1, MT2, MT5, MT6.

Biology: Woodland, larvae in dry rotten wood

Distribution: Europe; common in Belgium.

Erioptera lutea (Meigen, 1804)

Records: 10-17.VI.2015, 1 ♀; 20.VIII-30.X.2015, 2 ♂♂, 5 ♀♀; MT1.

Biology: All kind of wet places

Distribution: Europe; common in Belgium.

Gnophomyia viridipennis (Gimmerthal, 1847)

Records: 21.V-8.VII.2015, 3 ♀♀; 10-24.IX.2015, 3 ♂♂; MT1.

Biology: Woodland, larvae under the bark of poplar (*Populus*)

Distribution: Europe; common in Belgium.

Ilisia maculata (Meigen, 1804)

Records: 21-28.V.2015, 1 ♂, 1 ♀; 10-17.IX.2015, 2 ♀♀; MT1, MT2.

Biology: Moist and wet woodland

Distribution: Europe; local in Belgium.

Limonia hercegovinae (Strobl, 1898)

Records: 7.V-4.VI.2015, 3 ♂♂, 11 ♀♀; 1-9.X.2015, 1 ♀; 4-11.V.2016, 1 ♀; 17-24.V and 21.IX-12.X.2017, 1 ♂, 1 ♀; almost exclusively MT1 (16 specimens), MT2.

Biology: All kind of woodland but not too dry, spring and autumn species

Distribution: Europe; common in Belgium.

Limonia macrostigma (Schummel, 1829)

Records: 7-13.V.2015, 1 ♂; 12-25.X.2017, 1 ♀; MT1, MT2.

Biology: Wet woodland, spring and autumn species.

Distribution: Europe; uncommon in Belgium.

Limonia nubeculosa (Meigen, 1804)

Records: Several records:, almost year-round

Biology: Gardens, shaded woods, other habitats with shaded vegetation.

Distribution: Europe, widely distributed; common in Belgium.

Limonia phragmitidis (Schrank, 1781)

Records: 13.V-26.VI.2015, 3 ♂♂, 13 ♀♀; almost exclusively MT1 (15 specimens), MT2.

Biology: All kind of woodland but not too dry.

Distribution: Europe, widely distributed; common in Belgium, can be numerous.

Limonia trivittata (Meigen, 1804)

Records: 28.V-15.VII.2015, 20 ♂♂, 37 ♀♀; 1-30.VI.2017, 2 ♀♀; almost exclusively MT1 (54 specimens), MT2, MT6.

Biology: Moist shaded places often on (mildly) calcareous soil.

Distribution: Europe, widely distributed, but local in Belgium.

Lipsothrix nervosa (Edwards, 1938)

Records: 4-26.VI.2015, 3 ♂♂; MT1, MT2

Biology: Wet woodland, larvae in saturated rotting dead wood even in small branches

Distribution: Local in Europe, first record in Belgium in 2013, until now from 6 widespread localities. Not yet in the Netherlands.

Metalimnobia quadrinotata (Meigen, 1818)

Records: 7.V-1.VII.2015, 2 ♂♂; 10-17.IX.2015, 1 ♀; MT1, MT2

Biology: Woodland, a fungivorous species

Distribution: Europe, widespread in Belgium.

Molophilus medius (de Meijere, 1918)

Records: 20-27.VIII.2015; 1 ♂, 5-11.V.2017, 3 ♂♂; MT2; 1-8.VI.2017, 3 ♂♂, 1 ♀; 23.VIII-01.IX.2017, 4 ♂♂; MT6

Biology: Wet woodlands and marshland

Distribution: Europe, scattered distribution; *Molophilus* are difficult to identify, little is known about the distribution in Belgium.

Molophilus obscurus (Meigen, 1818)

Records: 21.IX-12.X.2017, 3 ♂♂, 1 ♀, MT6

Biology: Wet pastures and other wet habitats

Distribution: Europe, widely distributed, common in Belgium.

Molophilus ochraceus (Meigen, 1818)

Records: 21.V-17.IX.2015: 10 ♂♂, 2 ♀♀, almost exclusively MT1, 2 specimens in MT2

Biology: Marshland

Distribution: Europe, widespread in Belgium.

Neolimnophila placida (Meigen, 1830)

Records: 27.VIII-4.IX.2015, 1 ♀, MT1

Biology: Forests, larvae in bark and wood, maybe fungivorous

Distribution: Europe, widespread but local in Belgium.

Neolimonia dumetorum (Meigen, 1804)

Records: 8-27.VIII.2015, 1 ♂♂, 1 ♀; 1-15.VI.2017, 2 ♀♀; MT1, MT2

Biology: Wet and dry woods, larvae live in decaying wood

Distribution: Europe, widespread but local in Belgium.

Ormosia depilata (Edwards, 1938)

Record 1-8.VI.2017, one ♂, MT6

Biology: A wet woodland species

Distribution: Europe, local; probably also local in Belgium.

Ormosia lineata (Meigen, 1804)

Records: 13-21.V.2015, 1 ♀; 20-30.X.2015, 1 ♀; 14.IV-11.V.2016, 13 ♂♂, 7 ♀♀; 5-11.V.2017, 6 ♂♂, 2 ♀♀; MT1, MT2

Biology: Common spring species, woodland, but also in wet grasslands

Distribution: Europe, widely distributed, common in Belgium

Phylidorea ferruginea (Meigen, 1818)

Records: >20 specimens, in every month from May to October, MT1, MT2, MT6

Biology: Marsh, wet grassland and open wet forest.

Distribution: Europe. Common in Belgium.

Pilaria discicollis (Meigen, 1818)

Records: >20 specimens, 30.VII-4.IX.2015, 1.VI-21.IX.2017; MT1, MT2, MT6.

Biology: Wet woodland and marsh.

Distribution: Europe. Common in Belgium.

Pilaria fuscipennis (Meigen, 1818)

Records: 7-21.IX.2017, 2 ♀♀, MT2, MT6

Biology: Wet woodland and marsh.

Distribution: Europe. Very rare in Belgium, the Jardin being the only recent locality.

Pseudolimnophila lucorum (Meigen, 1818)

Records: 1-22.VII.2015, 2 ♀♀; 12-25.X.2017, 1 ♀; MT1, MT2, MT6

Biology: Wet woodland, but also in open marsh, in acid to mildly calcareous conditions.

Distribution: Europe. Uncommon in Belgium.

Pseudolimnophila sepium (Verrall, 1886)

Records: 4.VI-17.IX.2015, 3 ♂♂, 8 ♀♀; 1.VI-21.IX.2017 2 ♂♂, 2 ♀♀; MT1, MT2, MT6.

Biology: As *P. lucorum* but in more calcareous conditions.

Distribution: Europe. Uncommon in Belgium.

Rhipidia maculata (Meigen, 1818)

Records: >50 specimens, only females, in every month from April to December, almost exclusively in MT1

Biology: Great diversity of habitats.

Distribution: Europe, North-America, Russia, China, Japan. Common in Belgium.

Rhipidia uniseriata (Schiner, 1864)

Records: 17-26.VI.2015, 1 ♀, MT2

Biology: Wet woodlands with saprophageous larvae in large rot holes in living trees or large rotting logs.

Distribution: Europe. Very rare in Belgium, the Jardin being the only recent locality.

Rhypholophus bifurcatus (Goetghebuer, 1920)

Records: Several Records:, 19 ♂♂ and 18 ♀♀ between 1.X-12.XI.2015 and between 21.IX-25.X.2017; MT1, MT2, MT6.

Biology: Especially woodlands on calcareous clay

Distribution: Europe, common in calcareous woods. This might be the same in Belgium, but the Jardin is the only recent locality. The species was not found in 5 other Malaise trap campaigns. In the Netherlands, it was just recorded in 2013 (Dek & Oosterbroek, 2013) but it proves to be a common species.

Symplecta stictica (Meigen, 1818)

Records: 12-20.VIII.2015, 1 ♂; 1-21.IV.2016, 5 ♂♂, 10 ♀♀; 1-8.VI.2017, 1 ♂, 2 ♀♀, MT1, MT2, MT6.

Biology: Wet grasslands or other wetlands, can be very common in coastal areas

Distribution: Europe, widely distributed, common in Belgium.

Thaumastoptera calceata (Mik, 1866)

Records: 4-26.VII.2015, 4 ♂♂; 1-8.VI.2017, 1 ♂; MT1, MT6

Biology: Marsh and wet woodland, preferably on calcareous soil

Distribution: Europe, very rare in Belgium, these two being the only recent records.

Discussion

One species of Cylindrotomidae and 41 species of Limoniidae were found to date. Several very rare species or species with a very local distribution were recorded. A lot of Limoniidae species have a hidden life and more species are to be expected. Collecting with Malaise traps over a longer time seems to be a good way to record more species.

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First checklist of meniscus midges (Diptera: Dixidae) from the Botanic Garden Jean Massart in Brussels-Capital Region, Belgium

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Abstract

A first list of meniscus midges (Dixidae) from the Botanic garden Jean Massart in Auderghem is presented.

Keywords: Culicoidea, freshwater, indicators

Introduction

Most people are more familiar or known with the larvae, which can be found suspended from the surface of waters. The adults are often not recognized and dismissed with chironomids or other families.

Meniscus midges are yellow or brown midges of about 3-5,5 mm in length. The scutum has yellowish and brown patterns.The wings can be either hyaline or have darkened (cross-)veins in several species. The legs are long like in craneflies. The antennae are long, very slender and have 16 segments. The family is related to mosquitoes (Culicidae), but the females are not able to sting and there are no scales on the wing membrane. Two European genera are known, *Dixa* and *Dixella. Dixa* is found especially near flowing water and *Dixella* near stagnant water (Wagner, 1997)

The larvae can be found in a characteristical U-shaped position, very close to the water surface or just above it. They are called 'meniscus midges', because the larvae are present in the water meniscus. Species of Dixidae can be a good indicator of the ecological value of swamps, as the larvae are restricted to a very particular microhabitat and the species have different preferences of pH and calcium values, consistence of different rushes, sedges or grasses (Disney, 1975).

Material and methods

The Dixidae were identified based on material caught in the Malaise traps. Identification can be done with Shtakel'berg (1989) and Disney (1999) (British Isles).

Results

Three specimens of Dixidae were collected in the Malaise traps, all of them were males. They belonged to two different species: *Dixa nubilipennis* Curtis, 1832 and *Dixa nebulosa* Meigen, 1830. In *D. nubilipennis*, the last tergite has hooks, which are absent in *nebulosa*. Both species have clouded wings, but there is some variation in the density. In the collected specimen of *D. nebulosa*, the wing markings were quite faint, compared to other specimens. Specimens of *D. nebulosa* are found in both stagnant and flowing water. Recent findings in the Netherlands mainly consist of larvae caught 1,5 m in the water, along edges with a vegetation of reed, the grass *Glyceria maxima* and yellow flags *Iris pseudoacorus.* Other larvae were found in

deeper waters and also from shallow zones (Kruyt & Zuyderduyn, 2012). *D. nubilipennis* is especially recorded on dead leaves of trees or stones in shallow, shaded streams (Disney, 1975).

For Belgium, 11 species of Dixidae were mentioned in Grootaert, De Bruyn & De Meyer, 1991. Oosterbroek *et al*. (2005) also mention 11 species. For the Netherlands, 14 species are listed so one would expect to find a few species more in Belgium.

Some information is given about the records, the observations are also shared at waarnemingen.be.

Dixidae

Dixa nubilipennis Curtis, 1832

Record. 1 ♂, 12.X-25.X.2017, 50°48'47.12"N 4°26'15.90"E (MT5) and 1 ♂, 25.X-08.XI.2017, 50°48'49.02"N 4°26'6.97"E (MT6)

Dixa nebulosa Meigen, 1830

Record. 1 ♂, 21.IX-12.X.2017, 50°48'49.02"N 4°26'6.97"E (MT6)

Discussion

Two species were found to date, more sampling might reveal also other species.

Acknowledgements

We would like to thank Dr. Patrick Grootaert for sending the Dixidae to identify for this project.

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First checklist of Pediciidae (Diptera) from the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium)

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Abstract

A first list of Pediciidae from the Botanic Garden Jean Massart in Auderghem is presented, based on collections with Malaise traps. Three species were recorded with the remarkable presence of the very rare *Pedicia littoralis* (Meigen, 1804).

Keywords: craneflies, Tipuloidea

Introduction

Pediciidae are craneflies with species varying from 5 mm in the genus *Dicranota* to 35 mm in *Pedicia.* Species of the subfamily Pediciinae live in wet habitats, while members of Ulinae are especially found in woods and related to fungi. They have hairy eyes and two anal veins. Trichoceridae, often confused with craneflies, also have hairy eyes, but in Pediciidae the ocelli are absent and anal vein A2 is at least half the length of A1. The wing markings in some species can be characteristic. Species of *Tricyphona* can be found in wetland habitats like bogs, species of *Pedicia* and *Dicranota* near small streams and watercourses, often sheltered by vegetation. Species of *Ula* are found in woodlands, their larvae feed in fungi.

Material and methods

The Pediciidae were identified based on material caught in Malaise traps (Grootaert *et al.* 2023). Identification can be done with Stubbs (1994), Peeters & Oosterbroek (2014a, 2014b and 2016), Boardman (2016) and Stubbs & Kramer (2016).

Results

Three species were caught in the traps. Remarkable is the presence of two specimens of the very rare *Pedicia littoralis* (Meigen, 1804).

For Belgium, 15 species of Pediciidae were mentioned in Grootaert, De Bruyn & De Meyer, 1991. Oosterbroek *et al*. (2005) mention 16 species. Peeters & Oosterbroek (2013) also mention 16 species. Worldwide, 498 species are described (www.ccw.naturalis.nl, checked 3 May 2022).

Some information about the records, biology and distribution are discussed. Details about biology and distribution are based on Boardman (2016), Stubbs (1994), Stubbs & Kramer (2016) and distribution details at ccw.naturalis.nl, or otherwise when mentioned.

Pediciidae

Pedicia littoralis (Meigen, 1804)

Records: 1-9.X.2015, 1 ♀; 21.IX-12.X.2017, 1 ♀; MT2, MT6

Biology: Wet woodland and marshes, larvae aquatic in small streams.

Distribution: Europe, very rare in Belgium, 3 other recent records (from 2015 on) in the southern half of the country, as documented on www.waarnemingen.be.

Tricyphona immaculata (Meigen, 1804)

Records: 7-28.V.2015, 1 ♂, 7 ♀♀; 17.IX-12.XI.2015, 2 ♂♂, 7 ♀♀; 14.IV-11.V.2016, 15 ♂♂, 12 ♀♀; 5-11.V.2017, 1 ♂; 21.IX-12.X.2017, 5 ♀♀; MT1, MT2, MT6.

Biology: Common in many different wetland habitats.

Distribution: Europe, common; common in Belgium

Ula sylvatica (Meigen, 1818)

Records: 10.VI-1.VII.2015, 1 ♂, 1 ♀, MT1

Biology: Woodland, larvae live in ground mushrooms (Ševčík, 2003).

Distribution: Europe, USA, Canada, uncommon in Belgium.

Discussion

Three species were found to date. *Pedicia littoralis* is a remarkable species with critical habitat preferences and rare in Belgium. More species can be expected.

Acknowledgements

We would like to thank Dr. Patrick Grootaert for sending the Pediciidae to identify for this project.

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First species checklist of winter craneflies (Diptera: Trichoceridae) from the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium)

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Abstract

A first species list of Trichoceridae from the Botanic Garden Jean Massart in Auderghem is presented. All specimens were collected with Malaise traps. Only three species were found, all of them very common, but more species are still to be expected.

Keywords: swarms, longlegs, Trichoceroidea

Introduction

The Trichoceridae are longlegs, often mistaken for one of the 'real' cranefly families. However, they are not very closely related as they belong even to a different superfamily, the Trichoceroidea. Trichoceridae especially occur in temperate regions. Worldwide there are about 116 described species (Ebejer, 2015). Their wing venation looks like a member of the Tipulidae, but the larvae of Trichoceridae are more similar to members of the family Anisopodidae. In contrast to other craneflies, trichocerid flies have three ocelli on the head and two anal veins, one of which is short and bend. Their antennae can be quite long and slender. Although they are called 'winter craneflies', they are also present in autumn and spring. In winter, especially on sunny days, they can swarm in huge numbers which are hard to miss; hence their name. The swarms predominantly consist of males, trying to mate with any females entering the swarm. The larvae live in rotting organic material like leaves.

Only the genus *Trichocera* is recorded from Belgium. Most species are grey or brown, sometimes with banded abdomens. The wings can be transparent or spotted. The ovipositors of the females can be noticeably curved downwards.

Material and methods

The Trichoceridae were identified based on material caught in Malaise traps (Grootaert *et al.* 2023) . Identification could be done using Freeman (1950), Stackelberg (1989), Starý & Martinovsky (1993), Starý (1995), Starý & Martinovsky (1996), Starý (1999) or Peeters & Oosterbroek (2014). All specimens were collected between 12 October and 5 November 2017, usually with large numbers per sample.

Results

Three species of Trichoceridae were found to date in the Botanic Garden Jean Massart. All species are very common and abundant. It is surprising that *Trichocera regelationis* (Linnaeus, 1758) was not found yet in the samples. As this is also a very common species, this is surely to be found there.

For Belgium, six species of Trichoceridae are mentioned in Grootaert, De Bruyn & De Meyer, 1991. Oosterbroek *et al*. (2005) equally cites six species. Mortelmans & Dekeukeleire (2012) reported *Trichocera forcipula* Nielsen, 1920 as new for the Belgian fauna, thus bringing the total to seven species. Two additional species have been observed in Belgium, but are not yet published (publication in prep.).

Some information is given about the records; the observations are also shared at https://waarnemingen.be/. Biology and distribution are discussed.

Trichoceridae

Trichocera annulata Meigen, 1818

Records: 12-25.X.2017, 6 specimens; 21.IX-12.X.2017, 29 specimens; 25.X-08.XI.2017, 12 specimens (the terminalia from some specimens were damaged so that the sex could not be determined and hence all are mentioned as specimen).

Biology: Common in gardens, woods, grasslands, everywhere.

Distribution: Europe, very common; very common in Belgium.

Trichocera hiemalis (De Geer, 1776)

Records: 12-25.X.2017, 1 ♂; 21.IX-12.X.2017, 5 ♀♀.

Biology: Common in gardens, woods, grasslands, everywhere.

Distribution: Europe, very common; very common in Belgium.

Trichocera saltator (Harris, 1776)

Records: 21.IX-12.X.2017, 2 specimens; 25.X-08.XI.2017, 1 ♂.

Biology: Very common, but seems to be more abundant in woods.

Distribution: Europe, very common; very common in Belgium.

Discussion

Three species of Trichoceridae were found to date, however, some other species may still be expected. Because in the present research the Malaise traps were also present in winter, these species were recorded. In late autumn or winter, most entomologists do not sample or only rarely and thus, Trichoceridae are underrecorded. For sure, one or two species may be found by more research and probably even more.

Acknowledgements

We would like to thank Dr. Patrick Grootaert (RBINS) for sending the Trichoceridae to identify for this project.

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A brief survey of the Lonchaeidae (Diptera) from the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) including seven species new to Belgium

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Abstract

A set of four Malaise trap samples representing one week of sampling in the Botanic Garden Jean Massart in Auderghem were analysed and all Lonchaeidae were extracted and identified to provide a preliminary list of species present in the garden. In all, thirteen species were identified to species level, three to species group level and one to genus level. Seven species are recorded from Belgium for the first time: *Dasiops perpropinquus* Morge, 1959, *Lonchaea contigua* Collin, 1953, *Lonchaea iona* MacGowan, 2001, *Lonchaea kapperti* MacGowan, 2020, *Lonchaea nitens* Bigot, 1885, *Lonchaea subneatosa* Kovalev, 1974, and *Protearomyia withersi* MacGowan, 2014. All recorded species are discussed briefly.

Keywords: faunistics, survey

Introduction

The Lonchaeidae are a family of relatively small acalyptrate flies that are generally little studied. The main reason why they receive little attention is probably that they generally occur in low numbers and because of their rather inconspicuous life style. Adult flies usually have a body length between 2 and 5 mm and the colour of the body is black with or without green to blue metallic sheen on parts or the whole of the body. They have large, reddish eyes and, depending on the species, only parts of the legs and sometimes antennae are paler (yellow or reddish brown, respectively). The mesonotum is relatively strongly arched, the halters are black, the abdomen is broad and the legs are relatively short. Most parts of the body are moderately to strongly setose. The wings are hyaline to yellowish or brownish and there are no costal breaks. Females have a well-developed, usually considerably extendable ovipositor which is used to lay eggs in suitable places, for example deep cracks in the bark of dead trees. The shape and chaetotaxy of the ovipositor can have significant diagnostic value. A summary of general information on the family is given by MacGowan & Rotheray (2008).

Laymen will find the flies most often on foliage and sometimes on flowers. However, those who work on the invertebrate fauna of dead trees will readily encounter them on trunks of dead trees or will rear them from material collected behind the bark of dead trees. Many known larvae live as predators behind the bark of dead trees but some groups may have larvae that live in other kinds or decaying organic (plant) matter.

MacGowan & Rotheray (2008) give a number of 97 European species in the Lonchaeidae but since then at least 13 new species were described from Europe (MacGowan, 2022). The Belgian species can be mostly identified using the keys in MacGowan & Rotheray (2008), but it is often necessary to compare the specimens with all described features of species treated in that work since several continental European species are not included in the key. These

do not occur in the UK or were recorded or even described after the publication of this key. MacGowan (2022) provides a provisional key to the European species, but strictly speaking it only covers the males. It is always advisable to prepare male genitalia since a number of species complexes comprise species for which reliable identification can only be based on male genitalia. It falls beyond the scope of this paper to list all papers after the publication of MacGowan & Rotheray (2008) so only papers relevant to the present publication are listed below.

The Belgian Lonchaeidae fauna is poorly known. No systematic study has been performed in recent years and the list of known species is the one provided by Gosserries (1991; 14 species) and the only additions to that list are the three species added by Baugnée (2017).

Material and methods

All Lonchaeidae specimens identified were collected by 4 Malaise traps positioned within the Botanic Garden Jean Massart in 2017. The analysed samples represented just the week of 17-24 May 2017 as a subset of a sampling period that lasted several months. The positions of the traps varied between the border of flower beds and a hedge (Malaise trap 2), an old arboretum (Malaise trap 4), flower meadow in old apple orchard (Malaise trap 5) and wet areas close to reed beds, above small ponds (Malaise trap 6) (Grootaert *et al.*, 2023), with various numbers of specimens obtained from each.

Distributional data are mainly based on the data provided by MacGowan (2022), but are sometimes supplemented with data from other publications. Each individual country record is followed by a reference to the relevant publication.

Results

Dasiops perpropinquus Morge, 1959 – **Belg. sp. nov.**

A single female of this species was collected by MT6.

Little is known about the biology of this species, but Morge (1959) reared this species from larvae collected on a dead *Carpinus betulus*. Despite the fact that the majority of species belonging to other families collected by this trap seem to reflect the humid area to the north of it, it is highly probable that this species is a representative of the fauna inhabiting the shrubbery and forest surrounding the ponds.

Distribution: Austria, Czech Republic, Finland, Germany, Hungary, Italy, Netherlands, Poland, Russia (Morge, 1959), Slovakia, Sweden, Switzerland, United Kingdom (Chandler, 1998). First record for Belgium.

Lonchaea chorea (Fabricius, 1781)

A single female of this species was collected by MT2.

According to MacGowan & Rotheray (2008) this species is the most common species of *Lonchaea* in the British Isles. The reason why it is so common probably lies in the fact that the larvae are purported to live in various kinds of decaying organic (plant) matter (including manure and dead wood) rather than just live between bark and sapwood on dead trees.

Distribution: Belgium, Czech Republic, Estonia, Finland, France, Germany, Ireland, Italy (including Sardinia), Latvia, Lithuania, Netherlands (De Jong & Beuk, 2002), Poland, Russia,

Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom. Outside Europe: Canada, Kazakhstan, Tuva, United States.

Lonchaea contigua Collin, 1953 – **Belg. sp. nov.**

Three females of this species were collected by MT6.

According to MacGowan & Rotheray (2008), this species is probably the commonest lonchaeid found as adults on *Fagus* but it has been reared from many other species of broadleaved trees, mainly *Fraxinus*.

Distribution: Czech Republic, France, Ireland, Netherlands (De Jong & Beuk, 2002), Sweden, Turkey, United Kingdom. First record for Belgium.

Lonchaea fugax Becker, 1895

This species was collected by all traps and in all 13 specimens were counted (MT2: 6 females, MT4: 1 female; MT5: 1 female; MT6: 1 male and 4 females).

Lonchaea fugax is a common species and closely resembles the equally common *L. scutellaris*. Larvae and puparia of these two species are frequently found together on broadleaved trees, but adults of the latter have been reported to been bred from conifers as well. In the British Isles the former seems to be more dominant on *Populus* and *Ulmus*, the latter on *Fagus*, *Quercus* and *Acer* (MacGowan & Rotheray, 2008). Adults can be separated reliably using the colour of the tarsi (entirely yellow in *L. fugax*, only metatarsus and sometimes ventral base of second segment yellow in *scutellaris*). In case specimens are encountered that are intermediate, one should be aware of *L. lateralis* MacGowan in MacGowan & Bächli, 2016. Characters of the male genitalia can then be used to confirm species identity.

Distribution: Austria, Belgium (Gosserries, 1991), Bulgaria, Czech Republic, Finland, France, Germany, Greece, Hungary, Netherlands (De Jong & Beuk, 2002), Norway, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, United Kingdom.

Lonchaea iona MacGowan, 2001 – **Belg. sp. nov.**

Two traps collected this species (MT4: 1 male and 1 female; MT6: 1 female).

The distribution of this species is largely unknown because it was only recently recognised as separate species in the group of *Lonchaea* with hairy eyes. The ecology of this species is unknown, but as it was collected under similar circumstances as the closely related *L. fraxina* MacGowan & Rotheray, 2000, it is assumed that it has a similar biology with larvae living between bark and sapwood of dead or decaying *Fraxinus* and *Populus* species (MacGowan, 2001). It is a typical spring species, active from April till June (MacGowan & Rotheray, 2008).

Distribution: Czech Republic, France, Ireland, Sweden, United Kingdom. First record for Belgium.

Lonchaea kapperti MacGowan, 2020 – **Belg. sp. nov.**
Fig.1

Two males and two females were collected by MT2.

This species was described very recently and the description was based on a small number of specimens. No biological data were collected with the specimens, but even the small number of available specimens made it clear that some of the diagnostic characters commonly used to

Fig. 1. *Lonchaea kapperti* MacGowan, 2020, habitus male with aedeagus in inset. © Paul L.T. Beuk

Fig. 2. *Lonchaea nitens* Bigot, 1885, habitus male. © Paul L.T. Beuk

identify *Lonchaea* specimens (in this case the number of katepisternal setae) may be subject to variation and that in many cases confirmation using the male genitalia is required. Male genitalia were also used to confirm the identity of this species in the Botanic Garden.

Distribution: Germany. First record for Belgium.

Lonchaea nitens Bigot, 1885 – **Belg. sp. nov.**
Fig. 2

Three specimens of *L. nitens* were collected (MT2: 1 male, MT4: 1 female, MT6: 1 male).

Among the European species, it can be easily recognised by the hairy eyes, multiple rows of genal setae, dark squamal fringes and the basal 2-3 tarsal segments yellow. It can only be confused with *L. albigena* Collin, 1953, which has only the metatarsi yellow. In the British Isles it has only been reared from *Fraxinus* (MacGowan & Rotheray, 2008).

Distribution: Andorra (Carles-Tolrá & Pujade-Villar, 2003), Austria, Czech Republic, Finland, France, Germany, Hungary, Netherlands (De Jong & Beuk, 2002), Poland, Slovakia, Sweden, Switzerland, United Kingdom. First record for Belgium.

Lonchaea palposa Zetterstedt, 1847

Two females were collected by MT4.

With strongly enlarged and protruding palpi, this is an easily recognisable species. The species seems to breed mainly in *Populus* species and related genera, but has been recorded from *Crataegus* and *Betula* as well and is considered as a European lowland deciduous forest species (MacGowan & Rotheray, 2008).

Distribution: Andorra (Carles-Tolrá & Pujade-Villar, 2003), Belgium (Gosserries, 1991), Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands (De Jong & Beuk, 2002), Russia, Sweden, Switzerland, United Kingdom.

Lonchaea scutellaris Rondani, 1874

Only a single female was collected by MT2. For a further discussion, see *L. fugax*.

Distribution: Andorra (Carles-Tolrá & Pujade-Villar, 2003), Austria, Belgium (Gosserries, 1991), Czech Republic, France, Germany, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Sweden, Switzerland, Turkey, United Kingdom.

Lonchaea subneatosa Kovalev, 1974 – **Belg. sp. nov.**

Three females were collected by MT6.

This is another species that seems to favour *Populus* species for breeding, though it appears that the main criterium seems to be that the trees have a thick fibrous bast and are in a later stage of decay, with earthworms already invading (MacGowan & Rotheray, 2008).

Distribution: Czech Republic, Finland, France, Greece, Hungary, Russia, Slovakia, Sweden, United Kingdom. First record for Belgium. Outside Europe: Primorskii Kraj, Tuva.

Lonchaea sp. *fraxina* group

Two females of this group were collected (one in MT2 and MT6, respectively).

These were different from *L. iona* mentioned above. Since species can only be confirmed with certainty on the basis of characters in the male genitalia, the specimens remain unidentified.

Lonchaea sp. *mallochi* group

Two females of this group were collected (both in MT2).

Since species can only be confirmed with certainty on the basis of characters in the male genitalia, the specimens remain unidentified.

Lonchaea sp. *peregrina* group

One female of this group were collected (MT4).

Since species can only be confirmed with certainty on the basis of characters in the male genitalia, the specimen remains unidentified.

Lonchaea sp.

Two females of a so far unidentified species of *Lonchaea* were collected by MT2.

It resembles *L. subneatosa* but is larger, sternite 1 is narrower than in *L. subneatosa* and entirely bare. Possibly associated males are present in other samples that were not yet analysed for Lonchaeidae.

Protearomyia nigra (Meigen, 1826)

One male was collected by MT2.

The diversity within the genus *Protearomyia* has only been recognised during the last decade (MacGowan, 2014; MacGowan & Reimann, 2021). Before these publications it was generally assumed there was only one species in Northwestern Europe, *P. nigra*, but as it turned out, this was not the case. Altogether there are now six species found in Northwestern Europe with two additional species in the Western Mediterranean (MacGowan & Reimann, 2021). These species can only be reliably identified using the male genitalia (MacGowan, 2014). Bearing this in mind, all older records of *P. nigra* from Belgium must be considered doubtful, but on the basis of the abovementioned specimen it can be confirmed as a Belgian species.

Nothing definite is known about the biology of *Proteraromyia* species, but it has been associated with several herbs with woody stems (MacGowan & Rotheray, 2008). Swarming has been observed in this species (Dobson, 1997) with only males in the swarm.

Distribution: Andorra? (Carles-Tolrá & Pujade-Villar, 2003), Belgium, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.

Protearomyia withersi MacGowan, 2014 – **Belg. sp. nov.**
Fig. 3

Two males were collected by MT5.

For general information on *Proteraromyia* species, see *P. nigra*. The observed preference for ancient woodland and parkland in the United Kingdom may actually be due to the fact that these areas may have relatively undisturbed meadows that thus favour *Protearomyia* species (MacGowan & Reimann, 2021).

Distribution: France, Germany, Greece, Poland, Portugal, Spain, Sweden. First record for Belgium.

Protearomyia sp.

Females of *Protearomyia* were collected by three traps (MT2, MT4 and MT5), 1 female each.

At present it is not possible to identify the females of *Protearomyia*. As males of two species of the genus were collected during this sampling period and identified, it is unwise to assume association of any of these females with either species.

Silba fumosa (Egger, 1862)

Two traps collected this species (MT2: 5 females; MT6: 1 female).

Despite the fact that this is probably the largest lonchaeid species in Belgium and that it is generally considered to be a common species, it was not recorded formally from Belgium until reported by Baugnée (2017). Its biology differs from the very similar species of *Lonchaea* in that it is not a saproxylic species. Adults have been reared from various kinds of dead and decaying plant matter, including parts that were still attached to living plants (MacGowan & Rotheray, 2008). Although adults are frequently found on leaves, they are more conspicuous when they feed on the flowering parts of plants but not necessarily on nectar. This may explain why the largest number were collected by MT2.

Fig. 3. *Protearomyia withersi* MacGowan, 2014, habitus male. © Paul L.T. Beuk

Distribution: Andorra (Carles-Tolrá & Pujade-Villar, 2003), Austria, Belgium, Bulgaria, Czech Republic, Finland, France, Germany, Greece, Ireland, Italy (including Sardinia), Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom. Outside Europe: Canada, Israel, Kazakhstan, Morocco, Uzbekistan, United States.

Discussion

With the present publication, the number of recorded Lonchaeidae from Belgium is raised from 17 to 24. This is still considerably lower than the number of the neighbouring Netherlands (34; see Beuk & De Jong, 2019) and less than half the number of the British Isles, which have been thoroughly investigated (51; see Chandler, 2021). It should be noted that the three unidentified species assigned to species groups will turn out to be additions to the Belgian fauna, as there are no representatives of these groups on the Belgian list that these specimens can belong to.

It is interesting to see that the highest diversity of Lonchaeidae species was found in the site of MT2, with flowerbeds and the hedge, and that this trap accounted for more than half of the collected specimens (Table 1). This is not the site where most species will breed, but it could be that they were trapped here during their movements between breeding and feeding sites. The second most diverse site, that of MT6 at the edge of the humid areas, yielded three species not found in the other sites. Perhaps this is related to the nearby trees and accompanying dead wood.

Table 1: Distribution and numbers of Lonchaeidae species collected by Malaise traps in the Botanic Garden Jardin Massart during the week of 17-24.V.2017.

Species	**MT2**	**MT4**	**MT5**	**MT6**	**Total**
Dasiops perpropinquus Morge, 1959				1	1
Lonchaea chorea (Fabricius, 1781)	1				1
Lonchaea contigua Collin, 1953				3	3
Lonchaea fugax Becker, 1895	6	1	1	5	13
Lonchaea iona MacGowan, 2001		2		1	3
Lonchaea kapperti MacGowan, 2020	4				4
Lonchaea nitens Bigot, 1885	1	1		1	3
Lonchaea palposa Zetterstedt, 1847	2				2
Lonchaea scutellaris Rondani, 1874	1				1
Lonchaea subneatosa Kovalev, 1974				3	3
Lonchaea sp. *fraxina* group	1			1	2
Lonchaea sp. *mallochi* group	2				2
Lonchaea sp. *peregrina* group		1			1
Lonchaea sp.	2				2
Protearomyia nigra (Meigen, 1826)	1				1
Protearomyia withersi MacGowan, 2014			2		2
Protearomyia sp.	1	1	1		3
Silba fumosa (Egger, 1862)	5			1	6
Total number of specimens	27	6	4	16	53
Number of identified species	8	3	2	7	13
Number of unidentified species	4	2	1	1	5

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Hybotidae (Diptera) of the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) with description of two new *Platypalpus* species and comments on the Red Data List

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Abstract

Ninety hybotid species are recognized in the Botanic Garden Jean Massart (Brussels) representing 52 % of the species ever recorded in Belgium. Two species new to science are described: *Platypalpus massarti* sp. nov. and *P. pictitarsoides* sp. nov. Following three species are reported for the first time in Belgium: *Drapetis infitialis* (Collin, 1961), *Platypalpus negrobovi* Grootaert, Kustov & Shamshev, 2012 and *Trichina opaca* Loew, 1864. In addition, comments are given on a selected number of species: *Bicellaria intermedia* Lundbeck, 1910, *Platypalpus aurantiacus* (Collin, 1926), *Platypalpus longimanus* (Corti, 1907), *Platypalpus nanus* (Oldenberg, 1924), *Platypalpus rapidoides* Chvála, 1975, *Platypalpus subtilis* (Collin, 1926), *Stilpon subnubilus* Chvála, 1988 and on the genus *Hybos* Meigen, 1803. The holotype of *Platypalpus cryptospina* (Frey, 1909) is revised. Only 30 species or 33% of the species present are in a 'Safe/Low risk' Red Data Book category meaning that the other 66% are in a more or less 'Threatened' category.

Keywords: biodiversity survey, Malaise trap, Hybotidae

Introduction

The present study reports on Hybotidae examined as part of a comprehensive three-year survey of the Diptera in the Botanic Garden Jean Massart (Brussels, Belgium) as described in Grootaert *et al*. (2023). The Botanic Garden Jean Massart is a tiny 4.5 ha site, squeezed in between the eastern border of the city of Brussels and the Sonian forest. Nearly 2,000 plant species have been recorded in this Natura 2000 site. The area is composed of various biotopes such as humid areas with a swamp and ponds, an old orchard on dry grassland, a medicinal plants garden, an arboretum and an evolution garden. All is mixed with patches of semi natural woods.

In a previous study on the genus *Drapetis* Macquart, five species were found including *Drapetis bruscellensis* Grootaert, 2016, a species new for science. In the present paper attention is paid to all the hybotid genera and species of special interest are commented. The Red Data Book status of the various hybotid species was examined (Grootaert *et al.*, 2001) in order to assess the value of the biodiversity in the Botanic Garden Jean Massart.

Material and methods

The present survey is based on a sampling in 6 sites with Malaise traps. However, the sampling in the various sites was spread over three years as is shown in Table 1. The present study is limited to Malaise trap sampling only and details on the sampling are described in Grootaert *et al.* (2023).

The hybotid material is stored in ethanol. In the listing of the records 'ref.' refers to the reference number of the specimens of the Diptera from the Botanic Garden Jean Massart in the collections of the Royal Belgian Institute of Natural Sciences in Brussels (RBINS).

Table 1. Overview of the sampling effort per site and a summary of the habitat characteristics.

	MT1	MT2	MT3	MT4	MT5	MT6
	50°48'52.57"N 4°26'20.31"E	50°48'52.70"N 4°26'22.50"E	50°48'50.68"N 4°26'22.14"E	50°48'52.83"N 4°26'15.62"E	50°48'47.12"N 4°26'15.90"E	50°48'49.02"N 4°26'6.97"E
start	7.V.2015	7.V.2015	21.IV.2016	14.III.2017	14.III.2017	14.III.2017
end	23.III.2017	23.III.2018	14-III-17	23.III.2018	23.III.2018	23.III.2018
years	2	3	1	1	1	1
soil	humid/loamy	humid/loamy	humid/loamy	dry/loamy	dry/loamy	swampy loamy-sand
exposure	partly shaded	sun exposed	shaded	shaded	sun exposed	partly shaded
habitat	border of meadow, behind compost heap	border of flowerbeds, border of hedge	inside small wood; next to heap of decomposing wood	arboretum; no or short herbaceous layer	flowery meadow in old apple orchard	close to reed bed, above small ponds

Analysis Red Data Book Data

The Red Data Book (RDB) categories used in the present study are those listed in Grootaert *et al*. (2001) for the Empididae *sensu lato*. At that time the empidoids (minus the Dolichopodidae) contained the Empididae, Hybotidae, Microphoridae (now as Microphorinae in the Dolichopodidae), Atelestidae and some Brachystomatidae. In this study, all species were assigned to Red Data Book categories which are based on a combination of a rarity and a trend criterion. Rarity is expressed as the proportion of the total number of UTM 5 km squares sampled in which the species have been found since 1981. The trend criterion is interpreted as the change of the species rarity between 1887-1980 and 1981-1999. A comparable number of UTM 5 km squares was investigated during the two time periods. In addition, the level of endangerment to specific habitats, where the species is living, was also taken into account as a criterion for the categories.

Since records from Brussels-Capital Region, in which the Botanic Garden Jean Massart is situated, were included in the Red Data Book of Flanders, the RDB can be used for an assessment of the empidoids in the Botanic Garden Jean Massart.

Results

All the hybotid flies (except those of a few missing samples) identified were collected during the three-year survey (from May 2015 until April 2018) at the Botanic Garden Jean Massart. This resulted in 4,192 specimens belonging to 90 species.

Table 2 gives an overview of the species and their occurrence in the six investigated sites (MT1 to MT6). Since site 1 (MT1) and site 2 (MT2) were respectively sampled during 2 and 3 years, the data are presented for each year separately (MT1-2015, MT1-2016; MT1-2015, MT1-2016 and MT1-2017), which allows a quick overview of the differences per year. This separation per year also illustrates the turnover of the species for each season. This is best illustrated in site 2 (MT2) where a total number of 79 species were recorded over the three-year survey. The turnover of the number of species is large: 58 species were recorded in 2015, 61 species in 2016 and 59 species in 2017. Although the number of species per year is more or less the same in MT2, the turnover per year is very high: in 2016 there were 12 species absent from 2015, but 15 were new; in 2017 there were 18 species not present in 2015 and 17 species not present in 2016.

In addition to the differences in turnover per year, there is a difference of diversity in site 1 (MT1) and site 2 (MT2), laying just 43m opposite each other in the evolution garden (Grootaert *et al.*, 2023, Fig. 3). In site 1, 41 species were recorded in 2015 while 42 species in 2016. In site 2, 58 species were recorded in 2015 and 61 species in 2016. This difference in diversity is attributed to the different insolation of the two sites. Site 1 receives direct sunlight in early morning only, while site 2 receives direct sunlight from noon until late evening. Likely, site 2 is warming up more than site 1 so that the activity of the flies is different, which is reflected not only in the number of specimens sampled, but also in the number of species.

Site 3 (MT3) is continuously shady, with an undergrowth of grasses and a huge pile of decaying wood. Only 38 hybotid species were found in this site but the largest population of *Platypalpus optivus* in the Garden was observed here. The population of *Platypalpus exilis* and *P. luteolus*, both yellow species, was also the largest at this site. This is not exceptional, since these yellow species thrive in shaded conditions. On the other hand, the population of the yellow *Elaphropeza ephippiata* was very low although grasses were ample present in the undergrowth being a favourite microhabitat of *E. ephippiata.*

Site 4 (MT4) has the lowest diversity of all sites. Only 57 specimens were found belonging to 24 species. The arboretum is characterised by a partly naked soil or a very low herb layer from Spring onwards. There is never direct sunlight.

Site 5 (MT5) has 44 species. In this old apple orchard, *P. aristatus* was dominant in spring and several other ubiquist species were abundant such as *P. longicornis*, *P. pallidiventris* and *P. calceatus* amongst others.

In Site 6 (MT6) has also 44 species. *Platypalpus pictitarsoides* sp. nov. was the dominant species with 123 specimens. It was also the site were most specimens of this species were found.

