Acta Biologica Szeged. *27* (1—4), pp. 169—179 (1981)

MALAISE TRAP INVESTIGATIONS IN INUNDATION, SODIC AND SANDY AREAS I. QUALITATIVE RELATIONS

M. MÓCZÁR and GY. GYÖRFFY

Department of Zoology, Attila József University, Szeged

(Received September 15, 1980)

Abstract

In 5 different areas 38 000 insect specimens were collected by Malaise trap from 1972 to 1978 in 35 periods. The ratio of Diptera being predominant everywhere increases during season in flood area meadow, decreases in sandy forest and has a summer minimum in the sodic area. Among the 12 Hymenoptera superfamilies Ichneumonoides have the greatest number of species. From the 11 Macrolepidoptera families Noctuidae is the reachest in species. The species richness of flood area meadow is about 2/3 of that of sandy forest and 1/3 part of sodic areas. The number of species decreases from the spring to autumn. Cicadellidae is the most important from the 6 Cicadinea families collected and families Coccinellidae, Curculionidae and Chrysomelidae are most important among the 21 Coleoptera families collected. In a given area species similarity indices of Hymenoptera, Cicadinea and Coleoptera are highest between spring and summer but as for Lepidoptera spring-autumn Jaccard indices are the highest in inundation and sodic areas. The differences between Coleoptera, Cicadinea and Hymenoptera species communities are highest between sodic and inundation areas, but the species composition of Lepidoptera communities of these two areas is very similar. The habitat specificity of the order Hymenoptera is strongest and this is followed by Cicadinea. The specificity of Coleoptera and Lepidoptera is much less.

Introduction

The Malaise trap was published almost 50 years ago (MALAISE, 1937) but this very advantageous method has been widely used only in the last decades as an auxiliary method of faunistical investigations (e.g. KASZAB, 1966). The efficacy of this method was analysed only in certain insect groups (MARSTON, 1965; CHANTER, 1965; MÓCZÁR, 1967; GEIJSKES, 1968; MATTHEWS and MATTHEWS, 1970) because of the very huge material collected in sufficient conditions. Light traps are much more widely spread for collecting flying insects, but Malaise trap being not attractive reflects better the natural species composition (OWEN, 1969, GUNDSTREAM and CHEW, 1967). According to BREELAND and PICKARD (1965) Malaise trap is more efficient quantitatively than the other traditional methods. Other advantage of these traps is that since there is no bait in them and the animals are collected from the next environment, the material collected is clear and it can be conservated without difficulties. This method is very useful first of all to investigate in the structure of insect communities, flying activity (CLARK, 1979), seasonality, species diversity etc. (MATTHEWS and MATTHEWS, 1971).

The efficiency of Malaise trap was investigated in three types of natural conservation areas being almost at natural stage. These areas are: a flood area meadow, a sodic meadow and three sandy areas being ecologically very similar. Faunistical data were also obtained for the investigated areas.

The first step of zoological investigation of a given area is to determine the qualitative composition of the animal communities present (JERMY, 1977). Then the role of populations, their interactions and their place in the material and energy flow system can be investigated. In the course of present investigations we compared the insect communities of the areas from qualitative and relative quantitative points of view. We also studied the seasonal differences, relations between the diversity of certain insect groups and the complexity and species richness of the insect groups collected. The quantitative analysis and diversity relations will be published in an other paper. The qualitative and quantitative pecularities of the order Diptera will be discussed separately, too.

Study sites

Körtvélyes: An isle situated between 201st and 204th river kms of River Tisza surrounded by the river and a dead arm of the Tisza. It is flooded almost every year. The vegetation is hygrophilous. Malaise trap were placed on the central meadow. Its plant associations are as follows: *Alopecuretum pratensis; Carici-Typhoidetum arundinaceae; Glycerietum maximae* (ANDÓ, BODROGKÖZY and MARIÁN, 1974). The arboricole species lives in the surrounding woods: *Salicetum triandrae, Salicetum albae-fragilis populetosum* and *Ulmo-Fraxinetum* that are at least 200 m from the place of the trap. "The surface of the water of large mass has an extreme modifying effect on climate. The annual cloud formation is here the smallest in the country. The degree of average cloudiness of the month August is lower than 35 percent (ANDÓ, 1958, 1959).

