FOLIA ENTOMOLOGICA HUNGARICA
ROVARTANI KÖZLEMÉNYEK
LVI 1995 p. 153–162

Dipterous assemblages of sheep-run droppings in Hungary (Diptera) I.: Qualitative results*

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Dipterous assemblages of sheep-run droppings in Hungary (Diptera) I.: Qualitative results – Sampling and survey were completed in two Transdanubian and one Kiskunság NP areas in order to assess elements of community organisation of coleopteran and dipteran assemblages. Isochronous sheep droppings were selected and covered by isolators (as photoeclectors). The distances of isolators were measured and these data were converted into coordinate values yielding a "map of droppings". In 32 samples 11 215 ex. of 122 species were recorded. For locating droppings, the flies may be divided in two groups: a) good flier species with ability of long-distance detection of smells and b) small or minute flies, which use the pasture vegetation as take-off grounds, blown by the wind randomly to places close to droppings and which are orientated by smells from a short distance. Pan traps (30 × 4 × 4 × 0.1 m samples with more than 15 000 flies) fix the insects landed on given points of sheep-runs from the aerial plankton in surprizingly high number. Species developing very far from pastures were also captured which are obviously not members of the coprophagous or pasture assemblages.

INTRODUCTION

The scientific cognition of the flies colonizing on and breeding in sheep droppings is still rather scanty. Sheep is an animal species alien to all landscapes of the present Hungary (Papp 1993); it was introduced into the Carpathian Basin only some seven thousand years ago and it became mass only two or three thousand years ago. The fly populations found on and breeding in sheep droppings on pastures are recruited from the flies breeding in cattle pats, in droppings of horse and of cervid games (Rohácek 1984, Papp 1985*a*, 1993).

Some of the earlier literature stressed production biological or veterinary importance (Olechowicz 1974, Papp 1985*b*). Formerly we studied interactions of flies and dung beetles in dry sheep pastures (Ádám 1986, Papp 1985*a*, Papp and Ádám 1986), which surrendered usable data but that pioneer work has not been accomplished. It seemed necessary to collect more data on the species composition of the flies on sheep droppings in all parts of Hungary. Indeed, some collectings had been made and whose results were published (Papp 1993).

As noted by Papp (1993) the species composition of the dipterous assemblages on sheep droppings does not seem less rich than that of the flies on other dung. A comparison of the species composition of the dipterous assemblages with those on dung of other hoofers (cattle, horse, etc.) did not indicate any significant difference (Rohácek 1984,

* This study was supported by the National Scientific Research Fund (OTKA) No. 3188.

Papp 1985*a*, 1993), e.g. any species on red deer droppings may occur on sheep droppings. It is possible that some specimens are from the pastures of cattle (even rather distant from these sheep-runs) but it is sure that at least a part of the specimens is autochthonous (emerged from sheep droppings on their pasture).

As a part of the project "Zoocenological structures" supported by the National Scientific Research Fund (OTKA No. 3188) sampling and survey were made on droppings of dry sheep-runs in two Transdanubian (W Hungary) and one Kiskunság NP (C Hungary) areas in order to detect elements of community colonisation of coleopteran and dipteran populations. In our present studies we were to collect data on the steps of community organisation of these pioneer assemblages and also on the source of specimens colonizing droppings. In this paper only the qualitative results with the data matrix are published.

MATERIALS AND METHODS

Sampling and survey were made on droppings of dry sheep-runs in two Transdanubian (Zámoly, Forráspuszta and Vértesboglár) and one Kiskunság NP (Kunszentmiklós: Janovics-hodályok) areas. When sampling 20 seemingly isochronous (1 to 2 days old) sheep droppings each were selected and covered quickly by metal-and-glass isolators; isolators worked as photoeclectors for collecting flies. The flies crawled up into the isolator and were narcotized by chloroform. Beetles were manually selected thereafter (altogether 70 coleopteran species recorded, published elsewhere). Flies are colonizing and females lay eggs on fresh droppings of one or two days; droppings lose most of their odours attractive for females later (one day in hot summer, two or more days in cool autumn weather). During one day (and night) or two days also the beetles can colonize droppings in high numbers (as for abundances as well as species numbers). Since we were to study both insect groups on the same droppings, droppings of that age were selected for sampling. The sampling were usually made at a 100 to 300 m distance from the sheep-pens. The mean quantity of sheep droppings per surface units is very low in these dry sheep-runs (cf. White 1960, Olechowicz 1974). At those places sheep were grazing (and stayed for some time) before entering and just after leaving the sheep-pens; the density of sheep droppings is much higher (20 to 30 times higher) in these places than the mean density on the sheep-runs (an estimate is ca. five pieces/day/hectares calculated for one grazing sheep on 1 ha).

