SEPSIDAE (DIPTERA) ASSOCIATED WITH ANIMAL AND HUMAN DECOMPOSITION IN THE CZECH REPUBLIC

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Abstract: Applied research method is a combination of search retrieval and empirical part based on observing two experiments carried out between 2011 and 2012 and between 2012 and 2013. In all experiments model carcasses of pigs *Sus scrofa* f. *domestica* Linnaeus, 1758 were used. Pig carcasses meant to imitate the real crime scenes, substituting human corpses. Samples were collected from dead bodies and from nearby vegetation. The objective of the experimental part was to observe and annotate which species of Sepsidae family were present at given time and to elaborate on possible relation between their presence and phases of cadaver decomposition. During trials, altogether 15 195 adult specimens of family Sepsidae were collected which belonged to 15 species. The most abundant species was *Nemopoda nitidula* (Fallén, 1820) which larvae were collected from both carcasses. The experiment leads to broadening of the available knowledge about Sepsidae family and helped to verify applied data collecting methods.

Key Words: Sepsidae, forensic entomology, pyramidal trap, Acalyptratae, species identification

INTRODUCTION

Sepsidae family is currently understudied potential colonization interval indicator. Flies have small, ant resembling body and wing-waving habit, which is typical for the family. Species of Sepsidae family are located worldwide, there are 283 species in all (Meier 1996) and 31 of those are listed in the checklist of Diptera from the Czech Republic (Barták 2009). They are found mostly on excrements, cadavers and decaying vegetation which create environment for laying eggs and further larvae development (Pont and Meier 2002). Sepsidae family prefers bigger cadavers in advanced stage of decomposition to fresh cadaver (Wayne 1994, Byrd and Castner 2009). Smith (1986) states that Sepsidae spp. are occurred on approximately 3–6 months old body, but they could be found on the relatively fresh and on small cadaver (De Jong and Hoback 2006). There may be swarms of these flies at the crime scene, depending on its location (Gennard 2007).

In a forensic entomology context, several authors reported various Sepsidae species from animal decomposition studies and from human corpses. De Jong and Hoback (2006) documented *Themira putris* on rat carcass on day 7 of the trial. Adult Sepsidae flies were caught from rabbit and monkey carcass on 5th day of decomposition (Azwandi et al. 2013). Various species from Sepsidae family were collected during the study of the insects of buried human bodies (Motter 1898). Schoenly et al. (2007) compared colonization of pig carcass and human corpse. The results showed that Sepsidae flies were found equally on human bodies and on pig carcasses.

MATERIAL AND METHODS

Description of localities

The first experiment labelled as “Summer” took place in a fenced ground of the Police school in 9 – Hrdlořezy, the eastern suburb of the capital. The research site was open, sunlit place with grass, bushes and trees. Geographic coordinates: 50°5’22" N, 14°30’19" E; altitude: 240 m amsl.

The second experiment named as "Spring" was situated in a fenced experimental field of the Czech University of Life Sciences in Prague, in district Troja, the northern part of the capital. Research site was grass-covered, open and sunlit with fruit trees and bushes. The area was on west-facing slope near Vltava River, in a flooding zone. Geographic coordinates: 50°7'16" N, 14°23'53" E; altitude: 185 m amsl.

Both experimental sites were chosen as typical locations of founding dead human bodies in urbanized areas in the Czech Republic.

Description of experiments and collecting methods

The first experiment called "Summer" was based on using pig carcass as models for human decomposition. The pig was about 65 kg; it was killed on 13 July 2011 by a single shot to the front of its head with a 0.22 calibre rifle and moved to the research site within 20 minutes. Dead pig was foil-wrapped during its transport to avoid an earlier oviposition before reaching the site. Before exposition, the pig was dressed in a cotton shirt and overalls to imitate a common homicide crime scene. Pig was exposed on the research field on 13 July 2011; this day is day 1 of the experiment. The experiment was conducted from 13 July 2011 (day 1) to 18 October 2012 (day 464) until the carcass decomposition was finished. Samples were collected with insect net and pitfall traps. Control intervals were: day 1 to 17 once a day; day 17 to 62 once two to three days, day 62 to 195 once ten to fourteen days and day 195 to 464 once a month.

Pig used in the second experiment called "Spring" was about 53 kg and died by natural cases in the evening on 19 March 2012 and was stored in a cool room (at about 6 °C) to avoid an earlier oviposition. Day after the pig was transported to the research field and dressed in T-shirt and trousers. The experiment was conducted from 20 March 2012 (day 1) to 6 June 2013 (day 444) until a flood in Prague damaged the experimental site. Adult flies were collected over the pig with pyramidal trap (Barták and Roháček 2011) which was placed above the carcass for all time duration of the trial. The trap was situated 20 to 40 cm above ground or vegetation level to make accessible the carcass to insect, base of the trap was 2 x 2 m in size.

