CATCHES OF BLOOD-FEEDING FLIES WITH NZI TRAPS IN AFRICAN SWINE FEVER AFFECTED AREAS OF LITHUANIA

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Introduction

African Swine Fever (further in the text – ASF) virus is one of the most infective and lethal viruses for domestic pigs and wild boars. Lithuania is one of the countries suffering big economic losses caused by this virus, therefore all the data about the virus, its ways of distribution, natural reservoirs and possible insect vectors is crucial in order to diminish the risks of the spreading of this deadly disease.

The ASF spread into the Baltic states and Poland in 2014 (EFSA, 2015), it was found in the Czech Republic and Romania in 2017, and reached Hungary and Bulgaria in 2018 (OIE, 2018). The ASF virus is circulating between the domestic pigs (*Sus scrofa domesticus* Erxleben, 1777) and wild boars (*S. scrofa* Linnaeus, 1758) in Lithuania. Although current biosecurity measures in pig farms are rather successful, there are occasions when this virus enters even the farms with the highest levels of biosecurity in place. These cases raise the suspicion, that not only humans can be the cause of ASF transferring from the wild into the farms.

It was proven several decades ago, that stable flies *Stomoxys calcitrans* (Linnaeus, 1758) can transmit the ASF virus mechanically (Mellor *et al*., 1987). Moreover, Olesen *et al*. (2018) proved that *S. calcitrans* can transmit the virus not only by sucking the blood, but also if accidentally eaten by a pig. *Stomoxys* Geoffroy, 1762 flies are obligate blood-sucking insects and may have a direct role in the epidemiology of transmissible diseases, as mechanical vectors of pathogens, including viruses, bacteria, protists, and helminths (Olesen *et al*., 2018). Furthermore, some newest research shows that other insects, such as blowflies (Diptera: Calliphoridae) could possibly be vectors, reservoirs or, more probably, mechanical vectors of the ASF virus (Forth *et al*., 2017).

No data on stable fly population dynamics in Lithuania are available, only general data on biology (Mastauskis, 1947; Šivickis, 1956; Danilevičius *et al*., 1966) or several distribution points (Valenta & Podėnas, 1985) are given, whereas detailed studies have been carried out in southwestern France (Jacquiet *et al*., 2014), Belgium (Lempereur *et al*., 2018), Denmark (Skovgard & Nachman, 2012), and Israel (Kahana-Sutin *et al*., 2017). The same can be said of the horse and deer flies (Tabanidae) in Lithuania – only scattered data is available for the 38 species known in the country (Pakalniškis *et al*., 2006).

The NZI trap represents a major improvement for Stomoxyinae fly cathing, including the cosmopolitan species *Stomoxys calcitrans*, with up to eight times the catch for key African *Stomoxys* spp. relative to the best trap for this group (the Vavoua) (Mihok, 2002). Besides *Stomoxys*, the NZI trap can also catch Tabanidae flies (Desquesnes *et al*., 2013) and therefore this kind of traps was selected for our field research.

The aim of this study was to analyse the seasonal activity of several species of biting

insects (Diptera: Tabanidae and Muscidae (*Stomoxys*)), which could act as potential vectors of the ASF virus in the territories of Lithuania, considered to be infected by ASF.

Material and Methods

On 10th of July, 2018 three standard NZI type traps (Fig. 1) (Rincon-Vitova Insectaries, Inc., Ventura, CA 93002, USA, www.rinconvitova.com) were placed in three localities in the areas where wild boars infected by ASF were previously found. Traps were checked once a week during July and August and once in two weeks in September and October, until the 30th of October. 1.2-Propanediol of 99.5% (Carl Roth GmbH, Germany) was used as a fixating liquid in the traps.

The locality in Poškaičiai was inside the pig farm territory, with corn fields around the complex where wild boars are regularly spotted. The other two localities were in private farms, where some pigs were kept and the area around those farms was also considered to be ASF infected. In Papečiai, there was a water pond nearby and in Skuoliai – a small rivulet just behind the farm; therefore, surroundings of those localities were considered to be suitable for the development of horse-fly larvae.

Several keys were used for the identification of the specimens: Olsufev (1988), Krčmar *et al*. (2011), and Falck (2014) – for Tabanidae, Gregor *et al*. (2002) – for *Stomoxys*. The material is stored at Museum of Zoology of Vilnius University (MZVU).

List of localities

Locality	Administrative district	Coordinates (LAT, LONG)
Papečiai	Lazdijai district	54.265548, 23.552006
Poškaičiai	Vilnius district	54.891858, 25.429798
Skuoliai	Ukmergė district	55.222213, 25.064745

Fig. 1. The NZI trap in the territory of the pig farm in Poškaičiai, Vilnius district.

