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Biting midges (*Culicoides*) (Diptera: Ceratopogonidae) along the Sea Scheldt and its tributaries (Flanders, Belgium)

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Abstract

Along the Sea Scheldt and its tributaries *Culicoides* (Diptera: Ceratopogonidae) were collected using a Mosquito Magnet Liberty Plus trap (MMLP). At 83 sites a MMLP operated one week during the period May-October of 2007 and 2008. In total, 1244 adult *Culicoides* were collected in 48 out of 83 sites and 17 of the 45 known Belgian *Culicoides* species were found during the study. *Culicoides chiopterus* (MEIGEN, 1830), *Culicoides dewulfi* GOETHGEBUER, 1936, *Culicoides riethi* KIEFFER, 1914, *Culicoides obsoletus* (MEIGEN, 1818) - *scoticus* DOWNES & CATTLE, 1952 complex and *Culicoides punctatus* (MEIGEN, 1804) were the most abundant. This study taught us that the MMLP could act as an efficient trap to collect a large range of *Culicoides* species. This paper documents on the first detailed study on the distribution of *Culicoides* in a particular region in Belgium and on the presence of some important candidate vectors of the bluetongue virus along the river Scheldt.

Keywords: *Culicoides*/ distribution maps/ Sea Scheldt/ Mosquito Magnet Liberty Plus

Samenvatting

Langsheen de Boven- en Zeeschelde en haar zijrivieren werden *Culicoides* (Diptera: Ceratopogonidae) verzameld met de Mosquito Magnet Liberty Plus val (MMLP). Op 83 locaties was gedurende één week een MMLP operationeel tijdens de periode mei-oktober van 2007 en 2008. Een totaal van 1244 *Culicoides* individuen werd ingezameld op 48 van de 83 locaties en 17 van de 45 gekende Belgische *Culicoides* soorten werd teruggevonden tijdens de staalname. *C. chiopterus*, *C. dewulfi*, *C. riethi*, *C. obsoletus* - *scoticus* complex en *C. punctatus* waren de meest abundante. Deze studie toonde aan dat de MMLP een zeer efficiënt valtype is om een groot aantal *Culicoides*-soorten in te zamelen. We presenteren hier de eerste gedetailleerde verspreidingskaarten van *Culicoides* in een bepaalde regio in België en tonen tevens aan dat sommige belangrijke mogelijke blauwtong vectoren aanwezig zijn langsheen de Schelde.

Introduction

Culicoides or biting midges are worldwide best known as vector of viruses pathogenic for various mammals. They can also transmit roundworms and protozoa in birds, humans and other animals (MELLOR *et al.*, 2000). The female *Culicoides* sucks blood from warm-blooded animals. As they often occur in swarms, they can be a nuisance to humans, especially for people that react allergic to their bites (CHITRA BA, 2002).

Several *Culicoides* sp. are also known as important key-species for vector-borne diseases of veterinary importance as bluetongue virus (BTV). Bluetongue has historically made only

Table 1. *Culicoides* species collected in 2007 and 2008 along the Sea Scheldt and its tributaries with BTV species known as possible Bleutongue vectors in the field (DE DEKEN *et al.*, 2009) and BTV LAB species known as Bleutongue vectors in the laboratory only (DE DEKEN *et al.*, 2009), and the amount of sites where the species were found.

Species	BTV	BTV LAB	Number of sites
Culicoides chiopterus Meigen, 1830	*		21
Culicoides dewulfi Goetghebuer,1936	*		9
Culicoides riethi Kieffer, 1914		*	11
Culicoides obsoletus (Meigen, 1818) / *Culicoides scoticus* Downes & Cattle, 1952 complex	*		26
Culicoides punctatus (Meigen, 1804)	*		5
Culicoides pulicaris (Linnaeus, 1758)	*		5
Culicoides nubeculosus (Meigen, 1830)		*	2
Culicoides newsteadi Austen, 1921	*		3
Culicoides circumscriptus Kieffer, 1918	*		2
Culicoides stigma (Meigen, 1818)			1
Culicoides duddingstoni Kettle & Lawson, 1955			1
Culicoides lupicaris Downes & Kettle, 1952	*		2
Culicoides festivipennis Kieffer, 1914			2
Culicoides pallidicornis Kieffer, 1919			1
Culicoides pictipennis (Staeger, 1839)			1
Culicoides puncticollis Becker, 1903	*		2
Culicoides vexans (Becker, 1903)			2

brief, sporadic incursions into the southern fringes of Europe (MELLOR & BOORMAN, 1995; BAYLIS *et al.*, 1997). Recently however bluetongue has received most attention because of its impact on livestock in southern Europe and its ability to spread rapidly by their insect vectors (TABACHNIK, 2004). *Culicoides* vectors can occur in huge abundances under suitable conditions, and can also be dispersed on air-streams for several kilometers in a single night, leading to rapid spread of the pathogens they carry (SELLERS *et al.*, 1977; 1978).