Head of the trap was filled with mixture: 1.5 l of water, 2 ml of 36–38% formaldehyde and 1 ml of detergent. Captured material was collected: day 1 to 197 once a week, day 197 to 267 every fourteen days, day 267 to 393 once a month and then until the end of the trial on day 444 again every fourteen days. The intervals corresponded with seasons.

Species identification

The identification of Sepsidae species was based on the identification key from monography The Sepsidae (Diptera) of Europe (Pont and Meier 2002), all specimens were identified by T. Olekšáková and M. Barták. Specimens of both families are deposited in collections of the Institute of Criminalistics in Prague (ICP).

Meteorological measurements

During both trials, daily (shade) air temperatures and ground surface temperature were measured. In Hrdlořezy ("Summer" experiment), air temperatures were determined with Volcraft DL-141TH (Volcraft) digital datalogger which was attached to an upright post approximately 1.5 m away from the carcass and 2 m above the ground level. It was enclosed in a waterproof casing and shielded from direct sunlight. During the experiment in Troja ("Spring"), data about air temperatures and ground surface temperatures were taken from a stationary weather station placed on the ground of the Czech University of Life Science which was located approximately 40 m away from the carcass.

RESULTS

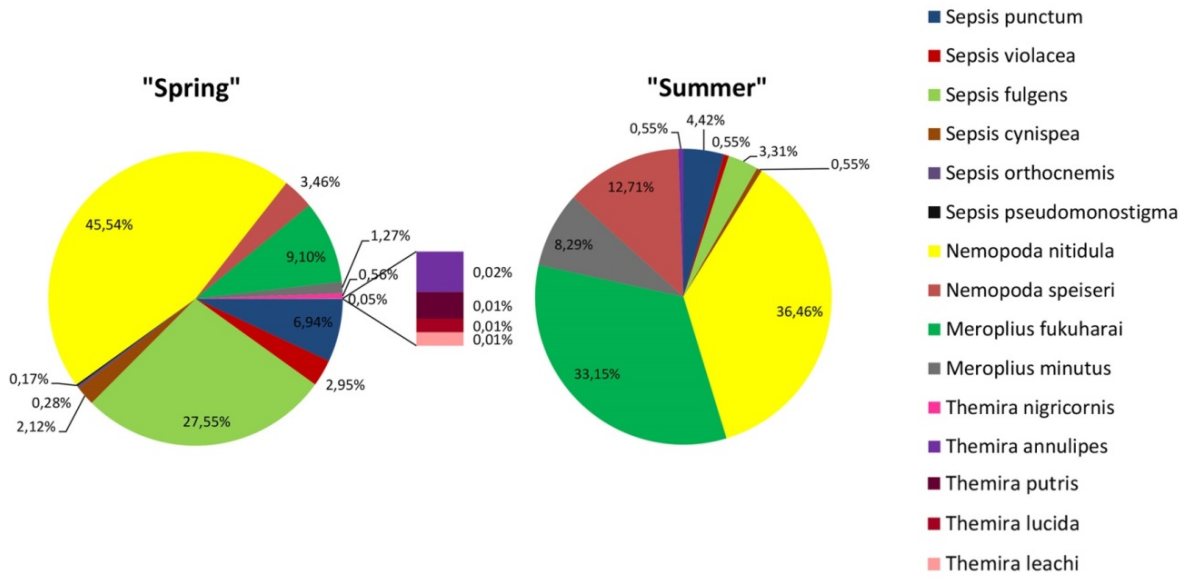
There were collected 181 adult specimens of the Sepsidae family during "Summer" experiment. In "Spring" trial 15 014 adult specimens were collected.

The "Summer" trial simulated colonization of a corpse, that started in the beginning of Summer. Altogether nine Sepsidae species were collected. These species were, in alphabetic order: *Meroplius fukuharai* (Iwasa, 1984), *Meroplius minutus* (Wiedemann, 1830), *Nemopoda nitidula* (Fallén, 1820), *Nemopoda speiseri* (Duda 1926), *Sepsis cynipsea* (Linnaeus, 1758), *Sepsis fulgens* (Meigen, 1826),

Sepsis punctum (Fabricius, 1794), *Sepsis violacea* (Meigen, 1826) and *Themira annulipes* (Meigen, 1826). Most numerous species of the experiment was *Nemopoda nitidula*, which represented 36.46% (n = 66) of all samples (Figure 1). The first females arrived on the cadaver during the first day of the experiment and they were identified as *Sepsis punctum*. On the second day, *Nemopoda nitidula* females were found on the cadaver. Larvae collected from the carcass were reared out under laboratory conditions until adults, which were identified as *Nemopoda nitidula*.

