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A study of the cow pat Diptera on the Hortobágy, Hungary

L. PAPP

Department of Zoology, Hungarian Natural History Museum
and Animal Ecology Research Group of the Hungarian Academy of Sciences
H-1088 Budapest, Baross u. 13, Hungary. E-mail: lpapp@nhmus.hu

Abstract – Applying a novel way of sample collection and a quick method of identification, cow pat Diptera of the Hortobágy National Park (at Nagyiván, Hungary) were sampled in 2003 to 2005. In 1015 samples of standardised sample collection 92680 individuals of 106 species were found and determined, of them 75 species were represented by less than 0.1% relative abundance. The dominance of *Coproica lugubris* (HALIDAY, 1836) was most characteristic, independently to the dry or wetter periods. Three species new to Hungary and ten species new to the Hortobágy National Park are reported. With 2 figures and one table.

Key words – Ecology, Diptera, cow pats, sampling methods, identifications, Hortobágy, Hungary.

INTRODUCTION

Generally accepted in the literature, that proper samples of insect and other animal collections (whose individual numbers are high enough), reflecting the structure of real multispecies populations sampled, show characteristic distribution of species frequencies or species abundance. It is important to make distinction of the former term to the number, or, frequency of species, which may mean also the number of species in given abundance classes. As for "structure", in our case we have to mean a kind of abundance structure (represented e.g. by a frequency vector). We do not need to presume direct relationships (trade-offs) between species populations, or these kinds of relationships are negligible. This is a result of the fact that larval populations do not compete for food; foodstuffs are available in multiply quantity of requirement (see PAPP 1971, etc.). Further on, the predator populations prey upon not only

dipterous larvae; their number is not significant and they are not food specialists. In this sense this multispecies assemblage has no biological i.e. functional structure. Basic models of species abundance structures like the truncated lognormal model of species abundance distribution and similar models are based on the independence of individual species frequencies, that is, they are so-called neutral models (IZSÁK & PAPP 2008).

From an ecological point of view our project is not a study of the fly assemblages of cow pats, but rather an abundance survey of Diptera populations captured on cow pats in a definite state of succession, on a definite small area in a definite moment, demonstrated by a very high number of samples.

Cow pats form a rapidly changing environment with a conspicuously rapid succession of insect assemblages (PAPP 1971). In the moment of falling down to ground, beetles and flies appear on them. As for Diptera, first visitors are species of *Haematobia* LE PELETIER et SERVILLE, 1928 and *Haematobosca* BEZZI, 1907, *Sepsis cynipsea* (LINNAEUS, 1758), *Sepsis thoracica* (ROBINEAU-DESVOIDY, 1830), *Musca autumnalis* DE GEER, 1776, *Musca larvipara* PORTSCHINSKY, 1910, *Adia cinerella* (FALLÉN, 1825). In addition, in the first half of an hour *Hydrotaea tuberculata* RONDANI, 1866 and other *Hydrotaea* ROBINEAU-DESVOIDY, 1830 may lay their larvae there. Adults of *Neomyia cornicina* (FABRICIUS, 1781) and those of the dominant species, *Coproica lugubris* (HALIDAY, 1836), may be found on the freshest dung. Later adults of *Coproica lugubris* became most numerous, indeed. Some hours old cow pats are visited by other species of *Sepsis* FALLÉN, 1810, the two species of *Saltella* ROBINEAU-DESVOIDY, 1830 inhabiting Hungary, *Ravinia pernix* (HARRIS, 1780), etc. One to two days old cow pats are visited also by the adults of the two European *Lotobia* LIOY, 1864 spp., several species of *Ischiolepta* LIOY, 1864, *Chaetopodella scutellaris* (HALIDAY, 1836) and numerous species of Muscidae, which come to find proper place for their eggs. In that stage of succession we can find also adults of Hybotidae species (*Crossopalpus humilis* (FREY, 1913), *C. minimus* (MEIGEN, 1838), *C. setiger* (LOEW, 1859), *Drapetis flavipes* MACQUART, 1834, possibly also other species), which hunt there on minute flies, mites and other small arthropods. They lay eggs on/into in several days old dung only. Several days old cow pats are still attractive for species of Chironomidae (*Pseudosmittia* GOETHGEBUER, 1932), Sphaeroceridae (*Opalimosina* ROHÁČEK, 1983 spp., *Philocoprella* RICHARDS, 1929 spp.), etc. Larvae of the latter species are feeding on bacteria and microfungi, rather than on the original matter of the dung.