Kiskundorozsma: ("dorozsmai nagyszék", abbreviation: D): It is a solontschak sodic meadow situated near Szeged town. The solontschak flat is bordered by a small "brown sand" dune that is covered by Potentillo-Festucetum pseudovinae plant association. The main types of the plant associations forming a mosaic-like pattern on the solontschak flat are: *Lepidio-Camphorosmetum* annuae and *Lepidio-Puccinellietum limosae.*

Ásotthalom: It is about 30 km west of Szeged. The trap was placed into a clearing of the so-called "Kiss Ferenc Memory Wood" being a natural conservation area. The plant associations of this sandy soil area are: *Festuco-Quercetum populatosum albae, Festucetum vaginatae danubiale* and *Astragalo-Festucetum rupicolae* (BODROGKÖZY, 1957).

Fülöpháza: The trap was placed in an area of the Kiskunság National Park, that is about 20 km west of Kecskemét town, where some areas of different types meet. One of them is a pasture with *Artemisio-Festucetum pseudovinae lepidietosum* association the other is a little salt lake with *Lepidio-Camphorosmetum* annuae and *Lepidio-Puccinellietum limosae* vegetation in its shore. About 400 m NW of the trap there was a sand dune with xeromorphic vegetation its basic association is *Potentillo-Festucetum pseudovinae* (BARANYAI, G., 1979, manuscript). There were also a rye field in east direction. Only few collections were made here.

Bugacpuszta: It also belongs to Kiskunság National Park. The trap was in the centre of a 2 ha area without grazing activity. The area is a typical mosaic complex that consists of wind furrows and small sand dunes. The typical plant association is *Festucetum vaginatae* on the dunes and *Molinio-Salicetum rosmarinifoliae* in wind furrows. The grassland is bordered by wood stand that is about 100 m from the place of the trap. It is characteristical for the microclimate of this area that the annual precipitation is much less than the country average and the fluctuations in temperature are very strong.

Methods

The original Malaise trap (GRESSITT and GRESSITT, 1962, TOWNES, 1962) was modified by MÓCZÁR (1967) and this modified type was used. Samples were taken generally three times a year (spring, summer and autumn). The traps were emptied every day in morning hours (9—10 a.m.). The time data of the collections are as follows:

Körtvélyes:
Spring: 7—12 June 1972; 21—26 June 1973; 2—6 June 1974.
Summer: 18 July—08 August 1972; 18—23 July 1973.
Autumn: 10—13 Oct. 1972; 23—27 Sept. 1975.

Kiskundorozsma:
Spring: 6—12 June, 1972; 13—18 June 1973; 15—19 June 1974; 17—20 June 1975.
Summer: 9—11 July. 1972; 26 July—08 August 1973; 30 July—08 August 1974; 25—28 August 1975.
Autumn: 21—29 Sept. 1972; 19—25 Sept. 1974; 24—27 Sept. 1975.

Ásotthalom:
Spring: 29 May—06 June 1972; 30 June—06 July 1973; 31 May—06 June 1974; 21—27 June 1975.
Summer: 18—25 July 1972; 2—7 August 1973; 6—11 August 1974; 21—24 August 1975.
Autumn: 18—20 Oct. 1972; 8—18 Oct. 1974; 18—21 Sept. 1975.

Fülöpháza:
12—16 July 1977; 3—8 June 1978; 2—8 August 1978; 1—6 Sept. 1978.

Bugacpuszta:
16—23 June 1976; 31 August—6 Sept. 1976. As for meteorological factors the influences of the cold and warm fronts were evaluated but significant correlation wasn't found.

Elaborating the collected materials the main orders, Hymenoptera, Macrolepidoptera, Cicadinea and Coleoptera were identified on species level.

For the qualitative characterization of areas or time aspects we used the number of families and their species richness. To compare different areas and seasons Jaccard's index was used:

$$J_a = \frac{c}{a+b-c}$$

where a = number of species in sample A; b = number of species in sample B and c = number of species common to samples A and B.

Results

In the course of trappings altogether 37,763 insect specimens were collected, 8170 in the flood area at Körtvélyes, 8065 in the sodic area at Kiskundorozsma and 7581 at Ásotthalom. 8990 specimens were collected by the trap at Fülöpháza, but 86 p.c. of that was Diptera species and most of them Nematocera owing to the sodic lake.