Results and discussion

During the research season of 2018 in total 323 specimens of biting insects were collected by NZI traps: 4 deer flies *Chrysops* Meigen, 1803, 91 horse-flies *Haematopota* Meigen, 1803, 120 horse-flies *Hybomitra* Enderlein, 1922 (Tabanidae), and 108 stable flies *Stomoxys calcitrans* (Muscidae).

MUSCIDAE

***Stomoxys calcitrans* (Linnaeus, 1758)**

Papečiai, 07–14 08 2018, 7 spec., 14–20 08 2018, 3 spec., 20–27 08 2018, 5 spec., 27 08–12 09 2018, 5 spec., 12–28 09 2018, 12 spec., 28 09–12 10 2018, 12 spec., 12–30 10 2018, 3 spec.; Poškaičiai, 10–16 07 2018, 2 spec., 16–22 07 2018, 3 spec., 22 07–01 08 2018, 4 spec., 01–07 08 2018, 5 spec., 07–14 08 2018, 5 spec., 14–20 08 2018, 3 spec., 20–27 08 2018, 1 spec., 27 08–12 09 2018, 12 spec., 12–28 09 2018, 10 spec., 28 09–12 10 2018, 5 spec., 12–30 10 2018, 2 spec.; Skuoliai, 22 07–01 08 2018, 2 spec., 01–07 08 2018, 1 spec., 12–28 09 2018, 6 spec.

TABANIDAE

***Chrysops* (*Chrysops*) *relictus* Meigen, 1820**

Poškaičiai, 16–22 07 2018, 1 ♀.

***Chrysops* (*Chrysops*) *viduatus* (Fabricius, 1794)**

Papečiai, 10–16 07 2018, 1 ♀; Skuoliai, 10–16 07 2018, 1 ♀, 16–22 07 2018, 1 ♀.

***Haematopota italica* Meigen, 1804**

Papečiai, 22 07–01 08 2018, 1 ♀; Poškaičiai, 22 07–01 08 2018, 1 ♀.

***Haematopota pluvialis* (Linnaeus, 1758)**

Papečiai, 10–16 07 2018, 3 ♀; Poškaičiai, 10–16 07 2018, 14 ♀, 16–22 07 2018, 15 ♀, 22 07–01 08 2018, 25 ♀, 01–07 08 2018, 6 ♀, 07–14 08 2018, 4 ♀, 14–20 08 2018, 4 ♀; Skuoliai, 10–16 07 2018, 3 ♀, 16–22 07 2018, 1 ♀, 22 07–01 08 2018, 11 ♀, 01–07 08 2018, 1 ♀.

***Haematopota subcylindrica* Pandellé, 1883**

Poškaičiai, 22 07–01 08 2018, 2 ♀.

***Hybomitra* spp.**

Papečiai, 10–16 07 2018, 14 ♀, 16–22 07 2018, 46 ♀, 22 07–01 08 2018, 3 ♀; Poškaičiai, 10–16 07 2018, 13 ♀, 16–22 07 2018, 26 ♀, 22 07–01 08 2018, 10 ♀, 01–07 08 2018, 3 ♀; Skuoliai, 22 07–01 08 2018, 5 ♀.

Relative abundance of each taxon (except *Chrysops*, due to its low abundance) was calculated as a percentage from all the specimens of that taxon. Most specimens of the horse-flies *Haematopota* and *Hybomitra* were caught during July and the first half of August (Figs. 2, 3) and none were detected during the later period. Stable flies *Stomoxys calcitrans* were caught during the whole period of research (July to October) and their abundance rose at the end of August and this autumn peak lasted until the middle of October (Fig. 4).

Evaluation of seasonal dynamics of *Stomoxys calcitrans* showed a peak of activity in autumn. Such fact was similarly observed in southwestern France (Jacquiet *et al*., 2014), Denmark (Skovgard & Nachman, 2012), and Nebraska (Taylor *et al*., 2007). Unfortunately, as there was no opportunity to put out the traps earlier in the season, we have no data about the beginning of the activity season of *S. calcitrans* in Lithuania.

There is a possibility that this species has both spring–summer and summer–autumn activity peaks in Lithuania as well as such activity traits were found in southeastern France and Denmark (Skovgard & Nachman, 2012; Jacquiet *et al*., 2014).

It is hard to judge if the numbers of blood-feeding flies caught by NZI traps during our short research are high or low. On the one hand, the NZI trap opening serves to intercept the flight of flies coming from only one direction, but on the other hand, these traps are proved to be better suited for horse-fly diversity survey than either Box traps or Canopy traps (Mikuška *et al*., 2016). It was found that NZI traps facing south and east collected nearly twice as many stable flies (*Stomoxys*) as the traps facing north and west (Taylor & Berkebile, 2006), therefore the orientation of the trap has to be considered for the higher catch.