Choosing both the object and the site, as well as of the modes and ways of elaboration including identification, are based on author's experience of several decades (PAPP 1971, 1976, 1992, etc.). The present paper is for information on device and way of sample collection, on details of our identification method, as well as on faunistical data; i.e. listing species names with total number of individuals and a comparison to former sampling. A quantitative ecological analysis of our data, particularly so for species abundance distribution, is given in another paper (IZSÁK & PAPP 2008).

MATERIALS AND METHODS

Sample collection

Based on our previous experience, we had to choose a cow pasture, which had been grazed by cattle for several decades. During that long period of time populations of all those dipterous species have occupied cow pats, which are living on cattle pastures in Hungary. In addition, their populations have reached the best proportional sizes, which is characteristic in cow pat assemblages in Hungarian Great Plains.

All these factors were considered when two pastures of the plains at Nagyiván (Hortobágy National Park) were chosen as study areas. Pastures around Új-kút [New well] and Mérges-kút [Angry/Poison well] are in a distance of less than 5 km from each other. In 2003 both sites, in 2004 and 2005 (as well as in 2002) only Új-kút area were sampled. Samples were taken from comparatively small areas of drinking places of cows. On these grounds the number of cow pats are much higher than that of the mean for that pasture. 50 samples per day were planned, but it was impossible to achieve this number within the given time limits on the other wide parts of the pastures due to the scattered pattern of the cow pats.

Based on our former studies, our starting point was that the proportional sizes of the populations of the numerous Diptera species show the smallest fluctuations from the beginning of July to the middle of August. Consequently, samples were taken between July 25 and August 19 (in 2002 on the 23rd of August).

In order to avoid the effects of diurnal activity of flies, samples were taken in the hours prior and just after noon, between 10 a.m. and 4 p.m. (N.B. an hour time summer change is performed also in Hungary). Some basic meteorological data (cloud cover, wind, air temperature just over ground in shade) were also recorded. Sampling was not possible for several days after heavy rains as a consequence of dilution of cow pats and possible damages to dipterous adults. Cloudy weather with high temperature or drizzling rain did not seem to influence sampling results, or the latter seemed to increase the activity of dipterous adults.

In 2003 samples were taken twice in five-day periods: from July 28 to August 1 and from August 11 to 15. Weather was not continuously proper even in those periods (strong winds and also a heavy storm), so altogether only 400 samples were taken instead of the planned ten times 50 samples. The mean number of adults captured was somewhat less than that of the preliminary sampling in 2002 (1146 individuals/15 samples), in all probability as a consequence of the

very hot weather, which had begun rather early in the summer and was continuing also during the sampling period. Those 400 samples contained 21,009 individuals of adult flies. There were 300 samples taken in 2004. Suffering again from periodically bad weather, sampling days were on the 26th and 27th of July, as well as on the 4th, 6th, 17th and 19th of August. Altogether 29,525 individuals were sampled in 2004 (Table 1).

There were 300 samples taken in 2005 again. Weather conditions were ideal between the 25th of July and the 3rd of August. Exactly 41 thousand individuals were captured in the last year of sampling.

Originally we planned to sample approximately 24-hour old cow pats. Those ones contain the most species rich assemblages, and at the same time, their species composition seem to change rather slowly. The species, which are characteristic for the fresh dung, are still present, and, also the species, which utilise the older dung under the crust of the cow pat, have already been appeared. We had to change our plans under the hot summer conditions of the Hortobágy National Park. We sampled cow pats of 12 to 24 hours in order to follow the original aim. The 24 hour-old pats (laid morning, sun-heated during the daytime) have already had hard crust with beetle-made holes (for better ventilation). The age of cow pats was determined by observation on cows (as for defecation) and using my several decade long experience.

