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Muscidae and Syrphidae (Diptera) collected by window-trapping at the IJzer estuary (Belgian coast)

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Abstract

By means of window-trapping Muscidae and Syrphidae (Diptera) were collected in the fore-dunes, grey dunes and in the old and new salt marshes of the IJzer estuary (Belgian coast). The Syrphidae are mainly represented by migratory species. The Muscidae are ubiquists, except for *Helina protuberans*, which is a typical species for sand dunes. We discuss the absence of other habitat specialists. Also some notes are included on *Hydrotaea aenescens* (Muscidae), which is reported for the first time from Belgium.

Keywords: *Hydrotaea aenescens*, *Helina protuberans*, window trapping, dunes, salt marshes

Samenvatting

Door middel van venstervallen werden Muscidae and Syrphidae (Diptera) verzameld in de zeereepduinen, de grijze duinen en in de oude en nieuwe schorren van de IJzermonding (Belgische kust). We geven hier de resultaten weer alsook een soortenlijst van deze staalname tijdens 2006 en 2009. De Syrphidae worden vooral vertegenwoordigd door migrerende soorten. Met uitzondering van *Helina protuberans*, een typische soort van zandduinen, zijn de Muscidae-soorten ubiquisten. De

afwezigheid van andere habitatspecialisten wordt besproken. We hebben het ook over *Hydrotaea aenescens* (Muscidae), een soort die voor het eerst gerapporteerd wordt uit België.

Introduction

The river IJzer is located in the western part of Belgium. It has a short intertidal zone at the North Sea. This area has an eventful history. About the year 1200 the estuary still consisted of many creeks, salt marshes and extensive coastal dunes. From early medieval time until about 1986 different phases of habitat destruction and degradation took place (VERHULST, 1995). The sea tidal influences were limited by sluices, dunes were urbanised, a naval port and a marina were constructed and salt marshes were covered with dredged materials (HOFFMANN, 2004; 2006; DESENDER *et al.*, 2007).

Nevertheless the natural remains of the estuary still contained many organisms of high conservation interest (HOFFMANN, 2004; 2006; DESENDER *et al.*, 2007). In 1998 the Flemish Government started a nature restoration project, within the framework of LIFE. On the right bank of the estuarine part of the river IJzer, the natural ecological gradients typical for a coastal estuarine ecosystem were restored. The buildings, roads, jetties and quays of the formal naval basis were demolished and removed. The reclaimed land was excavated so that a new tidal mud flat could form. Dune-like hills and a dune-like dike along the tidal mud flat were created. The works ended in March 2001 (GROOTAERT, 2003; HOFFMANN, 2004; 2006; MAELFAIT *et al.*, 2007).

The invertebrate fauna of this area is relatively well known. The IJzer estuary has been a favourite study location for many entomologists from about 1850 onwards. Since 1989 continuous monitoring by pitfall trapping was performed in the old dunes and salt marshes (DESENDER, 1996; 2005). In 2001 monitoring of the restoration measures started. At that time also pan traps and window traps were installed (GROOTAERT, 2003; HOFFMANN, 2006).

So far most effort was spend on ground beetles and spiders (DESENDER, 1996; 2005; DESENDER *et al.*, 2007; MAELFAIT *et al.*, 2007; KARAKOC *et al.*, 2011). In 1989, 1992 and during the period 2001-2005 also some Diptera families ware assessed in the IJzer estuary, i.e. Empididae, Dolichopodidae, Asilidae, Bibionidae, Therevidae, Bombyliidae and Stratiomyidae (GROOTAERT, 2003; HOFFMANN, 2006). A general overview of the presence of flies along the Belgian coast is available in GROOTAERT & POLLET (2004). POLLET & GROOTAERT (1996) report on Dolichopodidae, Empididae and Hybotidae. BONTE *et al.* (2002) compare the Asilidae fauna of the coastal dunes with that of inland dunes and GROOTAERT *et al.* (2001) did the same for Therevidae. GOETGHEBUER (1942) gives an overview of Diptera on groynes.