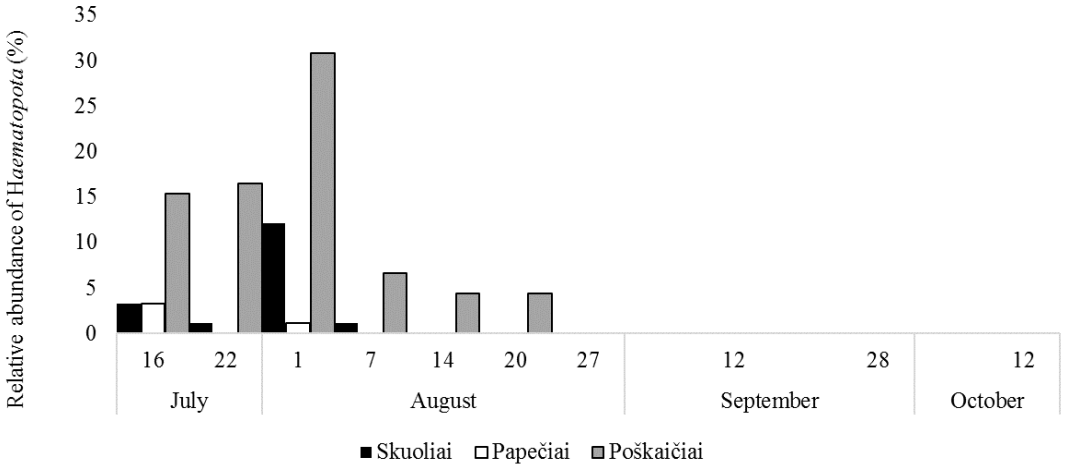
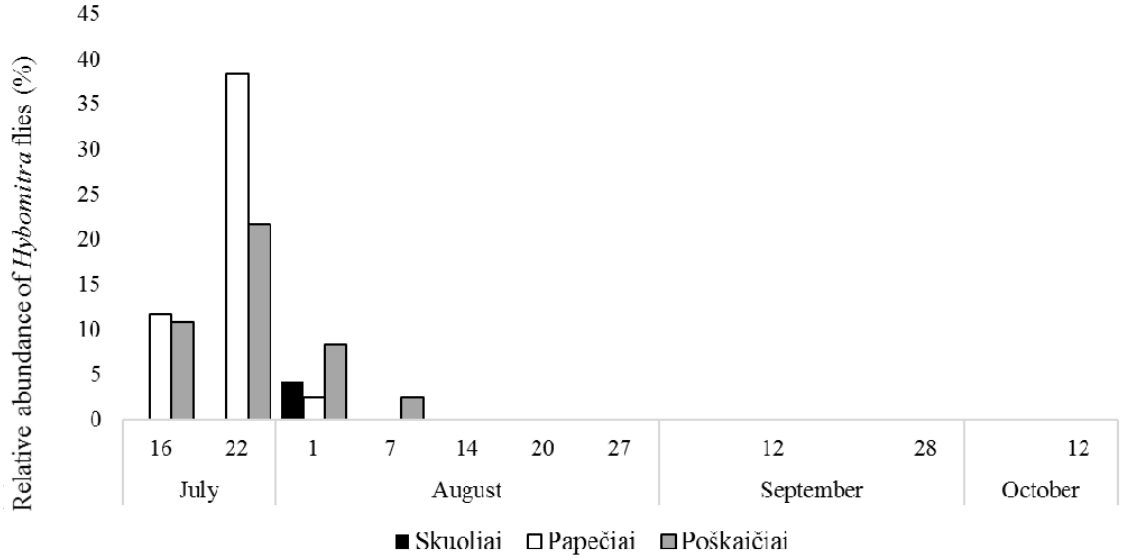
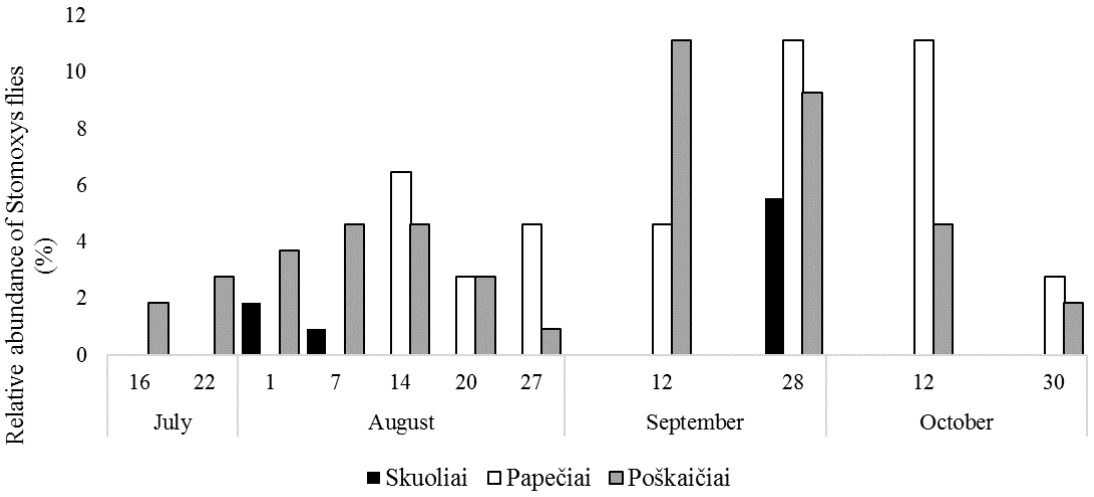