The sampling device was developed based on our former experience on studying flies of cow pats and it is a result of several more of less successful previous trials. Our sampling device (Figs 1–2) was actually a very fine mesh, exactly conical net of 30–31 cm diameter and of a 70 cm depth. Its rim is formed from a 5 to 6 cm wide metal plate. For safety reasons we prepared three copies. An important part of our device is a tube, running around inside the rim, fixed at several places to the rim. The tube is with 18 small holes at a distance of 5 cm from each other, which are formed to emit air towards down and inside. The neck-point of the tube is with an Y-tube, whose third hole is connected with the flexible air tube. The air tube is blown by the user. The 12 to 24 hours old cow pat is covered quickly but carefully, starting with obliquely turned device from one side, after careful approaching of the selected pat. Blowing air into the tube will not allow flies to close the rim and so to crawl out under the rim and get free. On the other hand, air blowing will drive flies into air from the surface of dung and of the grass blades, and they continue their emergence in crawling upwards on net tissue by instinct. That is particularly so, if we move the rim gently horizontally, keeping it continuously pushed tightly to the ground. After all the flies have left dung surface, we drive all to the narrow end of the net by grabbing the rim strongly and making some strong sweeping moves, i.e. using our device like a sweeping net.

Closing the apical part of the net with flies by our other hand, the end of net is immersed into 70% ethyl alcohol in a small dish, which kills dipterous adults immediately. The net is turned out and all the flies are washed into the alcohol. After sieving them by the partner, they are carried and preserved in 70% alcohol. That way they were ready for identification.

There were cases, when one sample was taken over two small cow pats, but we do not think it important. It seems more important, that we really captured all the adult flies, that were present in a given moment on a cow pat. Actually, our method is not an estimation but a counting as regards individual cow pats.

Table 1. Abundance of the dipterous species in 2002–2005

Species	2002	2003	2004	2005
Psychodidae sp.	0	1	1	5
Ochlerotatus LYNCH ARRIBÁLZAGA, 1891	3	4	44	508
Chironomidae sp.1	6	5	1	0
Chironomidae sp.2	16	7	286	192
Chironomidae sp.3	1	2	33	23
Ch. foltos sz. [patterned wing]	0	2	3	0
Pseudosmittia GOETHGEBUER, 1932 sp.	1	0	30	7
Culicoides LATREILLE, 1809 sp.	9	5	10	153
Ceratopogonidae sp.	6	1	7	17
Swammerdamella brevicornis (MEIGEN, 1830)	0	2	3	10
Coboldia fuscipes (MEIGEN, 1830)	0	1	0	1
Cecidomyiidae sp.	1	10	26	23
Lycoriella FREY, 1942 sp.	2	3	16	15
Drapetis flavipes MACQUART, 1834	0	3	0	0
Crossopalpus humilis (FREY, 1913)	0	20	9	31
C. minimus (MEIGEN, 1838)	24	304	700	201
Crossopalpus aeneus (WALKER, 1871)	1	347	157	19
Crossopalpus BIGOT, 1857 sp.	0	1	0	0
Medetera micacea LOEW, 1857	0	55	120	342
Diplonevra funebris (MEIGEN, 1830)	0	7	2	0
Metopina pileata SCHMITZ, 1936	0	112	10	37
Megaselia RONDANI, 1856 sp.	0	19	20	12
Pseudacteon COQUILLETT, 1907 sp.	0	1	1	0
Saltella nigripes ROBINEAU-DESVOIDY, 1830	0	12	3	168
Sepsis barbata BECKER, 1907	0	1	0	0
Sepsis biflexuosa STROBL, 1893	0	19	187	389
Sepsis fissa BECKER, 1903	0	28	57	2
Sepsis fulgens MEIGEN, 1826	1	6	3	6
Sepsis nigripes MEIGEN, 1826	1	3	3	164
Sepsis orthocnemis FREY, 1908	0	7	5	71
Sepsis punctum (FABRICIUS, 1794)	0	1	0	0
Sepsis thoracica (ROBINEAU-DESVOIDY, 1830)	53	564	2,312	2,394
Sphaerocera curvipes LATREILLE, 1805	0	22	30	39
Lotobia africana (BECKER, 1907)	58	1,981	3,382	1,954
Lotobia pallidiventris (MEIGEN, 1830)	2	10	16	33
Ischiolepta vaporariorum (HALIDAY, 1836)	0	2	11	19
Lotophila atra (MEIGEN, 1830)	0	1	0	1
Norrbomia hispanica (DUDA, 1923)	0	1	0	1
Coproica acutangula (ZETTERSTEDT, 1847)	4	0	9	189
Coproica digitata (DUDA, 1918)	13	13	14	71
Coproica ferruginata (STENHAMMAR, 1854)	46	818	634	1,615
Coproica hirticula COLLIN, 1956	37	85	130	589
Coproica lugubris (HALIDAY, 1836)	735	15,116	19,032	26,691
Coproica vagans (HALIDAY, 1833)	2	193	76	961