The distances between isolators were measured and the distance data were converted into coordinate values by a software ("Profly 1.1") resulting in a "map of droppings" (orientated to the N).

Imagoes collected by the isolators were kept in vials with the number of the isolators and identified in the laboratory. So as regards individual sheep dropping, a *counting and not an estimation* of the dipterous specimens was performed. It is a matter of course that as for the relationships, the species composition of the given sites, etc. these countings were reduced in summary values in order to estimate parameters.

In order to detect the sources of coprophagous and other populations of sheep-run flies, pan-trapping of the insects falling down from the air-plankton was made parallel to collectings with isolators. In each case 16 (4 × 4) 0.1 m^2 pan traps of indefinite (dull creamy) colour were exposed in a 30 × 30 m network for three hours in one sampling (oriented to the wind direction). Water with some detergent was used; insects were filtered out and preserved in 70% alcohol for study.

Air temperature just on the ground and at a depth of 5 cm were measured in °C. The wind speed was always measured at 3 m height (supposedly the height of air-borne minute dung inhabiting flies).

In several cases singling for flies and beetles were also made in order to supplement data.

The voucher specimens are deposited in the collection of the Department of Zoology, Hungarian Natural History Museum, Budapest.

RESULTS AND DISCUSSION

Data of flies captured by the isolators are summarized in Table 1 (altogether 11 215 specimens). At Forráspuszta (below: FP or F) in 1992 four, at Vértesboglár (VB or V) in 1992–93 seven, at Kunszentmiklós (KSZ or K) in 1991–94 21 series of samples were taken (VB930914 was formed from 6 isolator samples only). When coding the samples, two or three letters for the site and two numerals each for the year, month and day were used (e.g. VB930914 is for the Vértesboglár site on the 14th of September, 1993).

In the data matrix of 122 × 32 = 3904 cells there are only 655 non-zero cells. At Forráspuszta 650 specimens of 55 species (mean number of species per sample series is 23.5), at Vértesboglár 884 specimens of 60 species (mean species number/ sample series is 21.43), at Kunszentmiklós 9 681 specimens of 96 species (mean species number/sample series is 16.6 spp. for 1992, 19.75 spp. for 1993 and 24.0 spp. for 1994) were collected.

In 32 sample series a total of 11 215 ex. of 122 dipterous species (in 28 families) were recorded. There are only eight families with four or more species (Scatopsidae 4, Hybotidae 7, Phoridae 6, Sepsidae 7, Sphaeroceridae 37, Carnidae 5, Anthomyiidae 6, Muscidae 9; total 81).

As it has been established formerly, dipterous populations and their assemblages on sheep droppings are extremely disproportional and show characteristics of pioneer colonizers.

Corroborating former findings, it was found that sheep droppings have no autochthonous Diptera *faunule*. Almost no species was found which had not been included in Papp's (1992) table for dipterous species developing in pasture dung in Hungary. The list of species given in Table 3 of Papp (1993) for imago samples collected on sheep droppings from different parts of Hungary is nearly identical with the present one. The sphaerocerid species *Coproica lugubris* is the most characteristic species for sheep droppings in all the three sites (and it is also dominant unless the masses of *C. vagans* do not suppress it).

The occurrence of the 122 species at the three sites are FVK 28, FV 2, F K 13, VK 18, F 12, V 12, K 37 species, respectively.

The Jaccard index (species identity, paired comparison of the sites) of the three sites are

$$J_{F,K} = 0.373,\ J_{F,V} = 0.353 \text{ and } J_{V,K} = 0.418$$

The Jaccard-index values of some samples from the same locality are as follows

At Kunszentmiklós sampling was taken on the 19th of May in all the three years (1992: 78 ex of 24 spp.; 1993: 543 ex. of 25 spp.; 1994: 744 ex. of 36 spp.):

$$J_{2,3} = 15/34 = 0.44;\ J_{2,4} = 17/43 = 0.40;\ J_{3,4} = 15/46 = 0.33.$$

The species identity of the Kunszentmiklós samples taken on the 14th and 15th of June, 1994 (135 ex. of 18 spp. and 339 ex. of 21 spp.) is: $J_{1,2} = 11/28 = 0.39$.