Table 2. Overview of the number of species per site/per year. Site 1 (MT1) and site 2 (MT2) were respectively sampled during 2 and 3 years, the data are presented for each year separately (MT1-2015, MT1-2016; MT2-2015, MT2-2016 and MT2-2017). Site 3 (MT3) was only sampled in 2016 while sites 4, 5 and 6 (MT4, MT5 and MT6) were only sampled in 2017.

species	MT1-2015	MT1-2016	MT2-2015	MT2-2016	MT2-2017	MT3	MT4	MT5	MT6	Total
Bicellaria intermedia			1							**1**
Bicellaria sulcata	5	13	2	2	1	3				**26**
Bicellaria vana	1	5	1	1	4		3	11		**26**
Crossopalpus abditus									1	**1**
Crossopalpus humilis							1			**1**
Crossopalpus minimus	1		1		2			3		**7**
Crossopalpus nigritellus					1		2	1		**4**
Drapetis arcuata				1						**1**
Drapetis assimilis			2		11			8	9	**30**
Drapetis bruscellensis			8	2	6				1	**17**
Drapetis exilis		1	5	6	28			1	3	**44**
Drapetis infitialis		1	1	1	2			2		**7**
Drapetis parilis	3	4	38	54	93	5	1	6	9	**213**
Drapetis pusilla	1		6	5	9			4	1	**26**
Drapetis simulans	1		1							**2**
Elaphropeza ephippiata	15	3	43	39	32	7	2	38	19	**198**
Euthyneura myrtilli	19	12	35	26	28	2	1	32	12	**167**
Hybos culiciformis		3	1	1	1					**6**
Hybos femoratus					1					**1**
Leptopeza borealis			1							**1**
Leptopeza flavipes	1		4	4	2	1			1	**13**
Oedalea apicalis	1		1		4				1	**7**
Oedalea flavipes	2	2	4	8	2	7	1			**26**
Oedalea holmgreni	3	1	22	5		2				**33**
Oedalea hybotina		1			3				1	**5**
Oedalea stigmatella	4		2	1	1					**8**
Oedalea tibialis	4	4	1	10	5	2		1	1	**28**
Oedalea zetterstedti	17	4	1	11	6	9	1	3	3	**55**
Platypalpus agilis		3	1	2	2					**8**
Platypalpus albicornis	1	1	3		4	1				**10**
Platypalpus albiseta		2			1			1		**4**
Platypalpus annulatus				9	13		1	1	11	**35**
Platypalpus annulipes	5	16	19	82	73	18		13	4	**230**
Platypalpus aristatus	7	4	57	29	36	4	2	86		**225**
Platypalpus articulatoides	1	1	19	6	4		1	16		**48**
Platypalpus articulatus			1							**1**
Platypalpus aurantiacus		2	6	1	4	1	1	1		**16**
Platypalpus australominutus	2		1							**3**
Platypalpus calceatus	16	2	63	38	54	24		22	5	**224**
Platypalpus candicans					1	2			14	**17**
Platypalpus ciliaris						1				**1**
Platypalpus clarandus		8	11	12						**31**
Platypalpus cothurnatus	19	29	63	77	62	21	1	9	26	**307**
Platypalpus coxatus		1	1	10		10				**22**
Platypalpus dessarti		1		1	1			1	1	**5**

species	MT1-2015	MT1-2016	MT2-2015	MT2-2016	MT2-2017	MT3	MT4	MT5	MT6	Total
Platypalpus divisus	1			2	1			4		**8**
Platypalpus exilis	1	7	10	9	2	39	3	2		**73**
Platypalpus interstinctus	1			4						**5**
Platypalpus kirtlingensis		5		9						**14**
Platypalpus laticinctus								1		**1**
Platypalpus leucocephalus						1		1		**2**
Platypalpus longicornis	27	56	35	13	28	13	11	76	7	**266**
Platypalpus longimanus			1		1					**2**
Platypalpus longiseta	5	7	9	13	12	12	5	5	14	**82**
Platypalpus luteoloides			3					1		**4**
Platypalpus luteolus	15	52	3	44	43	55	1	44	38	**295**
Platypalpus maculipes		1								**1**
Platypalpus massarti				1	1					**2**
Platypalpus minutus	5		5	8	10	1		6	4	**39**
Platypalpus nanus				1					10	**11**
Platypalpus negrobovi				3	9	1		2		**15**
Platypalpus niger			2	1	5				2	**10**
Platypalpus notatus	2		5	2		1			2	**12**
Platypalpus optivus		8	1	6	6	132	1	12	2	**168**
Platypalpus pallidiventris	13	18	33	50	45	26	5	46	28	**264**
Platypalpus pallipes	1		5	2	8	1		15	3	**35**
Platypalpus pectoralis	4	1	12	11	2	22	1	3		**56**
Platypalpus pictitarsis	1		1	3		1				**6**
Platypalpus pictitarsoides	1	40		10	20			7	123	**201**
Platypalpus praecinctus				2		1				**3**
Platypalpus pseudofulvipes		2	11	6	22				27	**68**
Platypalpus pseudorapidus					2			1		**3**
Platypalpus pulicarius									6	**6**
Platypalpus rapidoides		2	2						1	**5**
Platypalpus rapidus			1	1					1	**3**
Platypalpus stabilis	4		29	8	10		1	1		**53**
Platypalpus subtilis	1			1		2		1	2	**7**
Stilpon subnubilus			1	1						**2**
Symballophthalmus fuscitarsis			1	1	3			1		**6**
Tachydromia aemula									4	**4**
Tachydromia annulimana	1			1	4	6		6	2	**20**
Tachydromia arrogans									2	**2**
Tachydromia smithi									1	**1**
Tachydromia umbrarum				2	5					**7**
Tachypeza nubila	10	1	5	2	5	15		8	7	**53**
Trichina bilobata		1		1	3		1	8	24	**38**
Trichina clavipes	4	7	4	1	9	5	1		4	**35**
Trichina elongata	15	10	7	22	24	2	9	32	9	**130**
Trichina opaca									1	**1**
Trichinomyia flavipes		2	1	15	3	11				**32**
Total number of specimens	**241**	**344**	**613**	**700**	**780**	**467**	**57**	**543**	**447**	**4192**
Number of species	**41**	**42**	**58**	**61**	**59**	**38**	**24**	**44**	**44**	**90**
Total number per site	**58**		**79**			**38**	**24**	**44**	**44**	

Annotated checklist with description of new species

Bicellaria intermedia Lundbeck, 1910

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♂, 1-8.VII.2015 (ref. 98).

Additional material examined: Belgium: 1♀, Parette (prov. Luxembourg), (31UFR91), 3.VII.1980; 1♂, Vecquée (32UKB90), 10.VII.1951 (R. Tollet); 1♂, 1♀, Bihain (prov. Luxembourg), (31UGR06), 6.VI.1952 (R. Tollet); 2♂♂, Fagne des Mochettes, Samrée (31UFR96), 5.VI.1952 (R. Tollet); 5♂♂, 2♀♀, Samrée (31UFR86), 5.VI.1952 (R. Tollet); 6♂♂, 3 ♀♀, Franc Bois (31UFR33), 18.VI.1958 (leg. A Collart).

Comments. *Bicellaria intermedia* was not yet recorded from Flanders nor Brussels Region and is hence not in the Red Data Book (Grootaert *et al.*, 2001), however several specimens were recorded earlier from southern Belgium.

Drapetis infitialis (Collin, 1961)

Material examined: Oudergem, Botanic Garden Jean Massart: MT2: 2♂♂, 8-15.VI.2017 (ref. 1364); MT5: 1♂, 22-30.VI.2017 (ref. 1130); 1♂, 19-26.VII.2017 (ref. 1161).

This species, which is closely related to *D. exilis*, is new for the Belgian fauna. It differs from the latter species mainly by the large tip of the right cercus (Collin, 1961).

Hybos culiciformis (Fabricius, 1775)

Material examined: Oudergem, Botanic Garden Jean Massart: MT1: 3♀♀, 13-27.X.2016 (ref. 571); MT2: 1♀, 26.VI-1.VII.2015 (ref. 158); 1♀, 14-28.VII.2016 (ref. 920); 1♂, 23.VIII-1.IX.2017 (ref. 1352).

Hybos femoratus (Müller, 1776)

Material examined: Oudergem, Botanic Garden Jean Massart: MT2: 1♀, 22.IX-12.X.2017.

During the three consecutive years of the survey, only six specimens of *Hybos culiciformis* and one specimen of *Hybos femoratus* were recorded. *Hybos culiciformis* is considered as fairly common but 'Near threatened' due to a significant decline since 1981 (Grootaert *et al.*, 2001). *Hybos femoratus* is considered as 'Vulnerable' and considered as fairly 'Rare' with a strong decline of the populations. The third Belgian species, *H. grossipes*, mentioned as 'Endangered' with a significant decline of the populations, was not found at all during the present survey.

Hybos species are predators that catch small insects in the air with their huge raptorial hind legs. Altough there is a very high diversity of microhabitats with scrubs and vegetation that can be used as look-out for *Hybos* and moreover, ample prey is available, the abundance is very low. It seems that the general trend of decline that was already mentioned in Grootaert *et al.* (2001) is continuing.

Genus *Platypalpus* (Macquart, 1827)

Platypalpus species are small predators which catch prey landing on leaves of the vegetation. Forty-eight species were recorded.

Platypalpus aurantiacus (Collin, 1926)

Tachydromia aurantiaca Collin, 1926: 152.
Tachydromia aurantiaca in Collin, 1961: 207, description.

Platypalpus aurantiacus (Collin, 1926) *in* Smith & Chvála, 1976: 139, illustration male terminalia.
Platypalpus aurantiacus (Collin, 1926) *in* Chvála, 1989: 279, diagnosis and illustration male antenna (Fig. 12).

Material examined: Oudergem, Botanic Garden Jean Massart: MT1: 1♀, 3-9.VI.2016 (ref. 418); 1♀, 6-11.V.2016 (ref. 596); MT2: 1♀, 28.V-4.VI.2015 (ref. 578); 1♂, 21-28.V.2015 (ref. 584); 1♀, 21-28.V.2015 (ref. 627); 2♀♀, 13-21.V.2015 (ref. 686); 1♀, 13-21-May 2015 (ref. 745); 1♂, 6-11.V.2016 (ref. 1311); 1♀, 5-11.V.2017; 2♀♀, 17-24.V.2017 (ref. 1256); 1♂, 1-8.VI.2017 (ref. 1268); MT3: 1♀, 3-9.VI.2016 (ref. 445); MT4: 1♂, 24.V-1.VI.2017 (ref. 1087); MT5: 1♀, 11-17.V.2017.

Additional material examined: Belgium: 2♀♀, Buzenol, 19.V.1981; 5♀♀, Buzenol, 2.VI.1981 (leg. P. Grootaert).

Comments. This rare species was previously only known from the utmost south of Belgium where it was collected in a Malaise trap at the border of a deciduous forest. Here in the Botanic Garden it was found in 5 of the 6 investigated sites, always in very low numbers except in Site 2 (MT2), where during the three years of sampling 11 specimens were recorded. It was not found in the marshland (MT6).

Distribution. According to the Fauna Europaea it is recorded in Austria, Belgium, British Isles, Czech Republic, France, Germany and Hungary.

Platypalpus massarti **sp. nov.**
Figs 1-2

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Material examined: Holotype ♂: Belgium, Oudergem, (Brussels) Botanic Garden Jean Massart, MT2, 8-15.VI.2017 (ref. 1377, RBINS); Paratype: Belgium, Oudergem, (Brussels) Botanic Garden Jean Massart, 1♀, MT2, 23.VI-1.VII.2016 (ref. 872, RBINS).

Diagnosis. A small black species (1.5-1.6 mm) with one pair of yellow vertical bristles. Antenna entirely black. Postpedicel in male 2.5 times as long as wide, in female 2 times; arista 2 times as long as postpedicel. Palpus pale yellow with long pale apical bristle. Mesoscutum dusted. Sternopleura with a shiny black patch. Acrostichals short, biserial and widely separated. Four long dorsocentrals. Legs yellow, except for mid and hind coxae brown and all legs with all tarsomeres brown annulated, apical two tarsomere entirely brown. In female apical annulation of basal tarsomeres shorter and less pronounced than in male. Fore tibia in male only weakly swollen. Mid femur with a few short pale posteroventral bristles. Mid tibia in male and female with a very short, triangular, pale brownish apical spur. Left epandrial lamella with only short marginal bristles on the left side, limited to the apical half.

Etymology. The new species is dedicated to Prof Jean Massart, ecologist “avant-la-lettre”, who created the Botanic Garden Jean Massart 100 years ago, which was later named after him.

Description.

Male.

Length: body: 1.7 mm; wing: 1.7 mm.

Head. Black in ground-colour. Frons grey dusted, parallel-sided, as wide as pedicel. Face silvery grey dusted, parallel-sided, narrower than pedicel, clypeus shiny black. A pair of long yellowish

vertical bristles, widely separated. Antenna entirely black. Postpedicel nearly 2.5 times as long as deep. Arista 2 times as long as all three antennal segments together. Palpus pale yellowish, small, rounded, with a long white apical bristle longer than palpus.

Thorax. All bristles yellow. A long humeral, two long notopleurals; acrostichal bristles short, biserial, the rows widely separated. Four long dorsocentrals, the anterior longer than pedicel and bristles becoming longer towards scutellum ending in a long prescutellar; the row is preceded by a few minute bristles. Sternopleura shining black.

Legs. Yellow except for brown mid and hind coxae; all tarsi annulated brown, apical two tarsomeres of all tarsi entirely brown. Fore coxa with long pale bristles.

Fore femur thickened on basal half, wider than mid femur, with a row of long yellow ventral bristles, half as long as femur is wide. Fore tibia hardly spindle-shaped thickened.

Mid femur with a pale brownish anterior bristle on apical quarter, as long as femur is wide. A few yellowish posteroventral bristles, half as long as femur is wide. Mid tibia with a very short, pale brownish apical spur (half as long as tibia is deep), in dorsal view triangular.

Hind femur slender, narrower than mid femur, dorsoventrally bowed, with indistinct bristles.

Wings. Clear, with pale brownish veins, tip of subcostal quite swollen. Veins R4+5 and M parallel, just before ending in the costa, a little diverging. Haltere yellowish white.

Abdomen. Entirely black with short pale bristles. Male terminalia as in Fig. 2. Cerci small enclosed in epandrial lamellae. Right cercus in dorsal view with a broad truncate apex (Fig. 2 B).

Fig. 1. *Platypalpus massarti* sp. nov., holotype male, habitus. © Isabella Van de Velde.

Right margin of right epandrial lamella with a few long bristles (Fig. 2 A), near middle of the right lamella a row of 4 short bristles. Left epandrial lamella with marginal bristles on left side very short and limited to apical half (Fig. 2 C); marginal bristles on right side longer than on left side. Inside of apex of left epandrial lamella somewhat sculpted (Fig. 2 B).

Female.

Length: body: 1.6 mm; wing: 1.4 mm.

Identical to male in most characters including shape and colour of spur on mid tibia. Apical annulation of basal tarsomeres shorter and less pronounced than in male.

Comments. *Platypalpus massarti* sp. nov. is found in the samples together with *P. cothurnatus* Macquart, 1827, another small species with entirely black antenna and a small apical spur on the mid tibia. It can be recognized quickly by the coloration of the tarsomeres and the wing. In *P. cothurnatus* only tarsomere 4 and 5 are darkened while the basal tarsomeres are yellow. In *P. massarti* sp. nov. all the tarsomeres of all legs are brown annulated and the apical two tarsomeres entirely brown. In *P. cothurnatus* the wing is conspicuously yellow or yellowish brown clouded while in *P. massarti* sp. nov. there is no yellowish clouding at all. The apical spur in *P. cothurnatus* is nearly as long as tibia is wide and bears a tiny hair at tip in the male. The spur in *P. massarti* sp. nov. is even shorter and lacking a hair. In *P. cothurnatus*, the left epandrial lamella bears a large basal extension on the left side, bearing very long bristles (see Chvála, 1975, Fig. 418). In the new species, the marginal bristles on the left epandrial lamella are very short and confined only to the apical half and there is no basal protrusion at all (Fig. 2 C). A detailed diagnosis of *P. cothurnatus* can be found in Chvála (1975: 166, Figs 416-418; 1989: 311).

P. massarti sp. nov. belongs to a species-complex comprising *P. cryptospina* (Frey, 1909) and *P. aliterolamellatus* Kovalev, 1971 and hence these two species are dealt with in more detail below.

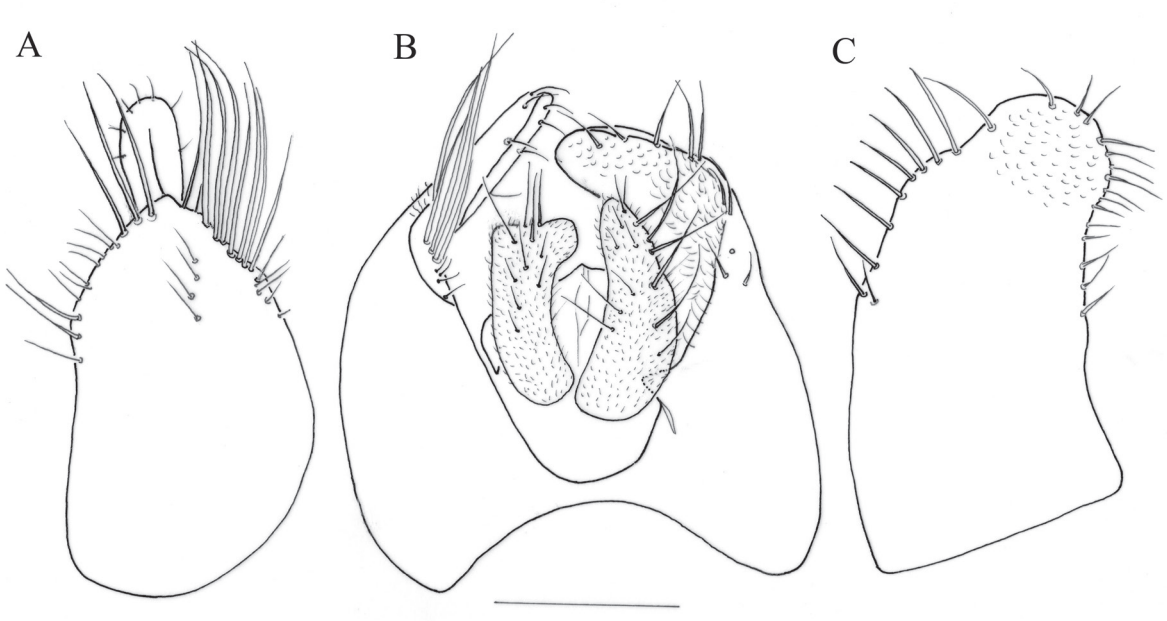

Fig. 2. *Platypalpus massarti* sp. nov., holotype male, terminalia. A, right epandrial lamella. B, epandrium dorsal. C, left epandrial lamella. Scale 0.1 mm.

Platypalpus cryptospina (Frey, 1909)
Fig. 3

Tachydromia cryptospina Frey, 1909: 8.
Tachydromia tantula Collin, 1926: 158.
Tachydromia tantula in Collin, 1961: 159, re-description and illustration male terminalia (Fig. 59).
Platypalpus cryptospina (Frey, 1909) *in* Chvála, 1975: re-description and illustrations (Figs 125, 216, 419-421, 717).

Material examined: Holotype male, Finland, Karislojo, H. Frey, Natural History Museum, Helsinki.

Male on pin, in good condition (missing a mid-leg and left antenna). The male terminalia of the holotype were not dissected so it is unlikely that the drawings of the terminalia in Chvála (1975)

Fig. 3. *Platypalpus cryptospina* (Frey, 1909), holotype male habitus with detail of head and male terminalia. ©Jere Kahanpää.

were made of the holotype. The drawing of the left epandrial lamella (Chvála, 1975: Fig. 421) fits the holotype though the long bristles on the left basal 2/3 are even a little longer and the tips are curled and not straight as shown by Chvála (see Fig. 421). In *P. massarti* sp. nov. the third antennal segment is 2.5 times as long as wide and thus longer than in *P. cryptospina*.
Platypalpus tantulus (Collin, 1926) was set synonym by Chvála (1975) to *P. cryptospina*, however the bristling on the left side of the left epandrial lamella is different from Chvála's (1975) drawings and those made by Collin (1961). To clarify this, the type material of *P. tantulus* should be re-examined. The drawings of the cerci, right and left epandrial lamellae in Collin (1961), do not correspond to *P. massarti* sp. nov. as well.

Diagnosis. Resembling *P. cothurnatus* but antennae with smaller third segment, dorsocentrals longer and less numerous, legs with dark annulated tarsi, very spindle-shaped fore tibiae and much shorter tibial spur.

Platypalpus aliterolamellatus Kovalev, 1971

Platypalpus aliterolamellatus Kovalev, 1971. Description (in Russian); illustration left side of left epandrial lamella.
Platypalpus aliterolamellatus in Chvála, 1989: 308, extended diagnosis.

This small species (1.1 – 1.4 mm) is very similar to *P. cryptospina*. The postpedicel is about 1.5 times as long as deep and the arista more than 2 times as long but the acrostichal bristles are wider apart and the legs are paler yellow including the tarsi. At most the two apical tarsomeres are brownish, no annulations are present; the posterior four coxae are yellowish. As in *P. cryptospina* the anterior four femora are equally stout and the fore tibia spindle-shaped dilated. The left border of the left epandrial lamella has very short marginal bristles in the apical third, with some longer bristles in the middle (Kovalev, 1971: Fig. 1).

Key to the *P. cryptospina*-species complex

1.- Tarsi not annulated brown, at most the apical two tarsomeres brownish; mid and hind coxae not darkened .....***P. aliterolamellatus* Kovalev**

-. All tarsi annulated brown, apical two tarsomeres almost entirely brown; mid and hind coxae brownish 2

2.- Fore tibia hardly dilated (Fig. 1); third antennal segment in male nearly 2.5 times as long as deep. Acrostichals widely separated. Left epandrial lamella with marginal bristles on left side very short and limited to apical half (Fig. 2 C) .....***P. massarti* sp. nov**.

-. Fore tibia distinctly spindle-shaped dilated (Fig. 3); third antennal segment about 2 times as long as deep. Acrostichals close together. Left epandrial lamella with marginal bristles on left side very long over the entire border, tips basal bristles curled (Fig. 3) .....***P. cryptospina* Frey**

Platypalpus nanus (Oldenberg, 1924)

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♀, 9-16.VI.2016; MT6, 2♂♂, 3♀♀, 24.V-1.VI.2017; 1♂, 4♀♀, 1-8.VI.2017; 1♀, 8-15.VI.2017.

Platypalpus nanus was most abundant in the swampy area (MT6), while only a single female was found during the three-year survey in site 2 (MT2).

This tiny *Platypalpus* species is mainly distributed in coastal areas in Belgium where it was found in 9 localities [Blankenberge, Boerekreek, Lombardsijde (Brandaris), Doel, Knokke, Koksijde, Oostende, Raversijde and the Zwin].

It was very abundant in the Maria-Hendrika park in Oostende where a Malaise trap, placed in a wood on clayish soils, collected no less than 363 specimens in 2 years. Comparably, two Malaise traps placed on wet clayish soil at the base of the dunes of the domain 'Prince Karel' at Raversijde, collected 390 specimens in the course of two years. At the moment, there are only three observations of *P. nanus* outside the coastal area. A single female was found on a sand heap in the harbour of Ghent (10.VI.1951, leg. M. Bequaert, coll. RBINS), a single female in Brussels (6.VI.1933, leg. M. Bequaert, RBINS), with unknown habitat, and another single female was found in an apple orchard in Gembloux (14.VI.1982, leg. C. Fassotte, RBINS). It is not excluded that the latter two females belong to other related unrecognized species.

Chvála (1989) already remarked that the species is very common in Belgium and the Netherlands, while he also reported it from the Czech Republic (one record), Germany and Hungary, where it is rare. It is not clear which ecological factors explain the distribution of the species in central Europe, while the large abundance in certain coastal areas in Belgium seems to point to a relation with wet, clayish soils.

Platypalpus negrobovi Grootaert, Kustov & Shamshev, 2012 versus *Platypalpus longimanus* (Corti, 1907)

Platypalpus negrobovi Grootaert, Kustov & Shamshev, 2012
Fig. 4.

Platypalpus negrobovi Grootaert, Kustov & Shamshev, 2012: 161, illustration antenna (Fig. 1), habitus (Fig. 2), fore and mid leg (Fig. 3), male terminalia (Figs 4-5).

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♀, 9-16.VI.2016 (ref. 892); 1♀, 16-23.VI.2017 (ref. 494); 1♂, 2♀♀, 1-8.VI.2017 (ref. 1274); 2♀♀, 8-15.VI.2017 (ref. 1237); 1♀, 8-15.VI.2017 (ref. 1375); 1♂, 15-22.VI.2017 (ref. 1060); MT5, 2♀♀, 1-8. VI.2017 (ref. 1284); 2♀♀, 22-30.VI.2017; MT3, 1♀, 23.VI-1.VII.2016 (ref. 892); MT5, 2♀♀, 1-8.VI.2017 (ref. 1284).

P. negrobovi was most abundant in site 2 (MT2), but was also recorded in site 3 (MT3) and 5 (MT5).

Males of the sister species *P. negrobovi* and *P longimanus* are quite peculiar in having a very long flattened apical tarsomere on the fore leg and the mid leg. These are unique features among representatives of the genus *Platypalpus* Macquart, 1827. Smith (1969) gave a re-description of *P. longimanus* and illustrated the fore and mid legs of male as well as the genitalia. There is some confusion about the authorship of *P. longimanus* that has been settled by Chvála (1989). Recently Grootaert *et al.* (2012) described *P. negrobovi* on the base of a single male from the Caucasus, although a female was found earlier in Belgium, but was not described by the lack of a male. This female did not correspond to the description of a female *P. longimanus*.

Key to the *P. negrobovi*-species complex based on Grootaert *et al.* (2012)

– Stylus in male nearly as long or a little longer than postpedicel (0.9 – 1.1 times); stylus in female longer: 1.3 to 1.4 times as long as postpedicel. Postpedicel in both sexes shorter than in *P. longimanus*. Male mid tarsus with apical tarsomere as long as tarsomeres 2, 3 and 4 combined ..... ***P. negrobovi* Grootaert, Kustov & Shamshev, 2012**

– Stylus in male half as long as postpedicel, in female 0.6 – 0.7 times as long. Postpedicel in both sexes longer than in *P. negrobovi*. Mid tarsus with apical tarsomere as long as tarsomeres 3 and 4 together ..... ***P. longimanus* (Corti, 1907)**

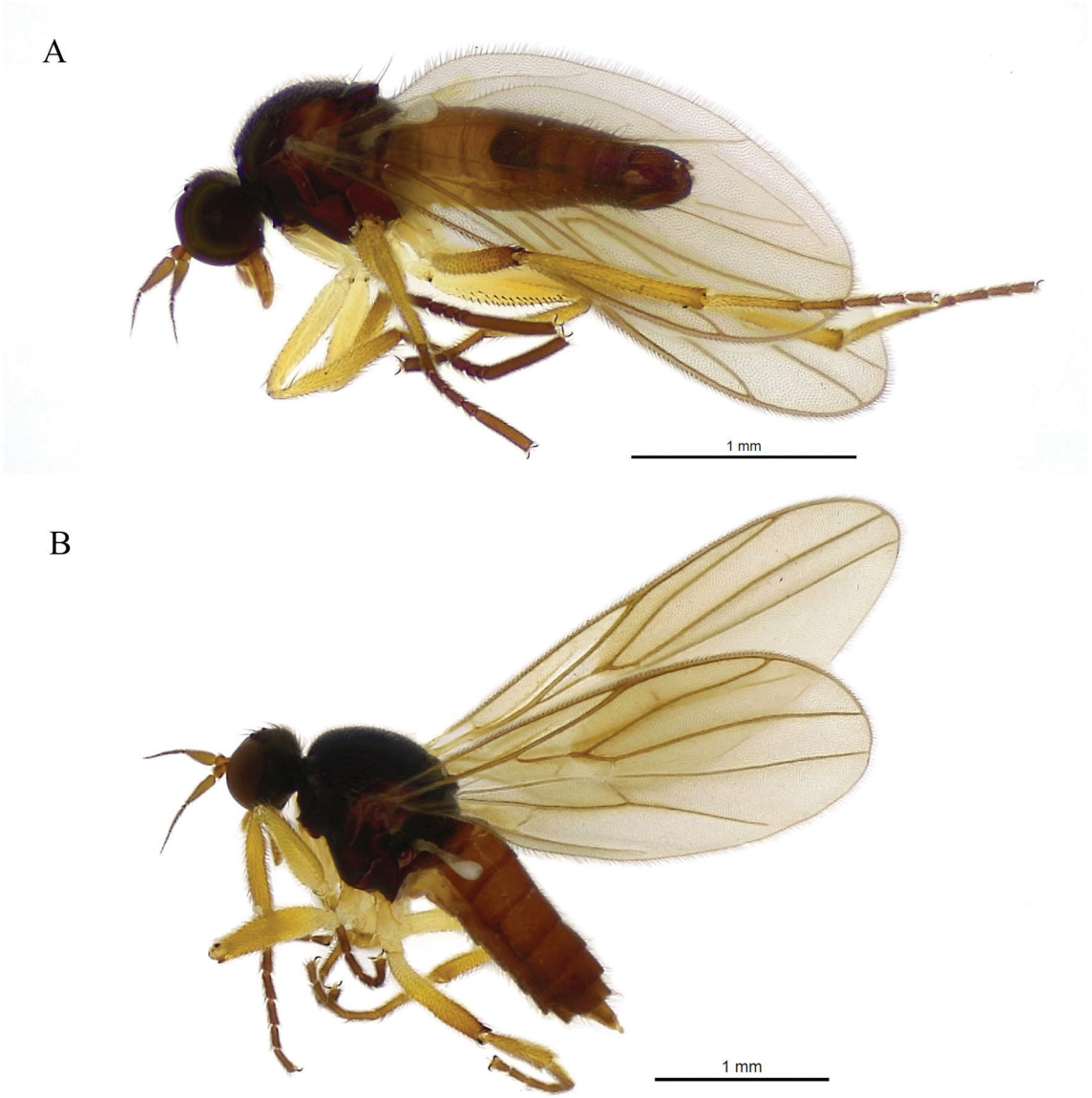

Fig. 4. *Platypalpus negrobovi* Grootaert, Kustov & Shamshev, 2012. A, male habitus, Botanic Garden Jean Massart (ref. 1274, RBINS). B, female habitus. © Isabella Van de Velde.

In the specimens studied in the present survey, the stylus in males is 1.1 times as long as postpedicel and a little longer in females ranging from 1.3 to 1.4 times as long as postpedicel.

Platypalpus longimanus (Corti, 1907)

Fig. 5

Tachydromia longimana Corti, 1907: 101.

Tachydromia longimana Strobl, 1910: 79.

Platypalpus (*Cleptodromia*) *longimana* (Corti, 1907) *in* SMITH, 1969: 108, illustration fore tibia and tarsus (Fig. 1), tarsus mid leg (Fig. 2), male terminalia (Fig. 3).

Platypalpus longimanus in CHVÁLA, 1989: 257, re-description and drawing antenna male (Fig. 3), antenna female (Fig. 4), male terminalia of holotype (Figs 5-7).

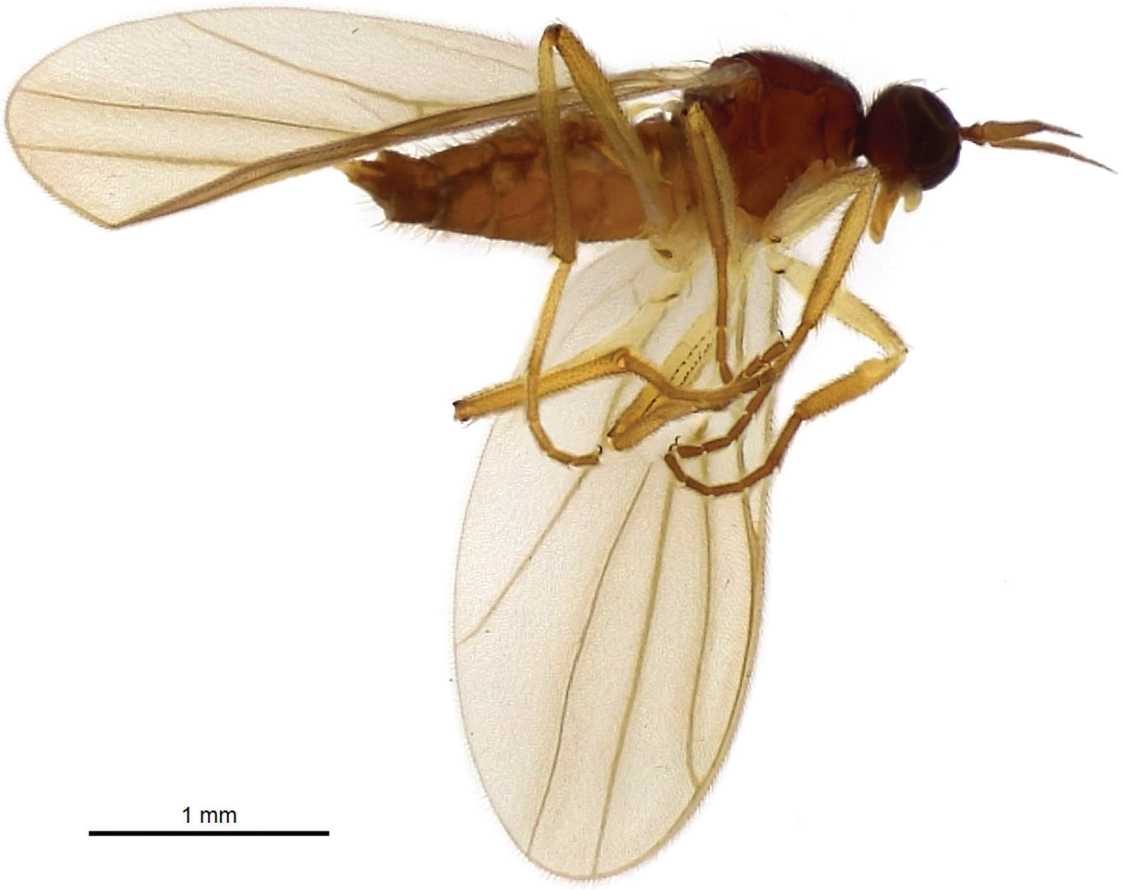

Fig. 5. *Platypalpus longimanus* (Corti, 1907), female habitus, Botanic Garden Jean Massart, ref. 1045 (RBINS). © Isabella Van de Velde.

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♀, 11-17.V.2017 (ref. 1046); MT5, 1♀, 17-24.V.2017 (ref. 1395).

The postpedicel in female *P. longimanus* is much longer than in *P. negrobovi* and the stylus is much shorter (proportion of 0.65 to 0.7 times as long as stylus).

Identification of both species is sometimes confusing since there are two pairs of black vertical bristles adpressed to the cranium, a little longer than the other postocular bristles and pointed forward (not upwards like in other *Platypalpus* with 2 pairs of vertical bristles). The fore tibiae are swollen in both sexes and the opening of the tibial gland is quite prominent.

Platypalpus pictitarsoides **sp. nov.**

Figs 6-8

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Material examined: Holotype ♂: Belgium, Oudergem, (Brussels) Botanic Garden Jean Massart, MT6, 1 – 8.VI.2017 (ref. 1194, RBINS). Paratypes: Belgium, Oudergem, (Brussels) Botanic Garden Jean Massart, MT6, 1♂, 24.V-1.VI.2017 (ref. 1176); 2♀♀, 24.V-1.VI.2017 (ref. 1178); 1♀, 1-8.VI.2017 (ref. 1357); 2♂♂, 9♀♀, 1-8.VI.2017 (ref. 1194); 3♂♂, 42♀♀,

8-15.VI.2017 (ref. 1207); 2♂♂, 46♀♀, 5-22.VI.2017 (ref. 1216); 7♀♀, 22-30.VI. 2017 (ref. 1321); 1♀, 26.VII-2.VIII.2017; 1♂, 1♀, 2-11.VIII.2017; 2♀, 23.VIII-1.IX.2017.

Type locality. Audergem; Botanic Garden Jean Massart site 6 (MT6). Only the specimens of site 6, the marshland, were assigned as holotype and paratype status. In total 201 specimens were found in the Garden, distributed over four sites: MT1: 41, MT2: 30, MT3: none, MT4: none, MT5: 7, MT6: 123.

Diagnosis. A small species (1.8 – 2.2 mm) of the *pallidiventris* - *cursitans* group, closely related to *P. pictitarsis*. Clypeus dusted. Third antennal segment 2.5 times as long as deep. Palpus brown in male and female. A very short anterior notopleural present, hardly a third of the length of the 2 posterior notopleurals. Acrostichal bristles biserial, the rows distinctly separated and the bristles directed backward, not uniserial nor diverging. Legs yellow, but fore coxa and basal half of fore femur in male brownish, yellow in female. Mid and hind coxae yellow, at most dusky in male. All tarsomeres annulated black. Mid tibiae in male and female with a long pointed apical spur. Left epandrial lamella with long marginal bristles over the entire length of the outer (left) margin.

Etymology. The species is named after its resemblance with *P. pictitarsis*.

Fig. 6. *Platypalpus pictitarsoides* sp. nov., holotype male, habitus. © Isabella Van de Velde.

Description.

Male.

Length: body: 1.74 – 1.9 mm: wing: 1.8 mm – 2 mm.

Head. Frons grey dusted, a little narrower than 2nd antennal segment. Face narrower than frons, silvery grey dusted, including clypeus. Basal antennal segments yellowish, sometimes somewhat reddish. Third antennal segment black, 2.5 times as long as deep, arista about 1.5 times as long as third segment. A pair of long yellowish white vertical bristles. Lower postoculars bristles longer and whitish.

Thorax. Grey dusted except for the black shiny spot on sternopleura. All bristles and hairs yellowish. Acrostichals biserial, the rows distinctly separated, the bristles are directed backward and hence not diverging.

Wing. With clear membrane, veins pale yellowish. Cross veins well separated. Veins R_{4+5} and M_1 running parallel up to ending in the costa. Haltere white. Squama white, set with white bristles.

Legs. Yellow except for the brownish fore coxa and basal half of the fore femur that are brownish (the intensity of the colour is variable). Knee fore femur with a very small black spot at both sides of the knee. Mid femur with a large black spot on both sides of the knee. Hind femur with a very small black spot at both sides of the knee. All trochanters with a small black ventral spot. All tarsomeres annulated dark brown.

Fore femur with a double row of white ventral bristles a little more than half as long as femur is wide. Fore tibia tubular, not swollen, with a number of pale brownish dorsal bristly hairs.

Mid femur stronger than fore femur, about 1.5 times wider; with white posteroventral bristles less than half as long as femur is wide. A pale anterior bristle on apical quarter. Mid tibia with a long pointed bristle apical, as long as tibia are deep.

Hind femur very narrow with a single row of pale ventral bristles over the entire length, as long as femur is deep. Hind tibia with some dorsal bristly hairs.

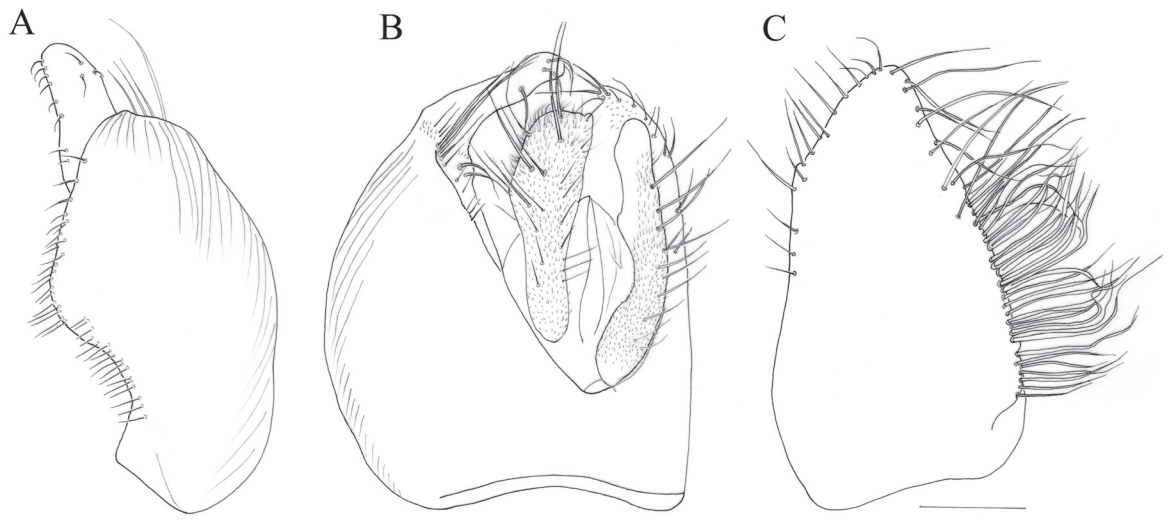

Fig. 7. *Platypalpus pictitarsoides* sp. nov., holotype male, terminalia. A, right epandrial lamella; B, epandrium dorsal. C, left epandrial lamella. Scale 0.1 mm.

Abdomen. All segments brownish black. All tergites with the sides at base narrowly dusted. Male terminalia (Figs 7 – 8). Both cerci are about equally long (Fig. 7 B). The right cercus has a truncate tip while the left cercus is slender with a pointed tip lacking microtrichia at the extreme tip. In lateral view the left cercus bears a large, inner protrusion (Fig. 8 H). The right epandrial lamella has a median protrusion of the right border (Fig. 7 A) and the right border is set with short bristles only. Some striae run over the median part of the right epandrial lamella. The left epandrial lamella is broad and the left margin is entirely set with long bristles. The apical bristles are interspaced while the basal bristles are densely set, some are bifurcate close to their base and the tips are often somewhat curled. The aedeagal complex bears two black rod-like and denticulate structures (Fig. 8 I).

Female.

Length: body: 2 – 2.4 mm, wing: 1.9 – 2.2 mm.

Resembling male in most characters. Legs entirely yellow, including mid and hind coxae. Ovipositor about as long as third antennal segment.

Comments. The general morphology of *Platypalpus pictitarsoides* sp. nov. and especially the structure of the male terminalia show that the species is closely related to *P. pictitarsis* and *P. kirtlingensis* (Fig. 8 A, D-E). However, *P. pictitarsoides* sp. nov. has the rows of biserial acrostichals well separated and not on (almost) one line with diverging bristles like in the former species. The new species only has a tiny anterior notopleural bristle in front of the longer posterior notopleurals bristles, which can easily be overlooked or considered as simple pubescence. This may lead to some confusion when using the key of Grootaert & Chvála (1992). The presence of a tiny anterior notopleural bristle and the fore and hind tibiae with distinct bristly dorsal hairs brings the new species to couplet 141 in the key Grootaert & Chvála (1992). The following key is simplified.

Simplified key to the *pictitarsis*- species complex

1.- Anterior notopleural bristle strong, nearly as long as posterior notopleurals. Ovipositor much longer than all antennal segments together ***P. pallidiventris*** **(Meigen) and** ***P. longiseta*** **(Zetterstedt)**

-. Anterior notopleural bristle smaller and finer, at most half as long as posterior notopleural bristles. Ovipositor about as long as all antennal segments together **2**

2.- The rows of acrostichal bristles distinctly separated and directed backward and hence not diverging. Left epandrial lamella with a row of long bristles on the entire outer (left) margin (Fig. 7 C; Fig. 8 C) ..... ***P. pictitarsoides*** **sp. nov**.

-. Acrostichals bristles closely bi-serial, almost alternating on one row and strongly diverging. Left epandrial lamella with short marginal bristles on apical part while the long bristles are confined to the central part of the outer margin (Fig. 8 A, B) **3**

3.- All coxae and trochanters black (fore coxa apically pale in female); fore femur more or less blackish on basal half, tarsi with sharp black annulations. Palpus brownish-black in both sexes. Left epandrial lamella rather blunt at tip and wider (Fig. 8 B), outer (left) side with very long, bifurcated bristles ..... ***P. pictitarsis*** **(Becker)**

-. Legs yellow including all coxae and the annulated black tarsi. Palpus yellow in male, dusky in female. Left epandrial lamella apically narrowed and rather pointed, outer (left) margin with less numerous, shorter and simple bristles (Fig. 8 A)..... ***P. kirtlingensis*** **Grootaert**

Comparison of the male terminalia in *P. kirtlingensis*, *P. pictitarsis* and *P. pictitarsoides* sp. nov. (Fig. 8).

Without preparation of the male terminalia, the three species can already be recognized by the shape of the left epandrial lamella. The apex of the left epandrial lamella is quite slender in *P. kirtlingensis* while broader in *P. pictitarsis* and even broader in *P. pictitarsoides*. In *P. pictitarsis* the long marginal bristles on the left side are confined to the basal half, while in *P. pictitarsoides* even on the apical half there are very long marginal bristles, but more interspaced than at the base. In *P. kirtlingensis* there is a bundle of long bristles, less dense than in the other two species. Moreover, the bristles are simple and not forked.

The tip of the left cercus, more particularly the inward directed apical protrusion is also different. Removal and clearing of the terminalia is generally needed to observe this structure that is laying below the left epandrial lamella in lateral view. In *P. kirtlingensis* (Fig. 8 D) the protrusion is pointed, brownish and directed upward. In *P. pictitarsis* the tip of the left cercus resembles a cap (Fig. 8 G). In *P. pictitarsoides*, the tip of the left cercus is elongated (Fig. 7 B, dorsal view) and lacks microtrichia at the extreme tip (Fig. 8 H). The inward directed protrusion has a different shape compared to the other two species (Fig. 8 H).