The "Spring" trial simulated colonization of the corpse starting in early Spring. Fifteen species of the Sepsidae family were collected, in alphabetic order: *Meroplius fukuharai* (Iwasa, 1984), *Meroplius minutus* (Wiedemann, 1830), *Nemopoda nitidula* (Fallén, 1820), *Nemopoda speiseri* (Duda, 1926), *Sepsis cynipsea* (Linnaeus, 1758), *Sepsis fulgens* (Meigen, 1826), *Sepsis orthocnemis* (Frey, 1908), *Sepsis pseudomonostigma* Urso 1968, *Sepsis punctum* (Fabricius, 1794), *Sepsis violacea* (Meigen, 1826), *Themira annulipes* (Meigen, 1826) *Themira leachi* (Meigen, 1826), *Themira lucida* (Staeger, 1844), *Themira nigricornis* (Meigen, 1826) and *Themira putris* (Linnaeus, 1758). Most numerous species of the experiment was *Nemopoda nitidula*, which represented 45.54% (n = 6838) of all samples (Figure 1). Various Sepsidae species were collected from the first day of the experiment. The larvae collected during the trial were reared out under laboratory conditions until adults, all specimens were identified as *Nemopoda nitidula*.

Figure 1 Percentage abundance of Sepsidae collected during "Spring" and "Summer" experiments



Mating behaviour was observed during both experiments. Mating on the cadaver was proved for following species: *Meroplius fukuharai*, *Themira nigricornis*, *Sepsis fulgens* and *Nemopoda nitidula*. The only species which developed entirely on the cadavers was *Nemopoda nitidula*.

DISCUSSION AND CONCLUSIONS

Altogether 15 species of Sepsidae family were collected during both experiments, representing 48.39% of all Sepsidae species known from the Czech Republic (Barták 2009).

There were a few species recorded during both experiments, which normally do not occur on cadavers, according to Pont and Meier (2002). Those species are: *Themira annulipes*, *Sepsis cynipsea*, *Sepsis violacea*, *Sepsis pseudomonostigma* and *Themira leachi*. All those were found during both trials, *Sepsis pseudomonostigma* and *Themira leachi* were found only during "Spring" trial. In any of the trials, there was no representative of *Nemopoda pectinulata*, which has similar distribution as *Nemopoda nitidula*, but *Nemopoda pectinulata* prefers colder environment (Pont and Meier 2002). *Sepsis orthonemcis*, *Sepsis pseudomonostigma*, *Themira annulipes*, *Themira putris*, *Themira lucida* and *Themira leachi* were detected in very small numbers (Figure 2, Figure 3); we assume that it was only a random capture.

Figure 2 Month by month percentage abundance of Sepsidae collected during "Spring" experiment