The only day when we managed to collect two series of samples (adjacent to each other) was at Forráspuszta on the 3rd of June, 1992. The Jaccard index value of the two series (348 ex. of 34 spp. and 206 ex. of 23 spp.) is: $J_{1,2} = 18/39 = 0.46$.

These values respectively show that we must not state that any geographical difference has been proved for these three sites. A good part of the species found only at Kunszentmiklós, namely *Drapetis flavipes, Sepsis neocynipsea, Aphaniosoma hungaricum, Tethina sp., Pelomyiella hungarica, Norrbomia hispanica, Norrbomia somogyii, Coproica digitata, Coproica pusio, Leptometopa niveipennis, Lispe sp.* (not all are coprophagous), is characteristic for the salty grasslands of Central and Eastern Hungary. All the other differences in species composition may be attributed to the smaller than *optimum* sample size (e.g. the number of shared species is largely proportional with the total number of specimens caught). That is, no more than pecularities of pastures in the salty grassland are to be recognized when comparing the sites. Sample sizes of the two Transdanubian sites are not large enough to represent more than the dominant-subdominant species of the assemblages *and* representatives of some rare species *randomly*. This is why the differences are seemingly so large between the samples (see Papp 1993). Extreme differences were found in the numbers of colonizing flies (incl. a dropping with 1 566 dipterous specimens, KSZ930602) but there were also droppings without any fly – particularly so for springtime and hot summer samples (remember: numbers given in Table 1 are reductions of 20 isolators each). Invariances are detectable for dominant-subdominant species only. In order to estimate the effect of randomness in the results in 20 isolators, computer simulations will be performed in the near future.

At the site of Kunszentmiklós the sample series collected in the spring of 1993 and 1994 are characterized by a comparatively high total abundance and by extremely high abundance of three *Coproica* species (*Coproica ferruginata, C. hirticula, C. vagans:* the dominant one), which develop mainly in dung heaps and in animal houses. The causes of those results are that dung was removed from sheep-pens and it was humped beside them. NW winds blew thousands of sphaerocerids from there into the grassland. And although all the three species normally develop in sheep droppings (Papp 1985a), the sheep droppings proper and present were not enough to maintain their high abundance; the imagoes were blown to and fro on the "puszta" (according to the mechanism described below) and their number decreased from week to week. The emergence of the next "generation" was not enough to replace aged imagoes which died in the meantime. A

	FP920603	FP920603	FP920916	FP921006	VB920513	VB920526	VB920528	VB930525	VB930609	VB930630	VB930914	KSZ910926	KSZ920519	KSZ920601	KSZ920616	KSZ920923	KSZ921013	KSZ930519	KSZ930602	KSZ930615	KSZ930622	KSZ930910	KSZ930916	KSZ930928	KSZ931013	KSZ940519	KSZ940602	KSZ940608	KSZ940614	KSZ940615	KSZ940621	KSZ940628	Σ
Cecidomyiidae sp. 1.	3	0	1	0	2	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	6	0	1	1	0	0	2	1	22
Sciaridae sp. 1.	0	0	0	0	1	1	1	0	0	1	0	1	3	0	1	0	0	0	0	0	0	0	0	6	2	4	0	1	0	0	0	0	22
Chironomidae sp. 1.	0	0	1	1	0	0	0	0	1	0	0	0	0	0	2	0	7	2	0	1	0	6	1	3	48	12	1	0	1	39	0	0	126
Chironomidae sp. 2.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	13	0	0	0	2	0	0	16
Chironomidae sp. 3.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Culicoides sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	3
Ceratopogonidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Bibio hortulanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Dilophus antipodalis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dilophus febrilis	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
Ectaetia clavipes	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4
Coboldia fuscipes	0	0	0	0	0	0	0	2	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6
Scatopse notata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Swammerdamella brevicornis	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	4
Crossopalpus aenescens	0	0	0	0	0	0	0	0	2	8	4	0	0	0	0	0	0	0	2	4	3	0	0	2	0	0	0	2	2	1	2	0	32
Crossopalpus flexuosa	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Crossopalpus humilis	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	2	1	0	0	0	0	11
Crossopalpus nigritella	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Drapetis assimilis	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Drapetis flavipes	0	0	0	0	0	0	0	0	0	0	0	0	5	10	0	0	0	5	2	3	0	0	0	0	0	0	4	12	8	7	0	4	60
Tachydromia brevipennis	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dolichopodidae sp.	0	0	0	0	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	9
Diplonevra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Triphleba sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Megaselia sp.	0	0	0	0	6	2	2	1	1	6	1	1	0	0	1	0	1	2	2	0	0	1	0	0	0	2	1	0	0	1	1	0	32
Metopina sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Phoridae sp. 1.	2	3	4	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	16
Phoridae sp. 2.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Micropeza brevipennis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2
Sepsis biflexuosa	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	5
Sepsis cynipsea	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
Sepsis duplicata	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Sepsis fulgens	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	6