Despite their importance, little is yet known about the biology and ecology for the majority of the species. They are moreover often difficult to distinguish based solely on morphological traits such that molecular identification tools are recommended (PURSE *et al.*, 2007).

Recently a study on the biology and ecology of the species *Culicoides riethi* (KIEFFER, 1914), which locally caused severe annoyance since the summer of 2005, was conducted in Gentbrugge (Belgium) (VERSTEIRT *et al.*, 2009, SOHIER *et al.* 2009).

The main goal of this paper is to explore the *Culicoides* diversity and species distribution patterns in the region of the Sea and Upper Scheldt and its tributaries in Belgium.

Material and method

At 83 sites along the Sea Scheldt (maximal distance from the river 9 km) a Mosquito Magnet Liberty Plus (MMLP) operated one week in the summers of 2007 and 2008. The MMLP, a CO_2 baited counter flow trap was used to catch Culicidae and Ceratopogonidae in all sites. The samples were taken in the framework of the MODIRISK-project; Mosquito vectors of disease: spatial biodiversity, drivers of change and risk (2007-2011) (see www.modirisk.be). In this project a network of MMLP traps was used throughout Belgium in a grid-based (10 x 10 km) sampling approach where different habitats in each grid were sampled. The sites were randomly allocated in three key habitats (urban, agricultural and natural).

All *Culicoides* were identified using the identification key of DELÉCOLLE (1985). All specimens belonging to *C. obsoletus* and/or *C. scoticus* were lumped together in the *C. obsoletus/scoticus* complex. Samples were stored in 70 % ethanol and deposited in the RBINS Diptera-collection.

Results and discussion

In 48 of the 83 sites along the Scheldt and its tributaries, one or more *Culicoides* species were found. A total of 1244 *Culicoides* individuals

were counted in these samples and 17 of the 45 known Belgian *Culicoides* species (DEBLAUWE *et al.*, 2009) were found so we can conclude that the MMLP seems to be an efficient trap to collect a large range of *Culicoides* species.

The following 5 species were the most abundant: *C. chiopterus*, *C. dewulfi*, *C. riethi*, *C. obsoletus-scoticus* complex and *C. punctatus*. Some species are candidate vectors of bluetongue virus such as *C. obsoletus, C. scoticus, C. dewulfi, C. chiopterus, C. circumscriptus, C. lupicaris, C. newsteadi, C. pulicaris, C. punctatus* and *C. puncticollis* (see table 1). *C. chiopterus* and *C. obsoletus-scoticus* complex were often collected at the same site; whilst *C. riethi* and *C. obsoletus-scoticus*-complex were rarely found together.

In 9 sites we collected three or more species: 3 species in Zwevegem, Lokeren (both urban sites) and Nazareth (agricultural site), 4 species were collected in Weert (agricultural site), 5 species in Groot buitenschoor (natural site) and Mont-de-l'enclus (agricultural site). In Schor Ouden Doel (natural site) and Kalken (agriculture site) we collected 8 species during one week and in Ketenisseschoor at Kallo, a nature reserve along the Scheldt, we collected 11 different species. We here present detailed distribution maps of 16 species and the specimens belonging to the *C. obsoletus/scoticus* complex. For some species as *C. circumscriptus* we can assume a preference for habitats with brackish water.

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Fig 1. 83 sites along the Scheldt and its tributaries ● with *Culicoides* and ▲ without *Culicoides*

Fig 2. Distribution of *C. chiopterus* along the river Scheldt and is tributaries.

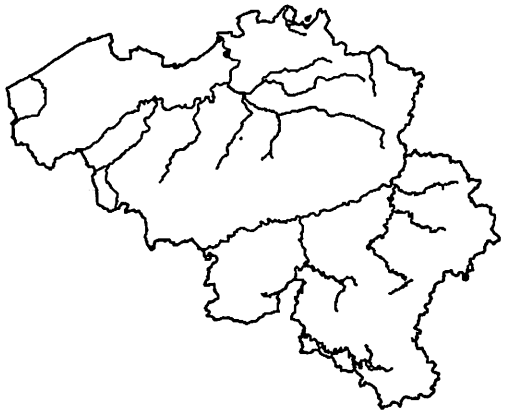

Fig 3. Distribution of *C. circumscriptus* along the river Scheldt and is tributaries.