In this paper we report on Syrphidae and Muscidae collected in 2006 and 2009 in the fore-dunes, grey dunes and in the old and new salt marshes.

Materials & methods

All sampling was done with window traps. These consist of a 50x50x10 cm reservoir which is green at the outer side and white at the inner site. The reservoir is placed at a height of about 80 cm. Two intersecting plexiglass panels with a height of 30 cm are mounted on the reservoir. The reservoir is filled with a formaline solution as a fixative and a few drops of detergent are added to lower surface tension. The traps were emptied at fortnightly intervals.

In total four window traps, at four different locations were involved. Most effort was spend to a site situated on the seaward side of the fore-dune, were continuous sampling by a window trap is going on since 2003. At second instance also some other habitats, that were sampled in 2006 and 2007, were assessed.

Figure 1 gives the location of the four sampling sites.

- Site AB is situated on the fore-dunes, on the seaward side. It has a sandy soil and a species-poor vegetation. Tussocks of *Ammophila arenaria* (L.) Link and to a lesser extend *Elymus farctus* (Viv.) Runemark ex Melderis *subsp. boreoatlanticus* (Simonet et Guinochet) Melderis cover about 50% of the vegetation. Only a few individuals of other plant species (eg. *Sonchus arvensis* L., *Euphorbia paralias* L., *Senecio jacobaea* L. and *Leontodon saxatilis* Lam.) were present.

Fig. 1. Overview of the location of the window traps in the IJzer estuary (Belgian coast)


Fig. 2. Window trap in the fore-dunes (site AB)

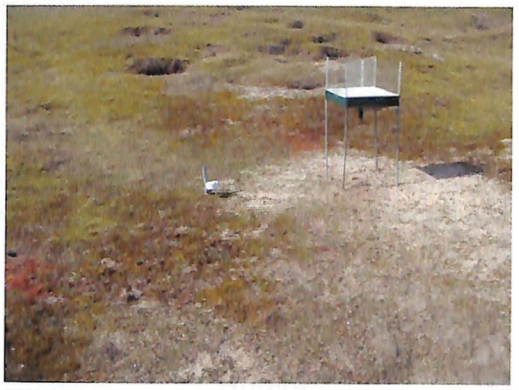
Fig. 3. Window trap in the grey dunes (site EB)


Fig. 4. Window trap in a newly created salt marsh (site NSB)

- Site EB is situated on a grey dune, with a more or less closed grassland and a well-developed sod layer. The vegetation is short-grazed by sheep and contains species such as *Carex arenaria* L., *Leontodon saxatilis*, *Erodium cicutarium* (L.) L'Hérit, *Erodium lebelii* Jord., *Plantago lanceolata* L., *Ononis repens* L., *Galium verum* L., *Senecio jacobaea*

and *Arenaria serpyllifolia* L.. In the vicinity also *Rubus sp.* is found.

- Site NSB is located in a newly created salt marsh. The window trap was installed on a low ridge in between two locations with a typical salt marsh vegetation. On the ridge the vegetation is dominated by *Elymus athericus* (Link) Kerguélen and contains species like *Leontodon saxatilis*, *Lotus corniculatus* L., *Medicago lupulina* L., *Trifolium repens* L. and *Plantago coronopus* L.. The principal species in the salt marshes are *Limonium vulgare* Mill., *Salicornia sp.*, *Suaeda maritima* (L.) Dum, *Puccinellia maritima* (Huds.) Parl. and *Plantago maritima* L..
- Site TN is located in an old salt marsh. The salt marsh vegetation contains more or less the same species as site NSB. However the vegetation is more closed and *Puccinellia maritima* is less abundant. On the other hand *Suaeda maritima*, *Plantago maritima*, *Spergularia media* (L.) C. Presl subsp. *angustata* (Clavaud) Kerguélen et Lambinon, *Halimione portulacoides* (L.) Aell. and *Elymus athericus* are more important. The last species is dominant at higher places.

