Biuletyn Sekcji Dipterologicznej Polskiego Towarzystwa Entomologicznego
DIPTERON
Bulletin of the Dipterological Section of the Polish Entomological Society
ISSN 1895–4464
Tom 33: 85-93
Akceptacja 20.12.2017
Wrocław 23 XII 2017

Annotated list of blowflies (Diptera: Calliphoridae) recorded during studies of insect succession on large carrion in Poland

Wykaz plujek (Diptera: Calliphoridae) stwierdzonych podczas badań nad sukcesją owadów w trakcie rozkładu dużej padliny w Polsce

KRZYSZTOF SZPILA

Nicolaus Copernicus University, Faculty of Biology and Environmental Protection
Chair of Ecology and Biogeography, Lwowska 1, 87-100 Toruń, Poland
e-mail: szpila@umk.pl

DOI 10.5281/zenodo.1129345

ABSTRACT. In Europe, as elsewhere, blowflies (Calliphoridae) are usually the most abundant and frequent insects visitors of the exposed remains of vertebrates. The total Polish calliphorid fauna consists 69 recorded species but only some of them are typical carrion breeders with confirmed forensic importance. This paper is based on data collected from experimental studies of insect succession on pig carrion conducted in Poland from year 2005 to year 2012. Surprisingly, adults of many species of non-necrophagous blowflies were observed as carrion visitors during these experiments. The updated list provided here consists of 24 species.

KEY WORDS: Calliphoridae, list, large carrion, insect succession, forensic entomology, Poland

INTRODUCTION

Information about the Polish fauna of the dipteran family Calliphoridae was summarised by DRABER-MOŃKO (2004, 2007). Since then, only four additional species have been reported and the total number of blowflies known from Poland stands at 69 (SZPILA *et* DRABER-MOŃKO 2008; SZPILA *et* AL. 2008; BYSTROWSKI *et* GRZYWACZ 2009; SZPILA 2015). The family Calliphoridae in its traditional broad form contains many non-necrophagous species. Most of them are parasites or parasitoids, infesting a wide range of various vertebrate and invertebrate hosts (ROGNES 1998). In Europe, hosts are mostly recruited among birds (nestlings), amphibians (anurans), earthworms and pulmonate snails (ROGNES 1991, DRABER-

MOŃKO 2004). In contrast to facultative parasitic necrophagous blowflies, the larvae of these true parasites (e.g. *Pollenia* spp. and *Bellardia* spp.) are unable to complete development by feeding on decaying vertebrate remains, (SZPILA, *personal observation*). The presence of adult specimens of true parasites cannot be treated as fully accidental because, for some of them at least, females feed on liquid and semi-liquid products of decomposition. Their forensic importance remains low, as in the case of many other taxa frequently visiting carrion as adults (MATUSZEWSKI *et* AL. 2010). During large-scale successional experiments recently conducted in Poland, a diverse assortment of blowflies was collected. MATUSZEWSKI *et* AL. (2008, 2010, 2013, 2016) mostly concentrated on species with confirmed forensic importance and information about the presence of many other taxa was treated as irrelevant and finally remained unpublished.

This approach seems to have been common in other forensically oriented studies. Information about non-necrophagous species is typically excluded to meet also the profile of the target journal profile (forensic medicine), the journal's restriction in manuscript size (page limit) or difficulties with the identification of parasitic species. However, information about the attractiveness of carrion for adults of truly parasitic blowfly species is relevant, at least for studies of the biology and evolution of the Calliphoridae. Therefore, I present here a full list of the blowflies that have been recorded during studies of insect succession on pig carrion undertaken in Poland.

MATERIAL AND METHODS

Field experiments. The data presented here are derived from MATUSZEWSKI *et* AL. (2008, 2010, 2013, 2014, 2016) which provide detailed descriptions of the experimental design and protocols for the sampling and handling of insects. The most important points are summarised below.