Table 1 (continued)

Species	2002	2003	2004	2005
Elachisoma aterrimum (HALIDAY, 1833)	13	37	123	619
Elachisoma bajzae L. PAPP, 1983	0	5	11	30
Elachisoma kerteszi (DUDA, 1924)	1	1	0	1
Elachisoma pilosum (DUDA, 1924)	3	6	0	36
Trachyopella melania (HALIDAY, 1836)	3	14	3	10
Philocoprella italica (DEEMING, 1964)	0	160	198	797
Spelobia (Bifronsina) bifrons (STENHAMMAR, 1854)	1	1	3	10
Spelobia (Eulimosina) ochripes (MEIGEN, 1830)	1	1	3	1
Chaetopodella scutellaris (HALIDAY, 1836)	0	1	0	418
Opalimosina mirabilis (COLLIN, 1902)	0	4	4	36
Rachispoda brevior (ROHÁČEK, 1991)	0	1	2	1
Rachispoda pseudohostica (DUDA, 1924)	0	2	0	1
Trixoscelis obscurella (FALLÉN, 1823)	0	1	0	0
Physiphora alceae (PREYSSLER, 1791)	0	2	0	0
Aphanotrigonum bicolor NARTSHUK, 1964	3	20	174	474
Meromyza pluriseta PÉTERFI, 1961	0	9	19	12
Desmometopa varipalpis MALLOCH, 1927	1	0	0	0
Leptometopa latipes (MEIGEN, 1830)	0	1	0	1
Meoneura flavifacies COLLIN, 1930	0	1	40	8
Meoneura freta COLLIN, 1937	0	138	10	3
Adia cinerella (FALLÉN, 1825)	19	251	815	569
Hylemya ROBINEAU-DESVOIDY, 1830 sp.	0	1	3	4
Azelia parva RONDANI, 1866	0	2	8	72
Azelia zetterstedti RONDANI, 1866	0	1	0	1
Morellia asetosa BARANOV, 1925	0	3	0	1
Musca autumnalis DE GEER, 1776	5	54	35	84
Musca domestica LINNAEUS, 1758	0	1	1	0
Musca osiris WIEDEMANN, 1830	69	288	124	209
Musca tempestiva FALLÉN, 1817	1	74	2	31
Neomyia cornicina (FABRICIUS, 1781)	0	15	78	67
Myospila meditabunda (FABRICIUS, 1781)	0	5	4	0
Haematobia irritans (LINNAEUS, 1758)	0	19	6	87
Haematobia titillans (BEZZI, 1907)	1	42	1	4
Limnophora rufimana (STROBL, 1893)	0	1	0	0
Pollenia dasypoda PORTSCHINSKY, 1881	0	2	0	0
Ravinia pernix (HARRIS, 1780)	2	37	17	5
Sarcophaga (Sarcotachinella) sinuata (MEIGEN, 1826)	0	1	3	0
Taxigramma heteroneurum (MEIGEN, 1830)	0	4	0	0
Dinera grisescens (FALLÉN, 1817)	1	8	1	1
Saltella sphondylii (SCHRANK, 1803)	0	0	11	142
Sepsis cynipsea (LINNAEUS, 1758)	0	0	1	1
Copromyza equina FALLÉN, 1820	0	0	2	1
Norrbomia costalis (ZETTERSTEDT, 1847)	0	0	1	0
Norrbomia somogyii (L. PAPP, 1973)	0	0	3	2

Table 1 (continued)