For 2009 all samples (beginning of March till mid October) from site AB were analysed. For 2006 all sites sampled at that time, were studied for two periods (29 April – 12 May and 21 July – 4 August). All collected Muscidae were mounted, labelled and are preserved at RBINS (Brussels, Belgium).

Results

Muscidae

In total 149 specimens and 15 species of Muscidae were found, including one habitat specialist. Table 1 and 2 respectively show the results of 2009 and 2006. The larvae of most species that we found are coprophagous or live in excrements as predators on other Diptera larvae. *Muscina prolapsa* larvae live in carrion as predators of Calliphoridae larvae, but are also reared from caterpillars and larvae of bumble bees. Species like *Helina evecta*, *Helina reversio*, *Phaonia subventa* and *Phaonia tuguriorum* can be found in moss, humus soil, decaying vegetation and rotting wood (SKIDMORE, 1985; GREGOR *et al.*, 2002).

Thirteen species were found in the fore-dunes. The most interesting species is *Helina protuberans* which is a typical species for sand dunes and sandy river banks (SKIDMORE, 1985; GREGOR *et al.*, 2002). We recorded three males and four females of this species.

Worth mentioning is also *Hydrotaea aenescens*, of which we found one male in the fore-dunes. It is the first time that this species is reported for Belgium. *Hydrotaea aenescens* is originally a Neotropical species, that is predatory on other Diptera larvae and that has been introduced to Europe as a bioregulator for *Musca domestica* Linnaeus, 1758 and other pest species (SKIDMORE, 1985; GREGOR *et al.*, 2002).

In the grey dunes and in the salt marshes respectively five and six species of Muscidae were found. These habitats revealed only two extra species, i.e. the common species *Morellia hortorum* and *Phaonia subventa*, both trapped in the newly created salt marsh. No habitat specialists of salt marshes were found.

Syrphidae

In total 15 species of Syrphidae were recorded, all of which are common generalists. Table 3 and 4 respectively show the results of 2009 and 2006.

In the fore-dunes the highest numbers of Syrphidae were counted in July, August and the first half of September. The most abundant species were *Episyrphus balteatus*, *Eristalis tenax*, *Eupeodes corollae* and *Scaeva pyrastri*. These species are well known as seasonal migrants (REEMER *et al.*, 2009; SPEIGHT, 2010).

Nearly all other species collected in the fore-dunes are to a greater or lesser extent migrants. The only exceptions are *Platycheirus albimanus* and *Rhingia campestris* (REEMER *et al.*, 2009; SPEIGHT, 2010), for which respectively one male and one female were trapped. Larvae of *Platycheirus albimanus* are predatory on aphids on trees and shrubs. Adults prefer rough herbage in and beside scrub or woodland, but can occur occasionally also in more open habitats. The larvae of *Rhingia campestris* breed in cow dung and the adults disperse widely (STUBBS, 2002; REEMER *et al.*, 2009; SPEIGHT, 2010).

In the grey dunes and in the salt marshes respectively five and four species of Syrphidae were found. These habitats revealed only one additional species, i.e. *Syrphus ribesii* which is migratory as well, but to a lesser extent as the above species. It was trapped in the grey dunes. In the newly created salt marsh only a few

Table 1. Muscidae collected in 2009

Site	AB																													
Date of emptying (2009)	10/04		24/04		11/05		25/05		5/06		19/06		3/07		31/07		17/08		31/08		12/09		28/09		9/10		22/10		Total		
Sex	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m+f
Helina confinis (Fallén, 1825)						5									2	2													2	7	9
Helina evecta (Harris, 1780)	22	13	12	11			2		1		4	1																	41	25	66
Helina lasiophthalma (Macquart, 1835)																															
Helina protuberans (Zetterstedt, 1845)							3	3		1																			3	4	7
Helina reversio (Harris, 1780)											2	2			1	1													3	3	6
Hydrotaea aenescens (Wiedemann, 1830)																	1												1		1
Hydrotaea dentipes (Fabricius, 1805)			1																										1		1
Morellia hortorum (Fallén, 1817)																															
Musca autumnalis De Geer, 1776																	1												1		1
Muscina prolapsa (Harris, 1780)					1																								1		1
Muscina stabulans (Fallén , 1817)					1																								1		1
Neomyia cornicina (Fabricius, 1781)	1				3																				1				5		5
Phaonia subventa (Harris, 1780)																															
Phaonia tuguriorum (Scopoli, 1763)							2				2				1														5		5
Stomoxys calcitrans (Linnaeus, 1758)					2	1											1												3	1	4