Between 2005 and 2007, 13 carcasses of domestic pigs were exposed in pine-oak forest, 13 in alder forest and 13 in hornbeam-oak forest (MATUSZEWSKI *et* AL. 2008, 2010). In 2011 a further nine carcasses were exposed in grassland, four in the ecotone at the edge of a forest, four in a birch ecotone in in grassland, five in hornbeam-oak forest, four in alder forest and four in birch forest (MATUSZEWSKI *et* AL. 2013). In 2012, a final s*et* of 24 carcasses were exposed in grassland (MATUSZEWSKI *et* AL. 2014, 2016). All studies were undertaken in the Biedrusko Military Training Ground, Poland.

At each carcass, adult flies were sampled with pitfall traps, as well as manually with an aerial sweep net. Fly larvae were similarly sampled with pitfall traps and manually with forceps. Two pitfall traps (with 50% ethylene glycol solution) were used per carcass. Insects were preserved in 70% ethanol. Sampling occurred daily until the end of active decay, after which it was less frequent.

Species identification. Identification of males and females was made using the monographs of DRABER-MOŃKO (2004) and ROGNES (1991). Larvae and puparia were identified using the keys of ERZINÇLIOĞLU (1985), SCHUMANN (1954, 1971) and SZPILA (2010).

RESULTS

Brief notes for each blowfly species recorded from the pig carcasses are given below. In the interests of brevity, the following abbreviations have been used: A – adult, FO – forest habitats, EC – ecotone, GR – grassland, L – larva.

Bellardia viarum (ROBINEAU-DESVOIDY, 1830); GR (A)

Only two specimens collected during summer. Widely distributed in the Palaearctic region (SCHUMANN 1986, ROGNES 1991). Ovolarviparous but the biology of the larval stages remains unknown.

Bellardia vulgaris (ROBINEAU-DESVOIDY, 1830); FO (A)

Only a few adult specimens collected during summer. A common species in Europe, also introduced to North America. An ovolarviparous parasite of earthworms, but precise information about the host is lacking (ROGNES 1991).

Calliphora subalpina (RINGDAHL, 1931); FO (A)

Only a single female collected during summer. Widely distributed in the Palaearctic region, where it is abundant in mountainous forest habitats. Oviparous and necrophagous, reported from a human cadaver in Sweden (LINDSTRÖM 2012).

Calliphora vicina (ROBINEAU-DESVOIDY, 1830); FO (A, L), GR (A, L), EC (A, L)

Abundant in all explored habitats, mostly during spring. A cosmopolitan species with confirmed forensic importance (SMITH 1986).

Calliphora vomitoria (LINNAEUS, 1758); FO (A, L), GR (A, L), EC (A, L)

Observed in all explored habitats during all three seasons. A Holarctic species, reported also from the Oriental region (ROGNES 1991), with confirmed forensic importance (SMITH 1986).

Cynomya mortuorum (LINNAEUS, 1761); FO (A, L), EC (A, L)

The most abundant during spring. A species with a Holarctic distribution. Reported a few times on human corpses (SZPILA 2010).

Onesia austriaca VILLENEUVE, 1920; FO (A), GR (A)

Only several males and females collected during spring and summer. A European species that is an ovolarviparous parasite of various species of earthworms (SCHUMANN 1964, 1986).

Chrysomya albiceps (WIEDEMANN, 1819); FO (A, L)

More than twenty larvae and few adult specimens collected on two carcasses during summer (SZPILA *et* AL. 2008). An Afrotropical species, common also in North Africa, the Middle East, and recently reported in many European countries. In the 1970s it was introduced to South America (BAUMGARTNER *et* GREENBERG 1984). The species has confirmed forensic importance (SMITH 1986).

Phormia regina (MEIGEN, 1826), FO (A, L); GR (A, L), EC (A, L)

Observed in all explored habitats during spring and summer. A Holarctic species, reported also from the Hawaiian Islands (ROGNES 1991), with confirmed forensic importance (SMITH 1986).

Protophormia terraenovae (ROBINEAU-DESVOIDY, 1830); FO (A, L), GR (A, L)

Recorded always with low abundance, mostly during spring. A Holarctic species with confirmed forensic importance (SMITH 1986).