Among the insects collected the order Diptera was predominant at every place (Fig. 1). On the humid flood area meadow and in sodic areas the ratio of Diptera was

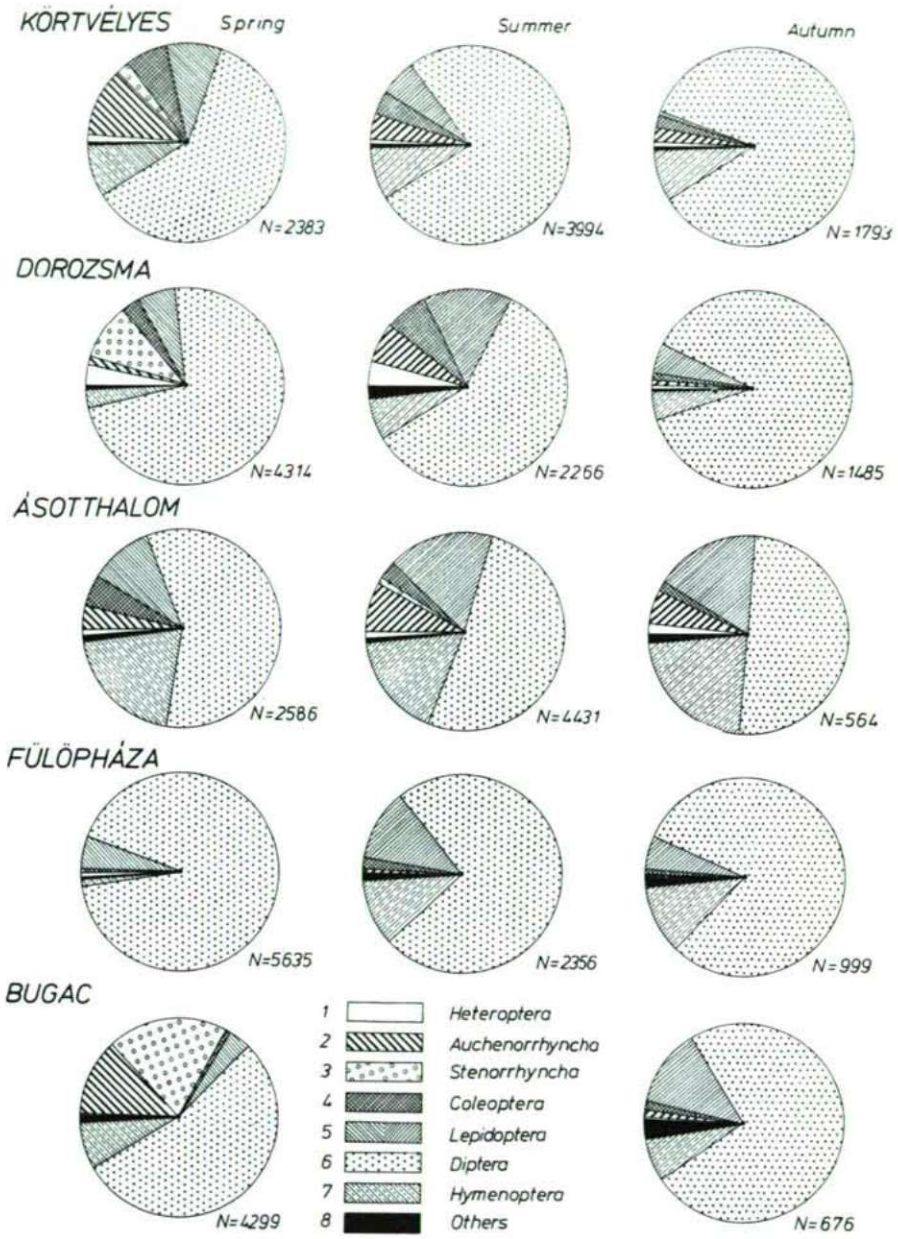

Fig. 1. Seasonal and local specimen distribution of the orders drawing together the data from 1972 to 1978 (N = number of specimens).