The aedeagal complex is also different. The position of the different parts is illustrated in a lateral view (Fig. 8 B), beneath the left epandrial lamella. In *P. kirtlingensis* (Fig. 8 D) the

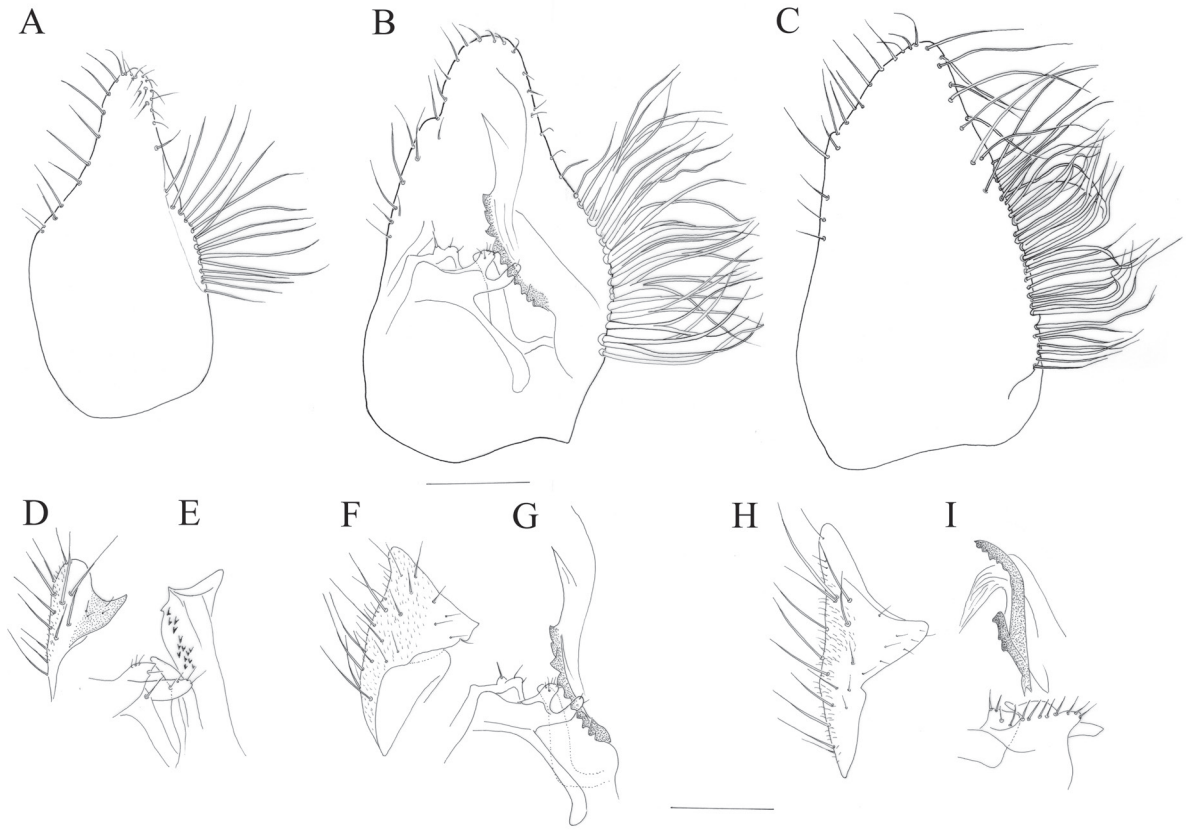

Fig. 8. Comparison of left epandrial lamella (A-C), left cercus in lateral view (D, F, H) and aedeagal complex (E, G, I) between *P. kirtlingensis*, *P. pictitarsis* and *P. pictitarsoides* sp. nov. A, *P. kirtlingensis* (paratype, France, St. Cyr en Archies, 1985). B, *P. pictitarsis* (France, St. Cyr en Archies, 1985) with the indication of the position of the aedeagal complex and the inner structures on the left epandrial. C, *P. pictitarsoides* sp. nov. (paratype, Oudergem, ref. 1176). D-E, *P. kirtlingensis*. F-G, *P. pictitarsis*. H-I, *P. pictitarsoides* sp. nov. Scale:0.1 mm.

denticulated part consist of a few scattered downward directed denticles. The denticles are more robust and inserted on a dark sclerotized sclerite in *P. pictitarsis*, while in *P. pictitarsoides* there are two separated denticulate sclerotizations, the denticles less strong than in *P. pictitarsis*.

The inner structures on the left epandrial lamella are not well understood. However, there are many differences between the different species. In *P. pictitarsis* the transverse rod-like structure ends in a fork, each segment bearing a few tiny apical hairs (Fig. 8 G). In *P. pictitarsoides* this rod-like structure is apically not forked and bears a row of hairs all along the apical side (Fig. 8 I). The structure of the transverse rod-like structure is comparable in *P. kirtlingensis*, though the apical row of hairs is limited to a few scattered hairs (Fig. 8 E).

Comparison with *P. stabilis* (Collin, 1961) and *P. annulitarsis* Kovalev, 1978.

Both *P. stabilis* and *P. annulitarsis* lack an anterior notopleural bristle, but have similar male terminalia as in *P. pictitarsoides*. The male terminalia of *P. stabilis* (Collin, 1961) do resemble somewhat those of *P. pictitarsoides* in that the outer marginal bristles of the left epandrial lamella are long along the entire margin. However, the tarsi in *P. stabilis* are faintly brownish annulated and darker on the apical two tarsomeres. In *P. pictitarsoides* they are equally annulated black. The third antennal segment is about twice as long as deep, black with yellow base. The third antennal segment is 2.5 times as long as deep and entirely black in *P. pictitarsoides*. The fore tibia is distinctly spindle-shaped in *P. stabilis* while tubular in *P. pictitarsoides*.

Platypalpus annulitarsis Kovalev, 1978 is another small species (less than 2 mm in body length) that resembles *P. pictitarsoides*. It has a polished clypeus. The apical half of the third antennal segment is black and the base yellow. The male has a long, blunt-tipped apical spur on the mid tibia which is pointed in the female. In *P. pictitarsoides* the mid tibial spur is pointed in both sexes. The left epandrial lamella is indented on its outer margin and the basal part is protruding with several rows of very long bristles. The outer margin of the left epandrial lamella is not indented and the basal part is not protruding in *P. pictitarsoides*. In addition, the right epandrial lamella is on the basal half of the right (outer) margin set with long bristles. In *P. pictitarsoides* there are only very short bristles all along the outer margin (Fig. 7 A).

Platypalpus pictitarsis (Becker, 1902)
Fig. 8 B, F, G

Platypalpus ruficornis Macquart, 1850 (non von Roser, 1840): 97.
Tachydromia pictitarsis Becker, 1902: 44.
Tachydromia pictitarsis Becker, 1902 *in* Collin, 1961: 168, re-description and illustration male terminalia (Fig. 62).
Platypalpus pictitarsis (Becker, 1902) *in* Grootaert, 1986: 190, re-description and illustration antenna, fore leg, male terminalia (Figs 8-13).
Platypalpus pictitarsis (Becker, 1902) *in* Chvála, 1989: 349, diagnosis.
Platypalpus pictitarsis (Becker, 1902) *in* Grootaert & Chvála, 1992: 175, diagnosis and illustration antenna, fore leg, male terminalia (Figs 190-195).

As can be seen in the synonym list above, *Platypalpus pictitarsis* has been subject of discussion several times. Collin (1961) clearly indicated variability of the characters, which in the end led to the description of *P. kirtlingensis* Grootaert, 1986. Collin (1961) was hesitative of the distinction of the two species and in fact he illustrated the left epandrial lamella (Fig. 62) from *P. kirtlingensis* while the description is from *P. pictitarsis*. DNA barcoding might be a useful tool to elucidate the genetic differences hopefully corroborating the morpho-species as we identify them now.

Platypalpus rapidoides Chvála, 1975

Material examined: Oudergem, Botanic Garden Jean Massart: MT1: 1♂, 1♀, 23.VI-1.VII.2016 (ref. 1316); MT2: 1♀, 21-28.V.2015 (ref. 623); 1♀, 4-10.VI.2015 (ref. 340); MT6: 1♂, 1-8.VI.2017 (ref. 1197).

A rare species often found together with *P. rapidus* (Meigen). *P. rapidus* has the fore coxa and femur yellow, while they are black in *P. rapidoides*. The acrostichals are quadri-serial in *P. rapidus*, while irregularly six-serial in *P. rapidoides*.

Platypalpus subtilis (Collin, 1926)

Material examined: Oudergem, Botanic Garden Jean Massart: MT1: 1♀, 6-12.VIII.2015 (ref. 131); MT2: 1♀, 28.VII-4.VIII.2016 (ref. 980); MT3: 1♀, 1-6.VII.2016; 1♀ (ref. 945); 1♀, 6-14.VII.2016; MT5: 1♀, 30.VI-6.VII.2017 (ref. 1330); MT6: 1♀, 24.V-1.VI.2017 (ref. 1181); 1♀, 8-15.VI.2017 (ref. 1205).

Additional material examined: Belgium: 1♀, Gomery, 21.V.1981; 1♀, Ottignies, 1.VIII.1981; 1♀, 15.VIII.1981; 1♀, 29.VIII.1981; 1♀, Buzenol, 16.VI.1981; 1♀, 30.VI.1981; 1♀, 28.VII.1981; 1♀ 11.VIII.1981.

An enigmatic species known from only seven females in the Botanic Garden. The eight earlier records of this species from the south of Belgium are also females. Probably confused with other species. To our knowledge, there are no figures of the male terminalia available.

Trichina opaca Loew, 1864

Trichina opaca Loew, 1864: 40.
Trichina picipes Tuomikoski, 1935: 99.
Trichina opaca Loew, 1864 *in* Chvála, 1983: 130 and illustrations (Figs 231, 232, 249-254).

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♀, 8-15.VI.2017 (ref. 1201).

Comments. Using the key of Chvála (1983), the female found here at the Botanic Garden leads to *T. opaca* in having the anterior part of the mesoscutum covered with microtrichia. The third antennal segment is broader and much shorter than in *T. elongata* and the stylus is about half as long as the third segment. According to Chvála (1983) the female is much paler than the male which would fit to the female found here. Males are needed to confirm the presence of this species in Belgium.

Distribution. According to the Fauna Europaea, *T. opaca* is recorded from the British Isles, Central European Russia, Czech Republic, Finland, Germany, Ireland, Italy and Switzerland. Its occurrence in Belgium was thus expected.

Stilpon subnubilus Chvála, 1988

Stilpon subnubilus Chvála, 1988: 227 (description, Figs 1, 3-7).

Material examined: Oudergem, Botanic Garden Jean Massart: MT2, 1♂, 12-20.VIII.2015; 1♀, 24.XI-20.XII.2016 (ref. 401).

The species was recently reported from The Netherlands (Belgers *et al.*, 2021). It is very closely related to *S. moroccensis* (Grootaert *et al.*, 2021).

Discussion

In the present three-year survey at the Botanic Garden Jean Massart, 90 hybotid species were found, representing about 52 % of the species ever recorded in Belgium (GROOTAERT, 1991; GROOTAERT *et al*., 2001).

The species accumulation curve (Fig. 9) calculated with the programme EstimateS (COLWELL, 2013) shows the relation between number of sampling sites/seasons and number of species. The total number of species observed is 90 S(est) while Chao1 predicts 99 species, Bootstrap 97 species and Jackknife 103 species. The number of singletons and doubletons are clearly descending.

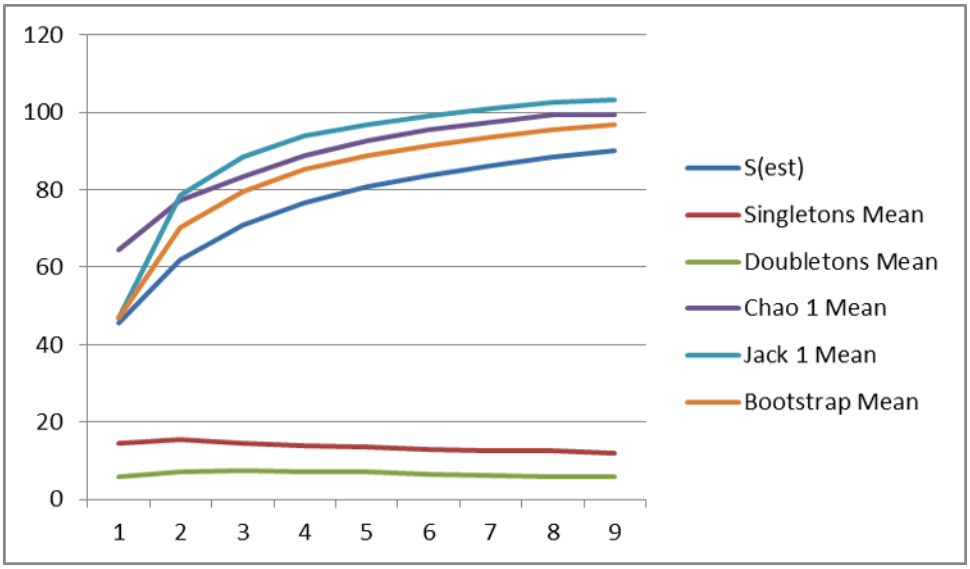

Fig. 9. Species accumulation curve calculated with the programme EstimateS (COLWELL, 2013).

Analysis of the RDB data

Table 3 shows the alphabetic list of the hybotid species found at the Botanic Garden Jean Massart with their Red Data Book status, while Table 4 shows the list of the Red Data Book status with the species assigned to them from highly threatened species to Safe/Low risks species. Table 5 provides an overview of the number of species per RDB category (GROOTAERT *et al.*, 2001).

Two species that were supposed to be 'Extinct' in Flanders and Brussels, were recorded here in the Botanic Garden: *Platypalpus pseudorapidus* Kovalev, 1971 and *Trichina bilobata* Collin, 1926. It is clear that these two species should be removed from this category and be placed in the category 1 'Critically endangered' species.

No species belonging to the category 'Critically endangered' were found, while two species belong to the category 'Endangered' and one species is considered 'Vulnerable'. On the other hand, one third of the species, more precisely 34 species, are considered as 'Susceptible'. This category groups species that are uncommon but for which no significant recent decrease in geographical distribution could be demonstrated. It also groups species from rare habitats.

Another third of the species (32 species) are considered to be 'Safe/Low risk'. Finally, 18 species are considered as 'Data deficient' which means that no trend of decline is visible, simply because they have not been observed before the pivot date of 1980 and hence the percentage observed before and after 1980 cannot be calculated. In addition, these species were not observed in threatened habitats which would put them automatically in a threatened category. In reality,

most of these species are rare and even when more surveys would be available, it is likely that they would not belong to the 'Safe/Low risk' category.

Since its publication in 2001, the Red Data Book on empidids (Grootaert *et al.*, 2001) has not been updated nor the data collected since 2001 up to present have been re-calculated nor re-evaluated. Nevertheless, the low percentage of 30% 'Safe/Low risk' species is an indication that there is a high number species in the Botanic Garden that are in one way or another threatened species. We are well aware of the main criticisms of Red Data Books that sampling efforts are never sufficient and that they do not reflect the exact condition of the population. According to Heijerman & Turin (1998), the results are therefore arbitrary. These arguments are valid but it must also be recognised that there is an urgent need for properly processed data, and that such data, even if incomplete, may reveal real patterns. Site quality assessments are preferably based on a combination of species' richness, abundance, rarity and vulnerability estimates of as many biota as possible. As reliable data on rarity and vulnerability are almost entirely restricted to Red Data Books, it seems evident that only organisms which have been investigated in this respect can be used in these assessment studies.

Table 3. Alphabetic list of the hybotid species found at the Botanic Garden Jean Massart with their Red Data Book status.

species name	MT1	MT2	MT3	MT4	MT5	MT6	Total	Red Data cat. 2001
Bicellaria intermedia Lundbeck, 1910		1					1	Data deficient
Bicellaria sulcata (Zetterstedt, 1842)	18	5	3				26	Susceptible
Bicellaria vana Collin, 1926	6	6		3	11		26	Safe/Low risk
Crossopalpus abditus Kovalev, 1972						1	1	Susceptible
Crossopalpus humilis (Frey, 1913)				1			1	Safe/Low risk
Crossopalpus minimus (Meigen, 1838)	1	3			3		7	Safe/Low risk
Crossopalpus nigritellus (Zetterstedt, 1842)		1		2	1		4	Safe/Low risk
Drapetis arcuata Loew, 1859		1					1	Data deficient
Drapetis assimilis (Fallén, 1815)		13			8	9	30	Susceptible
Drapetis bruscellensis Grootaert, 2016		16				1	17	Data deficient
Drapetis exilis Meigen, 1822	1	39			1	3	44	Data deficient
Drapetis infitialis (Collin, 1961)	1	4			2		7	Data deficient
Drapetis parilis Collin, 1926	7	185	5	1	6	9	213	Safe/Low risk
Drapetis pusilla Loew, 1859	1	20			4	1	26	Safe/Low risk
Drapetis simulans Collin, 1961	1	1					2	Safe/Low risk
Elaphropeza ephippiata (Fallén, 1815)	18	114	7	2	38	19	198	Safe/Low risk
Euthyneura myrtilli Macquart, 1836	31	89	2	1	32	12	167	Safe/Low risk
Hybos culiciformis (Fabricius, 1775)	3	3					6	Near threatened
Hybos femoratus (Müller, 1776)		1					1	Vulnerable
Leptopeza borealis Zetterstedt, 1842		1					1	Data deficient
Leptopeza flavipes (Meigen, 1820)	1	10	1			1	13	Susceptible
Oedalea apicalis Loew, 1859	1	5				1	7	Data deficient
Oedalea flavipes Zetterstedt, 1842	4	14	7	1			26	Safe/Low risk
Oedalea holmgreni Zetterstedt, 1852	4	27	2				33	Safe/Low risk
Oedalea hybotina (Fallén, 1816)	1	3				1	5	Susceptible
Oedalea stigmatella Zetterstedt, 1842	4	4					8	Susceptible
Oedalea tibialis Macquart, 1827	8	16	2		1	1	28	Safe/Low risk
Oedalea zetterstedti Collin, 1926	21	18	9	1	3	3	55	Susceptible

species name	MT1	MT2	MT3	MT4	MT5	MT6	Total	Red Data cat. 2001
Platypalpus agilis (Meigen, 1822)	3	5					8	Safe/Low risk
Platypalpus albicornis (Zetterstedt, 1842)	2	7	1				10	Susceptible
Platypalpus albiseta (Panzer, 1806)	2	1			1		4	Susceptible
Platypalpus annulatus (Fallén, 1815)		22		1	1	11	35	Safe/Low risk
Platypalpus annulipes (Meigen, 1822)	21	174	18		13	4	230	Safe/Low risk
Platypalpus aristatus (Collin, 1926)	11	122	4	2	86		225	Susceptible
Platypalpus articulatoides (Frey, 1918)	2	29		1	16		48	Safe/Low risk
Platypalpus articulatus Macquart, 1827		1					1	Safe/Low risk
Platypalpus aurantiacus (Collin, 1926)	2	11	1	1	1		16	Data deficient
Platypalpus australominutus Grootaert, 1989	2	1					3	Safe/Low risk
Platypalpus calceatus (Meigen, 1822)	18	155	24		22	5	224	Safe/Low risk
Platypalpus candicans (Fallén, 1815)		1	2			14	17	Susceptible
Platypalpus caroli Grootaert, 1987			1				1	Susceptible
Platypalpus ciliaris (Fallén, 1816)	8	23					31	Safe/Low risk
Platypalpus cothurnatus Macquart, 1827	48	202	21	1	9	26	307	Susceptible
Platypalpus coxatus (Zetterstedt, 1842)	1	11	10				22	Susceptible
Platypalpus dessarti Grootaert, 1983	1	2			1	1	5	Susceptible
Platypalpus divisus Walker, 1851	1	3			4		8	Data deficient
Platypalpus exilis (Meigen, 1822)	8	21	39	3	2		73	Susceptible
Platypalpus interstinctus (Collin, 1926)	1	4					5	Safe/Low risk
Platypalpus kirtlingensis Grootaert, 1986	5	9					14	Susceptible
Platypalpus laticinctus Walker, 1851					1		1	Susceptible
Platypalpus leucocephalus (von Roser, 1840)			1		1		2	Susceptible
Platypalpus longicornis (Meigen, 1822)	83	76	13	11	76	7	266	Safe/Low risk
Platypalpus longimanus (Corti, 1907)		2					2	Data deficient
Platypalpus longiseta (Zetterstedt, 1842)	12	34	12	5	5	14	82	Safe/Low risk
Platypalpus luteoloides Grootaert, 1983		3			1		4	Susceptible
Platypalpus luteolus (Collin, 1926)	67	90	55	1	44	38	295	Susceptible
Platypalpus maculipes (Meigen, 1822)	1						1	Safe/Low risk
Platypalpus massarti **sp. nov.**		2					1	Data deficient
Platypalpus minutus (Meigen, 1804)	5	23	1		6	4	39	Safe/Low risk
Platypalpus nanus (Oldenberg, 1924)		1				10	11	Susceptible
Platypalpus negrobovi Grootaert *et al.*, 2012		12	1		2		15	Data deficient
Platypalpus niger (Meigen, 1804)		8				2	10	Safe/Low risk
Platypalpus notatus (Meigen, 1822)	2	7	1			2	12	Safe/Low risk
Platypalpus optivus (Collin, 1926)	8	13	132	1	12	2	168	Susceptible
Platypalpus pallidiventris (Meigen, 1822)	31	128	26	5	46	28	264	Safe/Low risk
Platypalpus pallipes (Fallén, 1815)	1	15	1		15	3	35	Susceptible
Platypalpus pectoralis (Fallén, 1815)	5	25	22	1	3		56	Safe/Low risk
Platypalpus pictitarsis (Becker, 1902)	1	4	1				6	Susceptible
Platypalpus pictitarsoides **sp. nov.**	41	30			7	123	201	Data deficient
Platypalpus praecinctus (Collin, 1926)		2	1				3	Endangered
Platypalpus pseudofulvipes Frey, 1909	2	39				27	68	Susceptible
Platypalpus pseudorapidus Kovalev, 1971		2			1		3	Extinct
Platypalpus pulicarius (Meigen, 1830)						6	6	Data deficient
Platypalpus rapidoides Chvála, 1975	2	2				1	5	Data deficient
Platypalpus rapidus (Meigen, 1822)		2				1	3	Endangered

species name	MT1	MT2	MT3	MT4	MT5	MT6	Total	Red Data cat. 2001
Platypalpus stabilis (Collin, 1961)	4	47		1	1		53	Susceptible
Platypalpus subtilis (Collin, 1926)	1	1	2		1	2	7	Data deficient
Stilpon subnubilus Chvála, 1988		2					2	Data deficient
Symballophthalmus fuscitarsis (Zetterstedt, 1859)		5			1		6	Susceptible
Tachydromia aemula (Loew, 1864)						4	4	Susceptible
Tachydromia annulimana Meigen, 1822	1	5	6		6	2	20	Safe/Low risk
Tachydromia arrogans (Linnaeus, 1761)						2	2	Safe/Low risk
Tachydromia smithi Chvála, 1966						1	1	Susceptible
Tachydromia umbrarum Haliday, 1833		7					7	Susceptible
Tachypeza nubila (Meigen, 1804)	11	12	15		8	7	53	Safe/Low risk
Trichina bilobata Collin, 1926	1	4		1	8	24	38	Extinct
Trichina clavipes Meigen, 1830	11	14	5	1		4	35	Susceptible
Trichina elongata Haliday, 1833	25	55	2	9	32	7	130	Susceptible
Trichina opaca Loew, 1864						1	1	Data deficient
Trichinomyia flavipes (Meigen, 1830)	2	19	11				32	Susceptible
Total number specimens	**626**	**2137**	**467**	**57**	**550**	**567**	**4192**	
Total number of species	**58**	**80**	**38**	**24**	**44**	**44**	**90**	
Number of seasons sampled	**2**	**3**	**1**	**1**	**1**	**1**	**3**	

Table 4. List of the Red Data Book status with the species assigned to them.

species	Red Data Book
Platypalpus pseudorapidus Kovalev, 1971	Extinct
Trichina bilobata Collin, 1926	Extinct
Platypalpus praecinctus (Collin, 1926)	Endangered
Platypalpus rapidus (Meigen, 1822)	Endangered
Hybos femoratus (Müller, 1776)	Vulnerable
Bicellaria sulcata (Zetterstedt, 1842)	Susceptible
Crossopalpus abditus Kovalev, 1972	Susceptible
Drapetis assimilis (Fallén, 1815)	Susceptible
Leptopeza flavipes (Meigen, 1820)	Susceptible
Oedalea hybotina (Fallén, 1816)	Susceptible
Oedalea stigmatella Zetterstedt, 1842	Susceptible
Oedalea zetterstedti Collin, 1926	Susceptible
Platypalpus albicornis (Zetterstedt, 1842)	Susceptible
Platypalpus albiseta (Panzer, 1806)	Susceptible
Platypalpus aristatus (Collin, 1926)	Susceptible
Platypalpus candicans (Fallén, 1815)	Susceptible
Platypalpus caroli Grootaert, 1987	Susceptible
Platypalpus cothurnatus Macquart, 1827	Susceptible
Platypalpus coxatus (Zetterstedt, 1842)	Susceptible
Platypalpus dessarti Grootaert, 1983	Susceptible
Platypalpus exilis (Meigen, 1822)	Susceptible
Platypalpus kirtlingensis Grootaert, 1986	Susceptible
Platypalpus laticinctus Walker, 1851	Susceptible
Platypalpus leucocephalus (von Roser, 1840)	Susceptible
Platypalpus luteoloides Grootaert, 1983	Susceptible
Platypalpus luteolus (Collin, 1926)	Susceptible
Platypalpus nanus (Oldenberg, 1924)	Susceptible
Platypalpus optivus (Collin, 1926)	Susceptible
Platypalpus pallipes (Fallén, 1815)	Susceptible
Platypalpus pictitarsis (Becker, 1902)	Susceptible
Platypalpus pseudofulvipes Frey, 1909	Susceptible

species	Red Data Book
Platypalpus stabilis (Collin, 1961)	Susceptible
Symballophthalmus fuscitarsis (Zetterstedt, 1859)	Susceptible
Tachydromia aemula (Loew, 1864)	Susceptible
Tachydromia smithi Chvála, 1966	Susceptible
Tachydromia umbrarum Haliday, 1833	Susceptible
Trichina clavipes Meigen, 1830	Susceptible
Trichina elongata Haliday, 1833	Susceptible
Trichinomyia flavipes (Meigen, 1830)	Susceptible
Hybos culiciformis (Fabricius, 1775)	Near threatened
Bicellaria vana Collin, 1926	Safe/Low risk
Crossopalpus humilis (Frey, 1913)	Safe/Low risk
Crossopalpus minimus (Meigen, 1838)	Safe/Low risk
Crossopalpus nigritellus (Zetterstedt, 1842)	Safe/Low risk
Drapetis parilis Collin, 1926	Safe/Low risk
Drapetis pusilla Loew, 1859	Safe/Low risk
Drapetis simulans Collin, 1961	Safe/Low risk
Elaphropeza ephippiata (Fallén, 1815)	Safe/Low risk
Euthyneura myrtilli Macquart, 1836	Safe/Low risk
Oedalea flavipes Zetterstedt, 1842	Safe/Low risk
Oedalea holmgreni Zetterstedt, 1852	Safe/Low risk
Oedalea tibialis Macquart, 1827	Safe/Low risk
Platypalpus agilis (Meigen, 1822)	Safe/Low risk
Platypalpus annulatus (Fallén, 1815)	Safe/Low risk
Platypalpus annulipes (Meigen, 1822)	Safe/Low risk
Platypalpus articulatoides (Frey, 1918)	Safe/Low risk
Platypalpus articulatus Macquart, 1827	Safe/Low risk
Platypalpus australominutus Grootaert, 1989	Safe/Low risk
Platypalpus calceatus (Meigen, 1822)	Safe/Low risk
Platypalpus ciliaris (Fallén, 1816)	Safe/Low risk
Platypalpus interstinctus (Collin, 1926)	Safe/Low risk
Platypalpus longicornis (Meigen, 1822)	Safe/Low risk
Platypalpus longiseta (Zetterstedt, 1842)	Safe/Low risk
Platypalpus maculipes (Meigen, 1822)	Safe/Low risk
Platypalpus minutus (Meigen, 1804)	Safe/Low risk
Platypalpus niger (Meigen, 1804)	Safe/Low risk
Platypalpus notatus (Meigen, 1822)	Safe/Low risk
Platypalpus pallidiventris (Meigen, 1822)	Safe/Low risk
Platypalpus pectoralis (Fallén, 1815)	Safe/Low risk
Tachydromia annulimana Meigen, 1822	Safe/Low risk
Tachydromia arrogans (Linnaeus, 1761)	Safe/Low risk
Tachypeza nubila (Meigen, 1804)	Safe/Low risk
Bicellaria intermedia Lundbeck, 1910	Data deficient
Drapetis arcuata Loew, 1859	Data deficient
Drapetis bruscellensis Grootaert, 2016	Data deficient
Drapetis exilis Meigen, 1822	Data deficient
Drapetis infitialis (Collin, 1961)	Data deficient
Leptopeza borealis Zetterstedt, 1842	Data deficient
Oedalea apicalis Loew, 1859	Data deficient
Platypalpus aurantiacus (Collin, 1926)	Data deficient
Platypalpus divisus Walker, 1851	Data deficient
Platypalpus longimanus (Corti, 1907)	Data deficient
Platypalpus massarti sp. nov.	Data deficient
Platypalpus negrobovi Grootaert *et al*., 2012	Data deficient
Platypalpus pictitarsoides sp. nov.	Data deficient
Platypalpus pulicarius (Meigen, 1830)	Data deficient
Platypalpus rapidoides Chvála, 1975	Data deficient
Platypalpus subtilis (Collin, 1926)	Data deficient
Stilpon subnubilus Chvála, 1988	Data deficient
Trichina opaca Loew, 1864	Data deficient

Table 5. Summary of the number of species per RDB category.

RDB category	nr species
0. Extinct	2
1. Critically endangered	0
2. Endangered	2
3. Vulnerable	1
4. Susceptible	34
5. Near threatened	1
6. Safe/Low risk	32
7. Data deficient	18

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Empididae (Diptera) or dance flies of the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) with comments on Red Data Book status

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Abstract

Fifty-two Empididae, dance fly species, are recognized in the Botanic Garden Jean Massart (Brussels) representing 33% of the species recorded so far in Belgium. Only 20 species or 38% have a Safe/Low risk Red Data Book (RDB) status while the others are classified in 'Threatened' categories including the nine 'Data deficient' species that are anyhow rare species. Comments are provided for a number of remarkable species. Three species were supposed to be extinct in the area (last recorded before 1981): *Clinocera* (*Kowarzia*) *bipunctata* (Haliday, 1833), *Dolichocephala oblongoguttata* (Dale, 1878) and *Hemerodromia unilineata* Zetterstedt, 1842. Some very rare species - considered as threatened in RDB - were recorded: *Chelifera precabunda* Collin, 1961, *Chelifera precatoria* Fallén, 1815 and *Rhamphomyia* (*Pararhamphomyia*) *marginata* (Fabricius, 1787). Finally, some species are also very rare but missing in RDB: *Empis* (*Lissempis*) *nigritarsis* Meigen, 1804, *Hilara albitarsis* von Roser, 1840, *Hilara anglodanica* Lundbeck, 1913, *Rhamphomyia* (*Amydroneura*) *hirsutipes* Collin, 1926 and *Rhamphomyia* (*Megacyttarus*) *poissoni* (Tréhen, 1966).

Keywords: Biodiversity survey, Malaise trap, Empididae

Introduction

The present study reports on Empididae species examined as part of a comprehensive three-year survey of the Diptera in the Botanic Garden Jean Massart (Brussels, Belgium) as described in Grootaert *et al*. (2023). The Botanic Garden Jean Massart is a tiny 4.5 ha site, squeezed in between the eastern border of the city of Brussels and the Sonian forest. Nearly 2,000 plant species have been recorded in this Natura 2000 site. The area is composed of various biotopes such as humid areas with a swamp and ponds, an old orchard on dry flowered grassland, a medicinal plants garden, an arboretum and an evolution garden. All is mixed with patches of semi natural woods.

Material and methods

A three-year survey was done with Malaise traps (MT) in the Botanic Garden Jean Massart as described in Grootaert *et al*. (2023). Since not all the samples have been identified except for the sites 1 (MT1) and 2 (MT2) from 2015 and 2016, the other results provided for MT3, MT4, MT5 and MT6 are partial and hence the numbers should not be compared with those of MT1 and MT2. As for the subfamily Clinocerinae, samples collected from all six sites (MT1-MT6) were examined. The present study is based on Malaise trap samples only. In addition, Previous Belgian records on which the Red Data Book were based (Grootaert *et al*., 2001), are included in the results. The empidid material is stored in ethanol. In the listing of the records 'reg.' refers to the register

number of the specimens of the Diptera from the Botanic Garden Jean Massart in the collections of the Royal Belgian Institute of Natural Sciences in Brussels (RBINS).

The Empididae were identified by using the tables in Barták (1982, 2004), Chvála (1994, 2005) and Collin (1961).

The Red Data Book (RDB) categories are those listed in Grootaert *et al*. (2001). All species were assigned to a particular Red Data Book category as defined by the combination of a rarity and a trend criterion. Rarity is expressed as the proportion of the total number of UTM 5 km squares sampled to number of squares in which the species has been found since 1981. The trend criterion is the change in rarity between the periods 1887-1980 and 1981-1999. In addition, a third criterion is applied when the habitat of the species is threatened.

Results

Table 1. Overview of the empidid species recorded in the Botanic Garden Jean Massart. Only the data of MT1 and MT2 can be compared since the data from the other sites (MT3, MT4, MT5 and MT6) are incomplete. The Red Data Book status for each species is given, based on Grootaert *et al*. (2001).

Species	MT1	MT2	MT3	MT4	MT5	MT6	Total	Red Data Book
Chelifera precabunda Collin, 1961		1				2	3	Susceptible
Chelifera precatoria Fallén, 1815	1	1				36	38	Cr. Endangered
Clinocera (*Kowarzia*) *bipunctata* (Haliday, 1833)						2	2	Extinct
Dolichocephala irrorata (Fallén, 1815)	33	14			28	50	125	Safe/Low risk
Dolichocephala oblongoguttata (Dale, 1878)	29	8			16	115	168	Extinct
Empis (*Coptophlebia*) *albinervis* Meigen, 1822	28	65	3			1	97	Safe/Low risk
Empis (*Empis*) *acinerea* Chvala, 1985	13	17					30	Susceptible
Empis (*Empis*) *aestiva* Loew, 1867	30	44	1				75	Safe/Low risk
Empis (*Empis*) *chioptera* Meigen, 1804	15	12					27	Safe/Low risk
Empis (*Empis*) *nigripe*s Fabricius, 1794	4	16					20	Safe/Low risk
Empis (*Empis*) *nuntia* Meigen, 1938	31	22	1	1			55	Safe/Low risk
Empis (*Empis*) *pennipes* Linnaeus, 1758	9	18	2				29	Susceptible
Empis (*Empis*) *planetica* Collin, 1927		19					19	Safe/Low risk
Empis (*Empis*) *praevia* Collin, 1927	1	25					26	Safe/Low risk
Empis (*Empis*) *woodi* Collin, 1927	5	8					13	Susceptible
Empis (*Euempis*) *ciliata* Fabricius, 1787	1						1	Susceptible
Empis (*Euempis*) *tessellata* (Fabricius, 1794)	16	12					28	Safe/Low risk
Empis (*Kritempis*) *livida* Linnaeus, 1758	11	80	4		5		100	Safe/Low risk
Empis (*Lissempis*) *nigritarsis* Meigen, 1804	14						14	Data deficient
Empis (*Xanthempis*) *lutea* Meigen, 1804	1	3					4	Susceptible
Empis (*Xanthempis*) *stercorea* Linnaeus, 1761	9	13	2				24	Safe/Low risk
Empis (*Xanthempis*) *trigramma* Wiedemann, 1822)	151	61	1				213	Safe/Low risk
Heleodromia immaculata Haliday, 1833		3			5		8	Safe/Low risk
Hemerodromia unilineata Zetterstedt, 1842						2	2	Extinct

Species	MT1	MT2	MT3	MT4	MT5	MT6	Total	Red Data Book
Hilara albipennis von Roser, 1840	1	2					3	Susceptible
Hilara albitarsis von Roser, 1840		1					1	Data deficient
Hilara anglodanica Lundbeck, 1913		7					7	Data deficient
Hilara brevistyla Collin, 1927	58	1					59	Vulnerable
Hilara chorica (Fallén, 1816)		11					11	Safe/Low risk
Hilara cornicula Loew, 1873	1	16					17	Safe/Low risk
Hilara fuscipes (Fabricius, 1794)	7	23					30	Vulnerable
Hilara griseifrons Collin, 1927		14					14	Susceptible
Hilara hirtipes Collin, 1927	1						1	Data deficient
Hilara lurida (Fallén, 1816)	5	12	2				19	Endangered
Hilara manicata Meigen, 1822	6	20	1				27	Susceptible
Hilara maura (Fabricius, 1776)	69	18					87	Safe/Low risk
Hilara monedula Collin, 1927		8	14				22	Safe/Low risk
Hilara nigrina (Fallén, 1816)	1	4				3	8	Susceptible
Hilara thoracica Macquart, 1827	1	1					2	Susceptible
Phyllodromia melanocephala (Fabricius, 1794)		10					10	Safe/Low risk
Rhamphomyia (*Aclonempis*) *albohirta* Collin, 1926	25	38	1				64	Data deficient
Rhamphomyia (*Aclonempis*) *longipe*s (Meigen, 1804)	1	6					7	Safe/Low risk
Rhamphomyia (*Amydroneura*) *erythrophthalma* Meigen, 1830	15	9	6		2	3	35	Susceptible
Rhamphomyia (*Amydroneura*) *gibba* (Fallén, 1816)	1	8			9	2	20	Susceptible
Rhamphomyia (*Amydroneura*) *hirsutipes* Collin, 1926		1					1	Data deficient
Rhamphomyia (*Holoclera*) *flava* (Fallén, 1816)	2	1					3	Susceptible
Rhamphomyia (*Holoclera*) *nigripennis* (Fabricius, 1794)	31	33	7				71	Safe/Low risk
Rhamphomyia (*Megacyttarus*) *crassirostris* (Fallén, 1816)	22	15					37	Vulnerable
Rhamphomyia (*Megacyttarus*) *poissoni* (Tréhen, 1966)		4	10				14	Data deficient
Rhamphomyia (*Pararhamphomyia*) *albipennis* (Fallén, 1816)	1						1	Data deficient
Rhamphomyia (*Pararhamphomyia*) *marginata* (Fabricius, 1787)	1	2					3	Critically Endangered
Rhamphomyia (*Pararhamphomyia*) *pilifer* Meigen, 1838	12	2					14	Data deficient
Number of specimens	**663**	**709**	**55**	**1**	**65**	**216**	**1709**	
Number of species	**39**	**46**	**14**	**1**	**6**	**10**	**52**	

On a total of 1,709 identified specimens, 52 species of Empididae were recognized during the survey (Table 1). Their Red Data Book status as calculated in GROOTAERT *et al*. (2001) is provided for each species. Since not all the samples have been identified except for the sites 1 (MT1) and 2 (MT2), the results provided for MT3, MT4, MT5 and MT6 are partial and hence the numbers should not be compared with those of MT1 and MT2. Only the data for the subfamily Clinocerinae are complete and hence comparable over all the stations.

Annotated data on remarkable species

Chelifera precabunda Collin, 1961

RDB status: 4. Susceptible

Material examined. Oudergem, Botanic Garden Jean Massart: MT2: 1♂, 12-25.X.2017 (reg. 1351); MT6: 2♂♂, 11-17.V.2017 (reg. 1043).

Previous Belgian records. Rood Klooster (Rouge Cloître), 1♂, 16.V.1918; 1♂, 3.VII.1919 (leg. A. Tonnoir); Rood Klooster, 1♂, 2.VII.1941 (leg. A. Collart); 1♂, 24.VI.1941; 1♂, 27.VIII.1942; 1♂, 7.V.1942; 1♂, 1♀, 24.VI.1942; 1♀, 2.VI.1942 (leg. A. Collart); Ellezelles, 1♂, 1.VI.1960 (leg. M. Bequaert); Bois de Cerfontaine, 1♂, 12.VI.1950 (leg. R. Tollet); Malmédy, 1♂, 25.VII.1935 (leg. A. Collart); Mirwart, 1♂ (no date); Pepinster, 1♂, 13.VII.1949; Rekem, 1♀, 5.VIII.1997; 1♂, 5.VIII.1997; Tailles, 1♂, 14.V.1948 (leg. R. Tollet).

Comments. Several of the former records were from the locality Rood Klooster or Rouge Cloître, a site bordering the Botanic Garden Jean Massart.

Chelifera precatoria Fallén, *1815*

RDB status: 1. Critically Endangered

Material examined. Oudergem, Botanic Garden Jean Massart: MT1: 1♀, 16-23.VI.2016 (reg. 793); MT2: 1♂, 26.VI-1.VII.2015 (reg.179); MT6: 5♂, 5-11.V.2017; 15♂, 2♀♀, 11-17.V.2017 (reg. 1044); 6♂, 2♀♀, 24.V-1.VI.2017 (reg. 1164); 5♂, 1-8.VI. 2017 (reg. 1183); 1♂, 21.IX-12.X.2017.

Comments. The species was previously recorded 32 times from Belgium, but only 6 records date after 1980. This large decline in the records was the reason why this species got the status of 'Critically Endangered' in the RDB. In the Botanic Garden Jean Massart, *C. precatoria* was recorded seven times and 38 specimens were found. The environment seems to be favourable for the species.

Clinocera (*Kowarzia*) *bipunctata* (Haliday, 1833)

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT6: 1♀, 22-30.VI.2017 (reg. 1118); 1♀, 1-7.IX. 2017 (reg. 1118).

Previous Belgian records: Namur, 1♂, 22.VIII.1945 (leg. A. Collart, RBINS).

Comments. Only one earlier record in Belgium. The species is not listed in the Red Data Book of Flanders (Grootaert *et al*., 2001). It is widespread in Europe, in the Mediterranean region as well as in North Africa, but it is absent in Norway, Sweden and Finland (Fauna Europaea, 2022).

Dolichocephala oblongoguttata (Dale, 1878)

RDB status: 7. Data deficient

= *Dolichocephala engeli* Niesiolowski, 1990, syn.

Material examined. Oudergem, Botanic Garden Jean Massart: MT1, MT2, MT5, MT6: 74♂♂, 94♀♀ (168 specimens; Table 1).

Previous Belgian records of *D. oblongoguttata* as *D. engeli*: Ellezelles, 1♂, 17.VI.1959 (leg. M. Bequaert); 1♀, 14.V.1961; Falaen, 1♂, 2♀♀, 6.V.1949 (leg. M. Bequaert); Hoegne, 1♂,

2♀♀, 15.V.1952 (leg. A. Collart); Marbehan, 1♀, 15.VIII.1937(leg. M. Bequaert); Melle, 1♂, 24.IX.1937 (leg. M. Bequaert).

Comments. *Dolichocephala oblongoguttata* was reported earlier as *D. engeli* and considered to be 'Extinct' in the Red Data Book of Flanders since no data were recorded of this species after 1980 (Grootaert *et al*., 2001). In the present study, the species is recorded 27 times with 168 specimens and thus is the largest population ever observed in Belgium; at least if the formerly reported *D. guttata* were correctly identified and not have been confused with *D. oblongoguttata*. In this respect, only the males can be recognized with certainty and since we did not find males of *D. guttata* at all, we presumed that all the females belonged to *D. oblongoguttata*. The latter species has the parameres curved in lateral view (profile) while the parameres are longer and straight in profile in *D. guttata*, as is well illustrated by Drake & Chandler (1997: Figs 1-4). With thanks to Paul Beuk (pers. comm.) for bringing this to our attention.

The species has been recorded in Britain I., Belgium, Croatia, Czech Republic, France, Germany, Hungary, Ireland, Poland, Slovakia, Slovenia and Switzerland. It was not reported from Scandinavia nor the Mediterranean region according to the Fauna Europaea.

Empis (*Lissempis*) *nigritarsis* Meigen, 1804

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT1, 1♂, 11-19.V.2016 (reg. 964); 3♂♂, 4♀♀, 3-9.VI. 2016 (reg. 812); 2♂♂, 2♀♀, 9-16.VI.2016 (reg. 803); 2♀♀, 16-23. VI.2016 (reg. 794).

Comments. Only recorded in site 1 (MT1) in 2016. *Empis* (*Lissempis*) *nigritarsis* is not in the Red Data Book of Flanders and no records are available in the database on empidids from Belgium although it was reported in the Belgian catalogue (Grootaert, 1991) based on the record from 1♀ found at Chabresse (Méry) on 22.V.1937 (det. M. Bequaert) cited by Maréchal (1949). The RDB category Data Deficient is assigned here for this species.