Lucilia ampullacea (VILLENEUVE, 1922); FO (A), GR (A)

Several adult specimens were observed during all three seasons. Distributed in the Palaearctic but also Oriental and Australasian regions. Reported from a human cadaver in Italy (VANIN *et* AL. 2008) and experiments on pig carrion in southern Germany (GRUNWALD *et* AL. 2009)

Lucilia caesar (LINNAEUS, 1758); FO (A, L), GR (A, L), EC (A, L)

Observed in all explored habitats during all three seasons. Palaearctic in distribution and a dominant species in insect communities colonising large carrion in many European countries (e.g. ANTON *et* AL. 2011, PRADO E CASTRO *et* AL. 2012, ŠULÁKOVÁ *et* BARTÁK 2013). Confirmed to have forensic importance (VANIN *et* AL. 2008).

Lucilia illustris (MEIGEN, 1826); FO (A), GR (A, L), EC (A, L)

A relatively abundant species, collected mostly during summer, but collected only as several adult specimens in forest habitats. Species widely distributed in the Holarctic, Oriental and Australasian regions (ROGNES 1991). Confirmed to have forensic importance (SMITH 1986).

Lucilia pilosiventris KRAMER, 1910; GR (A)

Single male specimen only was collected (during summer) (Fig. 1). A rare species widely distributed in the Palaearctic. The biology of the larval stages is unknown (DRABER-MOŃKO 2004).

Lucilia sericata (MEIGEN, 1826); FO (A), GR (A, L), EC (A, L)

Abundant in grassland and ecotones, collected mostly during summer. Only several adult specimens collected in forest habitats. This species has almost a cosmopolitan distribution and is also with confirmed forensic importance (ROGNES 1991, SMITH 1986).

Morinia doronici (SCOPOLI, 1763); FO (A)

Only a single specimen collected during summer. A European species with the biology of the larval stages unknown (ROGNES 1991).

Pollenia amentaria (SCOPOLI, 1763); FO (A)

Only a few specimens collected during spring. This species has a west Palaearctic distribution (SCHUMANN 1986, ROGNES 1991). A common species but with the biology of the larval stages unknown (DRABER-MOŃKO 2004).

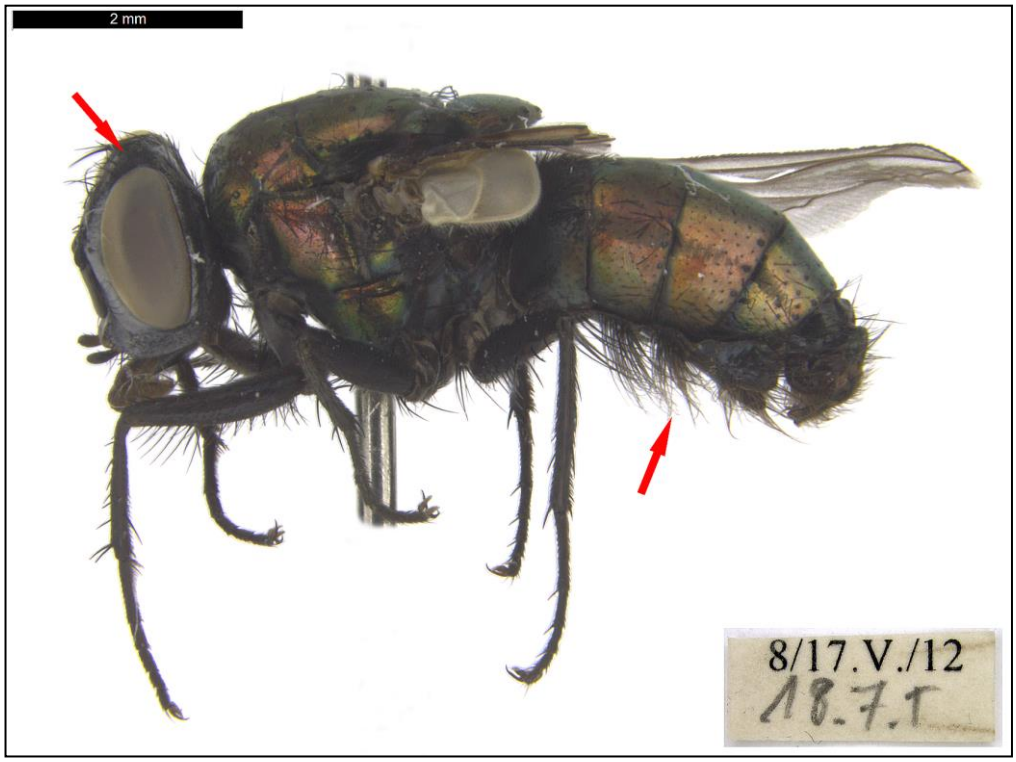

FIG. 1. Male specimen of *Lucilia pilosiventris* collected during studies in the Biedrusko Military Training Ground, Poland.