Species	2002	20203	2004	20025
Norrbomia sordida (ZETTERSTEDT, 1847)	0	0	11	34
Coproica hirtula (RONDANI, 1880)	0	0	1	10
Gonioneura spinipennis (HALIDAY, 1836)	0	0	6	1
Spelobia clunipes (MEIGEN, 1830)	0	0	9	4
Pullimosina heteroneura (HALIDAY, 1836)	0	0	2	0
Pullimosina pullula (ZETTERSTEDT, 1847)	0	0	1	0
Trachyopella leucoptera (HALIDAY, 1836)	0	0	1	8
Minilimosina (Allolimosina) alloneura (RICHARDS, 1952)	0	0	2	0
Opacifrons coxata (STENHAMMAR, 1854)	0	0	1	0
Leptocera nigra OLIVIER, 1813	0	0	376	174
Rachispoda hostica (VILLENEUVE, 1917)	0	0	13	14
Meoneura neglecta COLLIN, 1930	0	0	13	0
Sepsis duplicata HALIDAY, 1838	0	0	0	53
Themira minor (HALIDAY, 1833)	0	0	0	3
Alloborborus pallifrons (FALLÉN, 1820)	0	0	0	2
Philocoprella quadrispina (LAURENCE, 1952)	0	0	0	1
Opalimosina collini (RICHARDRS, 1929)	0	0	0	3
Hebecnema umbratica (MEIGEN, 1826)	0	0	0	1
Total	**1,146**	**21,009**	**29,525**	**41,000**

Identification

If our starting point were that a specialist in Diptera identifies 100 to 200 flies of pinned museum specimens daily, the task of identification of our sampled material ought to have regarded as not feasible. However, the method of handling and identifying materials of high individual numbers was a part of our methods, which had been elaborated during the seventies. Its draft is as follow:

1) One sample of the material previously preserved in 70% ethyl alcohol is poured in a petri dish. A part of the alcohol is carefully poured out on one side, which results in having flies on that side of the petri dish, in the form of a crescent. Evaporation of alcohol during the following procedure will not cause desiccation of the specimens.
2) We determine, which is the species represented by the highest number; let's name it as sp. A. Individuals of sp. A are left along the side of the petri dish, all the other species are moved centrally by a pair of featherweight forceps.
3) When separation is complete, "not-A" specimens are carefully replaced in alcohol under the original number of samples.
4) The individuals of sp. A are counted. By this process we have an opportunity to find specimens of "not-A" species, which were erroneously left among specimens of sp. A.
5) The process is continued for sp. B according to steps 2–4 above on the whole material of the same sample. We add those individuals of sp. A, which were originally left out erroneously.

The strength of the method is, beside its rapidness, that we can see twice every specimen.

Voucher specimens of every species were preserved in alcohol until they were prepared (minuten-pinned, labelled, etc.) in the Diptera Collection of the Department of Zoology, Hungarian Natural History Museum (HNHM), Budapest. They are approximately 2,800 museum specimens (of the 92,680 individuals sampled). Of course, it occurred that I was not able to identify some specimens originally in alcohol. All these specimens were put aside in vials with alcohol, they were identified later with the aid of specimens of comparison in the HNHM (later prepared on pins, etc.).

The time requirement of the identification of 92,680 individuals is estimated as ca. 300 to 350 working hours. Handling of the voucher specimens (drying, pinning, labelling, and repeated identification, placing them to the collection) is an addition, of course.

RESULTS

Qualitative results

The original data have been set up on the link of http://www.nhmus.hu /~lpapp/[1].

The first matrices were created in 2003 for the data from 2002 and 2003, where the list of species is given in a taxonomical order. Keeping that sequence, the list was complemented with the species, which were found in 2004 for the first time, and again, in 2005 the "newcomers" of that year were appended. This way it is easy to find the species, which appeared in 2004 and in 2005.

The fly assemblage, which we found, is completely in accordance of former observations, and it is in coherence with the description of species succession described above. The most characteristic feature of the sample series is the 66.5% super-dominance of *Coproica lugubris*. Indeed, we think it a characteristic finding, an objective fact. However, at the same time it meant that the total number of individuals in our sampling series had to overrun significantly the planned 50,000 individuals. That number was proposed as a minimal aim in our plans (to achieve a suitable sample for analysing the species abundance distribution of the "rest", or almost so). That was why our two-year sampling was modified to three years.