According to the Fauna Europaea it has been recorded from Britain I., Bulgaria, Czech Republic, Denmark (mainland), France, Germany, Greece, Hungary, Italy, Spain, Sweden and Switzerland.

Hemerodromia unilineata Zetterstedt, 1842

RDB status: 0. Extinct

Material examined. Oudergem, Botanic Garden Jean Massart: MT6: 1♂, 1♀, 15-22.VI.2017 (reg. 1058).

Previous Belgian records: St-Mard, 1♂, 1♀, 28.VII.1919 (leg. A.Tonnoir); Falaen, 2♂♂, VI.1921 (leg. A.Tonnoir); Postel, 1♂, VII.1922; Houyet, 1♀, 27.VI.1927 (leg. M. Goetghebuer); Gent, 1♀, 11.V.1932 (leg. M. Bequaert); Sy, 2♀♀, 24.VI.1933 (leg. M. Goetghebuer); Virton, 1♀, 23.VI.1934 (leg. M. Goetghebuer); Villers-Sur-Lesse, 6♂♂, 31.V.1934 (leg. L. Giltay); Houyet, 2♂♂, 18.VI.1936 (leg. L. Giltay); Colonster, 1♀, 2.VII.1943 (leg. A. Collart); Torgny, 2♀♀, 2.VII.1980 (leg. P. Grootaert); Torgny, 1♂, 2.VII.1980 (leg. P. Grootaert); Moha, 1♂, 4.VII.1980 (leg. R. Detry); Wanze, 1♂, 5♀♀, 24.VII.1981 (leg. R. Detry); Moha, 1♂, 5♀♀, 24.VI.1981 (leg. R. Detry); Treignes, 1♂, 11.VII.1984 (leg. Kurt Hofmans); Treignes, 1♂, 27.VI.1984 (leg. Kurt Hofmans); Logne, 1♀, 13.VIII.1986 (leg. J. Berteau).

Comments. The species has been reported quite often from the south of Belgium, but only twice from Flanders (Gent and Postel). It was not recorded from Flanders or Brussels after 1980 and hence considered as 'Extinct'. In fact, it should now receive the status of 'Data deficient'.

The species is widespread in Europe: Austria, Belgium, Britain I., Croatia, Czech Republic, France, Germany, Greece, Hungary, Ireland, Macedonia, Poland, Slovenia, Spain, Sweden, Yugoslavia (Fauna Europaea, 2022).

Hilara albitarsis von Roser, 1840

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT2: 1♀, 6-11.V.2016 (reg. 768).

Previous Belgian records: Fayembois, 1♀, 11.V.1946, (leg. A. Collart); Furfooz, 1♂, 22.V.1955 (leg. M. Bequaert); Waasmunster, 1♂, 13.V.2000 (leg. P. Grootaert); Wijnendalebos, 1♀, 16.V.2000 (leg. M. Pollet); Ename, 1♂, 24.V.2001 (leg. M. Pollet).

Comments. This species was only recorded in Flanders in 2000 and 2001 and hence not included in the RDB from 2001. Therefore, it is attributed the RDB status 'Data deficient'.

In Europe it is known from Austria, Belgium, Britain I., Czech Republic, Denmark (mainland), Finland, Germany, Hungary, Italy, Lithuania, Poland, Sweden, Switzerland and the Netherlands (Fauna Europaea, 2022).

Hilara anglodanica Lundbeck, 1913

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT2, 1♂, 6♀♀, 3-9. VI.2016 (reg. 801).

Previous Belgian records: Virelles, 2♂♂, 2♀♀, 28.VI.1986 (leg. N. Magis); 11♂♂, 4♀♀, 16.VII.1986 (leg. N. Magis); 1♂, 21.VII.1986 (leg. N. Magis); St-Truiden, 1♂, 2♀♀, 28.VI.1985 (leg. L. De Bruyn).

Comments. A very rare species previously only known from one single locality in Flanders, and one single locality in the south of Belgium.

It is known in Europe from Belgium, Britain I., Czech Republic, Denmark (mainland), France, Germany, Hungary, Ireland, Slovakia, Sweden, Switzerland and the Netherlands (Fauna Europaea, 2022).

Rhamphomyia (*Amydroneura*) *hirsutipes* Collin, 1926

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT2: 1♂, 21.IX-12.X.2017 (reg. 1349).

Previous Belgian records: Mont Rigi, 1♂, 24.VIII.1983; 5♂♂, 8.IX.1983; 21♂♂, 1.IX.1983 (leg. N. Magis); Duso Mupa, 1♂, 10.IX.1948 (R. Tollet); Hautes Fagnes, 2♂♂, 12.IX.1948 (R. Tollet).

Comments. This species was previously only known from the Plateau des Hautes Fagnes in the east of Belgium. It is always found together with *Rhamphomyia* (*Amydroneura*) *erythrophthalma* Meigen, 1830. Since the long hairs on the legs vary in length and density, several authors wondered if *Rh. hirsutipes* wasn't just simply a form of *Rh. erythrophthalma*.

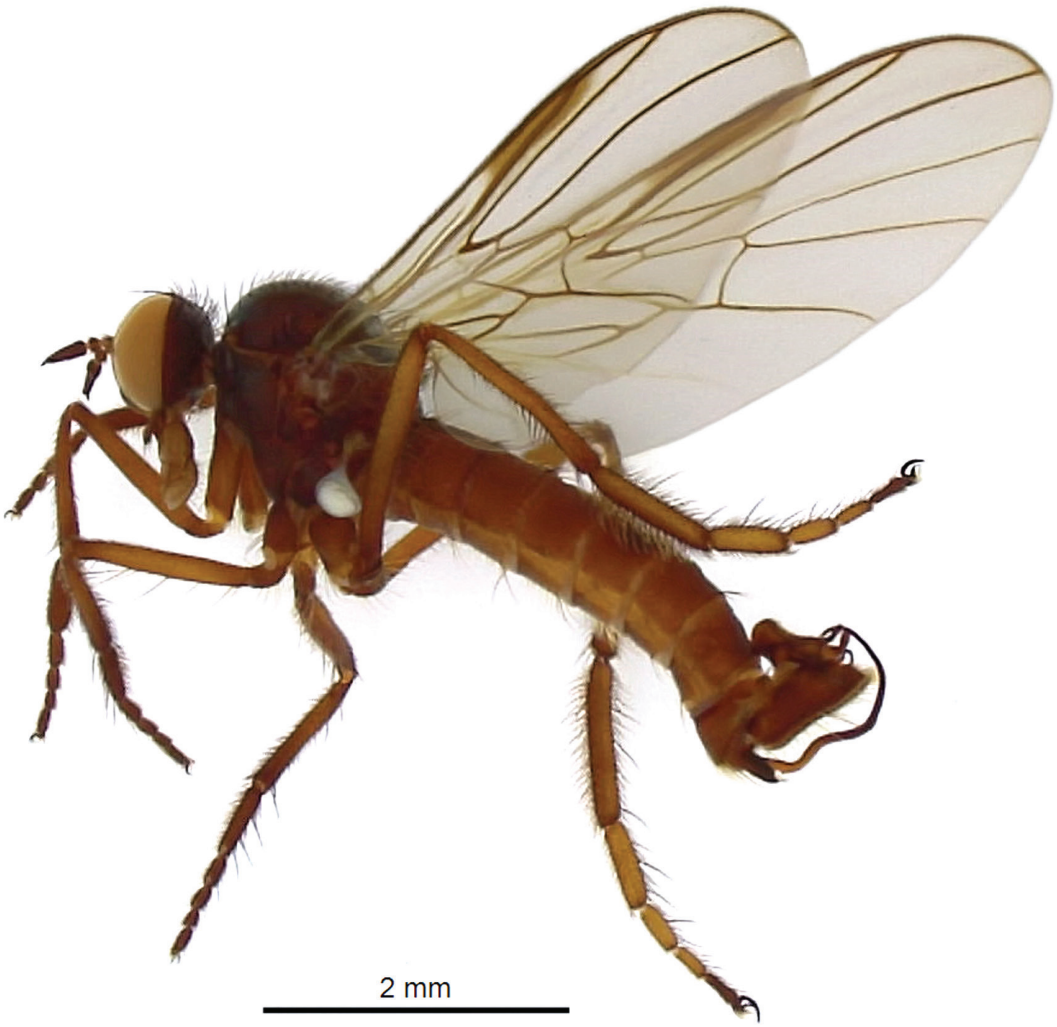

Fig. 1. *Rhamphomyia* (*Megacyttarus*) *poissoni* (Tréhen, 1966). Habitus ♂. © Isabella Van de Velde.

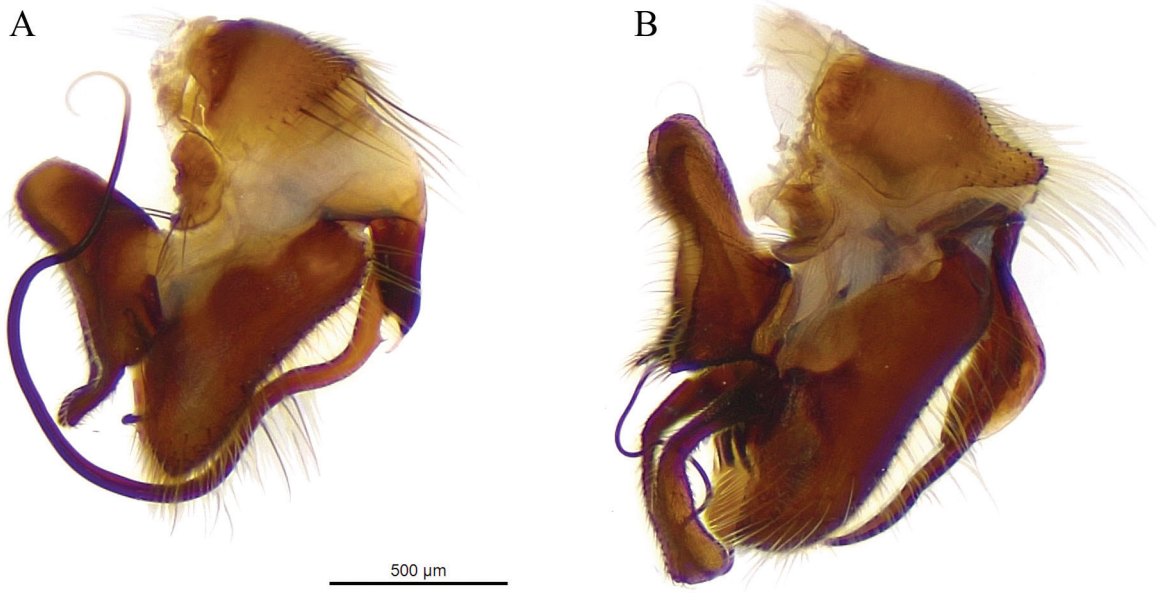

Fig. 2. *Rhamphomyia* (*Megacyttarus*), ♂ terminalia in left lateral view. A. *R. poissoni*. B. *R. crassirostris* (Fallén, 1816). © Isabella Van de Velde.

The distribution in Europe is limited to Belgium, Britain I., Czech Republic, Denmark (mainland), Germany, Ireland and Switzerland (Fauna Europaea, 2022).

Rhamphomyia (*Megacyttarus*) *poissoni* (Tréhen, 1966)
Figs 1, 2

RDB status: 7. Data deficient

Material examined. Oudergem, Botanic Garden Jean Massart: MT3**,** 2♂♂, 8♀♀, 3-9.VI.2016 (ref. 791).

Comments. Barták (2004) revised the species providing a re-description with illustrations and re-considered the former synonymy with *Rh.* (*Megacytttarus*) *tephraea* Meigen, 1822. Fig. 1 shows the habitus of a male *R.* (*M.*) *poissoni* while the male terminalia of *R.* (*M.*) *poissoni* are compared with those of the more common *R.* (*M.*) *crassirostris* (Fallén, 1816) in Fig. 2. The latter has the RDB status of Vulnerable.

The species is known from Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Poland and Switzerland (Fauna Europaea, 2022).

Rhamphomyia (*Pararhamphomyia*) *marginata* (Fabricius, 1787)

RDB status: 1. Critically Endangered

Material examined. Oudergem, Botanic Garden Jean Massart: MT1: 1♀, 7-13.V.2015 (reg.701); MT2: 2♀♀, 6-16.V.2016 (reg.1310).

Previous Belgian records: Buzenol, 2♀♀, 19.V.1981 (leg. P. Grootaert); Meerdaal, 1♂, 20.IV.1999 (leg. L. De Bruyn); Altenbroek, 1♀, 17.IV-I.V.2003, (VOER01, MT); 3♀♀, 14-V.2003 (VOER05, MT); 2♂♂, 1♀, 14.IV-l.V.2003 (VOER01, MT); 1♀,, 14-30.V.2003 (VOER04, MT); 1♀, 30.V-14.VI.2003 (VOER04, MT); Alserbos, 1♀, 14-30.V.2003 (VOER04, MT). (Grootaert *et al*., 2005).

Comments. This remarkable species has broadened wings with a black edge. In flight, this fly resembles a moth and it has frequently been cited in this way by lepidopterists. *Rh. marginata* is widespread in Europe: Austria, Belgium, Britain I., Czech Republic, Denmark (mainland), Finland, France, Germany, Hungary, Liechtenstein, Norwegian mainland, Romania, Slovakia, Sweden, Switzerland but it is not reported from Southern Europe such as Portugal, Spain, Italy and Greece (Fauna Europaea, 2022).

Discussion

With 52 species recorded, the diversity of the Empididae in the Botanic Garden Jean Massart is fairly large. The actual figure will be higher since not all samples of the three-year survey were identified. This included a large number of *Hilara* females that needed more attention. The 52 species represent about 33% of the actually recorded Empididae in Belgium. The species accumulation curve (Fig. 3) calculated with EstimateS (Colwell, 2013) shows that the number of recorded species S(est) is still rising, although the slope is not steep, but does not reach an asymptote yet. Chao1 predicts 55 species, Bootstrap 57 species while Jackknife predicts 62 species. Five species are represented by singletons, while three species by doubletons and both curves are descending, indicating that there is an onset of saturation of the species number.

The Red Data Book status of the species according to Grootaert *et al*. (2001) is summarized in Table 2. The Red Data Book geographically covered the fauna of Flanders (North Belgium) including Brussels-Capital Region. Since Flanders mainly has a fauna of the Atlantic Region,

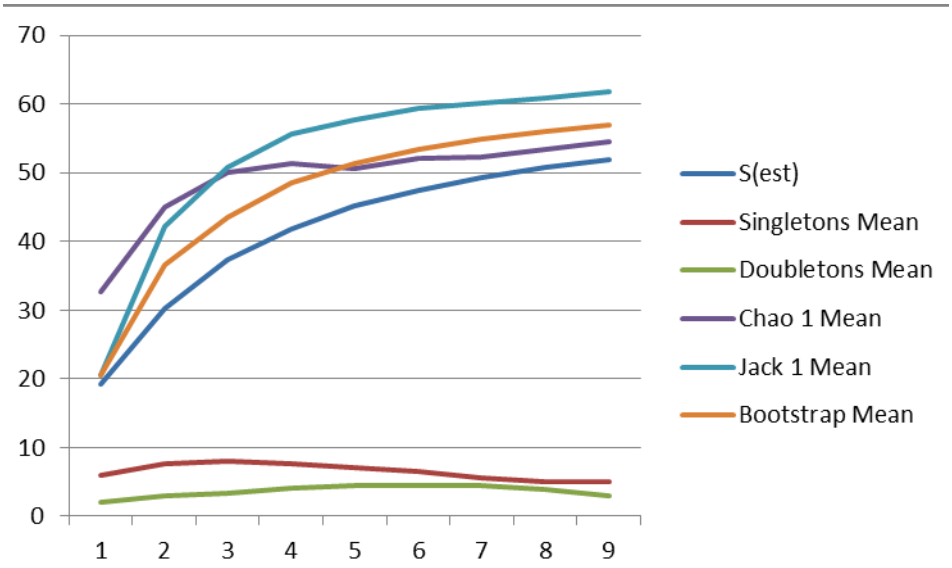

Fig. 3. Species accumulation curve calculated with EstimateS (Colwell, 2013): relation between number of sampling sites/seasons and number of species.

Table 2. Number of empidid species per Red Data Book category after Grootaert *et al*. (2001).

Red Data Book Category	**No species**
0. Extinct	3
1. Critically Endangered	2
2. Endangered	1
3. Vulnerable	3
4. Susceptible	14
6. Safe/Low risk	20
7. Data deficient	9

there are only a few Central European elements in its fauna. Hence, these Central European elements are less represented in the Red Data Book and in the calculation of their status, they will inevitably receive a more threatened status. The Botanic Garden Jean Massart is situated in a transition zone of the Atlantic to the Central European region. The Garden is on the border of the Sonian forest, part of the ancient Kolenwoud which is laying in the transition zone of the Atlantic to the Central European Region (Grootaert & Chvála, 1992: Fig. 1). As is shown in several examples in the annotated check list above, a number of species that were exclusively known from southern Belgium with a typical Central European faunal elements are now found in the Botanic Garden Jean Massart. They reach here the limit of their distribution area. This explains why such a large number of threatened species are found in the Botanic Garden.

Nearly 40% of the species found at the Botanic Garden have the RDB status Safe/Low risk, meaning that apart of nine species with Data deficient status, the other 23 species or 44 % belong to a more or less threatened category. The status of the 'Extinct' species in the Red Data Book (Grootaert *et al*., 2001) should now be changed to a lower threatened category such as 'Critically Endangered', however since no sound distribution data are available, these three 'Extinct' species should be provisionally assigned to the category Data deficient. In fact, an entire revision of the data of the RDB is mandatory. This might be difficult since during the last twenty years few surveys including empidid flies were done in Flanders and hence no recent data have been incorporated into the database to re-calculate the RDB status.

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The Psilidae of the centennial Botanic garden Jean Massart (Brussels-Capital Region, Belgium): five new species of Belgian Diptera with an updated Belgian checklist

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Abstract

During a survey of four sites with Malaise traps in 2017 in the Botanic Garden Jean Massart (Brussels-Capital Region), 105 specimens of Psilidae (Diptera) were found which belonged to 11 species. Some information about the larval ecology of the identified species is given. The checklist of Belgian Psilidae is updated to 22 species and 6 species are recorded for the first time, 5 based on our survey: *Chamaepsila limbatella* (Zetterstedt, 1847), *Chamaepsila persimilis* (Wakerley, 1959), *Chyliza* (*Chyliza*) *annulipes* Macquart, 1835, *Imantimyia albiseta* (Schrank, 1803) and *Imantimyia sylvatica* Meigen, 1826 were found in the Jardin. A sixth species *Psila merdaria* Collin, 1944 has been reported on a citizen science portal and is also confirmed.

Résumé

Lors d'une étude réalisée avec 4 pièges Malaise au Jardin botanique Jean Massart (Région de Bruxelles-Capitale) en 2017, 105 spécimens appartenant à 11 espèces de Psilidae ont été identifiés. Quelques informations à propos de l'écologie larvaire des espèces trouvées sont données. La liste des Psilidae de Belgique est mise à jour et cinq espèces sont rapportées pour la première fois: *Chamaepsila limbatella* (Zetterstedt, 1847), *Chamaepsila persimilis* (Wakerley, 1959), *Chyliza* (*Chyliza*) *annulipes* Macquart, 1835, *Imantimyia albiseta* (Schrank, 1803) et *Imantimyia sylvatica* Meigen, 1826. Une sixième espèce, *Psila merdaria* Collin, 1944, signalée sur un portail de science citoyenne, est également confirmée.

Keywords: Belgium, rust flies, checklist

Introduction

The Psilidae (Diptera, Psilidae) are a small family of acalyptrate Diptera (length up to 13 mm) classified in three subfamilies: Belobackenbardiinae, Chylizinae, and Psilinae. The flies generally have an elongate body and characteristic wing venation: vein C has a break at the distal end of vein Sc, which is incomplete and vein Cu2, bordering cell bcu distally, is straight (Lonsdale, 2020). The chaetotaxy is characterized by 0–1 notopleurals; acrostichals usually not differentiated (except for some species with a prescutellar pair) and pleura without differentiated setae, only with setulae (McAlpine, 1997; Freidberg & Shatalkin, 2008).

The larvae of the species are most likely all phytophagous (Ferrar, 1987; Iwasa, 1998), but not well known. Some associations are well documented from horticultural and agricultural data [e.g., *Chamaepsila rosae* (Fabricius, 1794) pest of crops, especially carrots *Daucus carota* L. (Dufault & Coaker, 1987; Bygebjerg *et al.*, 2011)]. Associations of larvae of other psilid

species with their host plants are mentioned mainly by Chandler (1975) and Shatalkin & Merz (2010), but remain sketchy overall. Important insights into the larval ecology of the species in their natural environment remain elusive.

About 340 species of Psilidae are recognized worldwide (Shatalkin, 2021). In Europe 55 species of rust flies are known (Sumner, 2018). For Belgium the first psilid species was reported by De Bormans (1883). During the following century nine other Psilidae records were published for Belgium (Meunier, 1905; Jacobs, 1906; Hennig, 1941; Goetghebuer, 1943; Collin, 1944; Muller, 1948; Leclercq, 1952; Brindle, 1965; Goot & Veen, 1987). After the checklist of De Bruyn (1991), mentioning 16 species, it seems that no further references to Belgian Psilidae were made in literature.

Material and methods

This study is based on the examination of 105 specimens in ethanol, all collected from a survey of four sites with Malaise traps (MT) during 2017 in the Botanic Garden Jean Massart.

This site is situated at the East side of the city of Brussels in the suburb town of Auderghem at the border of the Sonian forest. The garden, also a Natura 2000 site, is nearly 4.5 ha, and was created in 1922 by Jean Massart, a botanist and ecologist. It is composed of various small biotopes like woodlands, wetland with marshes and ponds as well as thematic collections such as medicinal and aromatic plants, a collection of cultivated plants, an old orchard, an arboretum, an evolutionary garden and experimental plots for students of the Université libre de Bruxelles (ULB). The Garden is now managed by 'Brussels Environment' (BIM-IBGE).

Details of the trapping and the sites can be found in Grootaert *et al.* (2023).

Where mentioned, the specimens studied were deposited in ethanol (70%) in the reference collections of the first author (coll. JC), the Royal Belgian Institute of Natural Sciences (coll. RBINS) and the Natuurhistorisch Museum Maastricht (coll. NHMM).

When male genitalia were dissected, they were separated from the abdomen with a mandrel needle holder and flexible clamps in ethanol and the genitalia are preserved in the tube with the specimen. Females were identified through a combination of external anatomical features, dry or in ethanol. Morphological features and terminalia were examined using stereomicroscopes. The keys in Withers & Claude (2021) were used for identification with the following papers in supplement: Hennig, 1941; Goot & Veen, 1987; Soós, 1985; Wang, 1988; Carles-Tolrá, 1993a, 1993b; Freidberg & Shatalkin, 2008; Roháček *et al.*, 2016; Buck & Marshall, 2006; Shatalkin & Merz, 2010; Bygebjerg *et al.*, 2011; Beuk, 2022.

Results

In total, 105 specimens of Psilidae collected in the Botanic Garden Jean Massart were examined, comprising 11 species. Species marked with * are new to the Belgian fauna.

Chamaepsila limbatella* (Zetterstedt, 1847) – **Belg. sp. nov.

Material examined: 1♀: MT2, 12.X.2017, 1♀ (coll. RBINS).

Only one female was found, a male would be welcome to confirm the presence of this species new to the Belgium list. Unknown larval habitat.

Chamaepsila nigra (Fallén, 1820)

Material examined: 1♀: MT6, 24.V.2017, 1♀ (coll. NHMM).

Unknown larval habitat.

Chamaepsila nigricornis (Meigen, 1826)

Material examined: 1♂, 5♀♀: MT2, 5.V.2017, 1♀, MT5, 1.IX.2017, 1♀, 5.V.2017, 2♀♀ (coll. RBINS), MT6, 24.V.2017, 1♂ (coll. NHMM), 26.VII.2017, 1♀.

The presence of this species is not surprising considering its association with various plants Apiaceae, *Daucus* sp. (Chandler, 1975), ornamental plants such as *Chrysanthemum* (Shatalkin & Merz, 2010) or lettuce (*Lactua sativa*; see Glendenning, 1952; Vernon, 1962).

Chamaepsila persimilis* (Wakerley, 1959) – **Belg. sp. nov.

Material examined: 33♂♂, 27♀♀: MT2, 1.VI.2017, 5♂♂, 4♀♀, MT4, 7.IX.2017, 1♂, MT6, 24.V.2017, 19♂, 9♀♀ (coll. NHMM), 1.VI.2017, 4♂♂, 23.VIII.2017, 4♂♂, 12♀♀ (coll. RBINS).

Unknown larval habitat.

Chamaepsila rosae (Fabricius, 1794)

Material examined: 16♀♀: MT2, 1.VI.2017, 3♀♀ (coll. RBINS), 5.V.2017, 1♀, 7.IX.2017, 6♀♀, 21.IX.2017, 6♀♀ (coll. JC), 26.VII.2017, 2♀♀ (coll. RBINS).

Species associated with roots of Apiaceae (not only *Daucus carota* but also *Pastinaca* sp., *Apium* sp., *Anthriscus* sp., *Heracleum* sp., *Conium* sp.) and Brassicaceae (Chandler, 1975; Ellis *et al.*, 1992; Гричанов *et al.*, 2005), Solanaceae (Hardman & Ellis, 1982) and potentially on Asteraceae (Miles, 1956; Van 't Sant, 1961) and Poaceae (Beirne, 1971). With this wide range of possible host plants this species is logically present in the Botanic Garden Jean Massart.

Chamaepsila agg. *rosae*/*nigricornis*

Material examined: 9 ♀♀: MT2, 24.V.2017, 4 ♀♀ (coll. NHMM), 1.IX.2017, 1 ♀ (coll. RBINS), MT4, 24.V.2017, 1♀ (coll. NHMM), MT5, 24.V.2017, 3♀♀ (coll. NHMM).

Some females belonging to this aggregate cannot be identified reliably. Hence they are listed under this aggregate name.

Chyliza* (*Chyliza*) *annulipes* Macquart, 1835 – **Belg. sp. nov.

Material examined: 1♀: MT5, 24.V.2017, 1♀ (coll. NHMM).

Associated with sap runs from coniferous trees (Lyneborg, 1987; Winter, 1988).

It should be noted that observations of this species on the citizen science portal https://waarnemingen.be are either unverifiable or the result of misidentification.

Chyliza (*Chyliza*) *leptogaster* (Panzer, 1798)

Material examined: 1♀: MT2, 24.V.2017, 1♀ (coll. NHMM).

Associated with deciduous trees (Dengler, 1997).

Fig. 1. *Imantimyia sylvatica* Meigen, 1826 male, Malaise trap 5, 24.IV.2017. © Paul Beuk.

Imantimyia albiseta* (Schrank, 1803) – **Belg. sp. nov.

Material examined: :1♂, 2♀♀: MT2, 23.VIII.2017, 1♀, 26.VII.2017 (coll. RBINS), 1♀, MT5, 23.VIII.2017, 1♂ (coll. RBINS).

There is no mention of this species in the literature, but there are several mentions, notably in Flanders, on the https://waarnemingen.be. *I. albiseta* (Fig. 1) is usually found in bogs or wet habitats with a lot of decaying (plant) matter (Shatalkin & Merz, 2010; Withers & Claude, 2021). The presence of the marshy area with ponds in the Botanic Garden could account for its presence.

Imantimyia sylvatica* Meigen, 1826 – **Belg. sp. nov.

Fig. 1

Material examined: 1♂, 1♀: MT2, 1.VI.2017, 1♀ (coll. RBINS), MT5, 24.V.2017, 1♂ (coll. NHMM).

Species associated in particular with Great wood-rush (*Luzula sylvatica*, see Chandler, 1975).

Loxocera (*Loxocera*) *aristata* (Panzer, 1801)

Material examined: 2♀♀: MT2, 1.IX.2017, 1♀, MT4, 1.VI.2017, 1♀ (coll. RBINS).

A very common species, but unfortunately its larval habitat remains unknown. It seems however that the genus is associated with the Juncaceae (base of the stems of *Juncus effusus*, see De Meijere, 1941).

Loxocera (*Platystyla*) *hoffmannseggi* Meigen, 1826

Material examined: 3♂♂: MT2, 1.VI.2017, 1♂ (coll. JC), MT6, 23.VIII.2017, 2♂♂ (coll. RBINS).

Unknown larval habitat but according to our observations it seems to be associated with wet, marshy habitats (sedge meadow (*Carex* sp.), canary grasses (*Phalaris* sp.), willows...).

The updated Belgian checklist of Psilidae, comprising 22 species, is presented in Table 1.

Table 1. List of Psilidae of Belgium, according to the current nomenclature and using the synonymy from the first checklist of De Bruyn (1991).

Checklist of Belgian Psilidae	**External references**
Chylizinae	
Chyliza (*Chyliza*) *annulipes* Macquart, 1835	De Bruyn (1991)
Chyliza (*Chyliza*) *leptogaster* (Panzer, 1798)	De Bruyn (1991)
Chyliza (*Chyliza*) *vittata* Meigen, 1826	De Bruyn (1991)
Chyliza (*Dasyna*) *extenuata* (Rossi, 1790)	
Psilinae	
Loxocerini	
Imantimyia sylvatica Meigen, 1826	
= *Loxocera sylvatica* Meigen, 1826	
Imantimyia fulviventris Meigen, 1826	De Bruyn (1991)
= *Loxocera fulviventris* Meigen, 1826	
Imantimyia albiseta (Schrank, 1803)	Frans Geerts (waarnemingen.be)
= *Loxocera albiseta* (Schrank, 1803)	
Loxocera (*Platystyla*) *hoffmannseggi* Meigen, 1826	De Bruyn (1991)
Loxocera (*Loxocera*) *aristata* (Panzer, 1801)	De Bruyn (1991)
Psilini	
Chamaepsila atra (Meigen, 1826)	De Bruyn (1991)
Chamaepsila buccata (Fallén, 1826)	De Bruyn (1991)
= *Chamaepsila gracilis* (Meigen, 1826)	
Chamaepsila limbatella (Zetterstedt, 1847)	
Chamaepsila morio (Zetterstedt, 1835)	De Bruyn (1991)
Chamaepsila nigra (Fallén, 1820)	De Bruyn (1991)
Chamaepsila nigricornis (Meigen, 1826)	De Bruyn (1991)
Chamaepsila pallida (Fallén, 1820)	De Bruyn (1991)
Chamaepsila pectoralis (Meigen, 1826)	De Bruyn (1991)
Chamaepsila persimilis (Wakerley, 1959)	
Chamaepsila rosae (Fabricius, 1794)	De Bruyn (1991)
Chamaepsila villosula (Meigen, 1826)	De Bruyn (1991)
Psila fimetaria (Linnaeus, 1761)	De Bruyn (1991)
Psila merdaria Collin, 1944	Philippe Deflorenne (waarnemingen.be)

Discussion

The valorisation of Psilidae captured in the Malaise traps of the Botanic Garden Jean Massart in Brussels allows us to advance local entomological knowledge by adding 11 species to the inventory. No species of *Psila* Meigen, 1803 were observed, which is surprising. It is very likely that more species will be discovered in the coming years. Knowledge of the Belgian Psilidae is still growing and at present 22 species are known (Table 1). As a result of this study, *I. albiseta* (Schrank, 1803), *I. sylvatica* Meigen, 1826, *Chy. annulipes* Macquart, 1835, *Cha. limbatella* (Zetterstedt, 1847) and *Cha. persimilis* (Wakerley, 1959) are the first additions to the Belgian Psilidae fauna in print after the first checklist in 1991. *I. sylvatica* and *P. merdaria* Collin, 1944 were already recorded online (see Tab. 1), but were not officially mentioned in literature. This list is still incomplete and taxonomic clarifications are expected in Europe (Claude & Tissot, in press). Many specimens in collections are still to be studied and additional material can be collected from different trap surveys in Belgium. New discoveries and taxonomic advances for the Psilidae are to be expected.

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Six new species of Diptera for the Belgian fauna from the Botanic Garden Jean Massart in Brussels-Capital Region, Belgium (Chloropidae, Drosophilidae, Fanniidae)

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Abstract

A three-year survey (2015-2017) of the insect fauna by means of Malaise trap sampling was carried out in the Botanic Garden Jean Massart in Auderghem. A number of dipteran families or family groups were more thoroughly investigated and the results are published in separate papers. This paper presents an account of dipteran species from the botanic garden belonging to families that are not separately reviewed, based on one sampling week in May 2017, and that were previously not recorded from Belgium: *Oscinella capreolus* (Haliday, 1838) (Chloropidae), *Acletoxenus formosus* (Loew, 1864), *Amiota alboguttata* (Wahlberg, 1839) and *Amiota flavopruinosa* Duda, 1934 (Drosophilidae), *Fannia metallipennis* (Zetterstedt, 1838) and *Fannia nidica* Collin, 1939 (Fanniidae).

Keywords: grass flies, fruit flies, latrine flies, faunistics, survey

Introduction

The insect fauna of the Botanic Garden Jean Massart in Auderghem was surveyed from 7 May 2015 till 23 March 2017 using Malaise trap sampling (Grootaert *et al.*, 2023). After initial analysis it was decided to give special attention to a number of dipteran families or family groups, depending on the status of the family (for example, popular, well studied families with relatively much ecological information and/or support of a red data list) or on the observed diversity in combination with available specialists. This resulted in number of special family (group) reports (references to: fungus gnat papers (Kurina & Grootaert, 2023), Syrphidae (Van De Meutter & Mortelmans, 2023), Sphaeroceridae (Brice & Beuk, 2023), Heleomyzidae (Van Der Weele *et al*., 2023), crane flies (Dek & Peeters, 2023), Sciomyzidae, Psilidae (Claude & Beuk, 2023), Scatopsidae (Haenni *et al*., 2023)). This automatically meant that other families or family groups received little or no special attention. Data for these families were derived from occasional field observations or small volumes set aside when samples were analysed for primary target taxa. It was decided to analyse a full set of four Malaise trap samples representing one week of sampling in 2017 in order to, at least partially, fill in the blanks in the list of Diptera from the Botanic garden. Numerous specimens belonging to a range of families were extracted and identified, sometimes supplementing data for the primary target taxa. This paper presents an account of species from the botanic garden that were previously not recorded from Belgium and are not treated in separate papers dealing with individual families.

Material and methods

All analysed samples were collected by four Malaise traps positioned within the Botanic Garden Jean Massart in 2017. The sampling period was the week of 17-24 May 2017. This week was

chosen because it covers both the end of the activity period of species active in spring and the start of the activity period of species active in summer (excluding of course the early spring species and typical high summer species). The positions of the traps varied between the border of flower beds and a hedge (Malaise trap 2), an old arboretum (Malaise trap 4), flower meadow in old apple orchard (Malaise trap 5) and wet areas close to reed beds, above small ponds (Malaise trap 6) (Grootaert *et al.*, 2023).

Specimens of various families were extracted during the analysis of the sample. For some families all specimens were extracted (in the scope of this paper that applies to the Drosophilidae), for other families only a small number of specimens was extracted (either because they 'stood out' or to have at least some records for a particular family without doing a time consuming full analysis; in the scope of this paper that applies to the Chloropidae and Fanniidae, respectively).

All identified specimens were stored in ethyl alcohol (70%) and were identified using a Wild M3Z stereomicroscope with a LitraPro LP1200 led light (light temperature 5700K). Identified specimens were transferred to ethyl alcohol (70%) in 2.5 ml vials with locality and identification labels. Whenever necessary, genitalia were prepared using lactic acid following the method described by Beuk (2021) and the genitalia were stored in the vial with the specimen. The material is deposited in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS) and in the Maastricht Museum of Natural History, Maastricht, the Netherlands (NHMM).

The occurrence of species in Belgium for the three mentioned families was first checked using the Catalogue of the Diptera of Belgium (Grootaert *et al.*, 1991). In the case that species were not mentioned in this catalogue, an extensive search was made for these species in available literature and online, to see if it was recorded from Belgium anywhere else. Only those species without any records are listed below.

Species accounts

The general distribution of the species discussed below is derived from Fauna Europaea (Pape & Beuk, 2013) even though by now it is somewhat outdated. Each separate country record that is not included in Fauna Europaea is referenced separately.

Family Chloropidae

The key in Nartshuk & Andersson (2013) is probably the only one that covers most of the Northwestern European species.

Oscinella capreolus (Haliday, 1838) – **Belg. sp. nov.**
Fig. 1

Material. 1♀, MT2, 17-24.V.2017.

A single female of this species was collected by MT2. This species is easily identified using the key by Nartshuk & Andersson (2013) and can be quickly recognised as being a small, black fly with strongly broadened, black arista. Nothing definite is known about the biology of this species but Schacht (1982) suggested the larvae might live on sedges (*Carex* sp.) and according to Falk *et al.* (2016) it seems to be associated with densely shaded broad-leaved woodland. With MT2 being erected at the edge of a stand of trees next to some flower beds and grassy vegetation, that association seems to fit.

Fig. 1. *Oscinella capreolus* (Haliday, 1838), ♀, Jardin Massart (MT2),17-24.V.2017. © Paul Beuk.

Distribution: Austria, Czech Republic, Denmark, France, Germany, Hungary, Italy, Netherlands, Poland, Slovakia, Russia (North Caucasus), Slovenia, Switzerland, United Kingdom. Outside Europe also present in the East Palaearctic. First record for Belgium.

Family Drosophilidae

The taxonomic knowledge of the European Drosophilidae is quite complete. Bächli *et al.* (2004) compiled a monograph on Fennoscandian Drosophilidae, including keys to all species then known from Europe. Most species that can be expected to occur in Belgium are both included in the keys and extensively described. Species that have increased their distribution from Southern Europe since the publication of the monograph were mostly treated in the keys and comments alone.

Acletoxenus formosus (Loew, 1864) – **Belg. sp. nov.**

Material. MT4: 1♀, 17-24.V.2017.

Many members of the Drosophilidae in northwestern Europe are quite easily identified as drosophillids because of their relatively plump build and feathered arista. *Acletoxenus formosus* is not one of them. The species is more delicately built than most other Drosophilidae, with relatively large wings, that are usually not folded over the abdomen, and a microtomentose arista. On top of that it is coloured black with bright yellow to white, which is more reminiscent of certain Agromyzidae or Chloropidae. The give-away characters for Drosophilidae are the reddish eyes (no microscope necessary) and a number of chaetotaxy and wing characters (microscope required).

The biology of *A. formosus* is as aberrant from that of the average drosophilid as the general appearance. It is one of the few European species that has predatory larvae. The larvae live on

leaves of various plants, where they feed mainly on pupae but also on nymphs of whiteflies (Homoptera: Aleyrodidae) (Bächli *et al.*, 2004). Thus they are considered to be beneficial insects. Adults are usually observed on leaves but there are frequent sightings indoors on windows (pers. obs.).

Distribution: Andorra, Austria, Canary Is., Croatia, Czech Republic, France, Germany, Hungary, Italy, Netherlands, Poland, Romania, Slovakia, Spain (Carles-Tolrá, 2004), Switzerland, Turkey (Brake & Bächli, 2008), United Kingdom, Ukraine. Outside Europe also present in North Africa, the Near East, the Far East (Brake & Bächli, 2008) and Australia (Brake & Bächli, 2008). First record for Belgium.

Amiota alboguttata (Wahlberg, 1839) – **Belg. sp. nov.**

Material. MT2: 1♀, 17-24.V.2017; MT5: 2♀, 17-24.V.2017.

Species of *Amiota* Loew, 1862, may be among the easiest of the Drosophilidae to recognise at genus level because of their blackish body with clear white spots on the postpronota and below the wing base and a white band on the face. Recognizing the species may be more complicated and in East and Southeast Asian, where the majority of species are found, identification of species relies heavily on the male genitalia (see e.g., Chen & Toda, 2001, and Hei *et al.*, 2009). Even identifying species in Western Europe may require dissection of the genitalia.

The main characters to distinguish *A. alboguttata* from the other Northwestern Europaean species of *Amiota* are its relatively small size, the blackish setae and setulae on the thorax and the short ventral branches of the arista.

Larvae of *Amiota* sp. from Western Europe have not yet been described although the larvae were supposedly found behind the bark of oak (*Quercus* sp.) and there are rearing records of *A. alboguttata* from the fungus *Daldinia concentrica* (Ruchin *et al.*, 2021).

Adults have been reported to be attracted to eyes of animals and humans where they drink from tear fluid (Bächli *et al.*, 2004). The flies apparently are most numerous in tree canopies. Ruchin *et al.* (2021) collected adult flies in crown fermental traps at 6-7 m high during their research into the effects of forest fires. After nine years it turned out that light surface fire had no effect on the occurrence of this species but it was not found in plots with more severe burn damage.

Distribution: Andorra, Austria, Czech Republic, Denmark, Finland, France, Germany, Greece (Máca, 2007), Hungary, Italy, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, United Kingdom, former Yugoslavia (Chen & Toda, 2001). Outside Europe also present in the East Palaearctis (Chen & Toda, 2001). First record for Belgium.

Amiota flavopruinosa Duda, 1934 – **Belg. sp. nov.**

Material. MT4: 1♀, 17-24.V.2017.

As far as known the general information on *Amiota* given above also applies to this species. Nothing more specific is known for this species. The morphology is very similar to that of

A. alboguttata but the mesonotum is distinctly yellowish pruinose (poorly visible in specimens in ethyl alcohol, though) and the thoracic setae and setulae are rather yellowish to golden brown.

Distribution: Croatia, Czech Republic, France, Italy (Bächli, 2008), Germany, Greece, Hungary, Slovakia, Sweden, Switzerland. First record for Belgium.

Drosophila (*Drosophila*) sp. *virilis* group

Material. MT4: 1♀, 17-24.V.2017.

The species of the *D. virilis* group are relatively large fruit flies that have a dark brown-black body colour like the species of the *D. obscura* group, but contrary to the species in that group the legs are palish and the cross veins are darkened. Species of the *D. virilis* group mostly have a northern Holarctic distribution but *D. virilis* Sturtevant, 1916, is now distributed worldwide frequenting wineries and breweries. The other species are usually found near river banks (Bächli *et al.*, 2004).

One specimen collected in the Botanic Garden is a female of the *D. virilis* group, but so far none of the species of this group was recorded from Belgium. Unfortunately identifying single females of this group is not possible, due to the lack of reliable morphological characters. Of the five European species included in the keys by Bächli *et al.* (2004), three also occur outside the Fennoscandian area: *D. virilis*, *D. littoralis* Meigen, 1830, and *D. lummei* Hackman, 1972. At present it seems most likely the collected specimen will belong to *D. littoralis* as the locality falls within the recorded range of this species (the southernmost European records being in Spain; see Bächli *et al.*, 2004). So far, *D. lummei* seems to be restricted to Northern and Central Europe. Though *D. virilis* may be expected to occur in Belgium as well, it seems less likely that the collected specimen should belong to this more synanthropic species as no other synanthropic species (like *D. hydei* Sturtevant, 1921, and *D. repleta* Wollaston, 1858) were found in the Botanic Garden.

Family Fanniidae

Identification of the European species of Fanniidae is possible using the keys by Rozkošný *et al.* (1997) and Barták *et al.* (2016). Whereas the former includes both keys to males and females and background information on all species, the latter gives some useful and even critical updates to the keys for the males of the family. The male genitalia are very useful for identifying species of this family, even though a considerable number of species also have conspicuous chaetotaxy or other morphological adaptations of the legs.

Fannia metallipennis (Zetterstedt, 1838) – **Belg. sp. nov.**

Material. 1♂, MT5, 17-24.V.2017.

The shape of the cercal plate of *F. metalllipennis* is quite characteristic, because it is deeply bilobed and the lobes are broadly separated (the distance between them about equal to the width of an individual lobe). Adults have been reared from bird nests and a squirrel drey (Rozkošný *et al.*, 1997).

Distribution: Austria, Bulgaria, Czech Republic, Denmark, Finland, Germany, Georgie (Pont, 2015), Hungary, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, United Kingdom. Outside Europe also present in the Near East, the East Palaearctic and the Nearctic region. First record for Belgium.

Fig. 2. *Fannia nidica* Collin, 1939, ♂, Jardin Massart (MT2),17-24.V.2017. © Paul Beuk.