Pollenia atramentaria (MEIGEN, 1826); GR (A)

Only a few specimens collected during summer. West Palaearctic distribution. Biology of preimaginal stages unknown (DRABER-MOŃKO 2004).

Pollenia griseotomentosa (JACENTKOVSKÝ, 1944); FO (A)

Two specimens collected in forest during spring. A European species, the larval biology of which is unknown (ROGNES 1991).

Pollenia labialis ROBINEAU-DESVOIDY, 1863; FO (A)

Relatively abundant, collected mostly during spring. A species with Holarctic distribution (ROGNES 1991) and unknown larval biology (DRABER-MOŃKO 2004).

Pollenia mayeri JACENTKOVSKÝ, 1941; FO (A)

Only a single specimen collected during summer. Reported only in Central Europe (DRABER-MOŃKO 2004). The first instar larva has peculiar morphology but the biology of immature stages remains unknown (SZPILA 2003, DRABER-MOŃKO 2004).

Pollenia pediculata MACQUART, 1834; FO (A), GR (A), EC (A)

Recorded as adults in all habitats, mostly during spring and summer, with high abundance in grassland. Widely distributed in the Palaearctic, Nearctic and Australasian regions. Known to be an earthworm parasite (ROGNES 1991).

Pollenia rudis (FABRICIUS, 1794); FO (A), GR (A), EC (A)

Recorded as adults in all habitats, mostly during spring and summer with very high abundance in grassland. Widely distributed in the Palaearctic, Nearctic, Oriental and Australasian regions. Known to be an earthworm parasite (ROGNES 1991).

Pollenia vagabunda (MEIGEN, 1826); FO (A)

Only a few specimens collected during summer. Species has a Holarctic distribution. The puparia of *P. vagabunda* have been found in the stem of corn infested by the moth *Sesamia nonagrioides* LEFEBVRE (ROGNES 1991).

DISCUSSION

The recorded number of 24 species constitutes 34.8% of the entire fauna of the species of Calliphoridae known from Poland. During the five years of the associated studies on pig carrion almost all of the species of Polish blowflies of forensic importance were collected. The absence of *Lucilia silvarum* (MEIGEN, 1826) is slightly surprising, given its expected occurrence at least in wet ground alder forest. *Calliphora loewi* ENDERLEIN, 1903 is often characterised as rare (ROGNES 1991) but this forensically important species (VANIN *et* AL. 2011, LINDSTRÖM 2012) is quite common in Poland (DRABER-MOŃKO 2004). However, this fly was not collected during the experiments in the Biedrusko Military Training Ground.

Certainly most of non-necrophagous species listed here should be treated as incidental elements of the carrion community. However, specimens of *Pollenia* ROBINEAU-DESVOIDY, especially those representing the *rudis* species-group, are regularly collected during carrion successional experiments in Europe and North America (e.g. ARNALDOS *et* AL. 2004, HWANG *et* TURNER 2005, ANTON *et* AL. 2011, BRUNDAGE *et* AL. 2011, PRADO E CASTRO *et* AL. 2012, BENBOW *et* AL. 2013, ŠULÁKOVÁ *et* BARTÁK 2013). ŠULÁKOVÁ *et* BARTÁK (2013) even proposed that *Pollenia* be assigned the status of a "predatory/parasite on […] necrophagous species" following the classification proposed by SMITH (1986). Earthworms, hosts of species of *Pollenia* representing *rudis* group, may participate in the decomposition of vertebrate carrion, but the presence of *Pollenia* on carrion seems to be rather related to the feeding on the liquid products of decomposition by adult flies as it was observed by author in many places (e.g. Fig. 2). The sex ratio of *Pollenia* collected during the Polish experiments was extremely female-biased (98%), which resembles the results of MARTIN-VEGA *et* BAZ (2013) in which males of this genus were completely absent. However, all randomly dissected females in the experiments were without mature eggs inside the reproductive system, which supports the supplementary feeding of adults as the reason for the mass occurrence of *Pollenia* on carrion. Most probably females need feed on protein (in this case from carrion) to develop their reproductive system.