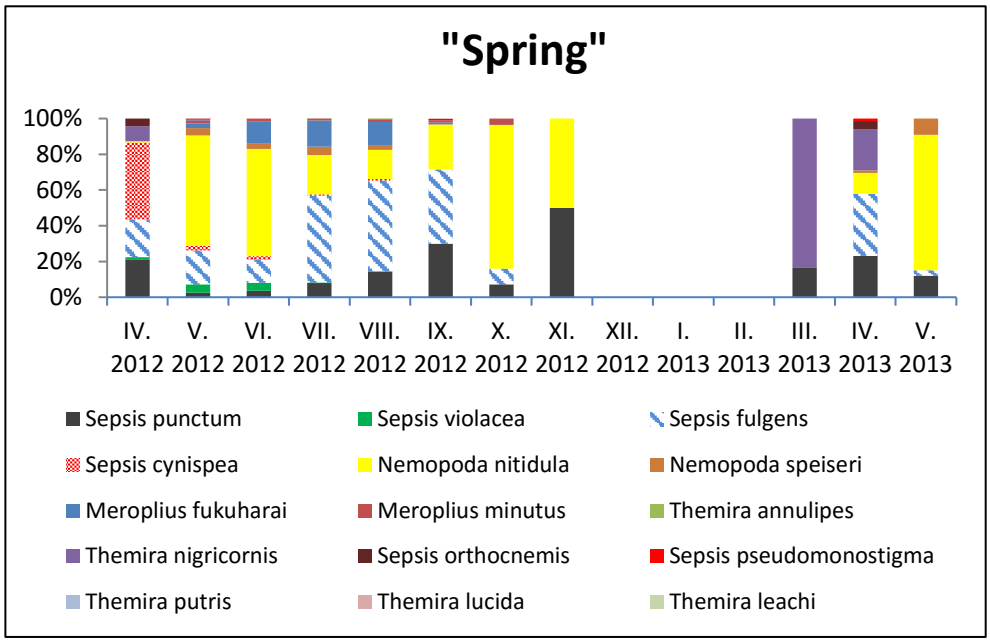
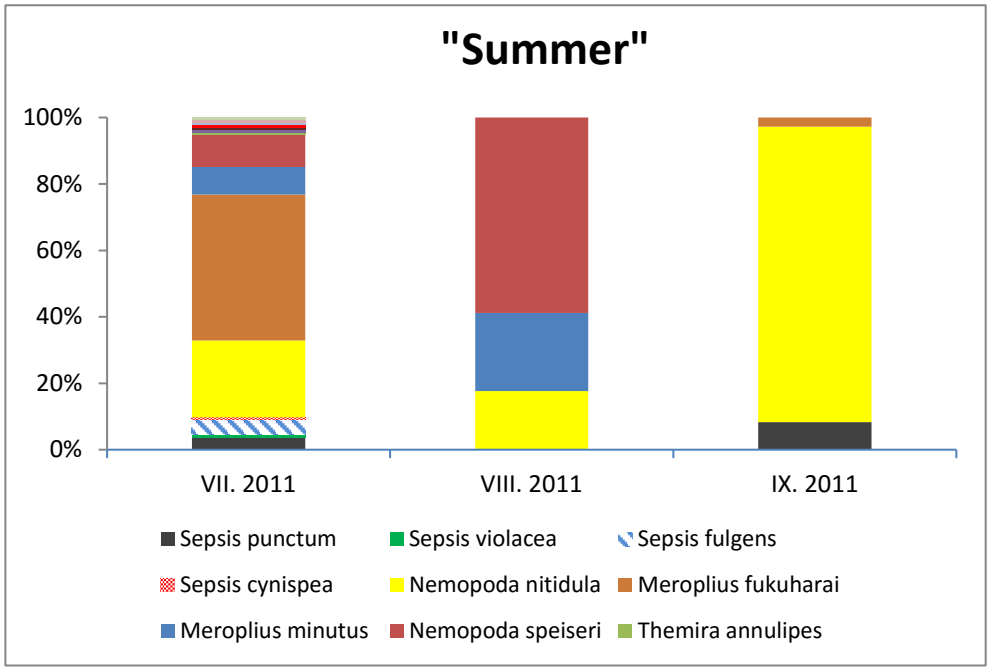


Figure 3 Month by month percentage abundance of Sepsidae collected during "Summer" experiment



Number of females and males for all species were compared. The highest difference between males and females showed *Nemopoda nitidula*. In "Spring" trial females represented 84.57% of all *Nemopoda nitidula* specimens, in "Summer" *Nemopoda nitidula* females represented exactly 75%. The highest incidence of females belonging to *Nemopoda nitidula* specie was recorded during the spring and early summer. In "Spring" trial, there was a periodic rise and fall of males, which we explains that for the most of the time was carcass visited by females for the purpose of laying eggs, and when the adults developed, the number of males temporarily increased (Olekšáková et al. 2014). For other species was proportion between males and females even, eventually males prevailed over females. *Nemopoda*

nitidula usually develops at vertebrate carrion (Van der Goot 1986) which was verified by successful rearing adults from puparia found on a dead pig.

Occurrence of mostly all species during the year corresponded with Pont and Meier (2002). In both trials, the most numerous species were *Nemopoda nitidula* (Figure 1), which is abundant in the Czech Republic (Barták and Vaněk 2009). Important is abundant occurrence of *Nemopoda speiseri*, which is considered as rare, according to Pont and Meier (2002), but it is occasionally collected from dead human bodies in the Czech Republic (Šuláková unpublished data). *Nemopoda speiseri* records are from June to August (Pont and Meier 2002). This does not correspond to results from "Spring" trial, when *Nemopoda speiseri* was presented from April to October (the first year of the experiment May to October, the second year April to May – see Figure 2) as well as to human corpses, when its living and active larvae were collected even at the end of December in an outdoor case with the beginning of the decomposition during July of the same year (Šuláková unpublished data).

In our opinion, most Sepsidae species are tightly bound to the season more than to the degree of cadaver decomposition, which was confirmed in "Spring" trial; a typical spring fly *Themira nigricornis* was captured first year of experiment in spring on fresh carcass, and one year later in the same period to nearly skeletonized carcass; similar incidence of spring species of Sepsidae confirmed Anton et al. (2011). The other Sepsidae species returned on the cadaver next year, regardless of its level of decomposition.

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