Fannia nidica Collin, 1939 – **Belg. sp. nov.**

Fig. 2

Material. 1♂, MT5, 17-24.V.2017.

The surstyli in the male genitalia of *F. nidica* are narrowed apically with an indistinct hook at the apex. The cercal plate is long and strongly narrowed on the apical 1/4 to 1/5. The larvae of this apparently scarce species have also been associated with bird nests (Rozkošný *et al.*, 1997).

Distribution: Czech Republic, Denmark, France (Withers, 2014), Germany (Adaschkiewitz, 2009), Netherlands (Prijs, 2002), Switzerland (Merz *et al.*, 2006), United Kingdom. First record for Belgium.

Discussion

The first records for Belgium of the above discussed species are of course interesting, but these first records should also be seen in context of the sampling effort for each of the families involved. The total number of species found in the Botanic Garden for each of the three families (see Grootaert *et al.*, 2023) gives a little more perspective on how remarkable the new records are (or not). Unfortunately, there are no up to date lists of the Belgian species for these families

and compiling such lists fell outside the scope of this project. Thus the exact number of Belgian species for these families is unknown.

In all, only four species of Chloropidae were identified from the samples analysed. No attempt was made to extract all Chloropidae, let alone identify these. Most specimens 'picked' were more conspicuous specimens that were (rightly or not) expected to be 'easy to identify'. It seems likely that many more chloropid species new for the Belgian fauna will be found should more material be thoroughly analysed.

A similar conclusion can be draw for the family Fanniidae, with two new species among the six recorded ones. The fraction of new species for this family is considerably higher than for the Chloropidae, certainly when one takes into account that the number of species in the family is much smaller than that in the Chloropidae.

A more realistic picture is painted by the Drosophilidae. There are nineteen named and one unnamed species on the list for the Botanic Garden. Of these, three species are recorded from Belgium for the first time, while the unnamed species will also be a first record when its identity is finally established. Even for this family 20% of the species in the Botanic Garden was not yet recorded from Belgium.

Neither of the three families above is particularly well studied in Belgium. Considering the fact that this applies to many other cayptrate and acalyptrate families, including several larger ones like Muscidae and Ephydridae, it stands to reason that dozens, if not hundreds, of additional species will be found when remaining samples from the Botanic Garden are analysed for (grossly) ignored families or when a similar project is ran in another area.

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First checklist of gall midges from the Botanic Garden Jean Massart (Brussels-Capital Region), Belgium (Diptera: Cecidomyiidae)

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Abstract

A first list of gall midges (Diptera: Cecidomyiidae) from the botanical garden Jean Massart in Auderghem is presented. The species were identified on the basis of their galls. A survey was carried out by the first author with a group of amateur naturalists on 6.VIII.2019 and additional data were provided by the second author from observations on several dates in 2021. The inventories took place within the framework of the "Objective 1000" project. In total, about 100 gall inducing organisms were recorded (fungi, insects, mites...), including 39 species of midges, all belonging to the subfamily Cecidomyiinae. Each species is briefly described and discussed. Although most of these species are relatively common, some rarer species are also observed. The number of midges on the site is probably much higher and further surveys should reveal new species for the site.

Keywords: Cecidomyiidae, gall midges, gall inducing organisms, jardin Jean Massart, Belgium

Résumé

Une première liste de cécidomyies (Diptera: Cecidomyiidae) du jardin botanique Jean Massart à Auderghem est présentée. Les espèces ont été identifiées sur base de leurs galles. Un relevé a été effectué par le premier auteur avec un groupe de naturalistes amateurs le 6.VIII.2019 et des données supplémentaires ont été fournies par le deuxième auteur provenant d'observations réalisées à plusieurs dates en 2021. Les inventaires ont eu lieu dans le cadre du projet « Objectif 1000 ». Au total, une centaine d'organismes cécidogènes ont été répertoriés (champignons, insectes, acariens…), parmi lesquels 39 espèces de cécidomyies appartenant toutes à la sous-famille des Cecidomyiinae. Chaque espèce est brièvement décrite et discutée. Bien que la plupart de ces espèces soient relativement communes, quelques espèces plus rares sont également observées. Le nombre de cécidomyies sur le site est probablement beaucoup plus élevé et des inventaires plus poussés devraient permettre de découvrir de nouvelles espèces pour le site.

Introduction

Cecidomyiidae are one of the most diverse and fascinating group of insects (Yukawa & Tokuda, 2021). The family is divided into subfamilies Lestremiinae, Micromyinae, Winnertziinae, Porricondylinae and Cecidomyiinae and Catotrichinae, the latest being absent from Europe (Gagné & Jaschhof, 2021). 6.651 Species of gall midges are known in the world (Gagné & Jaschhof, 2021 while more than 1.800 species are recorded from Europe (Skuhravá & Skuhravý, 2021).

Cecidomyiinae are mostly phytophagous and a lot are inducing galls; a few species have different feeding modes such as saprophagous, fungivorous or predaceous, and several species

live as inquilines in the galls induced by other species (either by gall midges or others). Most of the species in the other subfamilies are saprophagous or fungivorous.

The gall midges are one of the most important groups of gall inducing organisms. Emerging larvae produce stimuli and the host plant responds by producing galls, fascinating structures which provide food and shelter for the developing larvae. Most gall inducing midges are host specific and are only able to induce galls on one, sometimes a few, often related, plant species. The level of knowledge of Cecidomyiidae in Belgium has been considered as rather poor in Belgium until recent years (Roskam & Carbonnelle, 2015). Few Belgian entomologists have indeed paid attention to this group of insects (Gosseries, 1991). The first information on Belgian gall midges dates back to Lameere (1907). Scattered articles later mention the presence of gall midges in Belgium during the first half of the century. In the second half of the century, most of the information on Cecidomyiidae comes from Jacques Lambinon who, besides his well-known work on Belgian flora, cultivates a passion for cecidology. Lambinon also motivated and taught the discipline to a new generation of naturalists (Carbonnelle & Romain, 2016). Since then, records have been partially published in dispersed articles, excursion reports and online records (Roskam & Carbonnelle, 2015).

In 1991, Gosseries listed 125 species for Belgium. Roskam & Carbonnelle (2015) reported 270 species for the country. But Carbonnelle & Claerebout (unpublished), gathering all data for gall inducing animals (zoocecidia) in the area, are now adding 95 new species discovered since 2015. Compared to the neighbouring countries, Roskam & Carbonnelle (2015) listed 416 species for the Netherlands, Skuhravá *et al.* (2005) listed 668 species for France, and Skuhravá *et al.* (2014) listed 686 species for Cecidomyiinae for Germany. Continuous and more intensive searches would undoubtedly lead to new discoveries for Belgium.

The present paper is an output of the project "Objective 1000". This project deals with an inventory of the insects of the Botanic Garden « Jean Massart » supported by Brussels Environment. The study site on the outskirts of Brussels proved to host an interesting insect fauna as shown in different articles and list provided in the course of the project (Drumont & Kuhn, 2021).

Material and methods

Gall midges were recorded in the botanical garden « Jean Massart » that is situated on the outskirts of the city of Brussels. This garden is located in a valley and is surrounded on one side by the Sonian Forest (which is an old mature forest) and by urban infrastructure on the other sides (habitations, motorway…). The garden reaches nearly 5 ha and is included in the Natura 2000 network with a high diversity of habitats present (an orchard, an arboretum, a wetland…) and many species of plants occurring spontaneously or cultivated. Gall midges were recorded during one survey carried out by the first author with a group of amateur naturalists on the 6.VIII.2019. Additional records were provided by the second author from several dates in 2021.

Gall midges were identified on the basis of their galls, considered as "extended phenotypes", on specific host plants (Mani, 1964); both of these elements are considered as reliable for specific identification. Pictures were only taken for uncommon species.

Results

39 gall midges species were found to date in the Botanic Garden « Jean Massart », all species belonging to the subfamily Cecidomyiinae.

Species list

Classification and nomenclature in this checklist follow Gagné & Jaschhof (2021) for nomenclature and systematics; nomenclature and systematics of host plant species follow The Plant List (www.theplantlist.org). Descriptions of galls and main hosts for Belgium and Europe are from Roskam (2019). Identification is made on the basis of main references for identification of gall inducing organisms. These references are mentioned either as a page number or as a specific number given to each type of malformation: HB: buhr (1964/65); H: Houard (1908-13); DA: Dauphin & Aniotsbéhère (1997); DVL: Docters van Leeuwen (2009); RS: Redfern *et al.* (2011); NM: Roskam (2019); BNL: Roskam & Carbonnelle (2023). Distribution, biology and systematics are briefly discussed. Range and frequency classes for Europe are defined as in Roskam (2019) and precisions are given for Belgium on the basis of total known records and authors' experience.

Cecidomyiidae

Arnoldiola libera (Kieffer, 1909)

Record: 6.VIII.2019, on *Quercus* sp.

Biology: Host *Quercus petraea*, *Q. robur* (Fagaceae). Underside of leaf with round flat depressions.

References: HB: 5516, H: 1310, DA: p121, DVL: P226, RS: p247.

Range: Europe, moderately frequent; apparently rare in Belgium with fewer than 10 records.

Asphondylia lathyri Rübsaamen, 1914
Fig. 1

Record: 6.VIII.2019, on *Lathyrus pratensis.*

Biology: Host *Lathyrus pratensis* (Fabaceae). Local, oval or ± spindle-shaped swellings of the pod, inside covered with a dense mycelium.

References: HB: 3732, DA: p212, RS: p150.

Range: Europe, very rarely recorded; apparently rare in Belgium, this record is only the fifth for Belgium.

Asphondylia miki Wachtl, 1880
Figs 2-3

Record: 6.VIII.2019, on *Medicago sativa.*

Biology: Host *Medicago falcata*, *M. sativa* (Fabaceae). The pod is shortened and inflated, the wall is succulent fleshy, inside covered with a dense mycelium.

References: HB: 4210, H: 3512 SQ., DA: p200.

Range: Europe, widely distributed; apparently rare in Belgium, this record is only the second for Belgium.

Fig. 1. Pod gall with pupa of *Asphondylia lathyri* on *Lathyrus pratensis*, 6.VIII.2019. © Sébastien Carbonnelle.

Fig. 2. Pod gall of *Asphondylia miki* on *Medicago sativa*, 6.VIII.2019. © Sébastien Carbonnelle.

Fig. 3. Opened gall of *Asphondylia miki* on *Medicago sativa* containing parasitoid larvae, 6.VIII.2019. © Sébastien Carbonnelle.

Contarinia carpini Kieffer, 1897

Record: 6.VIII.2019, on *Carpinus betulus.*

Biology: Host *Carpinus betulus* (Betulaceae). Lamina between two side veins with a somewhat thickened, pod-like, ± yellowish or usually red upward fold; on the underside a furrow which opens at maturity.

References: HB: 1546, H: 1040, DA: p134.

Range: Europe, rare; maybe overlooked as it is quite frequent in Belgium.

Contarinia medicaginis Kieffer, 1895

Record: 6.VIII.2019, on *Medicago sativa.*

Biology: Host *Medicago sativa* (incl. subsp. *varia*), probably also on other *Medicago* species (Fabaceae). Flower buds more or less swollen; corolla unopened, its parts ± coalesced.

References: HB: 4208, H: 3514 SQ., DA: p200, DVL: p175-176, RS: p168.

Range: Euro-Siberian, very frequent; only moderately frequent in Belgium.

Contarinia pseudotsugae Condrashoff, 1961

Record: 6.VIII.2019, on *Pseudotsuga menziesii.*

Biology: Host *Pseudotsuga menziesii* (Pinaceae). Locally the needle turns yellow, pink or purple and swells, mainly at the underside.

References: NM. 832.

Range: First records in BE & NL in 2015, now widely recorded in Europe (Leroy *et al*., 2015). In N-Am, three close related species have been described, it has not yet been strictly confirmed that species found in Europe belongs to *C. pseudotsugae* and to this species only.

Contarinia nicolayi (Rübsaamen, 1895)

Record: 6.VIII.2019, on *Heracleum sphondylium.*

Biology: Host *Heracleum sphondylium* (Apiaceae). Flower buds swollen, not opening. Petals slightly thickened and, like the thickened stamens, bent inwards. Flower peduncle variously shortened, causing the flowers to cluster together.

References: HB: 3183, H: 4509, DA: p239, DVL: 149, RS: p134.

Range: Europe, rare; maybe overlooked as it is quite frequent in Belgium.

Contarinia rumicis (H. Loew, 1850)

Record: 6.VIII.2019, on *Rumex obtusifolius.*

Biology: Host *Rumex spp.* incl. mainly *R. crispus*, *obtusifolius*, *sanguineus* (Chenopodiaceae). Flower buds shortly stalked as result of infestation; therefore ± clustered, twice as large as healthy ones; oblong, irregularly bulging, yellowish to reddish. Stamens and ovaries distorted.

References: HB: 5979, cf. H: 2123, 2128, DA: p145, RS: p280.

Range: Europe, secondarily Holarctic, moderately frequent.

Contarinia scrophulariae Kieffer, 1896

Records: 6.VIII.2019, 13.VIII.2021, on *Scrofularia nodosa.*

Biology: Host *Scrophularia nodosa* (Scrophulariaceae). Flowers swollen, globular, usually unopened. Stamens and pistil enlarged.

References: HB: 6387, H: 5059 sq., DA: p265, DVL: p265, RS: p304.

Range: Europe, very frequent.

Cystiphora taraxaci (Kieffer, 1888)

Record: 6.VIII.2019, on *Taraxacum* sp.

Biology: Host *Taraxacum* spp. (Asteraceae). Lamina with flat circular blister, usually several in a leaf; rim of gall becomes dark red or purple; contains one larva under translucent epidermis.

References: HB: 6950, H: 6090, DA: p301, DVL: p280, RS: p323.

Range: Euro-Siberian, most frequent.

Dasineura auritae Rübsaamen, 1916

Record: 6.VIII.2019, on *Salix aurita.*

Biology: Host *Salix aurita*, *S. caprea*, *S. cinerea* and hybrids (Salicaceae). Downward leaf rolls, 9-12 mm long, the wall usually conspicuously rugose; solitary or with several coalescing, and with ± twisting of the lamina.

References: HB: 6137, DA: p102, DVL: p256, RS: p293.

Range: Europe, most frequent.

Dasineura crataegi (Winnertz, 1853)

Record: 6.VIII.2019, 13.VIII.2021, on *Crataegus sp*.

Biology: Host *Crataegus monogyna*, *C. laevigata* (Rosaceae). Leaves on distinctly stunted, slightly thickened shoot tip often in many densely tuft-like clusters. Leaf blade sessile, ± inhibited, rugose, occupied by many bolt-shaped or globular green or reddish proliferations.

References: HB: 2072, H: 2942, DA: p183, DVL: p118, RS: p90.

Range: Europe, most frequent.

Dasineura fraxinea Kieffer, 1907

Record: 6.VIII.2019, on *Fraxinus excelsior.*

Biology: Host *Fraxinus* spp. (Oleaceae). Pustule-shaped flat parenchyma galls, hardly 1 mm high, especially protruding on the underside with margins, up to 8 mm wide.

References: HB: 2808, H: 4647, DA: p248, DVL: p140, RS: p119.

Range: Europe, moderately frequent.

Dasineura irregularis (Bremi, 1847)

Record: 6.VIII.2019, 10.IX.2021, on *Acer pseudoplatanus*.

Biology: Host *Acer pseudoplatanus* (Sapindaceae). Lamina irregularly folded upwards and ± undulatory curled; marginally deflected or rolled, often ± reddened.

References: HB: 36, H: 3984 sq., DA: p21, DVL: p73sq., RS: p21.

Range: Europe, most frequent.

Dasineura lathyricola (Rübsaamen, 1890)

Record: 6.VIII.2019, on *Lathyrus pratensis.*

Biology: Host *Lathyrus pratensis*, and maybe other Fabaceae. Terminal stipules slightly swollen at bases, sometimes discoloured, shoot beyond these dies; larvae yellowish-white when young, later pale orange or light red.

References: HB: 3699, H: 3763 sq., DA: p211, DVL: p162, RS: p151.

Range: Euro-Siberian, very rarely recorded; maybe overlooked as it is quite frequent in Belgium.

Dasineura mali (Kieffer, 1904)

Record: 6.VIII.2019, on *Malus domestica.*

Biology: Host *Malus* spp. (Rosaceae). Leaves of young shoots with cartilaginous thickening, often on both margins, usually discoloured, often running parallel to the midrib, usually resulting in an upward roll.

References: HB: 4116, H: 2885, 6753, DA: p181, DVL: p172, RS: p166.

Range: Europe, secondarily Holarctic, frequent, rarely recorded in Belgium.

Dasineura plicatrix (H. Loew, 1850)

Record: 6.VIII.2019, on *Rubus* sp.

Biology: Host *Rubus* spp. (Rosaceae). Leaflets folded upwards along ± thickened main veins, undulatory curled and often ± discoloured, especially close to the vein; stunted and sometimes apparently more densely pubescent.

References: HB: 5907, H: Ru7 sq., 6769, DA: p185, DVL: p276, RS: 426.

Range: Europe, N-Africa, most frequent.

Dasineura pustulans (Rübsaamen, 1889)

Records: 6.VIII.2019, 13.VIII.2021, on *Filipendula ulmaria.*

Biology: Host *Filipendula* spp. (Rosaceae). On the underside of the slightly disfigured lamina occur 1 mm deep grooves in rotund, pale green spots, yellowish-margined up to 5 mm across with corresponding archings on the upperside. Often many per lamina, sometimes coalescing.

References: HB: 2741, H: 2829 sq., DA: p179, DVL: p138, RS: p115.

Range: Europe, most frequent.

Dasineura thomasiana (Kieffer, 1888)

Record: 6.VIII.2019, on *Tilia* sp.

Biology: Host *Tilia* spp. (Malvaceae). The more or less developed young laminas terminally on stunted shoots remain irregularly crisp and upwardly folded. Venation disfigured, undulate, slightly thickened, sometimes more pubescent.

References: HB: 7099, H: 4124 sq., 7064, DA: p227, DVL: 285, RS: p332.

Range: Europe, frequent.

Dasineura urticae (Perris, 1840)

Record: 6.VIII.2019, 10.XI.2021, on *Urtica dioica.*

Biology: Host *Urtica dioica*, *U. urens* (Urticaceae). Irregular rotund to oblong oval, yellowish-green or whitish hollow galls, about 3-7 mm large, relatively thin-walled, white, succulent, especially at basal part of laminas; also on younger stem parts as well as on primary and even on secondary axial parts of inflorescence; encroaching from there onto the flowers. With a narrow, slit-shaped exit on the upperside.

References: HB: 7356, H: 2095 sq., DA: p142, DVL: p295, RS: p342.

Range: Euro-Siberian, most frequent.

Dasineura viciae (Kieffer, 1888)

Record: 4.VII.2021, on *Vicia sativa.*

Biology: Host *Vicia sativa* and probably related species (Fabaceae). Leaflets folded upwards, pod-like. Wall succulent thickened. Often on strongly stunted, terminal or lateral shoot tips already the youngest leaves become galled and clustered into conspicuous balls.

References: HB: 7529, comp. H: 3696 sq., 6969 sq., DA: p209, DVL: p301, RS: p354.

Range: Euro-Siberian, most frequent.

Didymomyia tiliacea (Bremi, 1847)

Records: 6.VIII.2019, 10.XI.2021, on *Tilia* sp.

Biology: Host *Tilia* spp. (Malvaceae). Galls dispersed on the lamina, often many per leaf; tough-walled, rotund, up to 8 mm wide and about 4 mm high; on one side arched-conical, on the other side rather bulging disc-shaped; predominantly protruding more on the upperside, rimmed later on. The conical part separates centrally at maturity a cylindrical-conical, longitudinally grooved inner gall.

References: HB: 7101, H: 4137 sq., 7070 sq., DA: p228, DVL: p285, RS: p329.

Range: Euro-Siberian, very frequent.

Drisina glutinosa Giard, 1893

Records: 6.VIII.2019, 13.VIII.2021 on *Acer pseudoplatanus.*

Biology: Host *Acer pseudoplatanus* (Sapindaceae). Depression at the underside of leaf, about 1 mm across, surrounded by a circular, 5-7 mm wide, lighter area.

References: HB: 33, H: 3987 sq., DA: p224, DVL: p74, 75, RS: p22.

Range: Europe, very frequent.

Hartigiola annulipes (Hartig, 1839)

Records: 6.VIII.2019, 13.VIII.2021, on *Fagus sylvatica.*

Biology: Host *Fagus sylvatica* (Fagaceae). Gall slender, obtuse-cylindrical or barrel-shaped, leathery-woody, up to 3 (4) mm long, densely covered with brownish hairs.

References: HB: 2666, H: 1153-54, DA: p133, DVL: p134, RS: p112.

Range: Europe, most frequent.

Iteomyia capreae (Winnertz, 1853)

Records: 6.VIII.2019, 10.XI.2021, on *Salix caprea*.

Biology: Host *Salix caprea* and other sallows (Salicaceae). Outgrowths of leaf with tough, woody wall. Galls rotund, 1.5-2 mm or more across, ± equally protruding on both leaf sides; one-chambered; the underside with narrow, round exit hole. Usually many on leaves and often coalescing.

References: HB: 6108, H: S61 sq., 6370 sq., DA: p102, 104, DVL: p256, RS: p295, 296.

Range: Euro-Siberian, most frequent.

Iteomyia major (Kieffer, 1889)

Record: 6.VIII.2019, on *Salix* sp.

Biology: Host *Salix aurita*, *S. caprea*, *S. cinerea* and hybrids (Salicaceae). Separate galls rotund (1.5) 2-4 (5) mm across; with tough, woody wall; on both sides of the lamina, usually more prominent on the underside, there with small, rotund, central exit hole. Usually several galls coalesce into irregularly margined clusters. Often on the midrib, or the major lateral veins.

References: HB: 6165, H: S47 sq., DA: p101, DVL: p254, RS: p436.

Range: Europe, most frequent.

Jaapiella bryoniae (Bouché, 1847)

Record: 6.VIII.2019, on *Bryonia cretica* subsp. *dioica.*

Biology: Host *Bryonia cretica* subsp. *dioica* (Cucurbitaceae). Shoot tip stunted. Leaves especially thickened at the base, rolled upwards, clustered into a ± dense and expanded rosette, conspicuously haired.

References: HB: 1223, H: 5476 sq., DA: p277, DVL: p101, RS: p60.

Range: Europe, frequent.

Jaapiella hypochoeridis Sylvén, 1998

Record: 6.VIII.2019, on *Hypochaeris radicata.*

Biology: Host *Hypochaeris radicata* (Asteraceae). Larvae gregarious living free among the florets in the capitula, somewhat stunted.

References: HB: 1223, H: 5476 sq., DA: p277, DVL: p101, RS: p60.

Range: Europe, very rare, maybe overlooked as it is quite frequent in Belgium.

Jaapiella veronicae (Vallot, 1827)

Record: 13.VIII.2021, on *Veronica chamaedrys.*

Biology: Host *Veronica chamaedrys*, and other *Veronica* species (Plantaginaceae). Youngest pairs of leaves folded together, pouch-like, swollen, thickened. Transformed into a uniform, usually broad conical, sometimes laterally flattened, 2-valved, 5-10 mm long gall.

References: HB: 7435, H: 5080 sq., 7324, 7327, DA: p265, DVL: p298, RS: p350.

Range: Europe, most frequent.

Janetiella lemeei (Kieffer, 1904)
Fig. 4

Record: 6.VIII.2019, on *Ulmus minor*.

Biology: Host *Ulmus laevis*, *U. minor* (Ulmaceae). Bark of young shoot axial parts or on veins of laminas with blunt conical swellings, up to about 3 mm long, first succulent, later on tough-walled.

References: HB: 7309, DA: p139, RS: p341.

Range: Europe, rarely recorded; apparently also rare in Belgium with fewer than 15 records.

Lasioptera rubi (Schrank, 1803)

Records: 6.VIII.2019, 10.XI.2021, on *Rubus* sp.

Biology: Host *Rubus* spp. (Rosaceae). Rotund to constricted barrel-shaped swelling, mainly one-sided, about 10-20 (30) mm long and 5-7 (15) mm broad; later on woody with rough fissured bark.

References: HB: 5889, H: Ru5 sq., 6762 sq., DA: p185, DVL: p242, RS: 276.

Range: Euro-Siberian, most frequent.

Fig. 4. Leaf galls of *Janetiella lemeii* on *Ulmus minor*, 6.VIII.2019. © Sébastien Carbonnelle.

Macrodiplosis pustularis (Bremi, 1847)

Record: 6.VIII.2019, on *Quercus* sp.

Biology: Host *Quercus* spp. (Fagaceae). Tip of lobe broadly downward deflected, closely appressed to the leaf surface; slightly thickened, a little discoloured and yellow- or sometimes red-spotted.

References: HB: 5507, H: 1306, 1711, 1923, 6542, DA: p121, DVL: p226, RS: 249.

Range: Europe, most frequent.

Macrodiplosis roboris (Hardy, 1854)

Record: 6.VIII.2019, on *Quercus* sp.

Biology: Host *Quercus* spp., deciduous oaks (Fagaceae). Margin of expanded leaves narrowly tubular and rolled upwards between the lobes; roll clearly thickened and ± leathery-brittle.

References: HB: 5506, H: 1307 sq., 6483 sq., DA: p121, DVL: p227, RS: p249.

Range: Europe, most frequent.

Macrolabis heraclei (Kaltenbach, 1862)

Record: 6.VIII.2019, on *Heracleum sphondylium.*

Biology: Host *Heracleum*, and maybe other *Apiaceae*. Leaflets folded as in bud, shortened, curled; tissue close to larvae ± thickened and discoloured, prematurely withering after the departure of larvae. Galls often overtopped by expanded, not disfigured parts.

References: HB: 3174, H: 4512, DA: p236, 239, DVL: p149, RS: p134.

Range: Euro-Siberian, very frequent.

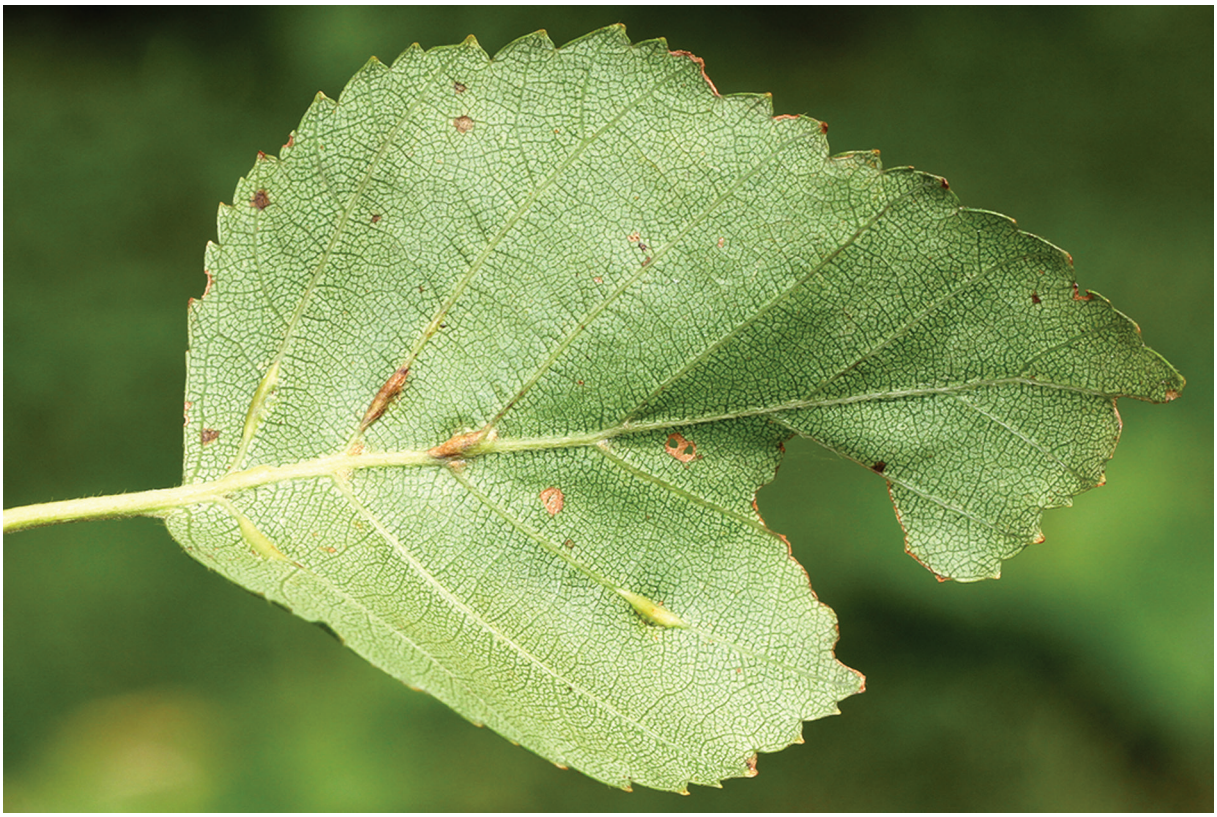

Fig. 5. Leaf galls of *Massalongia* sp. on *Betula utilis* var. *jacquemontii*, 13.VIII.2021. © Stéphane Claerebout.

Massalongia sp.
Fig. 5

Record: 13.VIII.2021, on *Betula utilis* var. *jacquemontii* (Fig. 5). The gall was found on an exotic ornamental *Betula.* Up to 6 galls per leaf were present and 4 localized on secondary veins. Depending on the host plant as well as the number, shape and position of the galls, the identification cannot be automatically attributed to *Massalongia rubra* (Kieffer, 1890). Despite a recent revision of the genus (Elsayed *et al*., 2020), knowledge about host range of the different *Massalongia* species is still incomplete, and another species cannot be completely ruled out. The examination of adults would make it possible to decide definitively.

Biology: Host *Betula pendula* and *B. pubescens* are main hosts of indigenous *Massalongia* species. *Massalongia rubra* induce spindle-shaped swellings, glabrous, hard, pale-green or often also ± purple-red on main, or more rarely lateral veins of leaf, occasionally also on the petiole, especially visible on the underside.

References: HB: 1070, 1070A?, H: 1075 sq., DA: p136, dvl: p97, RS: p56.

Range: (for *Massalongia rubra*) Europe up to Kazakhstan, very frequent.

Physemocecis hartigi (Liebel, 1892)

Record: 6.VIII.2019, on *Tilia* sp.

Biology: Host *Tilia* spp. (Malvaceae). Lamina usually with several to sometimes many flat, circle-shaped, umbilicate parenchyma galls, hardly protruding on the upperside, on the underside slightly arched, pustule-shaped.

References: HB: 7100, H: 4138 sq., DA: p228, RS: p329.

Range: Europe, rarely recorded.

Rabdophaga heterobia (H. Loew, 1850)

Record: 6.VIII.2019, on *Salix triandra.*

Biology: Host *Salix triandra* (Salicaceae). An up to about 10 mm large, ± bud-like converging, loose, inner rosette is surrounded by 3-6 sessile expanded leaves, which are only in their basal half shortened and widened, but otherwise almost normally developed. All laminas heavily white pubescent at their base.

References: HB: 6054, H: S10 sq., DA: p98, DVL: p247-248, 252, 260, RS: p430.

Range: Euro-Siberian, most frequent.

Rabdophaga salicis (Schrank, 1803)

Record: 6.VIII.2019, on *Salix* sp.

Biology: Host *Salix aurita*, *S. caprea*, *S. cinerea* (Salicaceae). Galls of the axis with ± broadened base, narrowed towards the lamina, varying in size; sometimes with only one, often with several, larval chambers which are always devoid of frass.

References: HB: 6160, H: S48, 854, DA: p101, DVL: p252, 254, 261, RS: p289, 294.

Range: Euro-Siberian, most frequent.

Rondaniola bursaria (Bremi, 1847)

Record: 6.VIII.2019, on *Glechoma hederacea.*

Biology: Host *Glechoma hederacea* (Lamiaceae). Lamina on the upperside often with numerous haired, cylindrical pouch galls, slender, ± corniculate or sac-shaped, up to 4 mm tall, dropping off when mature, leaving on the lamina a rotund, rimmed hole.

References: HB: 3049, H: 4809 sq., DA: p256, DVL: p147, RS: p130.

Range: Europe, most frequent.

Discussion

Recording galls, and maybe especially those of gall midges, requires time and patience. Only 39 species were found to date on the site, but the amount of species is probably far more important. All these species are belonging to the subfamily Cecidomyiinae. Many other species of the other subfamilies are probably present, but their survey needs different methods and their identification is limited to the skills of very few specialists worldwide. Most of the species reported here are considered to be frequent in the area, as they are generally in Europe. Nevertheless, several species probably rare in Belgium have been found. The records of *Asphondylia miki* and *A. lathyri* are respectively the second and sixth records for Belgium, while *Janetiella lemeii* and *Arnoldiola libera* have both fewer than 10 confirmed records in the country to date. In addition to gall midges, many other gall-inducing species have been observed during the survey such as fungi (especially rusts, moulds and other cecidogenic species), acari (mites belonging to Eriophyidae and Phytoptidae families) and other cecidogenic insects (aphids, cynipids, etc.). More than a hundred gall-inducing species have been listed. Several other Diptera have also been recorded. One gall-inducing Agromyzidae species, *Hexomyza cecidogena*, has been recorded on *Salix* sp., and several other common mining species: *Agromyza alnivora*, *Aulagromyza hendeliana*,

A. heringii, *Chromatomyia scolopendri*, *Liriomyza congesta*, *L. sonchi*, *L. valerianae*, *Phytomyza crassiseta*, *P. heringiana* and *P. spondylii.* Further prospection efforts in the site would undoubtedly lead to add more species to this first list.

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Tipulid craneflies from a Malaise trap campaign at the Botanic Garden Jean Massart in Brussels-Capital Region, Belgium (Diptera: Tipulidae)

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Abstract

A list of Tipulidae collected from Malaise traps (May 2015-November 2017) from the Botanic Garden Jean Massart in Auderghem is presented. In total, 36 species of Tipulidae are recorded, which is about one-third of the 98 species of Tipulidae known from Belgium. Collection dates, the status in Belgium/the Netherlands and some additional comments are given for each species. Several common or widespread species were found, but also the much rarer *Nephrotoma aculeata* in considerable numbers. Local populations are also possible for *Tipula irrorata*, *Tipula montium* and *Prionocera subserricornis*. Finally, the presence of *Nephrotoma lunulicornis*, *Nephrotoma quadristriata*, and *Prionocera subserricornis* is also remarkable.

Keywords: Tipulidae, craneflies, Jardin Jean Massart, Belgium

Introduction

The Tipulidae comprise in Europe a rather uniform family of large Nematocera as far as the adults are considered. Larvae on the other hand develop in very diverse but species specific conditions like dry, moist, wet or swampy soils, in mud and water, in dry and wet rotting wood or in wood holes. Some species are active flyers and can be found far from their larval habitat, others remain much more local (Stubbs, 2021).

In Belgium Tipulidae were actively studied some hundred years ago, but only in the beginning of this century a renewed interest started. From 2015 on in particular, the number of records is increasing exponentially. In the Netherlands on the other hand more research was done before 2000. This recent increase is due to the citizen science platforms in both countries, www.waarnemingen.be and www.waarneming.nl, where thousands of records of Tipulidae, often documented with photographs, are posted and reviewed.

Material and methods

The Tipulidae were identified based on material caught in Malaise traps. The location of the traps is described in Grootaert *et al*. (2023). Species were identified using the keys of Peeters and Oosterbroek (2015-2017). Samples were received from two periods, 7.V.2015-11.V.2016 (two traps installed) and 5.V-8.XI.2017 (four traps installed). No tipulid samples were received from the period VI-VII.2017.

Data on the status of all species was taken from Peeters & Oosterbroek (2015-2017) and for some rare species in the Netherlands from Oosterbroek & De Jong (2001). For recent data on particular species the records on the two observation platforms, www.waarnemingen.be and www.waarneming.nl, were consulted. Only reviewed and approved records were taken into account. In a few cases the author's experience as a collaborator in other Malaise trap campaigns was added. The results of two of them were published in Martens *et al.* (2014) and Tack *et al.* (2021).

Results

Thirty-six species of Tipulidae were found in the Botanic Garden Jean Massart as a result of this Malaise trap campaign. The following species list summarizes the records of each species, and the status in Belgium (B) and the Netherlands (NL) is given, together with some habitat characteristics and comments related to the trap campaign.

Species list

Ctenophora festiva (Meigen, 1804)

Records: 1-8.VI.2017: 1♀, MT2.

Status in B and NL Common spring and summer species, but in low numbers. Much recorded on the observation platforms due to its remarkable appearance. Larvae develop in decaying wood of deciduous trees of old forests and orchards (Oosterbroek *et al*., 2006).

Comments: Lower numbers than could be expected from the presence of old forest in the vicinity. The species was also not captured in six other Malaise trap campaigns in Belgium. This lack of Malaise trap records might have to do with the flight activity of the adults, most of the time they can be found in the vincinity of old trees, in search of suitable spots for oviposition (females) or females (males).

Ctenophora flaveolata (Fabricius, 1794)

Records: 15-17.V.2017: 1♂; MT2.

Status in B and NL Common spring species, but in low numbers. Much recorded on the observation platforms due to its remarkable appearance. Larvae develop in decaying wood of deciduous trees of old forests and orchards (Oosterbroek *et al*., 2006).

Comments: Lower numbers than could be expected from the presence of old forest in the vicinity. The species was also not captured in six other Malaise trap campaigns in Belgium (see above).

Dictenidia bimaculata (Linnaeus, 1760)

Records: 17-24.V.2017: 1♀; MT2.

Status in B and NL Quite common spring and summer species with larvae in dry dead wood.

Nephrotoma aculeata (Loew, 1871)

Records: 26.VI-20.VIII.2015: 48♂♂, 3♀♀; 15-30.VI.2017: 8♂♂, 5♀♀; MT1, MT2, MT6.

Status in B and NL Rare summer species from a variety of habitats. Only 11 other records in Belgium after 2010 and 7 in the Netherlands, although numerous photographs of *Nephrotoma* species are posted on the two observation platforms.

Comments: Remarkably numerous in the summer of 2015 in both MT1 and MT2. The period 30.VI to 23.VIII is lacking in the campaign of 2017 for Tipulidae.

Nephrotoma analis (Schummel, 1833)

Records: 26.VI-22.VII.2015: 5♂♂, 4♀; 22-30.VI.2017: 1♀; MT1, MT2.

Status in B and NL Uncommon summer species from moist sandy habitats.

Nephrotoma appendiculata (Pierre, 1919)

Records: 7-28.V.2015: 6♂♂, 2♀♀; 17-24.V.2017: 10♂♂, 1♀; MT1, MT2.

Status in B and NL Common spring species from grasslands. Frequently in high numbers.

Nephrotoma cornicina (Linnaeus, 1758)

Records: >30 specimens; 17.VI-15.VII.2015; 5-30.VI.2017; MT1, MT2, MT5, MT6.

Status in B and NL Common summer species from a variety of habitats but usually in or near forests.

Nephrotoma dorsalis (Fabricius, 1781)

Records: 1-22.VII.2015: 1♂, 1♀; 15-30.VI.2017: 2♂♂; MT1, MT2.

Status in B and NL Rare summer species in Belgium, more common in the Netherlands but much less common in the southern part of the country.

Nephrotoma flavipalpis (Meigen, 1830)

Records: >30 specimens; 10.VI-27.VII.2015; 15-30.VI.2017; MT1, MT2, MT5, MT6.

Status in B and NL Common summer and autumn species from a variety of habitats, often found indoors.

Nephrotoma guestfalica (Westhoff, 1879)

Records: 10.VI-6.VIII.2015: 20♂♂, 7♀♀; 5-22.VI.2017: 2♂♂; MT1, MT2, MT5.

Status in B and NL Common spring and summer species from a variety of habitats, frequently found in gardens.

Nephrotoma lunulicornis (Schummel, 1833)

Records: 28.V-10.VI.2015: 1♂, 1♀; MT1, MT2.

Status in B and NL Very rare spring and summer species from sandy soils (<10 records in Belgium).

Nephrotoma quadrifaria (Meigen, 1804)

Records: >30 specimens; 7.V-15.VII.2015; 4.V-30.VI.2017; MT1, MT2, MT4, MT5, MT6.

Status in B and NL Common spring and summer species from a variety of habitats.

Nephrotoma quadristriata (Schummel, 1833)

Records: 17-24.V.2017: 1♂; MT2.

Status in B and NL Spring and summer species from different habitats on sandy soils, very rare in Belgium (<20 records), more common in the Netherlands.

Nephrotoma scurra (Meigen, 1818)

Records: 30.VII-6.VIII.2015: 1♂; 7-21.IX.2017: 1♀; MT2.

Status in B and NL Common summer species from sandy soils.

Comments: Unexpected low numbers.

Nigrotipula nigra (Linnaeus, 1758)

Records: 1-22.VII.2015: 4♂♂; MT2.

Status in B and NL Common summer species from wet grasslands and marshes.

Prionocera subserricornis (Zetterstedt, 1851)

Records: 8-15.VII.2015: 1♂, MT2; 12-20.VIII.2015: 1♀, MT2; 23.VIII-1.IX.2017: 1♂, MT6.

Status in B and NL Very rare spring and summer species.

Comments: Only two other recent records in Belgium, namely from a Malaise trap at Beringen-Zwarte Beek in 2013 and a field observation in Mol-Buitengoor in 2017. In the Netherlands the species was found at 14 localities up to 2000, predominantly in the middle (peat district) and eastern part of the country (Oosterbroek & De Jong, 2001). According to these authors, the species is associated with ditches, brooks, and pools as can be found at alder groves, spruce forests, peat bogs, fenlands and along lake shores and rivers. Three newer records were added from the same regions after 2020.

In Britain it is a nationally rare species of *Sphagnum* bogs (Kramer, 2011). In France this holarctic species was found only recently for the first time, the locality being a marsh in Pas-de-Calais (Quindroit & Lemoine, 2020).

It is remarkable that the predominantly boggy or peaty conditions from most localities are not found at the Jardin Massart and the far surroundings.

Tanyptera atrata (Linnaeus, 1758)

Records: 13-28.V.2015: 3♂♂, 2♀♀; 4-11.V.2016: 1♂, 1♀; 17.V-8.VI.2017: 2♂♂, 2♀♀; MT1, MT2.

Status in B and NL Widespread spring species but only a few records in the western half of Belgium. Much recorded on the observation platforms due to its remarkable appearance. Larvae develop in decaying wood of deciduous trees in old forests and heaths.

Tanyptera nigricornis (Meigen, 1818)

Records: 7-13.V.2015: 1♀, MT1.

Status in B and NL Rare spring species with larval development in dead broad-leaved wood.

Comments: In Belgium the 19 recent records are from the middle part of the country, showing no clear distribution pattern for this species. In the Netherlands it is found especially in the eastern half of the country, often showing up in considerable numbers in Malaise traps (Oosterbroek & De Jong, 2001).

Tipula fascipennis (Meigen, 1818)

Records: 17.VI-1.VII.2015: 1♂, 1♀; 1-22.VI.2017: 4♂♂; MT2.

Status in B and NL Common spring and summer species mostly from moist habitats.

Tipula flavolineata (Meigen, 1804)

Records 1-28.V.2015: 1♂; 4-11.V.2016: 1♀; 17.V-15.VI.2017: 2♀♀; MT1, MT2.

Status in B and NL Quite rare spring species with larvae in soft rotting wood.

Tipula fulvipennis (DeGeer, 1776)

Records: 10-17.IX.2015: 1♀; MT2.

Status in B and NL Quite common species in the eastern part of Belgium and the forested parts of the Netherlands. This large species occurs mostly in and around moist and wet woods in late summer with a few spring records.

Tipula helvola (Loew, 1873)

Records: 8-15.VII.2015: 1♀; MT2.

Status in B and NL Widespread summer species of dry woods.

Tipula irrorata (Macquart, 1826)

Records: 8-30.VII.2015: 3♂♂, 3♀♀; 15-30.VI.2017: 3♂♂, 2♀♀; MT1, MT2.

Status in B and NL Rare spring and summer species of woods, from 2010 on at only eight other localities in Belgium, two in the Netherlands.

Comments: Larvae develop beneath bark on large logs and fallen trunks or within soft decaying wood. Three out of the nine Belgian localities are from Malaise traps.

Tipula lateralis (Meigen, 1804)

Records: 7-13.V.2015: 2♂♂; 17-24.IX.2015: 1♂; MT1, MT2.