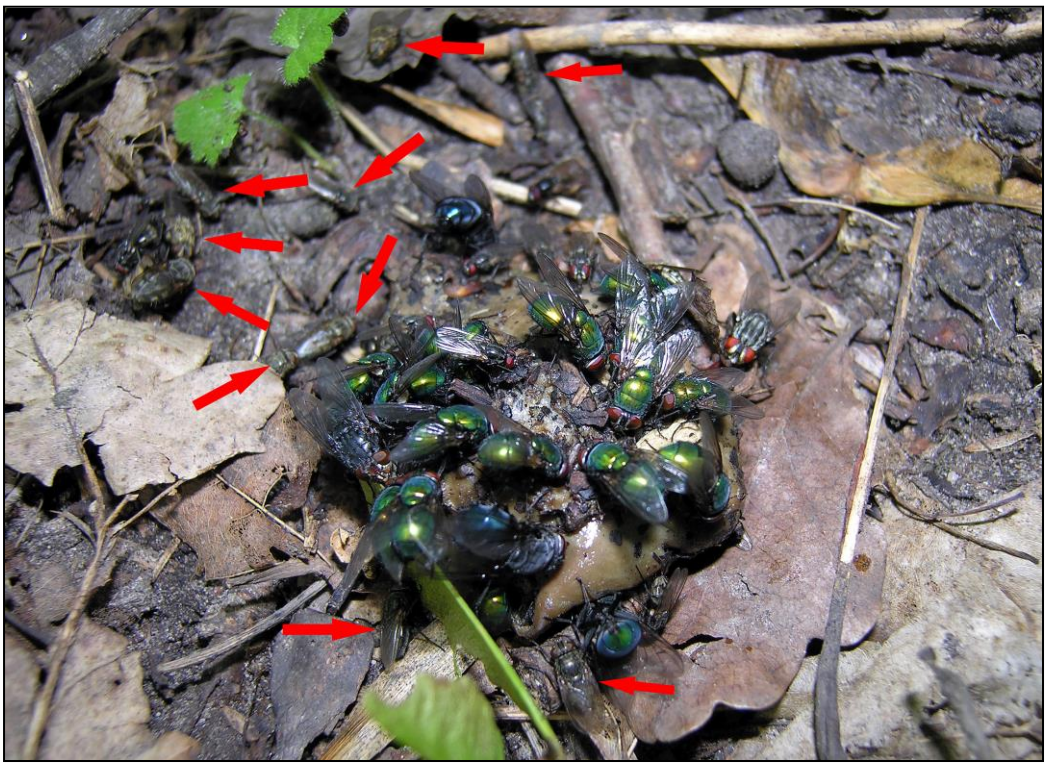

FIG. 2. Flies attracted to decomposed pig liver in Płutowo Nature Reserve (Poland, 53°16′36″N, 18°23′10″E). Females of *Pollenia* marked by red arrows.

REFERENCES

ANTON E., NIEDEREGGER S., BEUTEL R.G. 2011. Beetles and flies collected on pig carrion in an experimental setting in Thuringia and their forensic implications. Med. Vet. Entomol. **25**: 353 - 64.

ARNALDOS M.I., ROMERA E., PRESA J.J., LUNA A., GARCIA M.D. 2004. Studies on seasonal arthropod succession on carrion in the southeastern Iberian Peninsula. Int. J. Legal. Med. **118**: 197 - 205.

BAUMGARTNER D.L., GREENBERG B. 1984. The genus *Chrysomya* (Diptera: Calliphoridae) in the New World. J. Med. Entomol. **21**: 105 - 113.