Table 2. Muscidae collected in 2006

Date of emptying	12/05/2006								04/08/2006								Total											
Site	AB		EB		NSB		TN		AB		EB		NSB		TN		AB			EB			NSB			TN		
Sex	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m+f	m	f	m+f	m	f	m+f	m	f	m+f
Helina confinis (Fallén, 1825)							not sampled		3	3	5	2					3	3	6	5	2	7						
Helina evecta (Harris, 1780)																												
Helina lasiophthalma (Macquart, 1835)		1																1	1									
Helina protuberans (Zetterstedt, 1845)																												
Helina reversio (Harris, 1780)	1	3		1	3	1											1	3	4		1	1	3	1	4			
Hydrotaea aenescens (Wiedemann, 1830)																												
Hydrotaea dentipes (Fabricius, 1805)																												
Morellia hortorum (Fallén, 1817)													1											1	1			
Musca autumnalis De Geer, 1776													1										1		1			
Muscina prolapsa (Harris, 1780)												1									1	1						
Muscina stabulans (Fallén , 1817)																												
Neomyia cornicina (Fabricius, 1781)	1																1		1									
Phaonia subventa (Harris, 1780)													1										1		1			
Phaonia tuguriorum (Scopoli, 1763)									3		3		2		1		3		3	3		3	2		2	1		1
Stomoxys calcitrans (Linnaeus, 1758)									1	1		1		2			1	1	2		1	1		2	2			

specimens of common, migratory species were registered. In the old salt marsh, which is more exposed, no Syrphidae were found.

Discussion

Only 15 species of Muscidae and 15 species of Syrphidae were recorded. Though the Belgian checklists of both families contain quite a lot of species, i.e. respectively 201 (HOFMANS, 1991) and 338 (Belgian Syrphidae database, Van de Meutter, unpublished results).

Only one habitat specialist was found, i.e. *Helina protuberans*, a Muscid fly which is typical for sand dunes. The female of this species has been seen ovipositing in sand dunes and puparia have been found between roots of *Ammophila arenaria* (SKIDMORE, 1985). *Helina protuberans* occurs widely over Europe, from France and Italy to Ireland, Great-Britain, Fennoscandia and northern Russia (GREGOR *et al.*, 2002).

As mentioned above it is the first time that *Hydrotaea aenescens* is reported for Belgium. Originally it is a Neotropical species. In the second half of the past century *Hydrotaea aenescens* has been introduced in Europe (firstly recorded in Italy in 1964) as a bioregulator (SKIDMORE, 1985; GREGOR *et al.*, 2002). Larvae of this fly are predators and can kill 15-20 *Musca domestica* larvae daily. The adults can occur in large numbers in dark areas of animal confinement buildings, but they seem disinterested in animals and man (HOGSETTE *et al.*, 2002). *Hydrotaea aenescens* currently