Status in B and NL Common spring and summer species of every kind of marginal situations with wet sediment.

Comments: Remarkably few records.

Tipula luna (Westhoff, 1879)

Records: 24.V-1.VI.2017: 3♂♂; MT6.

Status in B and NL Common spring species of wet meadows, muddy ponds and lake margins.

Comments: Only a few records, may be because MT6 was only set up in 2017, at the wettest habitat of the Jardin Massart.

Tipula lunata (Linnaeus, 1758)

Records: 7.V-1.VII.2015: 11♂♂, 1♀; 5.V-15.VI.2017: 4♂♂, 2♀♀; MT1, MT2, MT6.

Status in B and NL Common spring species of light forests on moist soils.

Tipula luteipennis (Meigen, 1830)

Records: 21.IX-12.X.2017: 20♂♂, 9♀♀; 12-25.X.2017: 14♂♂, 22♀♀; 25.X-8.XI.2017: 1♀; MT6.

Status in B and NL Local autumn species of swamps, wet forest and wet heath.

Comments: Only found in MT6, located at the wettest habitat of the Jardin Massart, and therefore not found in the traps of 2015 as only MT1 and MT2 were in place. From these campaign data females appear to be active somewhat later in the season compared to males. The females are not very mobile.

Tipula maxima (Poda, 1761)

Records: 30.VII-6.VIII.2015: 1♀; 5.V-22.VI.2017: 2♂♂, 1♀; MT2.

Status in B and NL Common spring and summer species, but in low numbers. Usually found near wet places in forests.

Tipula montium (Egger, 1863)

Records: 20-27.VIII.2015: 1♀; 22.VI-22.VI.2017: 1♂; 23.VIII-1.IX.2017: 7♂♂, 2♀♀; MT2, MT6.

Status in B and NL Rare spring and summer species, but may be overlooked due to its close resemblance with the common *T. lateralis*.

Comments: The species was not found in six other Belgian Malaise trap campaigns (Peeters, unpublished).

Tipula obsoleta (Meigen, 1818)

Records: 9.X-12.XI.2015: 27♂; MT1, MT2.

Status in B and NL Common autumn species from a wide range of habitats.

Comments: Almost exclusively recorded in MT2 (25 out of 27 specimens). It is remarkable that only males were caught and the species was completely absent in 2017 although the same trap was in place.

Tipula oleracea (Linnaeus, 1758)

Records: 7.V-26.VI.2015: 3♀♀; 20-27.VII.2015: 1♂; 14.IV-11.V.2016: 1♂, 2♀♀; 5.V-1.VI.2017: 6♀♀; 23.VIII-21.IX.2017: 2♀♀; MT1, MT2, MT6.

Status in B and NL Common species of moist grasslands, occurring from spring until late summer with two peaks, the spring peak being most important. This pattern is reflected in the numbers from these traps.

Tipula pagana (Meigen, 1818)

Records: 30.X-12.XI.2015: 4♀♀; 22-30.VI.2017: 1♂; 12.X.-8.XI.2017: >50 specimens; MT2, MT6.

Status in B and NL Rather common, but overlooked due to the late flight period. Late autumn species, with rare records in spring.

Comments: Females are flightless. The species was not caught in MT1 (even not males), but numerous in MT2 although both traps are only 50 meters apart. The June record is representable for the exceptional spring presence of the species.

Tipula paludosa (Meigen, 1830)

Records: >200 specimens; 17-26.VI.2015 (1♂); 20.VIII-9.X.2015; 23.VIII-12.X.2017; MT1, MT2, MT6.

Status in B and NL Very common species of not too dry grasslands. Late summer until early autumn with rare spring records.

Comments: The species was much more numerous in MT2, which was located at the border of an open meadow, a probable larval habitat. As in *T. pagana*, the June record is representable for the exceptional spring presence of the species.

Tipula submarmorata (Schummel, 1833)

Records: 14-21.IV.2015 1♂, 1♀; MT2.

Status in B and NL Rare spring species of woodland with well-developed humus soils.

Tipula unca (Wiedemann, 1817)

Records: 7.V-30.VII.2015: 16♂♂, 11♀♀; 15-30.VI.2017: 3♂♂, 8♀♀; MT1, MT2, MT6.

Status in B and NL Rather common spring species in its habitat of marshes and wet woods.

Comments: Eight specimens in MT1, 24 in MT2, and 6 in MT6 in a short period of time.

Tipula varipennis (Meigen, 1818)

Records: 7.V-21.V.2015: 39♂♂, 2♀♀; 4-11.V.2016: 12♂♂, 1♀; 5-24.V.2017: 9♂♂, 2♀♀; MT1, MT2.

Status in B and NL Common spring species in wet woodland.

Comments: This species was almost exclusively caught in MT2.

Discussion

In Belgium 98 species of Tipulidae were recorded up to date, according to the Catalogue of the Craneflies of the World (Oosterbroek, 2022). A total of 36 species of Tipulidae is a very good number as compared to other recent extended Malaise trap campaigns in Belgium. In Bos t' Ename (Oudenaarde, prov. Easter Flanders, Tack *et al.*, 2021) 17 tipulid species, and in Sainte-Marie-sur-Semois (prov. Luxembourg at the French border) 22 tipulid species were found. In a survey of several Flemish salty meadows 14 tipulid species were found (Peeters, unpublished).

Several species were found in considerable numbers suggesting local reproduction. For *Tipula* these are in order of appearance during the season: *T. varipennis*, *T. lunata*, *T. unca*, *T. paludosa*, *T. luteipennis*, *T. obsoleta*, and *T. pagana*. For *Nephrotoma* these are *N. appendiculata*, *N. quadrifaria*, *N. guestfalica*, *N. cornicina*, *N. flavipalpis*, all common species, but also *N. aculeata*, a much rarer species in Belgium and the Netherlands.

Also for the rare *T. irrorata*, *T. montium* and *P. subserricornis* a population is plausible with several records spread over two or three years and with males and females. Several species were captured in very low numbers, maybe flying in from the wooded surroundings.

Some common Belgian species were not found in the Malaise traps. *Tipula vittata* (Meigen, 1804) is widespread in early spring in wet wood with bare soil; *Tipula vernalis* (Meigen, 1804) is very common in spring in several grassy habitats, and *Tipula confusa* (Van der Wulp, 1883) is a common autumn species of a wide variety of habitats. The first two species were already, albeit in low numbers, caught in at least one of six other Belgian Malaise trap campaigns, *Tipula confusa* on the other hand seems to have escaped each of these campaigns.

It is remarkable that most specimens from the *Tipula* species were caught in trap MT2, while *Nephrotoma* species were almost equally devided between MT1 and MT2. *Nephrotoma* species

occur more frequently in drier soils, but a closer look at the collection sites is necessary to explain these differences. The most swampy conditions of the location of MT6 attracted fair numbers of *T. luteipennis*, *T. luna*, *T. unca* and *T. pagana*. The first two species even occurred exclusively at that location. Except for *T. pagana* these species are typical of more wet and swampy habitats. Also *T. varipennis* can be expected, but was not collected here.

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Phoridae (Diptera) in the Botanic Garden Jean Massart: new species record for the Belgian fauna and some notes on relationships with ants (Hymenoptera: Formicidae) and ladybirds (Coleoptera: Coccinellidae)

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Abstract

A set of four Malaise trap samples representing one week of sampling in the Botanic Garden Jean Massart in Auderghem were analysed and selected groups of Diptera were extracted and identified to provide a basic list of species present in the garden. Of the dipteran family Phoridae not all specimens were extracted but only a subsample consisting mostly of specimens not belonging to the genus *Megaselia*. A total of 126 specimens were identified, belonging to 24 species in 11 genera. Six species are recorded from Belgium for the first time: *Anevrina unispinosa* (Zetterstedt, 1860), *Menozziola schmitzi* (Menozzi, 1921), *Metopina braueri* (Strobl, 1880), *Metopina perpusilla* (Six, 1876), *Phalacrotophora delageae* Disney, 1979, and *Pseudacteon brevicauda* Schmitz, 1925. These species are all discussed and special attention is given to those with parasitic relationships with ants and ladybirds.

Keywords: scuttle flies, faunistics, survey

Introduction

The Phoridae are a family of minute to small flies that are generally little studied. The main reason why they receive little attention is probably the amount of effort it may take to identify specimens, as explained below. Adult flies generally have a body length between less than 1 and 5 mm and the colour of the body ranges from entirely black or brown to largely yellow (clear, reddish or brownish) and almost every conceivable combination thereof, albeit noted that species with a light coloured body and dark legs are scarce. The flies have a general habitus which is quite consistent within the family for most winged species: somewhat hunched, with a relatively small head, usually a somewhat 'hanging' abdomen, enlarged femora and characteristic wing venation. Main characters of diagnostic value are found in chaetotaxy of legs and thorax, in the wing (chaetotaxy and venation) and the male genitalia. In some groups females are easy to identify because of some special structures or characteristics of sternites or tergites, but most often females cannot be identified on the basis of morphological characters (either because no females have been positively associated with known males or because characters of the females have not been studied or incorporated in keys).

Since most of the characters used for identification require the use of a microscope, standard practice among Phoridae specialists is to mount dissected specimens on microscope slides, with a wing, legs, head and the remainder of the body mounted separately. This procedure makes the study of Phoridae quite time consuming. Possibly the use of molecular techniques will allow more speedy identification in the future without the hassle of making microscope slides.

When it comes to discussing the biology of the Phoridae, let it suffice to say that there is almost no mode of living that cannot be found somewhere in the family. There are parasites and parasitoids (both on vertebrates and invertebrates), there are predators, saprophages (living in all kinds of decaying organic matter, both plant and animal), myrmecophiles, termitophiles, etc. In some cases their specialised life traits have resulted in special bodily adaptations, like strongly sclerotized ovipositors in a number of parasitoids or reduction of body parts (loss of wings, halters, legs, eyes, etc.) in a number of myrmecophilous and termitophilous species. In our region, the majority of species is assumed to have saprophagous or predatory larvae, living in decaying organic matter but nothing specific is known for most species.

Phorid flies can be found almost anywhere in any habitat, from on or even in the soil up to tree tops, on foliage, bark and any other surface that may offer food, breeding opportunities or mating ground. The number of specimens any general observer may see in the field usually does not compare with the actual number of specimens present, when numbers found in traps are compared with actual observations of specimens. The main reasons for this are the small size of virtually all species, their quick movements and their continuous activity. Most specimens are observed on leaves, either foraging (for example feeding on honeydew or bird droppings) or mating. Specialists will encounter more specimens in the wild when they survey specific substrates or potential hosts.

A general introduction to the family, including notes on morphology, systematics, identification, biology and ecology, and research methods was given by Disney (2004).

State of knowledge of Belgian Phoridae

The Belgian fauna of Phoridae is poorly known. The family as such has received no specialist attention. The last printed checklist was the one included in the Catalogue of the Diptera of Belgium (De Meyer, 1991). There it is mentioned that the list was based 'on previously identified material in the collections, and on records in the literature.' His statement, however, that the list comprised 119 species was erroneous. In all 128 valid species and one doubtful species were listed.

An extensive though not exhaustive search in the literature has yielded a number of species that were overlooked at the time or that were only recorded in the literature later on. These 19 species are listed in table 1. No effort was made to trace first records for all of these. At the same time, three species can be deleted from the list because they have been shown to be junior synonyms of other species on the list. These species are listed in table 2.

As a result, the known number of Belgian species of Phoridae before this publication was 144.

Table 1. Additional species of Phoridae recorded from that were either overlooked for the 1991 checklist or that were recorded for the first time after the checklist was published.

Added species	Source
Anevrina thoracica (Meigen, 1804)	Schmitz *et al.*, 1938-1981
Apocephalus borealis Brues, 1924	Ravoet *et al.*, 2013
Conicera floricola Schmitz, 1938	Schmitz *et al.*, 1938-1981
Conicera schnittmanni Schmitz, 1926	Schmitz *et al.*, 1938-1981
Conicera tibialis Schmitz, 1925	Schmitz, 1953
Diplonevra glabra (Schmitz, 1927)	Schmitz *et al.*, 1938-1981

Added species	Source
Megaselia discreta (Wood, 1909)	Weber *et al.*, 2013
Megaselia infraposita (Wood, 1909)	Weber *et al.*, 2013
Megaselia latior Schmitz, 1936	Schmitz, 1936
Megaselia minuta (Aldrich, 1892)	Disney, 1991
Megaselia oblongifrons Schmitz, 1939	Schmitz, 1940
Megaselia pseudociliata (Strobl, 1910)	Schmitz *et al.*, 1938-1981
Megaselia scalaris (Loew, 1866)	Dewaele *et al.*, 2000
Megaselia unguicularis (Wood, 1909)	Disney, 1991
Megaselia xanthozona (Strobl, 1892)	Schmitz *et al.*, 1938-1981
Peromitra erythrocera (Meigen, 1830)	Schmitz *et al.*, 1938-1981
Peromitra germanica (Schmitz, 1918)	Schmitz, 1940
Triphleba intempesta (Schmitz, 1918)	Disney, 1991
Triphleba renidens Schmitz, 1927	Schmitz *et al.*, 1938-1981

Table 2. Species deleted from the Belgian checklist because they have been shown to be junior synonyms of other species on the list.

Deleted species	Senior synonym
Diplonevra abdominalis (Fallén, 1823)	*Diplonevra florescens* (Turton, 1801) (= *D. florea* (Fabricius, 1794): preocc.).
Megaselia scutelliformis (Schmitz, 1925)	*M. scutellaris* (Wood, 1909).
Spiniphora helicivora (Dufour, 1841)	*S. maculata* (Meigen, 1830)

Material and methods

All phorid specimens identified were collected by four Malaise traps positioned within the Botanic Garden Jean Massart in 2017. The analysed samples represented just the week of 17-24 May 2017 as a subset of a sampling period that lasted several months. A single record from a later date was added (see below). The positions of the traps varied between the border of flower beds and a hedge (Malaise trap 2), an old arboretum (Malaise trap 4), flower meadow in old apple orchard (Malaise trap 5) and wet areas close to reed beds, above small ponds (Malaise trap 6) (Grootaert *et al.*, 2023), with various numbers of specimens obtained from each.

Distributional data for the species are primarily derived from Fauna Europaea (Weber *et al.*, 2013) but may be supplemented with data from other publications. Each additional country record will then be followed by a reference to the relevant publication. European distribution is given first and then followed by non-European distribution.

All specimens are kept in vials with 70% ethanol. Identifications were performed under a Wild M3Z stereomicroscope with magnifications ranging from 10x to 60x with LED light illumination (LitraPro LP1200 at 5700K light temperature). The material is stored in the collections of the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS) and the Natuurhistorisch Museum Maastricht, Maastricht, the Netherlands (NHMM). Starting point for identification were the keys by Disney (1983, 1990), occasionally supplemented by the key of Schmitz *et al.* (1938-1981). Other keys used pertain to species treated in the notes and the relevant references are given there.

Table 3. Identified Phoridae from the Botanic Garden Jean Massart. Species marked with * are new to the Belgian fauna.

Species	17-24.V.2017			2-11.VIII.2017			
	MT2	**MT4**	**MT5**	**MT6**	**MT5**	total	note
Anevrina thoracica (Meigen, 1804)			1			1	
Anevrina unispinosa (Zetterstedt, 1860) *	6					6	1
Anevrina urbana (Meigen, 1830)	1					1	
Conicera floricola Schmitz, 1938	3	1				4	
Diplonevra concinna (Meigen, 1830)		1				1	
Diplonevra florescens (Turton, 1801)	6		1			7	2
Diplonevra nitidula (Meigen, 1830)	18	4	3			25	
Diplonevra pilosella Schmitz, 1927	5	7	1			13	
Diplonevra sp.	1					1	2
Megaselia picta (Lehmann, 1822)				1		1	
Megaselia rufipes (Meigen, 1804)			1			1	
Megaselia subfuscipes Schmitz, 1935		1				1	
*Menozziola schmitz*i (Menozzi, 1921) *		2				2	3
Metopina braueri (Strobl, 1880) *	3					3	4
Metopina perpusilla (Six, 1876) *	3				1	4	5
Phalacrotophora delageae Disney, 1979 *		1	1			2	6
Phora atra (Meigen, 1804)	3		1			4	
Phora edentata Schmitz, 1920	2	1	1			4	
Phora holosericea Schmitz, 1920	1					1	
Phora tincta Schmitz, 1920		1				1	
Pseudacteon brevicauda Schmitz, 1925 *	1					1	7
Pseudacteon formicarum (Verrall, 1877)	3					3	7
Spiniphora bergenstammi (Mik, 1864)	1		2			3	
Triphleba distinguenda (Strobl, 1910)	12	1	11			24	
Triphleba nudipalpis (Becker, 1901)	2					2	
Triphleba sp.			10			10	
Number of specimens	71	20	33	1	1	126	
Number of species (ID-ed and not ID-ed)	16+1	10	10+1	1	1	24+2	

List of species

All references to material relate to the week of 7-14.V.2017 except for the record of *Metopina perpusilla* which is from the period of 2-11.VIII.2017.

1. *Anevrina unispinosa* (Zetterstedt, 1860) – **Belg. sp. nov.**
Fig. 1

Material examined: MT2: 6♂♂

Distribution: Austria, British Isles, Bulgaria (Langourov, 2021), Czech Republic, Denmark, Finland, France (Darinot *et al.*, 2010), Germany, Hungary, Ireland, the Netherlands, Poland, Romania, Russia (Disney, 2013), Slovakia, Spain, Sweden, Switzerland. Japan (Nakayama, 2012).

Fig. 1. *Anevrina unispinosa* (Zetterstedt, 1860) male habitus, Botanic Garden Jean Massart MT2. © Paul L.T. Beuk.

The larvae of this species are most often found to be necrophagous and are readily attracted to bait traps while they are hardly found in yellow pan traps (Disney, 2013), although they have been recorded on rotting wheat flower, mushrooms and vegetation as well. Flower visiting in Phoridae is observed only infrequently, but *A. unispinosa* was recorded on *Angelica sylvestris* (Disney, 1980).

Natural bait on which this species was recorded includes dead molluscs, earthworms and mice that will undoubtedly occur in the Botanic Garden.

2. *Diplonevra florescens* (Turton, 1801)

Identification of species of *Diplonevra* is mainly based on characters of the hind leg (chaetotaxy, secondary sexual characters at the base of the hind femur in the male), the colour of the halters and some body parts and the male genitalia (Disney, 1983). Still, colour characters sometimes show some variation, for example the extent of darkening of the halters and even the modification at the base of the male hind femur can be subject to variation. Disney (1983) illustrated the varying number of blunt setae on a ridge at the base of the hind femur for *Diplonevra florescens* (as *florea*). The listed material of *D. florescens* was basically identified using this structure. However, in a sample that was not fully analysed yet (and therefore not included in this paper) it appeared there also was variation in the presence or absence of an anteroventral seta on the hind tibia. In *D. florescens* this seta is supposed to be absent.

A single specimen of *Diplonevra* could not be identified using the key to Western European species (Disney, 1983) and may represent a specimen of a species described from Central Europe [possibly *D. amphichaeta* (Schmitz, 1949) or *D. lophochaeta* (Schmitz, 1927); based on the key by Schmitz *et al.* (1938-1981)].

3. *Menozziola schmitzi* (Menozzi, 1921) – **Belg. sp. nov.**
Fig. 2

Material examined: MT4: 1♂, 1♀

Distribution: Czech Republic, France, Hungary, Italy, Poland, Switzerland. Israel (Mostovksi, 2016b).

The systematics of the genus *Megaselia* Rondani, 1856, and similar genera is mostly unclear and currently there may be species (groups) which are placed in the genus that are more closely related to other genera than to other species (groups) in *Megaselia* (Hartop *et al.*, 2021). Disney (1990) discusses Palaearctic genera resembling *Megaselia* and in his key to 12 genera the *Megaselia* can be found in seven different places, which illustrates that there are *Megaselia* species similar to most of the other genera. This also applies to the genus *Menozziola* Schmitz, 1927, albeit that its species all share characters that are absent in *Megaselia* species. Most notable are the conspicuous long anal tube of the males of all *Menozziola*, which is longer than that of any *Megaselia* species, and the presence of finger-like extensions at the base of the ovipositor in the females. So, although the status of *Menozziola* still may remain unclear, its species are easy to recognise at least in the male sex. A male and a female were found in the sample of MT4 and the male was immediately identified as *Menozziola* based on the extreme long anal tube. Being aware of the presence of *Menozziola* the female was detected among the other Phoridae in the sample (mainly *Megaselia* sp.) but otherwise it might have gone unnoticed.

Currently three European species of *Menozziola* are recognised and these can be identified using the key in Gadau & Disney (1996). Using this key, the specimens were identified as *M. schmitzi*. This species was described as a parasitoid on *Crematogaster scutellaris* (Olivier, 1792) (Menozzi, 1921) and generally that ant species is given as its host. A very similar species, *M. obscuripes* Schmitz, 1927, is known to parasitize on species of *Camponotus* s.str. Mayr, 1861 (Gadau & Disney, 1996). After the synonymization of *M. camponoti* Schmitz,

Fig. 2. *Menozziola schmitzi* (Menozzi, 1921) female habitus, Botanic Garden Jean Massart MT4. © Paul L.T. Beuk.

1928, with *M. schmitzi* (see Disney, 1990; Gadau & Disney, 1996) it appeared that *M. schmitzi* could attack two ant genera (*Camponotus* and *Crematogaster*). At the time the sample with the Belgian *Menozziola* specimens was collected, neither ant genus had been recorded near the Botanic Garden yet, *Crematogaster* was even unknown to Belgium. Delving deeper into the literature learned that the synonymization of *M. camponoti* with *M. schmitzi* was later corrected when more material of *M. obscuripes* was discovered which showed more variation than was previously accounted for. The type specimen of *M. camponoti* has damaged genitalia and the pale colour of the legs on that specimen had lead Disney (1990) to the conclusion that the specimen could not be conspecific with *M. obscuripes*. When a series of 13 specimens of *M. obscuripes* was reared, it became clear that younger specimens of that species can also have pale legs. This and the assumption that each *Menozziola* species was more likely to have a narrow range of hosts rather than species in different subfamilies made Quivrin *et al.* (2003) conclude that *M. camponoti* was actually a synonym of *M. obscuripes*.

Bearing this in mind it became clear that it was more than likely that a colony of a *Crematogaster*, most likely *C. scutellaris*, had to be present in the surroundings of the Botanic Garden. As it turns out, this colony is indeed present and was discovered early 2022 right next to the Botanic Garden, at the Priory Rood Klooster (Dekoninck *et al.*, 2022). The authors presume that the ant may have been present there since the renovation of the 'Poorthuis' for which construction material was imported 'a few years ago' (no year was mentioned). It should be noted, however, that the ant can also be imported with plant material from abroad, for example with young yew trees (*Taxus baccata*) used for planting hedges (in the Netherlands, personal observation).

4. *Metopina braueri* (Strobl, 1880) – **Belg. sp. nov.**
Fig. 3

Material examined: MT2: 3♂♂

Distribution: Austria, British Isles, Bulgaria (Langourov, 2021), Czech Republic, Denmark, France (Withers, 1996), Germany, Hungary, Italy, the Netherlands, Poland, Slovakia, Spain, Switzerland. Israel (Mostovksi, 2016a).

Considering the fact that *Metopina* Macquart, 1835 is only a rather small genus with about 40 species described worldwide (Mostovski, 2016a), it is still one of the most difficult genera. In Northwestern Europe the genus is easy to recognise, being the only genus with a distinct bend in the anal vein. However, the small size of the species, the relative low number of usable characters and the frequent occurrence of several species at the same site have made the taxonomy of this genus quite obscure for a very long time (Disney, 1979b). The combined result of problematic identifications, the low presence in collections and in most types of samples and the lack of attention for the group in general result in a poor knowledge of the *Metopina* species. Both distribution and biology are poorly known. Of both species here recorded from Belgium the biology is unknown. Other European species are most often found in emergence traps [*M. oligoneura* (Mik, 1867) sometimes in very high numbers], have been reared from fungi (*M. heselhausi* Schmitz, 1914), and are found feeding on carrion but also on flowers (Disney, 1980; Mostovski, 2016a). With these two species and *M. galeata* (Haliday, 1833) the number of Belgian *Metopina* species now stands at three, while at least three more widespread European species can be expected.

Fig. 3. *Metopina braueri* (Strobl, 1880) female habitus, Botanic Garden Jean Massart MT2. © Paul L.T. Beuk.

5. *Metopina perpusilla* (Six, 1876) – **Belg. sp. nov**.

Material examined: MT2: 3♂♂, 2-11.VIII.2017, MT5: 1♂

Distribution: Austria, British Isles, Bulgaria (Langourov, 2021), Czech Republic, Denmark, France, Germany, Hungary, Italy, the Netherlands, Poland, Slovakia, Switzerland. Iran (Namaki-Khameneh *et al*., 2021).

See above for general discussion on *Metopina* species.

6. *Phalacrotophora delageae* Disney, 1979 – **Belg. sp. nov.**

Material examined: MT4: 1♀, MT5: 1♀

Distribution: British Isles (Irwin & Harvey, 2014), Czech Republic, France, Germany (Triltsch, 1999), Hungary, Poland, the Netherlands, Sweden (Hartop *et al.*, 2021).

Larvae of the species of *Phalacrotophora* Enderlein, 1932, live as internal parasitoids inside the pupa of ladybirds (Coleoptera: Coccinellidae). The females lay their eggs on the surface of the prepupa or perhaps even in them. After about a day, the larvae that hatch from the eggs will enter the host and will reach maturity after 3 to 12 days, after which they will leave the pupa and pupate themselves (Roy *et al.*, 2011). Seven species of *Phalacrotophora* were described from Europe and these can all be identified using a combination of the keys by Disney & Beuk (1997) and Lengyel (2009).

The taxonomy of the European *Phalacrotophora* was rather unclear for a very long time because of the sexual dimorphism of the species combined with the fact that several species were only known from one sex. The two most recent European species in the genus to be described, *P. delageae* Disney, 1979, and *P. beuki* Disney in Disney & Beuk, 1997, were both described from one sex, with the other sex being described years later (Disney, 1997a; Disney & Beuk, 1997; Durska *et al.*, 2003). As a result, the known distribution of these species may be wider than currently appears from the literature with older material in collections being misidentified. Considering the known distribution of the species and the fact that at least one of its hosts (*Adalia bipunctata* (Linnaeus, 1758); see Disney & Beuk [1997] and Triltsch [1999]) is common in Belgium, it was expected to occur in Belgium.

7. *Pseudacteon brevicauda* Schmitz, 1925 – **Belg. sp. nov.**

Material examined: MT2: 1♂

Distribution: Azores, British Isles, France, Germany, Spain, Switzerland.

8. *Pseudacteon formicarum* (Verrall, 1877)
Fig. 4

Material examined: MT2: 2♂♂, 1♀

Distribution: Austria, Belgium, British Isles, Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Poland, Slovakia, Switzerland.

Species of the genus *Pseudacteon* Coquillett, 1907 are all ant-decapitating flies. The two species found in the Botanic Garden both parasitize *Lasius* species. The females lay eggs in the gaster of workers by piercing through the intersegmental integument between the first two abdominal segments with their piercer. The eggs will hatch after about two days and the larvae will feed on the soft tissues and will migrate to the ant's head after about five days. In 13-14 days they will pupate and the head will fall off, creating a relatively secure environment for the pupa. The ants in the nest will move the detached head to the nest's garbage dump. Flies emerge after 4 to 5 weeks and adult flies will leave the empty head through the foramen. Even though an ant may be infected more than once, only one fly will emerge (Maschwitz *et al.*, 2008).

Fig. 4. *Pseudacteon formicarum* female habitus, Botanic Garden Jean Massart MT2. © Paul L.T. Beuk.

Considering the size of the head of the host ants, it is not surprising that *Pseudacteon* sp. are very small, generally less than 1 mm. Such small flies are very difficult to detect in the field and only readily collected near the nests of ants using a net with very fine mesh or using sampling methods like Malaise traps. An additional way to find it may be the survey of windows in rooms with open doors or windows on warm and sunny days. The flies can be drawn indoors and can then be found on windows when trying to find a way out again. European species can be identified using the key by Disney (2000). The two recorded species have different hosts. Although *P. formicarum* has been recorded as parasitoid from four species of *Lasius* in Europe, in Northwestern Europe this is only *Lasius niger* (Linnaeus, 1758). Formic acid seems to be the main attractant for the flies but since this is quite widespread among ants it is combined with visual stimuli (Weissflog *et al.*, 2008). In its turn, *P. brevicauda* parasitizes *Myrmica rubra* (Linnaeus, 1758) and it uses specific kairomones to locate the hosts (Witte *et al.*, 2010).

Discussion

With the result of the identification of the limited amount of examined material from the Botanic Garden Jean Massart the number of known Belgian species of Phoridae can already be increased with 8 to 151. Keeping in mind that this was possible with the identification of just 25 species and that the largest genus of the family, *Megaselia*, was virtually ignored, it becomes clear that there is not just little room for increasing the number of species. In all likelihood there is vast number of species that remain to be discovered.

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DNA-based species identification of mosquitoes collected with Malaise traps in the Botanic Garden Jean Massart (Diptera: Culicidae)

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Abstract

In the Botanic Garden Jean Massart in Auderghem (Brussels, Belgium), mosquitoes were collected with Malaise traps in 2016 and 2017, stored in 70% ethanol, and sorted out for morphological identification. Yet, in this way species-specific characters like scales may be lost, so that individuals become morphologically difficult to distinguish. Therefore, DNA-based techniques were applied for accurate species (or biotype for *Culex pipiens* s.s.) level identification of mosquitoes occurring in Belgium. This revealed the presence of six mosquito species, as well as two biotypes and their hybrids of *Culex pipiens* s.s., the most common and widespread mosquito species in Belgium. Some of the discovered species might act as vectors of arboviruses.

Keywords: biodiversity survey, Malaise traps, barcoding, COI, ITS2, CQ11 microsatellite locus, mosquitoes

Introduction

Malaise traps are rarely used to survey mosquito diversity. They mainly catch active and good flying insects (Martens *et al.*, 2013), a qualification that does not necessarily apply to all mosquitoes species. In contrast to mosquito traps such as MMLP Traps (Versteirt *et al.*, 2011) or Gravid Traps (Scott *et al.*, 2001), Malaise traps operate passively and only collect flying specimens by chance. In general, mosquitoes collected with Malaise traps are difficult to identify morphologically as they are directly stored (and kept for a long time) in 70% ethanol, so that important and species-specific characteristics like scales often disappear. However, a study in Virelles Nature Reserve, southern Belgium, proved that mosquitoes collected with Malaise Traps can be identified if the collected specimens are quickly transferred to a specialist (Dekoninck *et al.*, 2010).

In the Botanic Garden Jean Massart in Auderghem, Brussels, mosquitoes were collected with Malaise traps in spring, summer and autumn of 2016 and 2017 and sorted out for morphological identification. Due to prolonged storage in 70% ethanol, most mosquitoes

became morphologically hard or impossible to distinguish. Therefore, DNA-based techniques, including DNA-barcoding, were applied for species identification (Hebert *et al.*, 2003), following the DNA-based identification pipeline presented in Deblauwe *et al.* (2022a, see also https://github.com/BelgianBiodiversityPlatform/data-publication-ITG/tree/master/datasets/memo-occurrences/DNA-identification). This pipeline allows for an accurate identification to species (or biotype for *Culex pipiens* s.s.) level of most mosquitoes occurring in Belgium, using a combination of DNA sequences and techniques, as further detailed below. As such, this study presents and discusses the results of the DNA-based species identification of 90 adult mosquito specimens using this pipeline.

Material and methods

Sampling

Mosquitoes were collected in the field with six Malaise traps of the Townes type (2 m highest tip, 2 m long). Details of the trapping and the sites can be found in Grootaert *et al.* (2023). We studied 108 adult mosquitoes collected between June 9th 2016 and December 15th 2017. The collecting jars filled with 70% ethanol were emptied at weekly intervals, except for the winter period from November to the end of February, when samples were collected every two weeks (Grootaert *et al.*, 2023).

After retrieval of the samples, part of the ethanol was replaced by fresh 70% ethanol to reduce effects of dilution of the ethanol by evaporation, and to avoid maceration and acidification when large numbers of insects are collected together. Hence, DNA-based species identification of the specimens was possible. Some specimens of samples that dried out after collecting, were first identified by morphology and subsequently confirmed by DNA-based species identification.

DNA-based species identification

Out of the 108 collected specimens, 96 were further processed. DNA was extracted from abdomens or full specimens using the NucleoSpin® Tissue DNA extraction kit (Macherey-Nagel), following the manufacturer's protocol (elution volume: 70 µl). Remaining parts of mosquitoes and dried DNA extracts (kept at room temperature with GenTegra technology) are stored at the Royal Belgian Institute of Natural Sciences (Collection Identifier: I.G. 33400). The mitochondrial cytochrome *c* oxidase subunit I (COI) gene was PCR amplified using the universal primer set LCO1490 and HCO2198 (Folmer *et al*., 1994), targeting a 658 bp long fragment, or the C1N-2191 and C1J-1718 primer combination (Simon *et al.*, 1994), amplifying a 472 bp fragment of the COI barcode region. The second primer pair was used when the first PCR with universal primers failed to produce an amplicon. All PCR mixtures, cycling conditions, purification and sequencing details are as described by Ibáñez-Justicia *et al.* (2020). Raw sequences were trimmed, corrected, translated into amino acids and assembled using Geneious Prime® (Biomatters Ltd.), and a consensus sequence was generated for each specimen. Subsequently, the species identification engine of BOLD was used (www.boldsystems.org) with the species level barcode records option to find the closest matching reference sequence. Additionally, a Neighbour-Joining (NJ) tree (Geneious Prime®; Tamura-Nei distance model, 500 bootstrap replicates) was constructed to examine the clustering support of each species occurring in Belgium (Boukraa *et al.*, 2015; Deblauwe *et al.*, 2021; Smitz *et al.*, 2021; De Wolf *et al.*, 2021). To this end, the new sequences were aligned with all publicly available COI sequences of Belgian mosquitoes in BOLD, using ClustalW in Geneious Prime®. Beforehand, the new sequences were checked for stop codons and trimmed to retain the 658 bp barcode region. Downloaded sequences of less than 400 bp and conspecific identical sequences

were discarded. Two species of the genus *Mansonia* were included to root the tree (GenBank accession numbers: LC473703, LC473704, HQ341634, HQ341639). The final alignment included 2,424 downloaded unique sequences (BOLD) and 90 generated sequences.

For specimens identified by COI as *Anopheles maculipennis* s.l., further processing was required. To discriminate between the four species of the complex occurring in Belgium, viz. *An. maculipennis* s.s., *An. atroparvus*, *An. daciae* and *An. messeae*, the nuclear ribosomal internal transcribed spacer 2 (ITS2) flanked by portions of the conserved 5.8S and 28S rDNA was investigated. After PCR amplification following Smitz *et al.* (2021), the ITS2 amplicons were processed by two RFLP assays producing species-specific banding patterns. Purification and restriction of the PCR products using the Hha I (CGC↓G) and the Bsh 1236I (CG↓CG) enzymes were performed following Smitz *et al.* (2021). Restriction fragments were size-separated by electrophoresis on a 3% agarose gel, running for one hour at 80 V together with a 50 bp DNA ladder. Visualization was performed on a UV transilluminator using the MidoriGreen™ Direct staining method.

When the COI-based identification resulted in *Culex pipiens* s.l. or *Cx. torrentium*, a fragment size analysis of the acetylcholinesterase-2 locus (ACE2) was applied. This allows to discriminate between *Cx. pipiens* s.s., *Cx. torrentium* and *Cx. quinquefasciatus* (an exotic species with high invasion potential), by producing species-specific fragment sizes, viz. 610 bp for *Cx. pipiens* s.s., 416 bp for *Cx. torrentium*, and 274 bp for *Cx. quinquefasciatus*. The primers, PCR reactions and cycling conditions were as described in Smith & Fonseca (2004). PCR products were checked on a 2.5% agarose gel (45 min; 90 V). Finally, the CQ11 microsatellite locus was amplified to discriminate between the *Cx. pipiens* biotypes, producing biotype-specific fragment sizes of 200 bp for *Cx. pipiens* biotype *pipiens* and of 250 bp for *Cx. pipiens* biotype *molestus*. Hybrids between these biotypes occur in Belgium and show both bands (Vanderheyden *et al.*, 2022). The primers, PCR reactions and cycling conditions were as described in Bahnck & Fonseca (2006). As for ACE2, PCR products were checked on a 2.5% agarose gel (45 min; 90 V).

Results

The COI fragment was scored in 90 specimens, and consensus sequences were deposited in GenBank (https://www.ncbi.nlm.nih.gov/genbank/) with accession numbers: OP204423-OP204507 and OP204945-OP204949 (Fig. 1). Following the BOLD similarity percentages and the NJ-tree clustering, 32 specimens were assigned to *Anopheles maculipennis* s.l. (BOLD similarity percentage range: 99.07-100%), 32 to *Culex pipiens* s.l. (BOLD similarity percentage: 100%), 16 to *Coquillettidia richiardii* (BOLD similarity percentage: 100%), four to *Culex territans* (BOLD similarity percentage: 100%), three to *Culiseta annulata* (BOLD similarity percentage: 100%), two to *Culex torrentium* (BOLD similarity percentage range: 99.69-100%; confirmed by the ACE2 size fragment analysis), and one to *Aedes geniculatus* (BOLD similarity percentage: 100%).

ITS2 showed that the 32 *Anopheles maculipennis* s.l. specimens all belonged to *An. daciae*. The CQ11 analysis assigned 23 specimens to *Cx. pipiens* biotype *pipiens*, eight to *Cx. pipiens* biotype *molestus*, and one specimen displayed both bands on the agarose gel, thus being identified as a biotype hybrid (viz. *Cx. pipiens* biotype *pipiens* X *Cx. pipiens* biotype *molestus*).

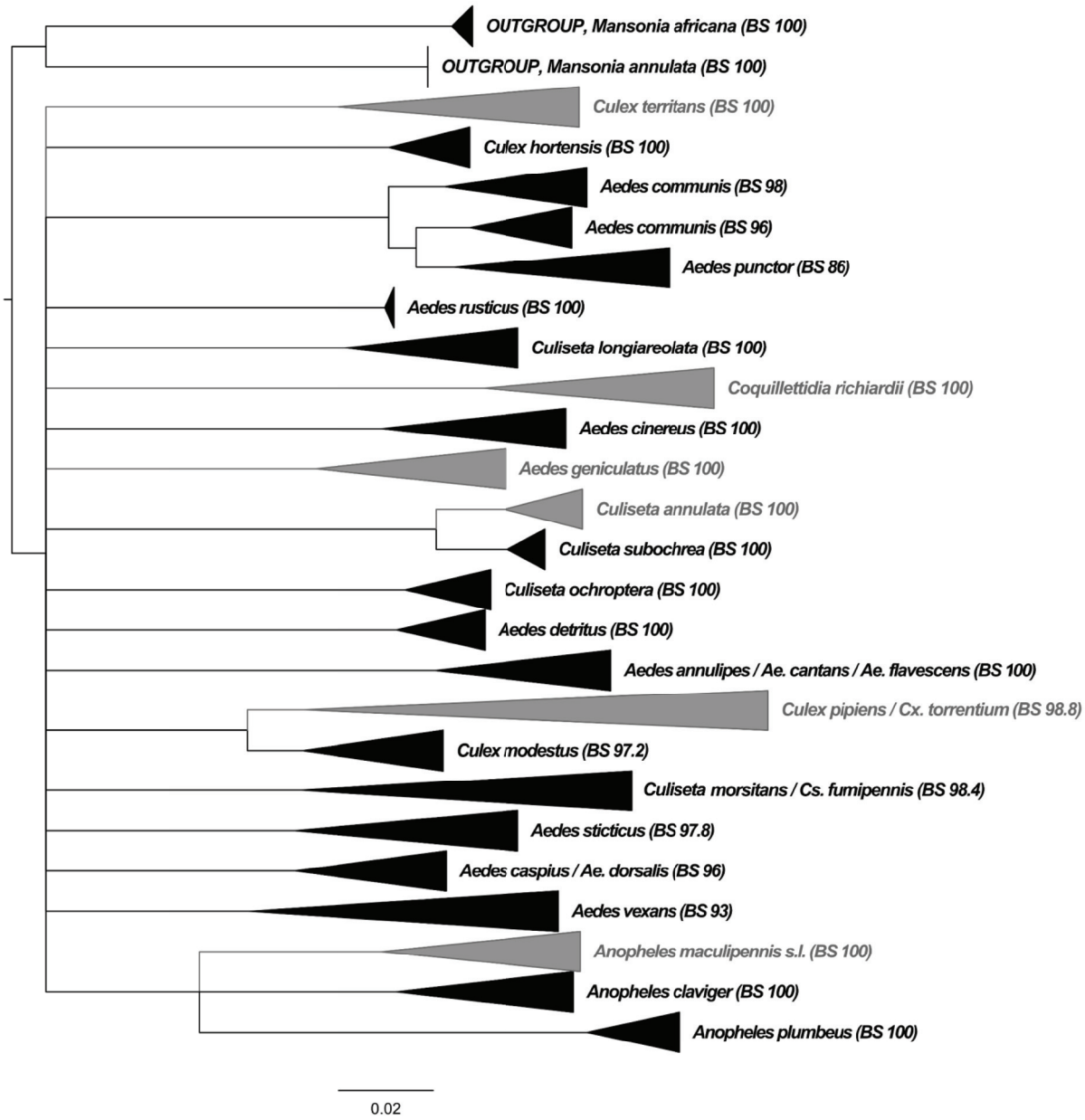

Fig. 1. Neighbour-Joining tree based on the COI sequences for all Culicidae species occurring in Belgium (Boukraa *et al*., 2015; Deblauwe *et al*., 2021; Smitz *et al*., 2021; De Wolf *et al*., 2021), including the sequences generated in this study. Species collected at the Botanic Garden Jean Massart are marked in grey. Bootstrap Support (BS) values are indicated at the tip of the labels (minimum BS threshold: 70%). Sequences were collapsed in species-clusters, and the NJ-tree was rooted with sequences of *Mansonia africana* (Theobald, 1901), and *M. annulata* Leicester, 1908.

Some remarkable species

Anopheles daciae Linton, Nicolescu & Harbach, 2004

This is a recently described species of the *An. maculipennis* complex (Nicolescu *et al.*, 2004) that is distributed throughout continental Europe (Bertola *et al.*, 2022). It was only recently recorded for Belgium using ITS2 sequencing (Smitz *et al*., 2021) to separate it from the other species within the complex: *An. maculipennis* s.s., *An. atroparvus* and *An. messeae*. It has been found during the past years in countries bordering Belgium, including Germany (Luhken *et al*, 2016; Weitzel *et al.*, 2012), the United Kingdom (Danabalan *et al*., 2014) and the Netherlands

(Ibáñez-Justicia *et al.*, 2022). In Belgium, the species was captured at localities located nearby nature reserves, comprising ponds and wetlands. The highest numbers of adults were collected in forest and seminatural areas where *An. daciae* co-occurred with *An. maculipennis* s.s. (Smitz *et al*., 2021). In the Netherlands, *An. daciae* was found in the southern inland areas of the country, where it occurs in sympatry with *An*. *messeae* at overwintering sites (Ibáñez-Justicia *et al.*, 2022).

In the Botanic Garden Jean Massart *An. daciae* was found in five out of the six Malaise traps. It was lacking in the Malaise trap that was installed inside a small wood patch on a humid and shaded spot. One individual was collected in April, all others in the period July 13th through October 27th, indicating that this species is primarily active in summer and autumn. We collected 5 times more males than females with the Malaise traps. No other members of the *An. maculipennis* complex were found.

Anopheles maculipennis s.l. may carry pathogens such as *Plasmodium*, Sindbis virus (SINV), Batai virus, and West Nile virus (WNV) (Filipe, 1972; Lindsay & Birley, 1996; Jöst *et al.*, 2010, 2011). Hence, it is important to map and monitor the distribution of these mosquitoes. For example, recent introductions of this complex have led to the reappearance of autochthonous cases of malaria in Southern Europe (ECDC, 2020).

Culex torrentium Martini, 1925

In one Malaise trap, two individuals of *Cx. torrentium* were collected in the period September-November 2017. This species is very common in Belgium (Versteirt *et al.*, 2011; 2013). It was observed in different habitats, including human neighborhoods (Werblow *et al*., 2014), with larvae often found in small artificial and nutrient-rich water bodies (Hesson *et al.*, 2014; Werblow *et al.*, 2014). While *Cx. torrentium* and *Cx. pipiens* s.s. are sympatric in some areas in Belgium, the former species was not yet collected in the north of the country (Deblauwe *et al.*, 2020; Vanderheyden *et al.*, 2022).