BENBOW M.E., LEWIS A.J., TOMBERLIN J.K., PECHAL J.L. 2013. Seasonal necrophagous insect community assembly during vertebrate carrion decomposition. J. Med. Entomol. **50**: 440 - 450.

BRUNDAGE A., BROS S., HONDA J.Y. 2011. Seasonal and habitat abundance and distribution of some forensically important blow flies (Diptera: Calliphoridae) in Central California. Forensic Sci. Int. **212**: 115 - 120.

BYSTROWSKI C., GRZYWACZ A. 2009. Stwierdzenie występowania pasożytniczej muchówki *Angioneura cyrtoneurina* (ZETTERSTEDT, 1859) (Diptera: Calliphoridae) w Polsce. Wiad. Entomol. **28**(4): 271 - 274.

DRABER-MOŃKO A. 2004. Calliphoridae, Plujki (Insecta Diptera). Fauna Poloniae **23**, Natura Optima Dux Fundation & MiIZ PAN; Warszawa, 659 pp.

DRABER-MOŃKO A. 2007. Calliphoridae. [In:] BOGDANOWICZ W., CHUDZICKA E., PILIPIUK I., SKIBIŃSKA E., Fauna Polski Charakterystyka i wykaz gatunków, Tom II, MiIZ PAN,Warszawa, 147 - 150, 230 - 231 pp.

ERZINÇLIOĞLU Y.Z. 1985. Immature stages of British *Calliphora* and *Cynomya*, with re-evaluation of the taxonomic characters of larval Calliphoridae (Diptera). J. Nat. Hist. **19**: 69 - 96.

GRUNWALD J., SWOBODA S., RECKEL F. 2009. A comparative study on the arthropod succession on dressed and undressed pig carrion in the city of Munich (Germany). 7th Meeting of the European Association for Forensic Entomology, Uppsala, abstract volume, 46 p.

HWANG C., TURNER B.D. 2005. Spatial and temporal variability of necrophagous Diptera from urban to rural areas. Med. Vet. Entomol. **19**: 379 – 391.

LINDSTRÖM A. 2012. First finding of *Calliphora subalpina* and *C. loewi* (Diptera, Calliphoridae) breeding in a human cadaver. 9th Meeting of the European Association for Forensic Entomology, Toruń, abstract volume, 74 p.

MARTIN-VEGA D., BAZ A. 2013. Sex-biased captures of sarcosaprophagous Diptera in carrion-baited traps. J. Insect. Sci. **13**: 14-14.

MATUSZEWSKI S., BAJERLEIN D., KONWERSKI S., SZPILA K. 2008. An initial study of insect succession and carrion decomposition in various forest habitats of Central Europe. Forensic Sci. Int. **180**: 61 - 69.

MATUSZEWSKI S., BAJERLEIN D., KONWERSKI S., SZPILA K. 2010. Insect succession and carrion decomposition in selected forests of Central Europe. Part 2: Composition and residency patterns of carrion fauna. Forensic Sci. Int. **195**: 42 - 51.

MATUSZEWSKI S., SZAFAŁOWICZ M., JARMUSZ M. 2013. Insects colonizing carcasses in open and forest habitats of Central Europe: search for indicators of corpse relocation. Forensic Sci. Int. **231**: 234 - 239.

MATUSZEWSKI S., KONWERSKI S., FRĄTCZAK K., SZAFAŁOWICZ M. 2014. Effect of body mass and clothing on decomposition of pig carcasses. Int. J. Legal. Med. 128: 1039 - 1048.

MATUSZEWSKI S., FRĄTCZAK K., KONWERSKI S., BAJERLEIN D., SZPILA K., JARMUSZ M., SZAFAŁOWICZ M., GRZYWACZ A., MĄDRA A. 2016. Effect of body mass and clothing on carrion entomofauna. Int. J. Leg. Med., **130**: 221 - 232.

PRADO E CASTRO C., SERRANO A., DA SILVA M., GARCIA M.D. 2012. Carrion flies of forensic interest: a study of seasonal community composition and succession in Lisbon, Portugal. Med. Vet. Entomol. **26**: 417 - 431.

ROGNES K. 1991. Blowflies (Diptera, Calliphoridae) of Fennoscandia and Denmark. Fauna Entomologica Scandinavica 24. Leiden, New York, Kopenhagen, Köln, E. J. Brill, 272 pp.