Table 3. Syrphidae collected in 2009

Site	AB																															
Date of emptying (2009)	10/04		24/04		11/05		25/05		5/06		19/06		3/07		31/07		17/08		31/08		12/09		28/09		9/10		22/10		Total		
Sex	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m+f
Episyrphus balteatus (De Geer, 1776)													1		21	3		3	6		3	4						1	31	11	42
Eristalis pertinax (Scopoli, 1763)																	1				1								2		2
Eristalis tenax (Linnaeus, 1758)					1										2	1			3	3									6	4	10
Eupeodes corollae (Fabricius, 1794)					1						1	1	1		8	8		1	1	4	1	1							12	16	28
Eupeodes latifasciatus (Macquart, 1829)															2														2		2
Eupeodes luniger (Meigen, 1822)															2	2	1												3	2	5
Helophilus trivittatus (Fabricius, 1805)																	1	5											1	5	6
Melanostoma mellinum (Linnaeus, 1758)	1		4												1	1			1										7	1	8
Melanostoma scalare (Fabricius, 1794)					1																								1		1
Platycheirus albimanus (Fabricius, 1781)			1																										1		1
Rhingia campestris Meigen, 1822																															
Scaeva pyrastri (Linnaeus, 1758)															8	3			6	3	1	1							15	7	22
Sphaerophoria scripta (Linnaeus, 1758)						1												1												2	2
Syrphus ribesii (Linnaeus, 1758)																															
Syrphus vitripennis Meigen, 1822																					1						1			2	2

Table 4. Syrphidae collected in 2006

Date of emptying	12/05/2006								04/08/2006								Total											
Site	AB		EB		NSB		TN		AB		EB		NSB		TN		AB			EB			NSB			TN		
Sex	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m+f	m	f	m+f	m	f	m+f	m	f	m+f
Episyrphus balteatus (De Geer, 1776)							not sampled		1			1					1		1		1	1						
Eristalis pertinax (Scopoli, 1763)		1		1														1	1		1	1						
Eristalis tenax (Linnaeus, 1758)											3	1		1						3	1	4		1	1			
Eupeodes corollae (Fabricius, 1794)	1								2		1			1			3		3	1		1		1	1			
Eupeodes latifasciatus (Macquart, 1829)																												
Eupeodes luniger (Meigen, 1822)																												
Helophilus trivittatus (Fabricius, 1805)									1				1				1		1				1		1			
Melanostoma mellinum (Linnaeus, 1758)	2	1															2	1	3									
Melanostoma scalare (Fabricius, 1794)	1	1															1	1	2									
Platycheirus albimanus (Fabricius, 1781)																												
Rhingia campestris Meigen, 1822		1																1	1									
Scaeva pyrastri (Linnaeus, 1758)																												
Sphaerophoria scripta (Linnaeus, 1758)									1	1				1			1	1	2					1	1			
Syrphus ribesii (Linnaeus, 1758)				1																	1	1						
Syrphus vitripennis Meigen, 1822									1								1		1									

occurs across Europe and in the Netherlands the species is even included in a list of invasive Arthropoda (REEMER, 2003). Although the species is now for the first time reported from Belgium, it occurs here already for several decades. A revision of the collection of Charel Verbeke revealed that this species was already present in the 1970's, at least in the region of Brugge. The first record goes back to 1th of July 1971 (2 males from Lissewege). The specimens in his collection are labelled as *Hydrotaea capensis*. *Hydrotaea aenescens* is not included in former identification keys like D'ASSIS FONSECA (1968) and SÉGUY (1923). Using these works *Hydrotaea aenescens* is identified as *Hydrotaea capensis*. Also HENNIG (1964) does not include the species in the keys, but he remarks in a footnote that *Hydrotaea aenescens* can be expected in the Palaearctic region and that it can be distinguished by it's yellow palpi. Correct determination is also possible with GREGOR *et al.* (2002).