A sepsid species, *Sepsis thoracica*, was represented in high numbers, likewise *Musca osiris* WIEDEMANN, 1830 and *Adia cinerella*. One can capture also

1 One can find there seven Excel files as follows: orig2002. xls (15 samples), orig.2003 1.xls (200 samples), orig.2003 2.xls (200 samples), orig.2004 1.xls (200 samples), orig.2004 2.xls (100 samples), orig.2005 1.xls (200 samples), orig.2005 2.xls (100 samples).

several specimens of *Musca autumnalis* and *Neomyia cornicina* on cow pats of 12 to 24 hours, although these species prefer fresh dung for egg-laying. Beside *Coproica lugubris,* the sphaerocerid species *Lotobia africana* (BECKER, 1907) was frequent in the Hortobágy cow pat assemblages in 2003. This is the dominant species in sheep droppings on dry sheep pastures in Hungary (PAPP 1985). Species of the genus *Coproica* RONDANI, 1861 (*C. ferruginata* (STENHAMMAR, 1854), *C. vagans* (HALIDAY, 1833) and also *C. hirticula* COLLIN, 1956 in lower numbers), which are characteristic for drier kinds of dung and dung heaps, were well represented. This is again a characteristic feature of the Diptera assemblages of the cow pats on the Hortobágy.

Figs 1–2. The sampling device. 1 = in use, 2 = from below, showing its inner tube with 18 holes

We found the presence of three species of *Crossopalpus* BIGOT, 1857 (Hybotidae) characteristic, and not in negligible individual numbers. Species of Psychodidae, Chironomidae and Sciaridae were represented just by one species each, while sphaerocerid species, like *Philocoprella italica* (DEEMING, 1964), several species of *Elachisoma* RONDANI, 1880 and some other sphaerocerids, characteristic to old dung of larger hoofers, are collectible in low numbers.

It is a peculiar feature of the given collection period, that we captured a minute phorid fly *Metopina pileata* SCHMITZ, 1936 in significant number. This species was sampled formerly by pan traps on dry sheep pastures. The analysis of the original samples show that its occurrence is rather hectic: numbers in consecutive days, or on the same day of the next year are extremely different, or even not captured at all.

The surveyed dipterous assemblage is species rich, indeed. If samples from 2002 are included, representatives of 106 Diptera species were found. However, there are 75 species, which are represented by less than 92 individuals, i.e. by less than 0.1% proportion of the whole collection. One may regard 0.1% dominance as the severest criterium of rarity (*cf.* PAPP 1999). There are but a very few species among those 106 specimens, which would not have been connected to dung, as to a substrate for development of larvae (see more below).

According to PAPP (1992), the number of possible species representations may be as high as 270 to 280 (see below). After all we have to regard the Hortobágy cow pat Diptera as a species rich assemblage. We have never seen such a high species number in cow pat Diptera. For comparison, in 1969 at Aranyosgadány 12,400 adults of 39 species were reared from cow pats collected on a really old cattle pasture (PAPP 1971).

Of the 106 species there were three species new for the fauna of Hungary. The milichid fly, *Desmometopa varipalpis* MALLOCH, 1927 was captured as a single individual (on the 23rd of August 2002). This record is the first (and still the only one) in Europe, too.

The identification process of the samples collected on the Hortobágy initiated a revision of the whole collection of the *Sepsis* species in the HNHM. It turned out that the species *Sepsis neocynipsea* MELANDER et SPULER, 1917 lives in our low mountains only; it is rare even there. We did not find any specimen among the more than 92,000 adults, and the specimen, which SOÓS (1981) identified and published from the Hortobágy National Park, does not belong to *S. neocynipsea*. Consequently, that species must be deleted from the list of

the Hortobágy Diptera. Contrarily, adults of two species new to Hungary, *Sepsis barbata* BECKER, 1907 and *Sepsis fissa* BECKER, 1903 (PAPP 2004) were captured in 2003. The other species of *Sepsis* had been known from the pasture dung of the large hoofers in Hungary (including cow pats).

Checking our list against the Diptera chapters of the book of the animals in the Hortobágy National Park (MAHUNKA 1983), we found ten other species, which have not formerly been collected in the Hortobágy NP. These are the following: Hybotidae: *Crossopalpus minimus* (MEIGEN, 1838); Phoridae: *Diplonevra funebris* (MEIGEN, 1830), *Metopina pileata* SCHMITZ, 1936; Sphaeroceridae: *Elachisoma bajzae* L. PAPP, 1983, *Elachisoma kerteszi* (DUDA, 1924), *Trachyopella melania* (HALIDAY, 1836), *Philocoprella italica* (DEEMING, 1964), *Rachispoda pseudohostica* (DUDA, 1924); Milichiidae: *Leptometopa latipes* (MEIGEN, 1830); Sarcophagidae: *Taxigramma heteroneurum* (MEIGEN, 1830).