72 p.c. because of the temporary water coverage, but it was only 54—56 p.c. in sandy areas. In spring, summer and autumn periods the dominancy is different within the single areas. For instance from spring to autumn in the flood area it increases from 53 up to 86 p.c. In the sodic areas it is the lowest in summer (58 p.c.), higher in spring (73 p.c.) and in autumn it can reach 87 p.c. In the sandy areas of Ásotthalom the dominancy of Diptera slightly decreases (58—49 p.c.) during season.

Hymenoptera (11 p.c.), Cicadinea and Lepidoptera (6—6 p.c.) are subdominant groups in the flood area. In the sodic area Lepidoptera (9 p. c.), Sternorrhyncha (5 p.c.) and Hymenoptera (4 p. c.) are subdominant but the the quantity of Coleoptera, Heteroptera and Cicadinea has also a certain significance (3 p.c.). In the sandy areas subdominants are: Hymenoptera (19 p.c.), Lepidoptera (15 p.c.) and Cicadinea (7 p.c.).

The following orders signed as "others" were represented in significantly less quantity in the Malaise trap: Ephemeroptera, Odonata, Blattodea, Orthoptera, Neuroptera. For details see Figure 1.

Hymenoptera

The total amount of Hymenoptera specimens is the second biggest after Diptera except for the sodic area. None of the superfamilies were limited to one of the three aspects. Ichneumonoides proved to have most species in every period and area (Table 1). The number of Ichneumonoide species was the greatest in spring, decreased to

Table 1. Superfamily distribution of Hymenoptera species

Superfamilia	Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac	
	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au
1. Tenthredinoidea	10	18	6	1	2	2	2	4	3	—	2	1	—	1
2. Ichneumonoidea	108	70	64	34	49	13	69	62	31	?	?2	?	87	7
3. Cynipoidea	—	—	—	—	—	—	2	—	—	—	—	—	—	—
4. Chalcidoidea	1	1	2	—	—	—	—	8	—	—	2	1	1	1
5. Proctotrupoidea	—	—	2	1	—	—	2	—	—	—	—	—	1	1
6. Chrysidoidea	3	—	—	—	—	—	1	2	—	2	4	1	—	—
7. Scolioidea	1	1	—	—	—	—	2	2	—	—	1	1	7	1
8. Formicoidea	—	1	1	1	1	—	4	3	1	—	1	—	2	1
9. Pompiloidea	3	3	—	8	4	—	9	19	2	—	2	—	1	1
10. Vespoidea	2	2	—	2	1	—	4	5	3	—	1	4	1	—
11. Sphecoidea	9	19	2	6	15	—	21	31	7	2	18	1	21	2
12. Apoidea	10	21	—	11	11	—	18	40	1	—	11	1	27	1
Sum total:	147	136	77	64	83	15	134	175	48	?4	?44	?10	148	16

summer and had a minimum in autumn. In the sodic area the number of species was less in spring than in summer, that fact might be a result of the long-lasting water coverage. In sandy areas the ratio of Sphecoidea and Apoidea was considerable. The number of Sphecoidea species had summer maxima at all localities. The Apoidea species were similar except sodic areas where the flower level is poor in species and soil has unsuitable nesting possibilities. The number of Pompiloidea is very high in the sandy area at Ásotthalom, which is very suitable biotop for them. In the flood

area meadow the number of Tenthredionoidea species is about 4 times higher than in other areas because that humid environment is very advantageous for their development.

It can be seen from the very low values of species similarities (Table 2) that there are considerable differences between different aspects of an area, because the majority of adult Hymenoptera have very short life span. It is conspicuous in the sodic area where there is no similarity between spring and summer periods.

Table 2. Species similarity values for Hymenoptera between areas and aspects

Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac			
Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au		
100	8.15	3.13	2.85			4.74			0.00			3.07		Sp	
	100	2.84		5.52			4.88			2.24				Su	K
		100			0.00			3.17			0.00		0.00	Au	
			100	6.20	0.00	7.89			0.00			3.34		Sp	
				100	3.06		5.11			4.80				Su	D
					100			0.00			0.00		3.22	Au	
						100	9.69	2.87	0.76			6.59		Sp	
							100	5.02		7.90				Su	Á
								100			1.75		3.22	Au	
									100	2.12	7.14	0.66		Sp	
										100	3.77			Su	F
											100		0.00	Au	
												100	1.24	Sp	
													100	Au	B

Comparing the whole year faunas of the different areas (Table 3) it can be established that the similarity of species composition is almost identical on a lower level.