Culex torrentium is an important vector for SINV in Sweden (Hesson *et al.*, 2015) and has a high potential to transmit WNV (Leggewie *et al.*, 2016; Jansen *et al.*, 2019). In view of the recent outbreaks of WNV infections in Germany and the Netherlands (ECDC 2020), it is important to closely monitor competent vectors like *Cx. torrentium* and *Cx. pipiens* s.s.. These two taxa are morphologically difficult to separate. Yet, the present DNA-based analyses confirm their co-occurrence in the Botanic Garden Jean Massart.

Culex pipiens s.s. Linnaeus, 1758

The biotypes of *Cx*. *pipiens* s.s., viz *Cx*. *pipiens* biotype *pipiens* Linnaeus, 1758, and *Cx*. *pipiens* biotype *molestus* Forskål, 1775 (Harbach *et al.*, 1984), are morphologically indistinguishable. However, making the distinction between *Cx*. *pipiens* s.s. and related *Culex* species, as well as *Cx. pipiens* s.s. biotypes and hybrids, is essential as they are the principal vectors for WNV and several other arboviruses in Europe (Brugman *et al.*, 2018). While the biotypes of *Cx*. *pipiens* s.s. are morphologically indistinguishable, they show several behavioral differences (Byrne & Nichols, 1999; Lundström, 1999; Rudolf *et al.*, 2013). Females of biotype *pipiens* prefer feeding on birds, breed in open spaces, overwinter in a state of diapause and need a bloodmeal to produce their first batch of viable eggs. In contrast, females of biotype *molestus* prefer feeding on mammals, breed in confined mating spaces, do not overwinter in a state of diapause and can produce a first batch of viable eggs without a bloodmeal (Becker *et al.*, 2012). In temperate regions of Europe, including Belgium, both biotypes co-occur in open aboveground spaces.

Nevertheless, biotype *molestus* prefers confined spaces such as cellars, cesspits, human-made basements, or subways, where it mates and remains active throughout the year (Becker *et al.*, 2012). In the Botanic Garden Jean Massart, both biotypes were found together in four of the six Malaise traps containing specimens of *Cx*. *pipiens* s.s.

According to Vanderheyden *et al*. (2022) *Cx. pipiens* biotype *pipiens* is more common and widespread in Belgium than *Cx*. *pipiens* biotype *molestus*, as the latter comprises only 13% of the DNA-based identified specimens (Deblauwe *et al.*, 2020). However, the sampling scheme in the study by Deblauwe *et al*. (2020), was biased towards industrial areas. As such, the *molestus* biotype, with its preference for hypogean habitats and highly eutrophic waters in confined spaces (Becker *et al.*, 2012), may have been underrepresented. Similarly, in the Botanic Garden Jean Massart a higher number of the *pipiens* biotype was recorded (74.2%), which could be due to the less suitable habitat for the *molestus* biotype.

Vanderheyden *et al.* (2022) confirmed the co-occurrence of both biotypes in urban, agricultural, forest and seminatural habitats in Belgium. Despite both biotypes occur sympatrically, only few hybrid specimens were found (1.7%), i.e., less than in Germany (4.2%) (Rudolf *et al*., 2013), Portugal (8–10%) (Gomes *et al.*, 2009), and Italy (14.4%) (Di Luca *et al.*, 2016). In the Botanic Garden Jean Massart only one hybrid specimen was found (21/ix/2017-12/x/2017).

The sympatric occurrence of the *Culex pipiens* biotypes and their hybrids with their opportunistic feeding behaviour (Gomes *et al.*, 2009) hints at the potential danger that these hybrids may transmit viruses from birds to humans, thus becoming bridge-disease vectors. However, the low frequency of hybrids likely limits their potential epidemiological role.

Discussion

This study reports on the DNA-based species identification of 90 adult mosquito specimens collected with Malaise traps in the Botanic Garden Jean Massart, situated in the middle of a highly urbanized area in Brussels. We detected six species and two biotypes of *Cx. pipiens* s.s as well as their hybrids. This is about 26 % of all Belgian mosquito taxa ever recorded (Boukraa *et al.*, 2015; Deblauwe *et al.*, 2021; Smitz *et al.*, 2021; De Wolf *et al.*, 2021). If other sampling techniques had been used, more species would probably have been recorded. Dekoninck *et al.* (2010) collected 1,277 mosquito specimens with Malaise traps in Belgium. They recorded nine mosquito species, yet they did not find species like *Anopheles plumbeus* when only Malaise traps samples were analyzed. This species is present in the Botanic Garden Jean Massart and its surroundings (e.g. domain "Rood Klooster") (Dekoninck: unpublished observations). Since several mosquito habitats/biotopes remain to be sampled in the Botanic Garden, it is expected that still more mosquito species may turn up. As such, the current data suggest that the mosquito fauna in the Botanic Garden Jean Massart might be richer than in most of the other, so far sampled sites in Belgium. It is also likely that all mosquito species recorded in this study do reproduce in the Botanic Garden Jean Massart and/or nearby areas (e.g. domain "Rood Klooster" and Sonian Forest), since the necessary adult and larval habitats are present there. For other Diptera families the Botanic Garden Jean Massart proved to be an exceptionally rich site, with no less than 1,185 dipteran species, of which 129 species were recorded for the first time in Belgium and three species were even new for science (Grootaert, 2023). In various families many species with Red Data Book status were found, species that are not only rare in Belgium but even on a European scale (Pollet & Grootaert, 2023). The high diversity of this small urban site of 4.5 ha is attributed to the diversity of habitats and good management during the last hundred years after its creation.

At present there is no evidence for the presence of introduced mosquito species. Nevertheless, the Botanic Garden Jean Massart is an anthropogenic park, in the middle of a highly urbanized area with a lot of human movement and activities. Hence one would expect lots of opportunities for introduced and invasive species. Therefore, the absence of introduced mosquito species in the Botanic Garden Jean Massart may reflect a sampling bias due to the exclusive use of Malaise traps. Indeed, some of the recently recorded exotic invasive and introduced mosquito species in Belgium were nearly always collected with Mosquito Magnet™ Liberty Plus/Executive/ Independence traps, BG-Sentinel traps, gravid traps with specific baits and by larval sampling (Deblauwe *et al.*, 2022b). Both native and introduced mosquito species might act as vectors of arboviruses. Hence it is meaningful to monitor the mosquito fauna and to compile a more profound and complete species inventory.

This study illustrates that, despite their suspected sampling bias, Malaise trap samples, when conserved in at least 70 % ethanol, might be useful to help constructing a species list of mosquitoes. Still, it would be useful to compare the sampling performance of different types of traps in the same site, to assess if sampling with Malaise traps is indeed biased for certain species or genera.

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The Botanic Garden Jean Massart as a reference site for the diversity of flies in Belgium (Insecta: Diptera)

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Abstract

A synthesys is given on the three-year survey of the Diptera in the centennial Botanic Garden Jean Massart (Brussels-Capital Region, Belgium). A total of 1,191 species of flies are recorded with 129 species for the first time in Belgium and three new species for science. In various families many species with Red Data Book status were found, species that are not only rare in Belgium but even on a European scale. The high diversity on this small urban site of 4.5 ha is attributed to the diversity of habitats and good management during the last hundred years after its creation.

Keywords: Diversity, survey, Diptera, Belgium

Introduction

The aim of the present survey was to get a general idea of the diversity of some groups of flies at the Botanic Garden Jean Massart and to compare this diversity with other surveys done in Belgium. Since the sampling started in 2015 in the Botanic Garden, we were startled by the unexpected high diversity and the presence of quite rare species, not only on a Belgian scale, but even on a European scale (Grootaert, 2016; Grootaert *et al*., 2020; Kurina & Grootaert, 2016). For this reason the original objective to do a one-year survey was extended to a full three-year survey.

Observations and discussion

General diversity

A total of 1,191 fly species were recorded during the three-year survey. This figure seems quite high, but is certainly not yet representative for the total number of flies that is present in the Botanic Garden. Hardly any attention was paid to the plant parasitic species. The main reason is because it is difficult to find experts who are available to do the identifications. Luckily, a number of gall midges were identified through their galls as well as some mining Agromyzidae (Carbonelle & Claerebout, 2023). Knowing that nearly 2,000 plant species were recorded in the Botanic Garden and that each plant species has at least one specific parasite, many more plant parasitic species are expected to occur.

The present study recorded 129 fly species for the first time in Belgium which is a little more than 10% of the total species reported from the Garden. This high figure is due to the huge number of new fungus gnats (Mycetophilidae and related families), a group that was never studied before in detail in Belgium.

Survey and sampling

To what extent was the sampling representative for the Botanic Garden? Were all the microhabitats surveyed and was the technique used representative?

The area covers about 4.5 ha and six different sites were sampled. Care was taken that a number of different biotopes were sampled that were representative for the Garden: semi-natural forest, border of cultivated plants beds in the Evolution Garden, the arboretum, an old apple orchard in a flowered meadow and a swampy area with reed beds, ponds and upwelling water as is shown in the introduction paper of the survey (Grootaert *et al*., 2023). However, there are definitely more habitats/biotopes to sample in the Botanic Garden that might give different species compositions and hence will rise the total number of species.

The sampling was done over three consecutive years, from Spring 2015 until Spring 2018. Each of the six sites was sampled for at least one full year. Site 2 (MT2) that had the highest Diptera diversity was even sampled during the full three years and can serve as comparison for the yearly variations.

We limited ourselves to Malaise trap sampling as this technique is standardized and sampling can be done under all weather conditions. In addition, the Malaise trap samples can be retrieved by any person. We are well aware that visual targeted observation to record species is of outmost importance to make a representative survey, as well as using a variety of other techniques (coloured pan traps, pheromone traps, … to name a few) to obtain a more in depth survey of the species present in an area. Although 117 species of hover flies were found (Van de Meutter & Mortelmans, 2023) many more species are expected. In the adjacent area of the Rood Klooster (Rouge Cloître), 175 hover fly species were reported over the last century. This area adjacent to the Botanic Garden is renown as a hot spot for hover flies in Belgium. The relatively low number in the Garden is simply because many tree visiting species fly too high to get trapped in the Malaise traps and are only recorded by visual observation. As a second example, visual observation is also important to record dolichopodid flies that live on tree stems or on wet soils. They are only accidentally trapped in Malaise traps (Pollet & Grootaert, 2023). Hence, also more dolichopodid species are expected than the figure we present now.

The diversity of flies in Belgium

The catalogue of the Belgian Diptera (Grootaert *et al.*, 1991) records the presence of 4,474 species, but it was already mentioned in this catalogue that in comparison to the British fauna at least 6,000 Diptera species are probably present in Belgium. Since the publication of the Belgian catalogue in 1991, several tens of species were added to the Belgian species list, but little attention was paid to continue a detailed faunal inventory. During the three-year survey in the Botanic Garden a little more than 25% of the number of species recorded in the Belgian catalogue were found. In most fly families that were studied here, one or more new species for the Belgian fauna are recorded (Beuk, 2023; Grootaert *et al.*, 2023). In fact, only the families for which an expert was available for the identification were sorted from the samples. At the end of the project, a series of samples of May 2017 were sorted for un-studied groups of flies what resulted in the record of an additional 26 species new for the Belgian fauna (*partim* Beuk, 2023).

Red Data Books and site quality

In a site quality assessment, it is not the number of species, nor the ubiquist species that occur in a site that show the quality of the site, but the species typical for a particular habitat, the rare species and the species that are threatened in the country. Keeping in mind the flaws and

weaknesses of Red Data Books, in so far there are any RDBs for Diptera, it is worth to know which threatened species do occur in the Botanic Garden Jean Massart. For the hover flies, a well-documented family of pollinators, *Cheilosia uviformis* has the RDB status of Critically Endangered while three other species are Endangered according to the recent Flemish Red list (VAN DE MEUTTER, OPDEKAMP & MAES *et al.*, 2021). In hybotid flies, 70% of the species are in a more or less threatened category. In the Dolichopodidae about 23% of the species can be termed rare to extremely rare, including five species that were previously considered extinct in Flanders (POLLET & GROOTAERT, 2023).

These results indicate that the Botanic Garden Jean Massart harbours quite a number of threatened and rare species, and therefore needs special protection.

Comparable surveys

It is very difficult to compare the present study to other surveys done in Belgium. In Table 1, the data of the Botanic Garden Jean Massart are compared to data compiled by TACK *et al.* (2021: Fig. 557) from eleven forested areas in Flanders. The sites are arranged by size and the Botanic Garden Jean Massart with its 4.5 ha is the smallest area of all. It is best compared with the survey of Bos t' Ename (Table 1) but the data for Bos t' Ename and the other sites were collected over at least 20 or more years. The data for the Botanic Garden Jean Massart were collected over a much shorter period: five years for the Coleoptera while only three years for the Diptera. Nevertheless, the Botanic Garden Jean Massart has the highest diversity of flies that were inventoried. This figure is interesting as a reference, but it does not say anything about the value of the area. (Table 1)

Table 1. Comparison between the arthropod fauna of the Botanic Garden Jean Massart and eleven sites in Flanders (after TACK *et al.* (2021). The sites are arranged by ascending order of surface area. The data of the Botanic Garden are highlighted in blue. The data in red are maximum number of species observed over all the sites.

	Botanic Garden Jean Massart	**Buitengoor Meergoor**	**Vorsdonk broek**	**Stropers Oost**	**Bos t' Ename**	**Zoersel bos**	**De Maat**	**Walenbos**	**Averbode bos heide**	**Liereman**	**Meerdaal woud**	**Zoniën woud**
Surface	4.5 ha	79 ha	141 ha	274 ha	300 ha	416 ha	432 ha	602 ha	1034 ha	1070 ha	1777 ha	5707 ha
Aranaea	208	N/A	N/A	N/A	233	119	N/A	N/A	N/A	N/A	N/A	N/A
Hemiptera	298	48	87	139	394	30	98	84	227	118	92	103
Lepidoptera	539	412	639	419	985	547	672	676	1036	754	600	808
Odonata	25	53	32	37	24	20	55	30	45	44	25	36
Orthoptera	12	19	20	16	13	14	25	16	25	26	15	15
Hymenoptera	220	76	144	75	371	26	97	124	288	314	144	173
Diptera	1191	184	243	128	703	134	186	257	481	322	334	276
Coleoptera	1359	173	309	247	1594	75	248	295	418	353	273	498
time/scale	5 years	>20 years	>20 years	>20 years	40 years	>20 years	>20 years	>20 years	>20 years	>20 years	>20 years	>50 years

To our knowledge, the Diptera were studied in great detail in a 25-year survey in the south of the Netherlands at the Kaaistoep near Tilburg (Van Wielink *et al*., 2020). The Kaaistoep is an area of nearly 420 ha of forest, fields, grasslands, heath and fens, all mainly on sandy soils. No less than 1,516 species of Diptera were recorded. Thirty authors tackled the Diptera and attention was paid to more families than were done here in the Botanic Garden. Moreover, there was a targeted sampling for some families by several experts using various collecting techniques. Hence the total results are not really comparable, nevertheless a number of remarkable observations can be made.

Table 2 shows a comparison between the Botanic Garden and the Kaaistoep. The data of the latter were extracted from the book by Van Wielink *et al.*, 2020 but it should be noted that the survey at the Kaaistoep is ongoing and records published in reports after 2020 were not integrated in the Table. As can be seen in Table 2, more attention was paid in the Kaaistoep to the plant parasitic species such as the Agromyzidae, Anthomyiidae, Chloropidae and Drosophilidae resulting in much higher numbers of species (Table. 2, highlighted in green). However, little difference in numbers is seen in the number of some other plant parasitic groups like Cecidomyiidae, Tephritidae and Tipulidae. In the Kaaistoep, clearly more attention was paid to groups with direct importance to men like biting midges (Ceratopogonidae) and mosquitoes (Culicidae), or to groups important in forensics like Calliphoridae, Muscidae and Sarcophagidae or to groups living in or near water bodies like non-biting midges (Chironomidae) and shore flies (Ephydridae) (Fig. 2 highlighted in blue).

Remarkable is the much higher number of robber flies (Asilidae) with 24 species at the Kaaistoep versus only three species in the Botanic Garden. The same counts for the related family of the stiletto flies (Therevidae) with four species versus one species (Fig. 2, highlighted in orange). The large diversity of both families in the Kaaistoep is because the Kaaistoep has mainly sandy soils with many very dry grasslands, heathlands and *Pinus*-forests. Last but not least, robber fly expert was doing a targeted collecting in the field. The Botanic Garden has humid loamy soils and the observations were only based on Malaise traps sampling.

The huge number of fungus gnats (Mycetophilidae, Bolitophilidae, Diadocidiidae, Ditomyiidae and Keroplatidae) in the Botanic Garden is clearly due to the more intensive study of this group during our survey.

To counter these superficial comparisons species accumulation curves should be calculated in order to see the trend of the curves of the number of species as well as the number of expected species per family.

What explains the high fly diversity in the Botanic Garden?

The diversity of the flies in general is distinctly very high in the Botanic Garden Jean Massart. Especially if we consider the small size of 4.5 ha of a rather isolated area at the border of a large city with only a narrow connection in the East with another park landscape, the Rood Klooster or Rouge Cloître and the old Sonian forest a little further to the East. The large number of microhabitats with differences in soil and air humidity, insolation (full exposure to the sun, dependent on the season or time of the day to areas permanently in the shade of tree canopies) are obvious reasons. Not to speak of the nearly 2,000 plant species that have been recorded.

Management of the area is done with care and mowing is done after the flowering season of the plants in the meadows allowing the survival of the pollinators. No biocides are used in the Garden and large piles of dead wood and compost heaps are present that are refuges, habitats for xylophages and mycetophagous species, nest spaces and places suitable for hibernation of many insects.

Table 2. Comparison between the number of species per family recorded at the Botanic Garden Jean Massart and the Kaaistoep (Tilburg, the Netherlands). The data of the Kaaistoep were extracted from VAN WIELINK *et al.*, 2020. Highlighted in green the plant parasitic flies, in blue the families related to water habitats, in grey families with important forensic indicators and in orange the families related to sandy soils. The fungus gnats (minus Sciaridae) are highlighted in light grey.

Family	number of species		Family	number of species	
	Botanic Garden	Kaaistoep		Botanic Garden	Kaaistoep
Acartophthalmidae	0	2	Lonchopteridae	2	2
Agromyzidae	11	120	Megamerinidae	1	1
Anisopodidae	1	2	Micropezidae	5	2
Anthomyiidae	3	35	Milichiidae	0	11
Anthomyzidae	0	8	Muscidae	10	45
Asilidae	3	24	Mycetobiidae	0	1
Asteiidae	1	4	Mycetophilidae	175	91
Atelestidae	2	0	Odiniidae	1	3
Aulacigastridae	0	1	Opetiidae	1	1
Bibionidae	4	5	Opomyzidae	5	7
Bolitophilidae	5	2	Pallopteridae	5	7
Bombyliidae	3	2	Pediciidae	3	4
Calliphoridae	9	21	Periscelididae	0	2
Camillidae	0	4	Phoridae	18	62
Campichoetidae	0	1	Piophilidae	4	6
Carnidae	0	4	Pipunculidae	37	10
Cecidomyiidae	38	40	Platypezidae	7	4
Ceratopogonidae	1	26	Platystomatidae	1	1
Chamaemyiidae	0	4	Pseudopomyzidae	0	1
Chaoboridae	0	3	Psilidae	22	10
Chironomidae	0	40	Psychodidae	21	18
Chloropidae	5	51	Ptychopteridae	3	1
Chyromyidae	0	1	Rhagionidae	10	6
Clusiidae	5	4	Rhinophoridae	0	1
Conopidae	5	10	Sarcophagidae	5	11
Culicidae	8	10	Scathophagidae	9	15
Cylindrotomidae	1	1	Scatopsidae	17	5
Diadocidiidae	2	1	Sciaridae	31	73
Diastatidae	3	3	Sciomyzidae	11	15
Ditomyiidae	2	0	Sepsidae	7	17
Dixiidae	2	2	Simuliidae	0	1
Dolichopodidae	122	68	Sphaeroceridae	42	70
Drosophilidae	20	40	Stratiomyidae	23	12
Dryomyzidae	1	3	Syrphidae	117	131
Empididae	52	43	Tabanidae	2	4
Ephydridae	2	21	Tachinidae	3	16
Fanniidae	6	10	Tephritidae	16	21
Heleomyzidae	27	25	Therevidae	1	4
Hippoboscidae	0	4	Tipulidae	36	35
Hybotidae	90	39	Trichoceridae	3	6
Keroplatidae	20	13	Ulidiidae	1	6
Lauxaniidae	18	29	Xylomyidae	1	1
Limoniidae	41	37	Xylophagidae	2	0
Lonchaeidae	15	13			
			Total species	**1191**	**1516**

The Botanic garden as a reference site

The high diversity of the flies is a first reason that the Garden can be considered as a reference site. Several very rare species for the Belgian fauna and even very rare on an European scale are present here. A large number, depending on the family, have a threatened Red Data Book status. Finally the garden is type locality of several species of flies.

The Garden is already a Natura 2000 protected site, and the above arguments only contribute to the need of careful management of the site.

The future

Conducting a full survey of an area like the Botanic Garden Jean Massart is demanding on labour efforts and costs. The identification process of the species depends on the availability of experts of the various groups of flies. To tackle this, DNA barcoding is a promising tool that can provide a quick help to identify large numbers of specimens. In addition, it shows the genetic diversity within populations as well as it can demonstrate the existence of corridors for genetic exchanges between regions.

During the survey, DNA barcoding of about 90 specimens of Culicidae was done which resulted in the identification of a number of species that were impossible to identify on morphological grounds (Dekoninck *et al.*, 2023). Barcoding of a number of *Microphor* specimens (Dolichopodidae, Microphorinae) showed the presence of a cryptic species in the kleptoparasitic fly *Microphor holosericeus* that was hardly distinguishable by its external morphology (Grootaert & Kappert, in prep.). The COI-barcoding showed two well separated clusters of 10% difference that were afterwards confirmed by the morphology of the male terminalia that differed clearly in these two groups.

Implementing environmental barcoding is not yet a recommended tool for surveys of flies since for quite a large number of species the DNA-barcodes are still unknown and hence these species will remain undetected. An automation of the barcoding process is a welcome tool to achieve rapid and accurate species identification. Specimens may be sorted by a machine and picked out of trays, photographed and separated in microvials (Wührl *et al*., 2022) followed by DNA extraction and NGS-barcoding (Srivathsan *et al.*, 2019; 2021).

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Checklist of the Diptera observed at the Botanic Garden Jean Massart (Brussels-Capital Region, Belgium) during the survey of 2015 – 2018

Patrick Grootaert [1], Paul Beuk [2], Yves Braet [3], David Brice [4], Sébastien Carbonnelle [5], Stéphane Claerebout [6], Jocelyn Claude [7], Niels-Jan Dek [8], Wouter Dekoninck [9], Jean-Paul Haenni [10], Kai Heller [11], Olavi Kurina [12], Gunnar Mikalsen Kvifte [13], Jonas Mortelmans [14], Kris Peeters [15], Marc Pollet [16], Frank Van de Meutter [17] & Ruud van der Weele [18]

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A total of 1,991 species of flies are recorded at the moment for the Botanic Garden. They belong to 70 families. The checklist is in alphabetic order per family and per species. The principal identifier of the species is indicated for each family. Several of the families have been treated in detail in the various papers of the present book. For some families that were not treated in detail, some short comments, if relevant, are added at the end of these families. The 129 species that were recorded for the first time in Belgium during the survey of the Botanic Garden are indicated with an *.

Agromyzidae

Sébastien Carbonnelle & Stéphane Claerebout

Agromyza alnivora Spencer, 1969
Aulagromyza hendeliana (Hering, 1926)
Aulagromyza heringii (Hendel, 1920)
Chromatomyia scolopendri (Robineau-Desvoidy, 1851)
Hexomyza cecidogena (Hering, 1927)
Liriomyza congesta (Becker, 1903)
Liriomyza sonchi Hendel, 1931
Liriomyza valerianae Hendel, 1932
Phytomyza crassiseta Zetterstedt, 1860
Phytomyza heringiana Hendel, 1922
Phytomyza spondylii Robineau-Desvoidy, 1851

Anisopodidae

Paul L.Th. Beuk

Sylvicola (*Sylvicola*) *cinctus* (Fabricius, 1787)

Anthomyiidae

Paul L.Th. Beuk

Pegomya caesia Stein, 1906
Pegomya rubivora (Coquillett *in* Slingerland, 1897)
Pegomya testacea (De Geer, 1776)

Asilidae

Patrick Grootaert

Choerades marginata (Linnaeus, 1758)
Dioctria linearis (Fabricius, 1781)
Dioctria rufipes (De Geer, 1776)

Asteiidae

Paul L.Th. Beuk

Asteia amoena Meigen, 1830

Atelestidae

Patrick Grootaert

Atelestus pulicarius (Fallén, 1816)
Meghyperus sudeticus Loew, 1850 *

Bibionidae

Patrick Grootaert

Bibio anglicus Verrall, 1889
Bibio marci (Linnaeus, 1758)
Bibio varipes Meigen, 1830
Dilophus febrilis (Linnaeus, 1758)

Bolitophilidae

Olavi Kurina

Bolitophila (*Bolitophila*) *cinerea* Meigen, 1818
Bolitophila (*Bolitophila*) *saundersii* (Curtis, 1836)
Bolitophila (*Cliopisa*) *glabrata* Loew, 1869
Bolitophila (*Cliopisa*) *hybrida* (Meigen, 1804)

Bombyliidae

Patrick Grootaert

Bombylius discolor Mikan, 1796
Bombylius posticus Fabricius, 1805
Villa hottentotta (Linaeus, 1758)

Calliphoridae

Yves Braet

Bellardia vespillo (Fabricius, 1794)
Calliphora vicina Robineau-Desvoidy, 1830
Calliphora vomitoria (Linnaeus, 1758)
Lucilia ampullacea Villeneuve, 1922
Lucilia caesar (Linnaeus, 1758)
Lucilia illustris Meigen, 1826
Lucilia sericata (Meigen, 1826)
Phormia regina (Meigen, 1826)
Protophormia terraenovae (Robineau-Desvoidy, 1830)

Cecidomyiidae

Sébastien Carbonnelle & Stéphane Claerebout

Arnoldiola libera (Kieffer, 1909)
Asphondylia lathyri Rübsaamen, 1914
Asphondylia miki Wachtl, 1880
Contarinia carpini Kieffer, 1897
Contarinia medicaginis Kieffer, 1895
Contarinia nicolayi (Rübsaamen, 1895)
Contarinia pseudotsugae Condrashoff, 1961
Contarinia rumicis (H. Loew, 1850)
Contarinia scrophulariae Kieffer, 1896
Cystiphora taraxaci (Kieffer, 1888)
Dasineura auritae Rübsaamen, 1916
Dasineura crataegi (Winnertz, 1853)
Dasineura fraxinea Kieffer, 1907
Dasineura irregularis (Bremi, 1847)
Dasineura lathyricola (Rübsaamen, 1890)
Dasineura mali (Kieffer, 1904)
Dasineura plicatrix (H. Loew, 1850)
Dasineura pustulans (Rübsaamen, 1889)
Dasineura thomasiana (Kieffer, 1888)
Dasineura urticae (Perris, 1840)
Dasineura viciae (Kieffer, 1888)
Didymomyia tiliacea (Bremi, 1847)
Drisina glutinosa Giard, 1893
Hartigiola annulipes (Hartig, 1839)
Iteomyia capreae (Winnertz, 1853)
Iteomyia major (Kieffer, 1889)
Jaapiella bryoniae (Bouché, 1847)
Jaapiella hypochoeridis Sylvén, 1998
Jaapiella veronicae (Vallot, 1827)
Janetiella lemeei (Kieffer, 1904)
Lasioptera rubi (Schrank, 1803)
Macrodiplosis pustularis (Bremi, 1847)
Macrodiplosis roboris (Hardy, 1854)
Macrolabis heraclei (Kaltenbach, 1862)
Massalongia sp.
Physemocecis hartigi (Liebel, 1892)
Rabdophaga heterobia (H. Loew, 1850)
Rabdophaga salicis (Schrank, 1803)
Rondaniola bursaria (Bremi, 1847)

Ceratopogonidae

Paul L.Th. Beuk

Serromyia morio (Fabricius, 1775)

Chloropidae

Paul L.Th. Beuk

Camarota curvipennis (Latreille, 1805)
Chlorops hypostigma Meigen, 1830
Elachiptera megaspis (Loew, 1858)
Oscinella capreolus (Haliday, 1838) *
Tricimba lineella (Fallén, 1820)

Clusiidae

Ruud van der Weele

Clusia flava (Meigen, 1830)
Clusia tigrina (Fallén, 1820)
Clusiodes albimanus (Meigen, 1830)
Clusiodes gentilis (Collin, 1912)
Clusiodes ruficollis (Meigen, 1830)

Conopidae

Patrick Grootaert

Leopoldius brevirostris (Germar, 1827)
Myopa tessellatipennis Motschulsky, 1859
Myopa testacea (Linnaeus, 1767)
Sicus ferrugineus (Linnaeus, 1761)
Thecophora pusilla (Meigen, 1824)

Culicidae

Wouter Dekoninck *et al*.

Aedes geniculatus (Olivier, 1791)
Anopheles daciae Linton, Nicolescu & Harbach, 2004
Coquillettidia richiardii (Ficalbi, 1889)
Culex pipiens molestus Forskal, 1775
Culex pipiens pipiens Linnaeus, 1758
Culex territans (Walker, 1856)
Culex torrentium Martini, 1925
Culiseta annulata (Schrank, 1776)

Cylindrotomidae

Niels-Jan Dek

Diogma glabrata (Meigen, 1818)

Diadocidiidae

Olavi Kurina

Diadocidia (*Diadocidia*) *ferruginosa* (Meigen, 1830)
Diadocidia (*Diadocidia*) *spinosula* Tollet, 1948

Diastatidae

Paul L. Th. Beuk

Campichoeta obscuripennis (Meigen, 1830)
Campichoeta punctum (Meigen, 1830)
Diastata costata Meigen, 1830

Ditomyiidae

Olavi Kurina

Ditomyia fasciata (Meigen, 1818)
Symmerus annulatus (Meigen, 1830)

Dixidae

Niels-Jan Dek

Dixa nebulosa Meigen, 1830
Dixa nubilipennis Curtis, 1832

Dolichopodidae

Marc Pollet & Patrick Grootaert

Achalcus cinereus (Haliday, 1851)
Achalcus flavicollis (Meigen, 1824)
Achalcus phragmitidis Pollet, 1996
Acropsilus niger (Loew, 1869) *
Anepsiomyia flaviventris (Meigen, 1824)
Argyra argentella (Zetterstedt, 1843)
Argyra argentina (Meigen, 1824)
Argyra argyria (Meigen, 1824)
Argyra atriceps Loew, 1857
Argyra diaphana (Fabricius, 1775)
Argyra grata Loew, 1857
Argyra ilonae Gosseries, 1988
Argyra leucocephala (Meigen, 1824)
Argyra perplexa Becker, 1918
Argyra vestita (Wiedemann, 1817)
Australachalcus melanotrichus (Mik, 1878)
Campsicnemus curvipes (Fallén, 1823)
Campsicnemus lumbatus Loew, 1857
Campsicnemus scambus (Fallén, 1823)
Chrysotimus flaviventris (von Roser, 1840)
Chrysotimus molliculus (Fallén, 1823)
Chrysotus blepharosceles Kowarz, 1874
Chrysotus cilipes Meigen, 1824
Chrysotus cupreus (Macquart, 1827)
Chrysotus gramineus (Fallén, 1823)
Chrysotus laesus (Wiedemann, 1817)
Chrysotus neglectus (Wiedemann, 1817)
Chrysotus pulchellus Kowarz, 1874
Chrysotus suavis Loew, 1857
Diaphorus oculatus (Fallén, 1823)
Dolichophorus kerteszi Lichtwardt, 1902
Dolichopus atripes Meigen, 1824
Dolichopus brevipennis Meigen, 1824
Dolichopus claviger Stannius, 1831
Dolichopus excisus Loew, 1859
Dolichopus festivus Haliday, 1832
Dolichopus griseipennis Stannius, 1831
Dolichopus latilimbatus Macquart, 1827
Dolichopus linearis Meigen, 1824
Dolichopus longicornis Stannius, 1831
Dolichopus nitidus Fallén, 1823
Dolichopus nubilus Meigen, 1824
Dolichopus plumipes (Scopoli, 1763)
Dolichopus popularis Wiedemann, 1817
Dolichopus signatus Meigen, 1824
Dolichopus simplex Meigen, 1824
Dolichopus subpennatus Assis Fonseca, 1976
Dolichopus trivialis Haliday, 1832
Dolichopus ungulatus (Linnaeus, 1758)
Dolichopus urbanus Meigen, 1824
Dolichopus wahlbergi Zetterstedt, 1843
Gymnopternus aerosus (Fallén, 1823)
Gymnopternus blankaartensis (Pollet, 1990)
Gymnopternus brevicornis (Staeger, 1842)
Gymnopternus celer (Meigen, 1824)
Gymnopternus cupreus (Fallén, 1823)
Gymnopternus metallicus (Stannius, 1831)
Gymnopternus silvestris (Pollet, 1990)
Hercostomus nanus (Macquart, 1827)
Hercostomus nigripennis (Fallén, 1823)
Hercostomus nigriplantis (Stannius, 1831)
Hercostomus plagiatus (Loew, 1857)
Hercostomus rusticus (Meigen, 1824)
Liancalus virens (Scopoli, 1763)
Medetera abstrusa Thuneberg, 1955
Medetera belgica Parent, 1936
Medetera dendrobaena Kowarz, 1877
Medetera feminina Negrobov, 1967
Medetera impigra Collin, 1941
Medetera inspissata Collin, 1952
Medetera jacula (Fallén, 1823)
Medetera jugalis Collin, 1941
Medetera pallipes (Zetterstedt, 1843)
Medetera parenti Stackelberg, 1925
Medetera peloria Negrobov, 1967 *
Medetera pseudoapicalis Thuneberg, 1955
Medetera saxatilis Collin, 1941
Medetera striata Parent, 1927
Medetera takagii Negrobov, 1970

Medetera truncorum Meigen, 1824
Neurigona abdominalis (Fallén, 1823)*
Neurigona pallida (Fallén, 1823)
Neurigona quadrifasciata (Fabricius, 1781)
Poecilobothrus nobilitatus (Linnaeus, 1767)
Rhaphium albifrons Zetterstedt, 1843
Rhaphium appendiculatum Zetterstedt, 1849
Rhaphium auctum Loew, 1857
Rhaphium caliginosum (Zetterstedt, 1843)
Rhaphium commune (Meigen, 1824)
Rhaphium crassipes (Meigen, 1824)
Rhaphium fasciatum Meigen, 1824
Rhaphium laticorne (Fallén, 1823)
Rhaphium micans (Meigen, 1824)
Rhaphium quadrispinosum (Strobl, 1898)
Sciapus platypterus (Fabricius, 1805)
Sciapus wiedemanni (Fallén, 1823)
Sybistroma crinipes Staeger, 1842
Sybistroma obscurellus (Fallén, 1823)
Sympycnus pulicarius (Fallén, 1823)
Syntormon bicolorellum (Zetterstedt, 1843)
Syntormon denticulatum (Zetterstedt, 1843)
Syntormon fuscipes (von Roser, 1840)
Syntormon macula Oldenberg, 1927*
Syntormon metathesis (Loew, 1850)
Syntormon pallipes (Fabricius, 1794)
Syntormon submonilis Negrobov, 1975*
Systenus bipartitus (Loew, 1850)
Systenus pallipes (von Roser, 1840)
Teuchophorus monacanthus Loew, 1859
Teuchophorus nigricosta (von Roser, 1840)
Teuchophorus simplex Mik, 1880
Teuchophorus spinigerellus (Zetterstedt, 1843)
Thrypticus smaragdinus Gerstäcker, 1864
Thrypticus tarsalis Parent, 1932
Xanthochlorus galbanus Chandler & Negrobov, 2008*
Xanthochlorus ornatus (Haliday, 1832)
Xanthochlorus tenellus (Wiedemann, 1817)

Drosophilidae

Paul L.Th. Beuk

Acletoxenus formosus (Loew, 1864)*
Amiota flavopruinosa Duda, 1934*
Chymomyza amoena (Loew, 1862)
Chymomyza fuscimana (Zetterstedt, 1838)
Drosophila (*Drosophila*) *kuntzei* Duda, 1924
Drosophila (*Drosophila*) *limbata* von Roser, 1840
Drosophila (*Drosophila*) *littoralis* Meigen, 1830
Drosophila (*Drosophila*) *phalerata* Meigen, 1830
Drosophila (*Sophophora*) *obscura* Fallén, 1823
Drosophila (*Sophophora*) *subobscura* Collin *in* Gordon, 1936
Drosophila (*Sophophora*) *subsilvestris* Hardy & Kaneshiro, 1968
Drosophila (*Sophophora*) *suzukii* (Matsumara, 1931)
Drosophila (*Sophophora*) *tristis* (Fallén, 1823)
Hirtodrosophila confusa (Staeger, 1844)
Lordiphosa andalusiaca (Strobl, 1906)
Phortica semivirgo (Máca, 1977)
Scaptomyza (*Parascaptomyza*) *pallida* (Zetterstedt, 1847)
Scaptomyza (*Scaptomyza*) *flava* (Fallén, 1823)
Stegana (*Steganina*) *similis* Laštovka & Máca, 1982

Dryomyzidae

Ruud van der Weele

Dryomyza anilis Fallén, 1820

Empididae

Patrick Grootaert & Paul L.Th. Beuk

Chelifera precabunda Collin, 1916
Chelifera precatoria (Fallén, 1816)
Clinocera (*Kowarzia*) *bipunctata* (Haliday, 1833)
Dolichocephala irrorata (Fallén, 1815)
Dolichocephala oblongoguttata (Dale, 1878)
Empis (*Coptophlebia*) *albinervis* Meigen, 1822
Empis (*Empis*) *acinerea* Chvála, 1985
Empis (*Empis*) *aestiva* Loew, 1867
Empis (*Empis*) *caudatula* Loew, 1867
Empis (*Empis*) *chioptera* Meigen, 1804
Empis (*Empis*) *nigripes* Fabricius, 1794
Empis (*Empis*) *nuntia* Meigen, 1838
Empis (*Empis*) *pennipes* Linnaeus, 1758
Empis (*Empis*) *planetica* Collin, 1927
Empis (*Empis*) *praevia* Collin, 1927
Empis (*Empis*) *woodi* Collin, 1927
Empis (*Euempis*) *ciliata* Fabricius, 1787
Empis (*Euempis*) *tessellata* Fabricius, 1794
Empis (*Kritempis*) *livida* Linnaeus, 1758
Empis (*Lissempis*) *nigritarsis* Meigen, 1804
Empis (*Xanthempis*) *lutea* Meigen, 1804
Empis (*Xanthempis*) *stercorea* Linnaeus, 1761
Empis (*Xanthempis*) *trigramma* Wiedemann, 1822)
Heleodromia immaculata Haliday, 1833
Hemerodromia unilineata Zetterstedt, 1842
Hilara albipennis von Roser, 1840
Hilara albitarsis von Roser, 1840
Hilara anglodanica Lundbeck, 1913
Hilara brevistyla Collin, 1927

Hilara cf *hirtipes* Collin, 1927
Hilara chorica (Fallén, 1816)
Hilara cornicula Loew, 1873
Hilara fuscipes (Fabricius, 1794)
Hilara griseifrons Collin, 1927
Hilara hirtella Collin, 1927
Hilara hirtipes Collin, 1927
Hilara lurida (Fallén, 1816)
Hilara manicata Meigen, 1822
Hilara maura (Fabricius, 1776)
Hilara monedula Collin, 1927
Hilara nigrina (Fallén, 1816)
Hilara thoracica Macquart, 1827
Phyllodromia melanocephala (Fabricius, 1794)
Rhamphomyia (*Aclonempis*) *albohirta* Collin, 1926
Rhamphomyia (*Aclonempis*) *longipes* (Meigen, 1804)
Rhamphomyia (*Amydroneura*) *erythrophthalma* Meigen, 1830
Rhamphomyia (*Amydroneura*) *gibba* (Fallén, 1816)
Rhamphomyia (*Amydroneura*) *hirsutipes* Collin, 1926
Rhamphomyia (*Holoclera*) *flava* (Fallén, 1816)
Rhamphomyia (*Holoclera*) *nigripennis* (Fabricius, 1794)
Rhamphomyia (*Megacyttarus*) *crassirostris* (Fallén, 1816)
Rhamphomyia (*Megacyttarus*) *poissoni* Tréhen, 1966
Rhamphomyia (*Pararhamphomyia*) *albipennis* (Fallén, 1816)
Rhamphomyia (*Pararhamphomyia*) *atra* Meigen, 1822
Rhamphomyia (*Pararhamphomyia*) *marginata* (Fabricius, 1787)
Rhamphomyia (*Pararhamphomyia*) *pilifer* Meigen, 1838
Rhamphomyia (*Pararhamphomyia*) *tibiella* Zetterstedt, 1838

Ephydridae

Paul L.Th. Beuk

Axysta cesta (Haliday, 1833)
Philygria interstincta (Fallén, 1813)

Fanniidae

Paul L.Th. Beuk

Fannia metallipennis (Zetterstedt, 1838) *
Fannia nidica Collin, 1939 *
Fannia rondanii (Strobl, 1893)
Fannia serena (Fallén, 1825)
Fannia sociella (Zetterstedt, 1845)
Fannia subsimilis Ringdahl, 1934

Heleomyzidae

Ruud van der Weele & Paul L. Th. Beuk

Eccoptomera filata Loew, 1862
Eccoptomera longiseta (Meigen, 1830)
Eccoptomera pallescens (Meigen, 1830)
Heteromyza rotundicornis (Zetterstedt, 1846)
Morpholeria ruficornis (Meigen, 1830)
Neoleria ruficauda (Zetterstedt, 1847)
Neoleria ruficeps (Zetterstedt, 1838)
Oecothea fenestralis (Fallén, 1820)
Schroederella bifida Papp & Carles-Tolra, 1994 *
Suillia affinis (Meigen, 1830)
Suillia atricornis (Meigen, 1830)
Suillia bicolor (Zetterstedt, 1838)
Suillia cf *similis* (Meigen, 1838)
Suillia fuscicornis (Zetterstedt, 1847) *
Suillia humilis (Meigen, 1830)
Suillia imberbis Czerny, 1924
Suillia laevifrons (Loew, 1862)
Suillia notata (Meigen, 1830)
Suillia oxyphora (Mik), 1900) *
Suillia pallida (Fallén, 1820)
Suillia similis (Meigen, 1838)
Suillia variegata (Loew, 1862)
Tephrochlamys flavipes (Zetterstedt, 1838)
Tephrochlamys rufiventris (Meigen, 1830)
Tephrochlamys tarsalis (Zetterstedt, 1847)
Trixoscelis frontalis (Fallén, 1823) *

Hybotidae

Patrick Grootaert

Bicellaria intermedia Lundbeck, 1910
Bicellaria sulcata (Zetterstedt, 1842)
Bicellaria vana Collin, 1926
Crossopalpus abditus Kovalev, 1972
Crossopalpus humilis (Frey, 1913)
Crossopalpus minimus (Meigen, 1838)
Crossopalpus nigritellus (Zetterstedt, 1842)
Drapetis arcuata Loew, 1859
Drapetis assimilis (Fallén, 1815)
Drapetis bruscellensis Grootaert, 2016 *
Drapetis exilis Meigen, 1822
Drapetis infitialis Collin, 1961 *
Drapetis parilis Collin, 1926
Drapetis pusilla Loew, 1859
Drapetis simulans Collin, 1961
Elaphropeza ephippiata (Fallén, 1815)
Euthyneura myrtilli Macquart, 1836