Table 1. Diptera sampled from 20 pieces each of sheep droppings in three Hungarian dry sheep-runs by isolators (1991-94) (for details see text)

Sepsis neocynipsea	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sepsis orthocnemis	5	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	1	0	0	15
Sepsis thoracica	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	7	6	3	1	3	2	6	2	2	4	3	1	1	44
Physiphora demandata	0	0	0	0	3	3	0	1	2	8	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	21
Chamaemyia juncorum	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Aphaniosoma hungaricum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Stiphrosoma sabulosum	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tethina sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Palomyiella mallochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hydrellia griseola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Sphaerocera curvipes	0	1	0	0	1	2	0	0	0	0	0	0	2	0	0	0	0	4	0	0	0	0	0	0	0	7	0	0	0	0	1	0	18
Ischiolepta pusilla	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
Ischiolepta vaporariorum	9	3	0	0	0	2	1	3	1	0	0	0	1	0	0	0	0	7	0	0	1	0	0	0	0	1	0	6	0	2	0	2	39
Lotobia africana	1	2	0	0	3	0	3	0	0	0	0	4	0	1	2	0	2	0	3	3	16	1	1	3	0	0	16	27	40	64	60	157	409
Lotobia pallidiventris	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	1	3	0	2	1	0	9	11	35
Crumomyia nigra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Lotophila atra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Copromyza equina	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	1	0	7
Norrbomia costalis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	5
Norrbomia hispanica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	2
Norrbomia sordida	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Norrbomia somogyii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	3
Coproica acutangula	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	3	0	0	11
Coproica digitata	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	10	9	0	0	0	0	1	1	4	5	2	5	18	59
Coproica ferruginata	5	10	2	5	2	2	39	36	2	6	0	1	2	7	4	0	1	133	56	2	1	4	1	48	113	12	1	4	1	0	5	2	507
Coproica hirticula	0	0	0	0	2	1	10	1	2	5	1	0	1	8	4	0	5	22	396	6	2	2	4	216	355	15	0	2	0	0	4	1	1065
Coproica hirtula	0	0	0	0	1	0	0	0	0	2	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	0	0	9
Coproica lugubris	86	51	10	14	44	36	83	28	49	14	4	2	20	30	30	2	18	84	58	116	103	18	11	134	101	44	50	90	52	178	54	74	1688
Coproica pusio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Coproica vagans	85	37	6	2	22	43	24	49	12	3	0	0	14	83	9	1	7	241	4176	6	7	1	1	40	332	553	3	38	6	4	20	3	5828
Philocoprella italica	14	38	0	0	2	5	22	0	3	0	0	0	3	1	4	0	0	2	7	8	48	0	0	1	0	0	3	14	3	25	0	1	202
Elachisoma aterrimum	3	0	0	0	1	0	5	2	1	0	0	0	0	1	1	0	0	5	7	1	2	0	0	0	0	3	2	2	0	0	0	1	37
Elachisoma bajzae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	5
Elachisoma pilosum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Halidayina spinipennis	3	1	0	0	0	4	61	1	0	0	0	0	6	2	2	0	0	4	0	0	0	0	0	0	0	9	0	0	0	0	0	0	93
Chaetopodella scutellaris	23	35	0	0	1	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	64
Pullimosina heteroneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1

Table 1 (continued)