Fig. 2. Relative abundance of *Haematopota* in three NZI traps in 2018.



Specimen data of *Stomoxys calcitrans* was so far known only from Lazdijai district (Valenta & Podėnas, 1985), although other authors mention it as being a common species in Lithuania (Mastauskis, 1947; Šivickis, 1956; Danilevičius *et al*., 1966). In this article, we provide additional distribution data from Ukmergė and Vilnius districts.



Chrysops relictus was known from Alytus (Ivinskis *et al*., 1993; Podėnas & Pakalniškis, 1997), Lazdijai (Valenta & Podėnas, 1985), Varėna (Podėnas, 1988), Švenčionys (Rakauskas, 1974) districts; we added the Vilnius district to a known distribution area of this species. *Ch. viduatus* has been already detected in Alytus, Jurbarkas (Podėnas & Pakalniškis, 1997), and Varėna (Valenta & Podėnas 1985; Podėnas, 1988) districts; the new records from the territories of Lazdijai and Ukmergė districts expanded a known distribution area.

Haematopota italica has been recorded in Alytus (Podėnas & Pakalniškis, 1997), Lazdijai, Ukmergė (Valenta & Podėnas, 1985), and Varėna (Podėnas, 1988) districts. *H. pluvialis* was known from Alytus (Ivinskis *et al*., 1993; Podėnas & Pakalniškis, 1997), Jurbarkas (Podėnas & Pakalniškis, 1997), Lazdijai, Ukmergė (Valenta & Podėnas, 1985), Ignalina, Utena (Eitminavičiūtė *et al*., 1981), Švenčionys (Rakauskas, 1974; Eitminavičiūtė *et al*., 1981), and Varėna (Podėnas, 1988) districts. The new records from the Vilnius district enlarged a known distribution area of these two *Haematopota* species. *H. subcylindrica* has been detected in Alytus, Jurbarkas (Podėnas & Pakalniškis, 1997), and Lazdijai (Valenta & Podėnas, 1985) districts; we added the Vilnius district to a known distribution area.

Although rather many horse-flies of the genus *Hybomitra* were collected, they turned out harder to identify reliably, so they were left identified to the genus level.

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Kraujasiurbių vabzdžių sugavimai NZI tipo gaudyklėmis Afrikiniu kiaulių maru užkrėstose teritorijose Lietuvoje

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Santrauka

Afrikinis kiaulių maras yra viena iš labiausiai užkrečiamų ir mirtinų kiaulių bei šernų ligų, o Lietuva yra viena iš šalių, kurioje dėl šios nuo 2014 metų plintančios ligos kiaulininkystės sektorius patiria didžiulius ekonominius nuostolius. Žinios apie afrikinio kiaulių maro sukėlėją, jo plitimo kelius, gamtinius židinius ir galimus pernešėjus yra būtinos norint sumažinti ligos plitimo riziką. Tyrimų metu 2018 metų liepos–spalio mėnesiais pirmą kartą Lietuvoje buvo išbandytos NZI tipo gaudyklės, skirtos kraujasiurbių musių – sparvų (Tabanidae) ir musių kandiklių (*Stomoxys calcitrans* (Muscidae)) – gaudymui. Iki šiol Lietuvoje apie šiuos vabzdžius buvo renkami tik atsitiktiniai duomenys, o mūsų atliktas tyrimas praplėtė žinias apie penkių sparvų rūšių (*Chrysops relictus, Ch. viduatus, Haematopota italica, H. pluvialis, H. subcylindrica*) ir musių kandiklių paplitimą bei sezoninį aktyvumą. Patvirtintas literatūroje minimas rudeninis *S. calcitrans* aktyvumo pikas rugpjūčio–spalio mėnesiais.

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