Species pool

As regards species richness of the dung inhabiting flies on the pastures of Hungary, PAPP (1992) listed 270 to 280 species of 26 Diptera families. For quantitative ecological studies (such as species richness estimations, species abundance distributions, etc.) that number is proposed to regard as the potential species pool (*cf.* IZSÁK & PAPP 2008). The species composition of those 106 species is dominated by widespread Palaearctic species characteristic for the plains and hilly parts of Hungary.

If our basic multitude is regarded to belong to a single guild of flies in a first approach, that would mean that all they are actually characteristic species of cow pats. After having made some considerations, we left in the basic tables of data not only the true dung feeders and special predators living in the cow pats, but also all those flies, which live not upon dung, but which are present regularly on the surface of cow pats, see above. However, there are only a rather few species among the flies sampled, whose larvae are not dependent on dung as medium of development. Their presence is not by chance, though. *Ochlerotatus dorsalis* (MEIGEN, 1830) (Culicidae) and the chloropid species are on the dung, because they find it as a microsite of higher humidity. The species *Medetera micacea* LOEW, 1857 (Dolichopididae) hunts probably on small flies over the surface of the cow pats. A tachinid species, *Dinera grisescens* (FALLÉN, 1817) is a parasitoid of carabids living under the crust of older cow pats. Consequently, it is not a surprise to find always the same tachinid species, though

represented by single individuals, in the samples. As for the species with medium-level individual numbers, there are only two species, *Medetera micacea* and *Aphanotrigonum bicolor* NARTSHUK, 1964, which are not dependent directly on dung.

As we have already stressed above, as regards dipterous adults present at a given moment on the surface of the individual cow pats, our method is not an estimation but a counting, on one hand. On the other, we are aware of the fact that even in this case we can only estimate the *ratios in activities* of the dipterous populations, and *not* those in their true abundance. Indeed, the relation of the activity to the abundance is different from species to species. Contrarily, we possess the numbers of individuals per species only.

As we mentioned above, we belive, we have done our best to reduce the effects of diurnal and seasonal changes in detectable individual numbers of the dipterous populations. However, there were significant differences in the weather conditions of the three years. The year of 2003 was dry during the whole summer. The year 2004 was with higher than usual mean precipitation during the collection period that was also characteristic for the whole year of 2005. The number of the additional species compared to previous year is significant (Table 1). We are sure, there is no need of investigations of homogeneity to consider the high frequency changes in numbers as for the particular years. Consequently, if we combine them, we have to regard our procedure as combination of supplementary data rather than combination of repetitions. Therefore, the samples from the same day and those of the consecutive days are usable to estimate the same probability parameter. Combination of collections of more distant samples in time is probably not so. As regards the estimation to the real abundance of the populations, a combination of the results from different years should approximate to mean abundance.

Despite the high sample sizes and number of samples taken, we found comparatively many additional species from one year to the other, and very irregular features of the species in the lowest frequency categories, etc. At least so, if we compare them to some sample series published on vertebrate communities or other less species rich animal assemblages. We think the reasons are not intricate. After all, we remained far below reaching the species pool. We are afraid, similar results have ever gained in studies of assemblages in less known habitats, on species rich assemblages, are to be regarded as a sign of the same inadequacy. As for their studies in the future, our results are recommended to be taken into consideration.

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Checklist of the Diptera of Hungary

Edited by L. Papp

This is an international undertaking of 20 authors: a checklist of the dipterous species found through the end of 2000 in Hungary, with references to their first reliable records in the territory of modern Hungary. The "minimum requirements" for a "first record" are to have the name of the identifier and the place of deposition, and to have evidence that the site is a locality of present-day Hungary. The starting point for most parts is Thalhammer's *Fauna Regni Hungariae* in 1900 and every family part has a short introduction. These parts contain data on the number of recorded species and on the number of species expected to occur in Hungary. Most of the voucher specimens are deposited in the Diptera collection of the Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM); in exceptional cases the name of the relevant institution is given. There are numerous species new to Hungary reported here for the first time, however, the dipterous fauna of Hungary is still poorly known with 5550 species in this book. According to our present knowledge no less than 10000 species may occur in the country.

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