Pullimosina pullula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
S. (Bifronsina) bifrons	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	3	0	1	0	0	0	0	0	1	12
S. (Spelobia) clunipes	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6
S. (Spelobia) simplicipes	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	5
S. (Eulimosina) ochripes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Telomerina pseudoleucoptera	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Opalimosina collini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Opalimosina mirabilis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Pteremis fenestralis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Opacifrons coxata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Leptometopa latipes	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leptometopa niveipennis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	4
Desmometopa sordida	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Meoneura flavifacies	3	1	4	1	0	0	1	0	0	0	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Meoneura freta	0	0	0	0	0	0	0	0	0	21	14	0	2	15	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	2	56	115
Meoneura hungarica	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Meoneura neglecta	44	10	2	0	1	4	1	0	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	73
Meoneura triangularis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ophiomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Liriomyza sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cerodontha denticornis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pseudopomyza atra-complex	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	6
Phytomyza horticola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Oscinella frit	0	0	4	2	1	2	0	0	0	0	0	0	4	2	0	0	1	4	0	1	0	0	5	1	0	19	2	0	0	1	3	0	52
Oscinella sp.	1	1	0	0	0	1	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Meromyza sp.	0	0	0	0	0	1	4	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Chlorops sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2
Oscinimorpha albisetosa	2	0	0	0	6	7	13	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	4	0	0	0	0	0	35
Incertella albipalpis	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Scathophaga stercoraria	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	10
Adia cinerella	8	2	2	4	3	1	1	1	3	2	2	4	1	3	1	2	2	15	2	2	1	3	4	4	7	12	4	8	6	1	4	3	118
Calythea dedecorata	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
Calythea nigricans	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hylemya variata	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Delia platura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	1	0	4
Anthomyia pluvialis	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Myospila meditabunda	3	1	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11

Table 1 (continued)

Table 1 (continued)

Hebecnema umbratica	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hydrotaea sp. (female)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lispe sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
Morellia hortorum	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Musca autumnalis	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	8
Musca domestica	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	5
Musca osiris	0	1	1	0	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	1	0	1	11
Neomyia cornicina	3	0	1	3	1	2	0	0	1	1	1	2	0	0	1	0	2	0	1	0	0	1	0	0	0	3	0	2	1	0	0	1	27
Lucilia richardsi	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lucilia sericata	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Agria latifrons	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ravinia striata	3	0	0	0	0	0	1	2	0	1	1	1	1	2	0	0	0	0	1	0	1	0	0	0	0	0	0	2	0	0	0	0	16
Bellieria melanura	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tachinidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
Sciaridae sp. 2.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Total specimens	348	208	49	45	114	130	289	130	86	68	47	20	76	175	68	8	48	543	4733	183	212	41	37	472	980	751	107	226	135	339	182	343	11215
Total species	34	23	20	17	27	27	28	15	18	20	15	12	24	22	19	6	12	25	24	24	19	11	15	20	20	36	23	24	18	21	23	23	122
Berger—Parker index (×1000)	247	245	204	311	386	33	287	377	570	239	298	200	256	474	441	250	375	444	882	634	486	439	297	456	362	736	467	398	385	625	330	458	0

similar but quicker process was detected in June, 1994. In the autumn of 1993, samples were taken in the increasing phase of that process only.

Based on our field observations, we may divide the flies according to their behaviour for locating droppings into two groups: a) good flier species with ability of long-distance detection of smells (*Adia cinerella, Musca spp., Neomyia cornicina, etc.*) and b) small or minute flies, which use the pasture vegetation as take-off grounds, blown by the wind randomly to places close to droppings and oriented by smells from a short distance. These small flies do not fly away from droppings when disturbed but just crawl or jump off and hide among the grass roots, etc. in order to keep olfactory contact with the droppings. By knowing this we left droppings after selecting them (and sticking poles nearby as signs) for at least half an hour, before we covered them by our isolators.

As it was experienced in very dry sites like localities in Afghanistan, not only coprophagous species are collectible on droppings but also those flies which are attracted by the higher humidity on or in the close vicinity of the droppings (mostly phytophagous species of the families Agromyzidae and Chloropidae).

Pan traps (30 × 16 samples with more than 15 000 flies) fix insects havinglanded at given points of sheep-runs from the aerial plankton in surprizingly high number. Most of the important coprophagous species were also collected this way. Nevertheless, species developing very far from pastures were also captured which are obviously not members of the coprophagous or pasture grass assemblages (detailed results will be published in a subsequent paper).

The results of quanlitative analysis of our data matrix with more sophisticated methods will be published in subsequent papers.

Acknowledgments – I wish to thank Mr László Ádám (Dept. Zoology, HNHM) for his help with sampling and for his advice. I am grateful to Dr Csaba Moskát (Ecological Research Group, Dept. Zoology, HNHM), the project leader of OTKA No. 3188 for continuously supporting of our studies.

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(Received 28th February, 1995)

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