Hybos culiciformis (Fabricius, 1775)
Hybos femoratus (Müller, 1776)
Leptopeza borealis Zetterstedt, 1842
Leptopeza flavipes (Meigen, 1820)
Oedalea apicalis Loew, 1859
Oedalea flavipes Zetterstedt, 1842
Oedalea holmgreni Zetterstedt, 1852
Oedalea hybotina (Fallén, 1816)
Oedalea stigmatella Zetterstedt, 1842
Oedalea tibialis Macquart, 1827
Oedalea zetterstedti Collin, 1926
Platypalpus agilis (Meigen, 1822)
Platypalpus albicornis (Zetterstedt, 1842)
Platypalpus albiseta (Panzer, 1806)
Platypalpus annulatus (Fallén, 1815)
Platypalpus annulipes (Meigen, 1822)
Platypalpus aristatus (Collin, 1926)
Platypalpus articulatoides (Frey, 1918)
Platypalpus articulatus Macquart, 1827
Platypalpus aurantiacus (Collin, 1926)
Platypalpus australominutus Grootaert, 1989
Platypalpus calceatus (Meigen, 1822)
Platypalpus candicans (Fallén, 1815)
Platypalpus ciliaris (Fallén, 1816)
Platypalpus clarandus (Collin, 1926)
Platypalpus collini (Chvála, 1966)
Platypalpus cothurnatus Macquart, 1827
Platypalpus coxatus (Zetterstedt, 1842)
Platypalpus dessarti Grootaert, 1983
Platypalpus divisus Walker, 1851
Platypalpus exilis (Meigen, 1822)
Platypalpus interstinctus (Collin, 1926)
Platypalpus kirtlingensis Grootaert, 1986
Platypalpus laticinctus Walker, 1851
Platypalpus leucocephalus (von Roser, 1840)
Platypalpus longicornis (Meigen, 1822)
Platypalpus longimanus (Corti, 1907)
Platypalpus longiseta (Zetterstedt, 1842)
Platypalpus luteoloides Grootaert, 1983
Platypalpus luteolus (Collin, 1926)
Platypalpus maculipes (Meigen, 1822)
Platypalpus massarti Grootaert sp. nov. *
Platypalpus minutus (Meigen, 1804)
Platypalpus nanus (Oldenberg, 1924)
Platypalpus negrobovi Grootaert *et al*., 2012 *
Platypalpus niger (Meigen, 1804)
Platypalpus notatus (Meigen, 1822)
Platypalpus optivus (Collin, 1926)
Platypalpus pallidiventris (Meigen, 1822)
Platypalpus pallipes (Fallén, 1815)
Platypalpus pectoralis (Fallén, 1815)
Platypalpus pictitarsis (Becker, 1902)
Platypalpus pictitarsoides Grootaert sp. nov. *
Platypalpus praecinctus (Collin, 1926)
Platypalpus pseudofulvipes Frey, 1909
Platypalpus pseudorapidus Kovalev, 1971
Platypalpus pulicarius (Meigen, 1830)
Platypalpus rapidoides Chvála, 1975
Platypalpus rapidus (Meigen, 1822)
Platypalpus stabilis (Collin, 1961)
Platypalpus subtilis (Collin, 1926)
Stilpon subnubilus Chvála, 1988
Symballophthalmus fuscitarsis (Zetterstedt, 1859)
Tachydromia aemula (Loew, 1864)
Tachydromia annulimana Meigen, 1822
Tachydromia arrogans (Linnaeus, 1761)
Tachydromia smithi Chvála, 1966
Tachydromia umbrarum Haliday, 1833
Tachypeza nubila (Meigen, 1804)
Trichina bilobata Collin, 1926
Trichina clavipes Meigen, 1830
Trichina elongata Haliday, 1833
Trichina opaca Loew, 1864
Trichinomyia flavipes (Meigen, 1830)

Keroplatidae

Olavi Kurina

Keroplatus reaumurii Dufour, 1839 *
Keroplatus testaceus Dalman, 1818
Keroplatus tipuloides Bosc, 1792
Macrocera fasciata Meigen, 1804
Macrocera phalerata Meigen, 1818
Macrocera stigmoides Edwards, 1925
Macrorrhyncha flava Winnertz, 1846
Monocentrota lundstroemi Edwards, 1925 *
Neoplatyura modesta (Winnertz, 1863)
Neoplatyura nigricauda (Strobl, 1893)
Orfelia bicolor (Macquart, 1826)
Orfelia discoloria (Meigen, 1818)
Orfelia fasciata (Meigen, 1804)
Orfelia lugubris (Zetterstedt, 1851)
Orfelia nemoralis (Meigen, 1818)
Orfelia nigricornis (Fabricius, 1805)
Orfelia pallida (Staeger, 1840)
Orfelia unicolor (Staeger, 1840)

Platyura marginata Meigen, 1804
Pyratula zonata (Zetterstedt, 1855)

Lauxaniidae

Paul L.Th. Beuk & Ruud van der Weele

Calliopum simillimum (Collin, 1933)
Calliopum tuberculosum (Becker, 1895)
Homoneura interstincta (Fallén, 1820)
Homoneura notata (Fallén, 1820)
Lauxania cylindricornis (Fabricius, 1794)
Meiosimyza decempunctata (Fallén, 1820)
Meiosimyza platycephala (Loew, 1847)
Meiosimyza rorida (Fallén, 1820)
Minettia (*Frendelia*) *longipennis* (Fabricius, 1794)
Minettia (*Minettia*) *fasciata* (Fallén, 1820)
Minettia (*Minettia*) *inusta* (Meigen, 1826)
Minettia (*Minettia*) *tubifer* (Meigen, 1826)
Peplomyza litura (Meigen, 1826)
Pseudolyciella pallidiventris (Fallén, 1820)
Sapromyza albiceps Fallén, 1820
Sapromyza obsoleta Fallén, 1820
Schumannimyia hyalinata (Meigen, 1826)
Tricholauxania praeusta (Fallén, 1820)

Limoniidae

Niels-Jan Dek & Kris Peeters

Atypophthalmus inustus (Meigen, 1818)
Austrolimnophila ochracea (Meigen, 1804)
Cheilotrichia cinerascens (Meigen, 1804)
Cheilotrichia imbuta (Meigen, 1818)
Dicranomyia affinis (Schummel, 1829)
Dicranomyia chorea (Meigen, 1818)
Dicranomyia lucida (de Meijere, 1918)
Dicranomyia mitis (Meigen, 1830)
Dicranomyia modesta (Meigen, 1818)
Dicranophragma adjunctum (Walker, 1848)
Dicranophragma nemorale (Meigen, 1818)
Ellipteroides lateralis (Macquart, 1835)
Eloeophila maculata (Meigen, 1804)
Epiphragma ocellare (Linnaeus, 1760)
Erioptera lutea (Meigen, 1804)
Gnophomyia viridipennis (Gimmerthal, 1847)
Ilisia maculata (Meigen, 1804)
Limonia hercegovinae (Strobl, 1898)
Limonia macrostigma (Schummel, 1829)
Limonia nubeculosa (Meigen, 1804)
Limonia phragmitidis (Schrank, 1781)
Limonia trivittata (Schummel, 1829)
Lipsothrix nervosa (Edwards, 1938)
Metalimnobia quadrinotata (Meigen, 1818)
Molophilus medius (de Meijere, 1918)
Molophilus obscurus (Meigen, 1818)
Molophilus ochraceus (Meigen, 1818)
Neolimnophila placida (Meigen, 1830)
Neolimonia dumetorum (Meigen, 1804)
Ormosia depilata (Edwards, 1938)
Ormosia lineata (Meigen, 1804)
Phylidorea ferruginea (Meigen, 1818)
Pilaria discicollis (Meigen, 1818)
Pilaria fuscipennis (Meigen , 1818)
Pseudolimnophila lucorum (Meigen, 1818)
Pseudolimnophila sepium (Verrall, 1886)
Rhipidia maculata (Meigen, 1818)
Rhipidia uniseriata (Schiner, 1864)
Rhypholophus bifurcatus (Goetghebuer, 1920)
Symplecta stictica (Meigen, 1818)
Thaumastoptera calceata (Mik, 1866)

Lonchaeidae

Paul L.Th. Beuk

Dasiops perpropinquus Morge, 1959 *
Lonchaea chorea (Fabricius, 1781)
Lonchaea contigua Collin, 1953 *
Lonchaea fugax Becker, 1895
Lonchaea iona MacGowan, 2001 *
Lonchaea kapperti MacGowan, 2020 *
Lonchaea nitens Bigot, 1885 *
Lonchaea palposa Zetterstedt, 1847
Lonchaea scutellaris Rondani, 1874
Lonchaea sp. fraxinus group
Lonchaea sp. mallochi group
Lonchaea sp. peregrina group
Lonchaea subneatosa Kovalev, 1974 *
Protearomyia withersi MacGowan, 2014 *
Silba fumosa (Egger, 1862)

Lonchopteridae

Paul L.Th. Beuk

Lonchoptera bifurcata (Fallén, 1810)
Lonchoptera lutea Panzer, 1809

Megamerinidae

Ruud van der Weele

Megamerina dolium (Fabricius, 1805)

Micropezidae

Ruud van der Weele

Calobata petronella (Linnaeus, 1761)
Micropeza corrigiolata (Linnaeus, 1767)
Neria cibaria (Linnaeus, 1761)

Neria commutata (Czerny, 1930)
Neria ephippium (Fabricius, 1794)

Microphoridae

Patrick Grootaert

Microphor anomalus (Meigen, 1824)
Microphor crassipes Macquart, 1827
Microphor holosericeus (Meigen, 1804)
Microphor cf *holosericeus* (Meigen, 1804)
Note: Microphoridae are now considered as Dolichopodidae *sensu lato*.

Muscidae

Yves Braet

Coenosia tigrina (Fabricius, 1775)
Helina depuncta (Fallén, 1825)
Hydrotaea capensis (Wiedemann, 1818)
Musca autumnalis De Geer, 1776
Muscina levida (Harris, 1780)
Muscina prolapsa (Harris, 1780)
Muscina stabulans (Fallén, 1817)
Neomyia viridescens (Robineau-Desvoidy, 1830)
Phaonia bitincta (Rondani, 1866)
Phaonia rufiventris (Scolpoli, 1763)

Mycetophilidae

Olavi Kurina

Acnemia nitidicollis (Meigen, 1818)
Allodia lugens (Wiedemann, 1817)
Allodia ornaticollis (Meigen, 1818)
Allodiopsis domestica (Meigen, 1830)
Allodiopsis rustica (Edwards, 1941)
Anatella ciliata Winnertz, 1863 *
Anatella simpatica Dziedzicki, 1923 *
Anatella turi Dziedzicki, 1923 *
Apolephthisa subincana (Curtis, 1837)
Boletina dubia (Meigen, 1804)
Boletina gripha Dziedzicki, 1885
Boletina nitida Grzegorzek, 1885 *
Boletina sciarina Staeger, 1840 *
Boletina trispinosa Edwards, 1913 *
Brachycampta barbata (Lundstrom, 1909) *
Brachycampta silvatica (Landrock, 1912) *
Brevicornu fissicauda (Lundstrom, 1911)
Brevicornu fuscipenne (Staeger, 1840)
Brevicornu griseicolle (Staeger, 1840)
Brevicornu intermedium (Santos Abreu, 1920)
Brevicornu proximum (Staeger, 1840) *
Brevicornu sericoma (Meigen, 1830)
Clastobasis loici Chandler, 2001 *
Coelophthinia thoracica (Winnertz, 1863) *
Coelosia flava (Staeger, 1840) *
Coelosia fusca Bezzi, 1892
Cordyla brevicornis (Staeger, 1840) *
Cordyla crassicornis Meigen, 1818
Cordyla fasciata Meigen, 1830 *
Cordyla fissa Edwards, 1925 *
Cordyla flaviceps (Staeger, 1840)
Cordyla fusca Meigen, 1804
Cordyla murina Winnertz, 1863
Cordyla pusilla Edwards, 1925 *
Docosia flavicoxa Strobl, 1900 *
Docosia fumosa Edwards, 1925 *
Docosia gilvipes (Haliday *in* Walker 1856)
Docosia sciarina (Meigen, 1830)
Dynatosoma fuscicorne (Meigen, 1818)
Ectrepesthoneura colyeri Chandler, 1980 *
Ectrepesthoneura hirta (Winnertz, 1846)
Exechia bicincta (Staeger, 1840)
Exechia chandleri Caspers, 1987 *
Exechia cincta Winnertz, 1863 *
Exechia contaminata Winnertz, 1863
Exechia dizona Edwards, 1924
Exechia fusca (Meigen, 1804)
Exechia neorepanda Lindemann, 2021
Exechia nigroscutellata Landrock, 1912
Exechia parva Lundstrom, 1909
Exechia pseudofestiva Lackschewitz, 1937 *
Exechia seriata (Meigen, 1830)
Exechia spinuligera Lundstrom, 1912 *
Exechiopsis (*Exechiopsis*) *fimbriata* (Lundstrom, 1909)
Exechiopsis (*Exechiopsis*) *intersecta* (Meigen, 1818)
Exechiopsis (*Xenexechia*) *crucigera* (Lundstrom, 1909) *
Exechiopsis (*Xenexechia*) *leptura* (Meigen, 1830) *
Greenomyia mongolica Laštovka & Matile, 1974 *
Grzegorzekia bushyae Chandler, 2015 *
Grzegorzekia collaris (Meigen, 1818) *
Leia arsona Hutson, 1978 *
Leia bimaculata (Meigen, 1804)
Leia cylindrica (Winnertz, 1863) *
Leia fascipennis Meigen, 1818
Leia piffardi Edwards, 1925 *
Leia winthemii Lehmann, 1822
Leptomorphus walker Curtis, 1831
Megalopelma nigroclavatum (Strobl, 1910)
Megophthalmidia crassicornis (Curtis, 1837) *
Monoclona rufilatera (Walker, 1837)

Mycetophila alea Laffoon, 1965
Mycetophila bialorussica Dziedzicki, 1884 *
Mycetophila britannica Laštovka & Kidd, 1975 *
Mycetophila cingulum Meigen, 1830
Mycetophila curviseta Lundstrom, 1911
Mycetophila distigma Meigen, 1830 *
Mycetophila dziedzickii Chandler, 1977 *
Mycetophila edwardsi Lundstrom, 1913
Mycetophila evanida Laštovka, 1972 *
Mycetophila formosa Lundstrom, 1911
Mycetophila fungorum (De Geer, 1776)
Mycetophila gibbula Edwards, 1925 *
Mycetophila hetschkoi Landrock, 1918 *
Mycetophila ichneumonea Say, 1823 *
Mycetophila idonea Laštovka, 1972 *
Mycetophila luctuosa Meigen, 1830
Mycetophila marginata Winnertz, 1863
Mycetophila mitis (Johannsen, 1912)
Mycetophila nigrofusca Dziedzicki, 1884 *
Mycetophila occultans Lundstrom, 1913 *
Mycetophila ocellus Walker, 1848
Mycetophila ornata Stephens, 1846
Mycetophila pictula Meigen, 1830
Mycetophila pumila Winnertz, 1863
Mycetophila rudis Winnertz, 1863
Mycetophila ruficollis Meigen 1818
Mycetophila sigmoides Loew, 1869 *
Mycetophila signatoides Dziedzicki, 1884 *
Mycetophila sordida van der Wulp, 1874 *
Mycetophila stolida Walker, 1856
Mycetophila strigata Stæger, 1840 *
Mycetophila strigatoides Landrock, 1927 *
Mycetophila subsigillata Zaitzev, 1999 *
Mycetophila trinotata Staeger, 1840
Mycetophila unicolor Stannius, 1831
Mycetophila xanthopyga Winnertz, 1863
Mycomya (*Cymomya*) *circumdata* (Staeger, 1840)
Mycomya (*Mycomya*) *annulata* (Meigen, 1818)
Mycomya (*Mycomya*) *britteni* Kidd, 1955 *
Mycomya (*Mycomya*) *cinerascens* (Macquart, 1826)
Mycomya (*Mycomya*) *marginata* (Meigen, 1818)
Mycomya (*Mycomya*) *occultans* (Winnertz, 1863) *
Mycomya (*Mycomya*) *parva* (Dziedzicki, 1885) *
Mycomya (*Mycomya*) *prominens* (Lundstrom, 1913) *
Mycomya (*Mycomya*) *tenuis* (Walker, 1856)
Mycomya (*Mycomya*) *winnertzi* (Dziedzicki, 1885)
Mycomya (*Neomycomya*) *fimbriata* (Meigen, 1818)
Neoempheria bimaculata (von Roser, 1840)
Neoempheria pictipennis (Haliday, 1833)
Neoempheria striata (Meigen, 1818)
Phronia basalis Winnertz, 1863
Phronia biarcuata (Becker, 1908)
Phronia conformis (Walker, 1856)
Phronia coritanica Chandler, 1992
Phronia egregia Dziedzicki, 1889 *
Phronia forcipata Winnertz, 1863
Phronia forcipula Winnertz, 1863 *
Phronia humeralis Winnertz, 1863
Phronia notata Dziedzicki, 1889 *
Phronia nigricornis (Zetterstedt, 1852)
Phronia nitidiventris (van der Wulp, 1859)
Phronia siebeckii Dziedzicki, 1889 *
Phronia strenua Winnertz, 1864
Phronia sylvatica Dziedzicki, 1889 *
Phronia tenuis Winnertz, 1863
Platurocypta punctum (Stannius, 1831)
Platurocypta testata (Edwards, 1925)
Pseudexechia tuomikoskii Kjaerandsen, 2009
Rondaniella dimidiata (Meigen, 1804) *
Rymosia bifida Edwards, 1925 *
Rymosia fasciata (Meigen, 1804)
Rymosia spinipes Winnertz, 1863
Saigusaia flaviventris (Strobl, 1894)
Sceptonia costata (van der Wulp, 1859)
Sceptonia cryptocauda Chandler, 1991
Sceptonia flavipuncta Edwards, 1925 *
Sceptonia fumipes Edwards, 1925 *
Sceptonia hamata Sevcik, 2004 *
Sceptonia humerella Edwards, 1925 *
Sceptonia membranacea Edwards, 1925
Sceptonia nigra (Meigen, 1804)
Sceptonia pughi Chandler, 1991 *
Sceptonia tenuis Edwards, 1925 *
Sciophila fenestella Curtis, 1837 *
Sciophila hirta Meigen, 1818
Sciophila lutea Macquart, 1826
Sciophila nigronitida Landrock, 1925 *
Sciophila pomacea Chandler, 2006 *
Synapha fasciata Meigen, 1818
Synapha vitripennis (Meigen, 1818)
Synplasta exclusa (Dziedzicki, 1910) *
Synplasta gracilis Winnertz, 1863 *
Tarnania fenestralis (Meigen, 1838)
Tetragoneura sylvatica (Curtis, 1837)

Trichonta foeda Loew, 1869 *
Trichonta fragilis Gagne, 1981 *
Trichonta melanura (Staeger, 1840)
Trichonta pulchra Gagne, 1981 *
Trichonta subterminalis Zaitzev & Menzel, 1996 *
Trichonta vitta (Meigen, 1830)
Zygomyia humeralis (Wiedemann, 1817)
Zygomyia matilei Caspers, 1980 *
Zygomyia pictipennis (Staeger, 1840)
Zygomyia pseudohumeralis Caspers, 1980
Zygomyia semifusca (Meigen, 1818)
Zygomyia valida Winnertz, 1863
Zygomyia vara (Staeger, 1840)

Odiniidae

Ruud van der Weele

Odinia sp.

Oestridae

Jonas Mortelmans

Cephenemyia stimulator (Clark, 1851)

Opetiidae

Patrick Grootaert

Opetia nigra Meigen, 1830

Opomyzidae

Ruud van der Weele

Geomyza balachowskyi Mesnil, 1934
Geomyza tripunctata Fallén, 1823
Opomyza florum (Fabricius, 1794)
Opomyza germinationis (Linnaeus, 1758)
Opomyza petrei Mesnil, 1934

Pallopteridae

Ruud van der Weele

Palloptera muliebris (Harris, 1780)
Palloptera quinquemaculata (Macquart, 1835)
Palloptera scutellata (Macquart, 1835)
Palloptera umbellatarum (Fabricius, 1775)
Palloptera ustulata Fallén, 1820

Pediciidae

Niels-Jan Dek

Pedicia littoralis (Meigen, 1804)
Tricyphona immaculata (Meigen, 1804)
Ula sylvatica (Meigen, 1818)

Phoridae

Paul L.Th. Beuk

Anevrina thoracica (Meigen, 1804)
Anevrina unispinosa (Zetterstedt, 1860) *
Anevrina urbana (Meigen, 1830)
Conicera floricola Schmitz, 1938
Diplonevra concinna (Meigen, 1830)
Diplonevra florescens (Turton, 1801)
Diplonevra nitidula (Meigen, 1830)
Diplonevra pilosella Schmitz, 1927
Megaselia picta (Lehmann, 1822)
Megaselia rufipes (Meigen, 1804)
Megaselia subfuscipes Schmitz, 1935
Menozziola schmitzi (Menozzi, 1921) *
Metopina braueri (Strobl, 1880) *
Metopina perpusilla (Six, 1878) *
Phalacrotophora delageae Disney, 1979 *
Phora atra (Meigen, 1804)
Phora edentata Schmitz, 1920
Phora holosericea Schmitz, 1920
Phora tincta Schmitz, 1920
Pseudacteon brevicauda Schmitz, 1925 *
Pseudacteon formicarum (Verrall, 1877)
Spiniphora bergenstammi (Mik, 1864)
Triphleba distinguenda (Strobl, 1892)
Triphleba nudipalpis (Becker, 1901)

Piophilidae

Paul L. Th. Beuk

Allopiophila vulgaris (Fallén, 1820)
Protopiophila latipes (Meigen, 1838)
Stearibia nigriceps (Meigen, 1826)

Pipunculidae

Jocelyn Claude

Beckerias pannonicus (Aczél, 1939)
Cephalops vittipes (Zetterstedt, 1844)
Chalarus fimbriatus Coe, 1966
Chalarus holosericeus (Meigen, 1824)
Chalarus immanis Kehlmaier & Assmann, 2008 *
Chalarus indistinctus Jervis, 1992
Chalarus latifrons Hardy, 1943
Chalarus longicaudis Jervis, 1992
Chalarus pughi Coe, 1966
Chalarus spurius (Fallén, 1816)
Clistoabdominalis fusculus (Zetterstedt, 1844)
Dorylomorpha extricata (Collin, 1937)
Dorylomorpha xanthopus (Thomson, 1870)
Eudorylas fuscipes (Zetterstedt, 1844)
Eudorylas jenkinsoni Coe, 1966
Eudorylas montium (Becker, 1897)
Eudorylas obscurus Coe, 1966
Eudorylas ruralis (Meigen, 1824)
Eudorylas subterminalis Collin, 1956
Eudorylas zermattensis (Becker, 1897)

Eudorylas zonellus Collin, 1956
Microcephalops opacus (Fallén, 1816)
Nephrocerus flavicornis Zetterstedt, 1844
Nephrocerus scutellatus (Macquart, 1834)
Pipunculus campestris Latreille, 1802
Pipunculus lenis Kuznetzov, 1991
Semicephalops ultimus (Becker, 1900)
Semicephalops varipes (Meigen, 1824)
Semicephalops varius (Cresson, 1911)
Tomosvaryella sylvatica (Meigen, 1824)
Verrallia aucta (Fallén, 1817)
Verrallia beatricis (Coe, 1966)
Verrallia fasciata (Roser, 1840)
Verrallia pilosa (Zetterstedt, 1838)

Platypezidae

Patrick Grootaert

Agathomyia unicolor Oldenberg, 1928
Lindneromyia dorsalis (Meigen, 1804)
Platypeza consobrina Zetterstedt, 1844
Platypeza hirticeps Verrall, 1901
Platypeza sp.
Polyporivora ornata (Meigen, 1838)
Protoclythia modesta (Zetterstedt, 1844)
Protoclythia rufa (Meigen, 1830)

Platystomatidae

Ruud van der Weele

Rivellia syngenesiae (Fabricius, 1781)

Psilidae

Jocelyn Claude & Paul L.Th. Beuk

Chamaepsila limbatella (Zetterstedt, 1847) *
Chamaepsila nigra (Fallén, 1820)
Chamaepsila nigricornis (Meigen, 1826)
Chamaepsila persimilis (Wakerley, 1959) *
Chamaepsila rosae (Fabricius, 1794)
Chyliza (*Chyliza*) *annulipes* Macquart, 1835 *
Chyliza (*Chyliza*) *leptogaster* (Panzer, 1798)
Imantimyia albiseta (Schrank, 1803)
Imantimyia sylvatica (Meigen, 1826) *
Loxocera (*Loxocera*) *aristata* (Panzer, 1801)
Loxocera (*Platystyla*) *hoffmannseggi* Meigen, 1826

Psychodidae

Gunnar Mikalsen Kvifte

Clytocerus splendidus (Ježek & Hajek, 2007)
Jungiella sp.
Mormia furva (Tonnoir, 1940)
Parajungiella longicornis (Tonnoir, 1922)
Pericoma pseudexquisita Tonnoir, 1940
Peripsychoda auriculata (Haliday *in* Curtis, 1839)
Philosepedon sp.
Pneumia nubila (Meigen, 1818)
Pneumia palustris (Meigen, 1818)
Promormia silesiensis Ježek, 1983 *
Psychoda alternata Say, 1824
Psychoda brevicornis Tonnoir, 1940
Psychoda gemina (Eaton, 1904)
Psychoda minuta Banks, 1894
Psychoda sigma Kincaid, 1899
Sycorax sp.
Tonnoiriella pulchra (Eaton, 1893)
Trichomyia urbica Haliday *in* Curtis, 1834
Trichopsychoda hirtella (Tonnoir, 1919)
Ulomyia cognata (Eaton, 1893)
Ulomyia fuliginosa (Meigen, 1804)

Ptychopteridae

Kris Peeters & Niels-Jan Dek

Ptychoptera albimana (Fabricius, 1787)
Ptychoptera contaminata (Linnaeus, 1758)
Ptychoptera lacustris (Meigen, 1830)

Rhagionidae

Patrick Grootaert & Paul L.Th. Beuk

Archicera avarorum Szilády, 1934 *
Chrysopilus asiliformis (Preyssler, 1791)
Chrysopilus cristatus (Fabricius, 1775)
Ptiolina obscura (Fallén, 1814)
Rhagio immaculatus (Meigen, 1804)
Rhagio lineola Fabricius, 1794
Rhagio maculatus (De Geer, 1776)
Rhagio scolopaceus (Linnaeus, 1758)
Rhagio tringarius (Linnaeus, 1758)
Spania nigra Meigen, 1830[1]
Note: [1]A male of this species was recorded in MT6 on 17-24.V.2017

Sarcophagidae

Yves Braet

Sarcophaga albiceps Meigen, 1826
Sarcophaga carnaria (Linnaeus, 1758)
Sarcophaga haemorrhoa Meigen, 1826
Sarcophaga vagans Meigen, 1826
Sarcophaga variegata (Scopoli, 1763)

Scathophagidae

Paul L.Th. Beuk

Cordilura (*Cordilurina*) *albipes* (Fallén, 1819)
Leptopa filiformis Zetterstedt, 1838
Nanna fasciata (Meigen, 1826)

Nanna flavipes (Fallén, 1819)
Nanna inermis (Becker, 1894)
Norellia spinipes (Meigen, 1826)
Norellisoma spinimanum (Fallén, 1819)
Scathophaga furcata (Say, 1823)
Scathophaga stercoraria (Linnaeus, 1758)

Scatopsidae

Jean-Paul Haenni & Paul L.Th. Beuk

Apiloscatopse flavicollis (Meigen, 1804)
Apiloscatopse picea (Meigen, 1818)
Apiloscatopse scutellata (Loew, 1846)
Coboldia fuscipes (Meigen, 1830)
Colobostema nigripenne (Meigen, 1830)
Colobostema triste (Zetterstedt, 1850)
Ectaetia clavipes (Loew, 1846)
Holoplagia lucifuga (Loew, 1870) *
Holoplagia richardsi (Edwards, 1934) *
Reichertella pulicaria (Loew, 1846)
Rhexoza subnitens (Verrall, 1886)
Scatopse notata (Linnaeus, 1758)
Swammerdamella acuta Cook, 1956 *
Swammerdamella adercotris Cook, 1972 *
Swammerdamella brevicornis (Meigen, 1830)
Thripomorpha coxendix (Verrall, 1912)

Sciaridae

Kai Heller

Austrosciara hyalipennis (Meigen, 1804)
Bradysia bellingeri Shaw, 1953
Bradysia fungicola (Winnertz, 1867)
Bradysia longistylia Mohrig & Krivosheina, 1982
Bradysia nocturna Tuomikoski, 1960
Bradysia polonica (Lengersdorf, 1929)
Bradysia trivittata (Staeger, 1840)
Claustropyga abblanda (Freeman, 1983)
Corynoptera dentata (Bukowski & Lengersdorf, 1936)
Corynoptera deserta Heller & Menzel, 2006
Corynoptera furcifera Mohrig & Mamaev, 1987
Corynoptera membranigera (Kieffer, 1903)
Corynoptera tetrachaeta Tuomikoski, 1960
Corynoptera tridentata Hondru, 1968
Cratyna fulvicauda (Felt, 1898)
Cratyna vagabunda (Winnertz, 1867)
Dolichosciara flavipes (Meigen, 1804)
Epidapus gracilis (Walker, 1848)
Lycoriella ingenua (Dufour, 1839)
Pseudolycoriella bruckii (Winnertz, 1867)
Pseudolycoriella paludum (Frey, 1948)
Trichosia caudata (Walker, 1848)
Trichosia lengersdorfi Heller & Köhler & Menzel, 2016
Trichosiopsis fuscipalpa (Mohrig & Mamaev, 1979)
Trichosiopsis rejecta (Winnertz, 1867)
Trichosiopsis scutellata (Staeger, 1840)
Trichosiopsis subpilosa (Edwards, 1925)
Zygoneura sciarina Meigen, 1830
Note: 3 more undescribed *Trichosiopsis* species were recorded

Sciomyzidae

Jonas Mortelmans & Paul L.Th. Beuk

Elgiva cucularia (Linnaeus, 1761)
Limnia unguicornis (Scopoli, 1763)
Pherbellia annulipes (Zetterstedt, 1846)
Pherbellia dubia (Fallén, 1820)
Pherbellia griseola (Fallén, 1820)
Pherbellia sp.
Pteromicra angustipennis (Staeger, 1845)
Renocera pallida (Fallén, 1820)
Sepedon spinipes (Scopoli, 1763)
Tetanocera elata (Fabricius, 1781)
Tetanocera ferruginea Fallén, 1820
Tetanocera phyllophora Melander, 1920
Tetanocera silvatica Meigen, 1830
Tetanocera sp.

Sepsidae

Paul L.Th. Beuk

Nemopoda nitidula (Fallén, 1820)
Sepsis cynipsea (Linnaeus, 1758)
Sepsis flavimana Meigen, 1826
Sepsis fulgens Meigen, 1826
Sepsis punctum (Fabricius, 1794)
Themira annulipes (Meigen, 1826)
Themira lucida (Staeger *in* Schiødte, 1844)

Sphaeroceridae

David Brice & Paul L.Th. Beuk

Apteromyia claviventris (Strobl, 1909)
Bifronsina bifrons (Stenhammer, 1855)
Chaetopodella scutellaris (Haliday, 1836)
Coproica ferruginata (Stenhammer, 1855)
Coproica hirticula Collin, 1956
Coproica hirtula (Rondani, 1880)
Coproica vagans (Haliday, 1833)
Copromyza equina Fallén, 1820
Copromyza nigrina (Gimmerthal, 1847)
Copromyza stercoraria (Meigen, 1830)
Crumomyia fimetaria (Meigen, 1830)
Crumomyia glabrifrons (Meigen, 1830)

Crumomyia nitida (Meigen, 1830)
Crumomyia rohaceki Norrbom & Kim, 1985 *
Crumomyia roserii (Rondani, 1880)
Elachisoma aterrimum (Haliday, 1833)
Eulimosina ochripes (Meigen, 1830)
Ischiolepta denticulata (Meigen, 1830)
Ischiolepta pusilla (Fallén, 1820)
Leptocera caenosa (Rondani, 1880)
Leptocera fontinalis (Fallén, 1826)
Leptocera nigra (Olivier, 1813)
Limosina silvatica (Meigen, 1830)
Lotophila atra (Meigen, 1830)
Minilimosina (*Allolimosina*) *secundaria* (Duda, 1918) *
Minilimosina (*Minilimosina*) *fungicola* (Haliday, 1836)
Minilimosina (*Svarciella*) *vitripennis* (Zetterstedt, 1847)
Opacifrons coxata (Stenhammer, 1855)
Opalimosina (*Opalimosina*) *mirabilis* (Collin, 1902)
Opalimosina (*Pappiella*) *liliputana* (Rondani, 1880)
Paralimosina (*Paralimosina*) *subcribrata* (Roháček, 1977) *
Pseudocollinella humida (Haliday, 1836)
Pullimosina (*Pullimosina*) *heteroneura* (Haliday, 1836)
Pullimosina (*Pullimosina*) *pullula* (Zetterstedt, 1847)
Pullimosina (*Pullimosina*) *vulgesta* (Roháček, 2001)
Rachispoda lutosa (Stenhammer, 1855)
Rachispoda lutosoidea (Duda, 1938)
Rachispoda opinata (Roháček, 1991) *
Spelobia clunipes (Meigen, 1830)
Spelobia luteilabris (Rondani, 1880)
Spelobia manicata (Richards, 1927) *
Spelobia palmata (Richards, 1927)
Spelobia parapusio (Dahl, 1909)
Spelobia talparum (Richards, 1927)
Sphaerocera monilis (Haliday, 1836)
Terrilimosina schmitzi (Duda, 1918)
Trachyopella (*Nudopella*) *leucoptera* (Haliday, 1836)
Trachyopella (*Trachyopella*) *kuntzei* (Duda, 1918)

Stratiomyidae

Patrick Grootaert & Jonas Mortelmans

Beris chalybata (Forster, 1771)
Beris clavipes (Linnaeus, 1767)
Beris morrisii Dale, 1841
Beris vallata (Forster, 1771)
Chloromyia formosa (Scopoli, 1763)
Chorisops nagatomii Rozkosný, 1979
Chorisops tibialis (Meigen, 1820)
Eupachygaster tarsalis (Zetterstedt, 1842)
Microchrysa cyaneiventris (Wiedemann, 1824)
Microchrysa flavicornis (Meigen, 1822)
Microchrysa polita (Linnaeus, 1758)
Neopachygaster meromelas (Dufour, 1841)
Oplodontha viridula (Fabricius, 1775)
Oxycera leonina (Panzer, 1798)
Oxycera nigricornis Olivier, 1812
Oxycera pardalina Meigen, 1822
Oxycera rara (Scopoli, 1763)
Oxycera varipes Loew, 1870
Pachygaster atra (Panzer, 1798)
Pachygaster leachii (Curtis, 1824)
Sargus bipunctatus (Scopoli, 1763)
Sargus cuprarius (Linnaeus, 1758)
Vanoyia tenuicornis Macquart, 1834

Syrphidae

Jonas Mortelmans & Frank Van de Meutter

Anasimyia contracta Claussen & Torp, 1980
Baccha elongata (Fabricius, 1775)
Brachyopa panzeri Goffe, 1945
Brachyopa pilosa Collin, 1939
Brachyopa scutellaris Robineau-Desvoidy, 1843
Brachypalpoides lentus (Meigen, 1822)
Brachypalpus laphriformis (Fallén, 1816)
Caliprobola speciosa (Rossi, 1790)
Ceriana conopsoides (Linnaeus, 1758)
Chalcosyrphus nemorum (Fabricius, 1805)
Cheilosia albipila Meigen, 1838
Cheilosia albitarsis (Meigen, 1822)
Cheilosia chloris (Meigen, 1822)
Cheilosia himantopus (Panzer, 1798)
Cheilosia lasiopa Kowarz, 1885
Cheilosia pagana (Meigen, 1822)
Cheilosia ruffipes (Preyssler, 1793)
Cheilosia scutellata (Fallén, 1817)
Cheilosia semifasciata Becker, 1894
Cheilosia uviformis Becker, 1894
Cheilosia variabilis (Panzer, 1798)
Chrysogaster solstitialis (Fallén, 1817)
Chrysotoxum bicinctum (Linnaeus, 1758)
Criorhina asilica (Fallén, 1816)
Criorhina berberina (Fabricius, 1805)
Criorhina ranunculi (Panzer, 1804)
Dasysyrphus albostriatus (Fallén, 1817)
Dasysyrphus tricinctus (Fallén, 1817)
Dasysyrphus venustus (Meigen, 1822)
Didea fasciata Macquart, 1834
Didea intermedia Loew, 1854

Epistrophe eligans (Harris, 1780)
Epistrophe flava Doczkal & Schmid, 1994
Epistrophe grossulariae (Meigen, 1822)
Epistrophe melanostoma (Zetterstedt, 1843)
Epistrophe nitidicollis (Meigen, 1822)
Epistrophe olgae Mutin, 1993
Epistrophella euchroma (Kowarz, 1885)
Episyrphus balteatus (de Geer, 1776)
Eristalinus sepulchralis (Linnaeus, 1758)
Eristalis nemorum (Linnaeus, 1758)
Eristalis pertinax (Scopoli, 1763)
Eumerus funeralis Meigen, 1822
Eumerus ornatus Meigen, 1822
Eumerus strigatus (Fallén, 1817)
Eupeodes bucculatus (Rondani, 1857)
Eupeodes corollae (Fabricius, 1794)
Eupeodes latifasciatus (Macquart, 1829)
Eupeodes luniger (Meigen, 1822)
Fagisyrphus cinctus (Fallén, 1817)
Ferdinandea cuprea (Scopoli, 1763)
Helophilus pendulus (Linnaeus, 1758)
Heringia sp.
Lejogaster metallina (Fabricius, 1781)
Matsumyia berberina (Fabricius, 1805)
Melangyna lasiophthalma (Zetterstedt, 1843)
Melanogaster hirtella (Loew, 1843)
Melanogaster nuda (Macquart, 1829)
Melanostoma mellinum (Linnaeus, 1758)
Melanostoma scalare (Fabricius, 1794)
Meligramma triangulifera (Zetterstedt, 1843)
Meliscaeva auricollis (Meigen, 1822)
Merodon equestris (Fabricius, 1794)
Myathropa florea (Linnaeus, 1758)
Neoascia interrupta (Meigen, 1822)
Neoascia meticulosa (Scopoli, 1763)
Neoascia obliqua Coe, 1940
Neoascia podagrica (Fabricius, 1775)
Neocnemodon pubescens (Delucchi & Pschorn-Walcher, 1955)
Neocnemodon vitripennis (Meigen, 1822)
Orthonevra brevicornis (Loew, 1843)
Paragus haemorrhous Meigen, 1822
Paragus pecchiolii Rondani, 1857
Parasyrphus punctulatus (Verrall, 1873)
Parhelophilus frutetorum (Fabricius, 1775)
Parhelophilus versicolor (Fabricius, 1794)
Pipiza festiva Meigen, 1822
Pipiza luteitarsis Zetterstedt, 1843
Pipiza noctiluca (Linnaeus, 1758)
Pipiza notata Meigen, 1822
Pipizella viduata (Linnaeus, 1758)
Pipizella virens (Fabricius, 1805)
Platycheirus albimanus (Fabricius, 1781)
Platycheirus angustatus (Zetterstedt, 1843)
Platycheirus clypeatus (Meigen, 1822)
Platycheirus europaeus Goeldlin, Maibach & Speight, 1990
Platycheirus fulviventris (Macquart, 1829)
Platycheirus occultus Goeldlin, Maibach & Speight, 1990
Platycheirus peltatus (Meigen, 1822)
Platycheirus scutatus (Meigen, 1822)
Pyrophaena rosarum (Fabricius, 1787)
Rhingia campestris Meigen, 1822
Rhingia rostrata (Linnaeus, 1758)
Riponnensia splendens (Meigen, 1822)
Scaeva pyrastri (Linnaeus, 1758)
Scaeva selenitica (Meigen, 1822)
Sericomyia silentis (Harris, 1776)
Sphaerophoria scripta (Linnaeus, 1758)
Sphaerophoria taeniata (Meigen, 1822)
Sphiximorpha subsessilis (Illiger *in* Rossi, 1807)
Syritta pipiens (Linnaeus, 1758)
Syrphus nitidifrons Becker, 1921
Syrphus ribesii (Linnaeus, 1758)
Syrphus torvus Osten-Sacken, 1875
Syrphus vitripennis Meigen, 1822
Temnostoma bombylans (Fabricius, 1805)
Temnostoma vespiforme (Linnaeus, 1758)
Volucella bombylans (Linnaeus, 1758)
Volucella pellucens (Linnaeus, 1758)
Volucella zonaria (Poda, 1761)
Xanthogramma pedissequum (Harris, 1776)
Xanthogramma stackelbergi Violovitsh, 1975
Xylota segnis (Linnaeus, 1758)
Xylota sylvarum (Linnaeus, 1758)
Xylota xanthocnema Collin, 1939

Tabanidae

Patrick Grootaert

Haematopota italica Meigen, 1804
Tabanus bromius Linnaeus, 1758

Tachinidae

Paul L.Th. Beuk

Cinochira atra Zetterstedt, 1845
Microsoma exiguum (Meigen, 1824)
Phania funesta (Meigen, 1824)

Tephritidae

Paul L.Th. Beuk & J.-Y. Baugnée

Anomoia purmunda (Harris, 1780)
Chaetostomella cylindrica Robineau-Desvoidy, 1830
Ensina sonchi (Linnaeus, 1767)
Euleia heraclei (Linnaeus, 1758)
Euphranta (*Rhacochlaena*) *toxoneura* (Loew, 1846)
Noeeta pupillata (Fallén, 1814)
Philophylla caesio (Harris, 1780)
Sphenella marginata (Fallén, 1814)
Tephritis bardanae (Schrank, 1803)
Tephritis crepidis Hendel, 1927
Tephritis dilacerata (Loew, 1846)
Tephritis formosa (Loew, 1844)
Tephritis vespertina (Loew, 1844)
Terellia (*Cerajocera*) *tussilaginis* (Fabricius, 1775)
Trypeta sp.
Trypeta zoe Meigen, 1826
Xyphosia miliaria (Schrank, 1781)

Therevidae

Jonas Mortelmans

Thereva nobilitata (Fabricius, 1775)

Tipulidae

Kris Peeters

Ctenophora festiva (Meigen, 1804)
Ctenophora flaveolata (Fabricius, 1794)
Dictenidia bimaculata (Linnaeus, 1760)
Nephrotoma aculeata (Loew, 1871)
Nephrotoma analis (Schummel, 1833)
Nephrotoma appendiculata (Pierre, 1919)
Nephrotoma cornicina (Linnaeus, 1758)
Nephrotoma dorsalis (Fabricius, 1781)
Nephrotoma flavipalpis (Meigen, 1830)
Nephrotoma guestfalica (Westhoff, 1879)
Nephrotoma lunulicornis (Schummel, 1833)
Nephrotoma quadrifaria (Meigen, 1804)
Nephrotoma quadristriata (Schummel, 1833)
Nephrotoma scurra (Meigen, 1818)
Nigrotipula nigra (Linnaeus, 1758)
Prionocera subserricornis (Zetterstedt, 1851)
Tanyptera atrata (Linnaeus, 1758)
Tanyptera nigricornis (Meigen, 1818)
Tipula fascipennis (Meigen, 1818)
Tipula flavolineata (Meigen, 1804)
Tipula fulvipennis (DeGeer, 1776)
Tipula helvola (Loew, 1873)
Tipula irrorata (Macquart, 1826)
Tipula lateralis (Meigen, 1804)
Tipula luna (Westhoff, 1879)
Tipula lunata (Linnaeus, 1758)
Tipula luteipennis (Meigen, 1830)
Tipula maxima (Poda, 1761)
Tipula montium (Egger, 1863)
Tipula obsoleta (Meigen, 1818)
Tipula oleracea (Linnaeus, 1758)
Tipula pagana (Meigen, 1818)
Tipula paludosa (Meigen, 1830)
Tipula submarmorata (Schummel, 1833)
Tipula unca (Wiedemann, 1817)
Tipula varipennis (Meigen, 1818)

Trichoceridae

Niels-Jan Dek

Trichocera annulata Meigen, 1818
Trichocera hiemalis (De Geer, 1776)
Trichocera saltator (Harris, 1776)

Ulidiidae

Ruud van der Weele

Seioptera vibrans (Linnaeus, 1758)

Xylomyidae

Patrick Grootaert

Solva marginata (Meigen, 1820)

Xylophagidae

Patrick Grootaert

Xylophagus ater Meigen, 1804
Xylophagus compeditus Wiedemann, 1820