In the grey dunes only five and in the salt marshes only six Muscidae species were found, none of which were habitat specific. Yet there exist a number of habitat specialists in Western Europe. In the 1930s and 1940s KABOS (1951) found on Texel (the Netherlands) several typical salt march species like *Spilogona aerea* (FALLÉN, 1825), *Spilogona biseriata* (Stein, 1916), *Lispe loewi* Ringdahl, 1922 and *Lispe litoreaI* Fallén, 1825. Their larvae are predatory and from the last three species larvae or pupae have been found under algae mats on saline mud (SKIDMORE, 1985; GREGOR *et al.*, 2002). At least *Spilogona aerea* and *Lispe litorea* could be expected as they occur on the Belgian checklist (HOFMANS, 1991). Other Belgian coastal species

are *Coenosia lacteipennis* (Zetterstedt, 1845), *Coenosia minutalis* (Zetterstedt, 1860) and *Villeneuvia aestuum* (Villeneuve, 1902). They are all predators. Puparia of *Coenosia lacteipennis* and *Coenosia minutalis* have been found respectively amongst seaweed and under the seed plant *Honckenya peploides* (L.) EHRH.. Larvae of *Villeneuvia aestuum* have been found in wet sand and under stones in the tidal zone, where they are predatory on several littoral animals (SKIDMORE, 1985; GREGOR *et al.*, 2002). Here however we assessed only a few samples from the salt marshes and non from sandy tidal zones. Further investigation is needed to reveal whether the above habitat specific species occur in the study area.

Also for the Syrphidae less species were found than expected. The fore-dunes itself are no suitable habitat for Syrphidae. However they are known to form a migration corridor for Syrphidae (ROTHERAY & GILBERT, 2011). This is reflected in our data for the Syrphidae. Most of our species are to a greater or lesser extent migrants. Amongst them the most abundant species *Episyrphus balteatus*, *Eristalis tenax*, *Eupeodes corollae* and *Scaeva pyrastri* are known to exhibit strong seasonal migration.

The grey dunes exhibit dry oligotrophic grassland. In the Netherlands species like *Chrysotoxum vernale* Loew, 1841, *Eumerus strigatus* (Fallén, 1817), *Paragus haemorrhous* Meigen, 1822, *Pipizella viduata* (Linnaeus, 1758), several *Sphaerophoria sp.* and *Cheilosia bergenstammi* Becker, 1894 are found in this habitat (REEMER *et al.*, 2009). None of these were recorded in our window trap. However, most of these species have been seen in the Belgian dunes several times recently (Belgian Syrphidae database).

Because of their exposed nature and the influence of salt and tides, salt marshes are only suitable for a few hoverfly species. In the Netherlands imago's of *Eristalinus aeneus* (Scopoli, 1763), *Eristalinus sepulchralis* (Linnaeus, 1758), *Platycheirus fulviventris* (Macquart, 1829), *Platycheirus immarginatus* (Zetterstedt, 1849) and *Sphaerophoria rueppelli* (Wiedemann, 1830) are found feeding on *Limonium vulgare*, Poaceae and Cyperaceae (REEMER *et al.*, 2009). None of these typical species were recorded in our traps. However, during a visit, *Sphaerophoria rueppelli* has been observed.

So far only a restricted number of samples from the salt marshes and grey dunes were assessed. Possibly, analysing more samples would reveal some typical species of these habitats.

Not only the number of species but also the number of specimens was quite low, for both Muscidae and Syrphidae, while the samples contained large amounts of Anthomyiidae. So the question arises whether window traps are efficient to trap these Diptera families. HOWLETT *et al.* (2009) assessed the efficiency of window traps for trapping flower visiting arthropods in onion and pak choi crops. They found that window traps are efficient to study most Diptera and Hymenoptera families. However they found a reduced capture rate for Syrphidae. There observations revealed that Syrphidae tend to fly around the trap windows. For Muscidae and Anthomyiidae they found a comparable efficiency.

Conclusions

Window trapping in the fore-dunes, grey dunes and in the old and new salt marshes of the IJzer estuary revealed 15 species of Muscidae and 15 species of Syrphidae. All of the Syrphidae are common generalists and the most numerous species are well known seasonal migrants. Among the Muscidae one habitat specialist has been found, i.e. *Helina protuberans* which is a typical species of sand dunes. *Hydrotaea aenescens* is a new species for the Belgian checklist.

Not one typical species of grey dunes or salt marshes have been found. However only a restricted number of samples from these habitats were assessed and possibly analysing more samples would reveal some typical species.

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