Fig 4. Distribution of *C. dewulfi* along the river Scheldt and is tributaries.

Fig 5. Distribution of *C. duddingstoni* along the river Scheldt and is tributaries.

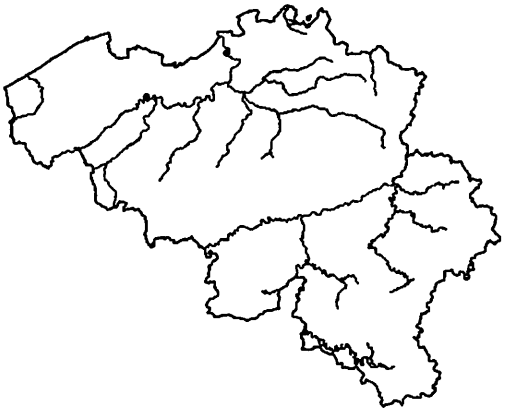

Fig 6. Distribution of *C. festivipennis* along the river Scheldt and is tributaries.

Fig 7. Distribution of *C. lupicaris* along the river Scheldt and is tributaries.

Fig 8. Distribution of *C. newsteadi* along the river Scheldt and is tributaries.

Fig 9. Distribution of *C. nubeculosus* along the river Scheldt and is tributaries.

Fig 10. Distribution *of C. obsoletus-scoticus*-complex along the river Scheldt and is tributaries.

Fig 11. Distribution of *C. pallidicornis* along the river Scheldt and is tributaries.

Fig 12. Distribution of *C. pictipennis* along the river Scheldt and is tributaries.

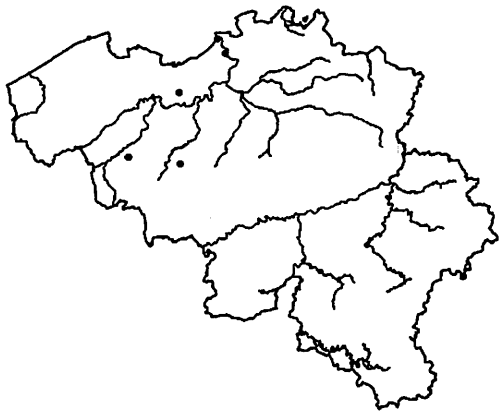

Fig 13. Distribution of *C. pulicaris* along the river Scheldt and is tributaries.

Fig 14. Distribution of *C. punctatus* along the river Scheldt and is tributaries.

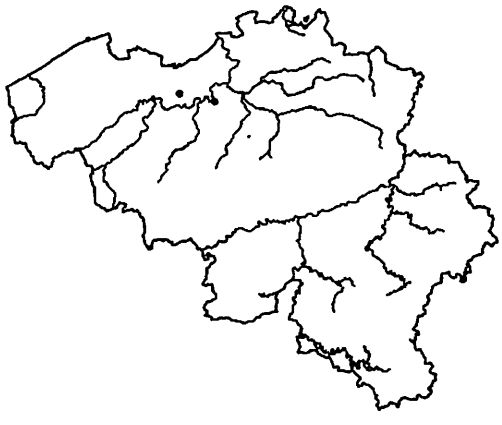

Fig 15. Distribution of *C. puncticollis* along the river Scheldt and is tributaries.

Fig 16. Distribution of *C. riethi* along the river Scheldt and is tributaries.

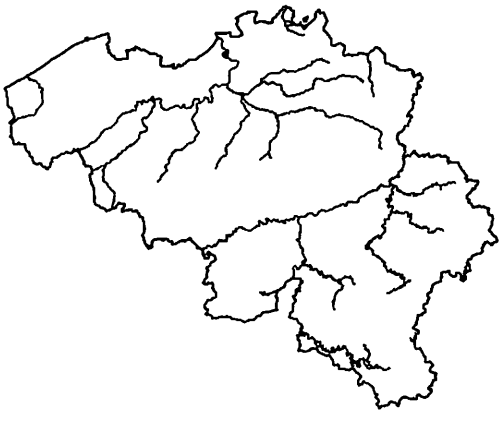

Fig 17. Distribution of *C. stigma* along the river Scheldt and is tributaries.

Fig 18. Distribution of *C. vexans* along the river Scheldt and is tributaries.