SCHUMANN H. 1954. Morphologisch-systematische Studien an Larven von hygienisch wichtigen mitteleuropäischen Dipteren der Familien Calliphoridae-Muscidae. Wissenschaftliche Zeitschrift der Universität Greifswald III(1953-54): 245 - 274.

Schumann H. 1964. Revision der Gattung *Onesia* Robineau-Desvoidy, 1830 (Diptera: Calliphoridae). Beitr. Entomol., Berlin, 10: 915-322.

SCHUMANN H. 1971. Die Gattung *Lucilia* (Goldfliegen). Merkbl. Angew. Parasitenkd. Jena **18**: 1 - 20.

SCHUMANN H. 1986. Family Calliphoridae. [In:] SOÓS A., PAPP L. (Eds), Catalogue of Palaearctic Diptera, Calliphoridae-Sarcophagidae. Vol 12. Akadémiai Kiadó, Budapest, Amsterdam, pp 11 - 58.

SMITH K.G.V. 1986. A manual of forensic entomology. The Trustees of the British Museum, London, 205 pp.

ŠULÁKOVÁ H., BARTÁK M. 2013. Forensically important Calliphoridae (Diptera) associated with animal and human decomposition in the Czech Republic: preliminary results. Čas. Slez. Muz. Opava (A) **62**: 255 - 266.

SZPILA K. 2003. First instar larvae of nine West-Palaearctic species of Pollenia Robineau-Desvoidy, 1830 (Diptera: Calliphoridae). Entomol. Fenn. **14**: 193 - 210.

SZPILA K. 2000. Three species of Calliphoridae (Diptera) new to the Polish fauna. Polish J. Entomol. **69**: 355–361.

SZPILA K. 2010. Key for the identification of third instars of European blowflies (Diptera: Calliphoridae) of forensic importance. [In:] AMENDT J., GOFF M.L., CAMPOBASSO C.P., GRASSBERGER M. (eds), Current Concepts in Forensic Entomology. Springer, Dordrecht Heidelberg London New York, pp 43 - 56.

SZPILA K. 2015. *Calliphora rohdendorfi* (GRUNIN, 1966) (Diptera: Calliphoridae) - gatunek nowy dla fauny Polski. Dipteron **31**: 50 - 54.

SZPILA K.**,** DRABER-MOŃKO A. 2008. Pollenia moravica (JACENTKOVSKÝ, 1941) recorded from Poland for the first time. Fragm. Faun. **51**(2): 139 - 142.

SZPILA K.**,** MATUSZEWSKI S., BAJERLEIN D., KONWERSKI S. 2008. *Chrysomya albiceps* (WIEDEMANN, 1819), a forensically important blowfly (Diptera: Calliphoridae) new for the Polish fauna. Polish J. Entomol. **77**: 351 - 355.

VANIN S., TASINATO P., DUCOLIN G., TERRANOVA C., ZANCANER S., MONTISCI M., FERRARA S.D., TURCHETTO M. 2008. Use of *Lucilia* species for forensic investigations in Southern Europe. Forensic Sci. Int. **177**: 37 - 41.

STRESZCZENIE

Wykaz plujek (Diptera: Calliphoridae) stwierdzonych podczas badań nad sukcesją owadów w trakcie rozkładu dużej padliny w Polsce

W warunkach europejskich plujki są zazwyczaj najczęściej i najliczniej spotykanymi owadami na szczątkach kręgowców. W Polsce dotychczas stwierdzono 69 gatunków z tej rodziny, jednak tylko część z nich to typowi padlinożercy o znaczeniu medyczno-sądowym. Przedstawiony artykuł opiera się na materiałach zebranych podczas badań na sukcesją owadów podczas rozkładu zwłok świni domowej przeprowadzonych w Polsce w latach 2005-2012. Co zaskakujące, podczas eksperymentów zaobserwowano obecność dorosłych osobników wielu niepadlinożernych plujek. Zaktualizowana lista Calliphoridae stwierdzonych podczas badań na poligonie w Biedrusku obejmuje 24 gatunki.