Comparing the same aspects of different areas (Table 2) it can be seen that the similarity is least in autumn and only a little similarity could be found between Ásotthalom and the flood area. The similarity of summer faunas is just below 5 p.c. and that of autumn is very different (3—8 p.c.).

Table 3. Species similarity of Hymenoptera between areas

K	D	Á	F	B	
100	6.76	6.79	2.36	4.12	K
	100	8.59	4.47	6.53	D
		100	7.20	8.58	Á
			100	7.51	F
				100	B

Table 4. Species similarity of Macrolepidoptera between areas

K	D	Á	F	B	
100	17.91	13.39	7.04	6.34	K
	100	14.85	8.33	5.76	D
		100	9.52	7.21	Á
			100	10.71	F
				100	B

Lepidoptera

After Diptera, Lepidoptera means together with Hymenoptera the second-third most important orders. Although Microlepidoptera represented 60—80 p.c. of the order they were not identified on species level because of the determination difficulties of this group. Otherwise the number of Macrolepidoptera specimens and species is great enough to be evaluated.

From the families collected (Table 5) it can be established that Noctuides have the highest species richness in every aspect. There were also many Geometridae, Satyridae and Pieridae species. Cossidae, Notodontidae and Sphingidae were collected only in spring, Hesperidae, Lycaenidae and Nymphalidae mostly in summer. The majority of Lepidoptera species were collected in sandy areas, in flood area 60—65, in sodic area only about 30 p.c. of them were cought. The widest species spectrum was measured in summer period and the poorest was the autumn fauna at all places.

Table 5. Family distribution of Macrolepidoptera species

Familia	Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac	
	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Su	Au
1. Hepialidae	—	—	—	—	—	—	—	—	—	—	—	1	—	—
2. Cossidae	—	—	—	1	—	—	—	—	—	—	—	—	—	—
3. Notodontidae	—	—	—	—	—	—	1	—	—	—	—	—	—	—
4. Noctuidae	8	13	1	6	11	1	15	20	5	6	8	12	5	7
5. Geometridae	—	5	—	—	2	—	8	16	2	—	1	5	2	3
6. Sphingidae	—	—	—	—	—	—	1	—	—	—	—	—	—	—
7. Hesperidae	—	3	—	—	—	—	1	2	—	—	1	—	1	2
8. Pieridae	2	4	—	2	4	1	1	3	1	—	3	1	—	—
9. Lycaenidae	—	2	—	—	1	—	1	1	—	1	1	—	—	—
10. Nymphalidae	—	1	—	—	2	—	1	3	—	—	—	—	—	—
11. Satyridae	2	4	—	3	1	3	4	8	3	—	1	1	3	2
Sum total:	12	32	1	12	21	5	33	53	11	7	15	20	11	14

The species identity indeces are high (11—24 p.c.) between different periods of a given area, in the sodic and sandy areas the spring and autumn faunas are most similar, probably because of the multivoltine species. In the flood area in autumn only one species represented the order Lepidoptera and it differed from all species having lived there in spring and summer.

Comparing the different places in yearly relations it can be seen that the fauna collected at Fülöpháza has only a very weak similarity to the others except Bugac (Table 4). The Lepidoptera communities of the sodic and flood areas are very near to each other. On the basis of the similarity indices the species composition of the inundation area is most related to that of sodic area (25 p.c.) in spring and it differs most from the fauna of Fülöpháza. The fauna of sodic area is similar to the inundation area in spring and summer and to Ásotthalom in autumn. The fauna of Ásotthalom is most similar to the inundation area in spring and summer and to the sodic area in autumn (Table 6).

Table 6. Local and seasonal species similarity of Macrolepidoptera

Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac			
Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au		
100	13.63	0.00	25.00			13.33			0.00			4.34		Sp	
	100	0.00		16.98			12.94			10.63				Su	K
		100			0.00			0.00			0.00		0.00	Au	
			100	18.18	23.52	11.11			0.00			4.34		Sp	
				100	11.53		12.16			8.33				Su	D
					100			18.75			0.00		0.00	Au	
						100	17.44	13.63	2.50			2.27		Sp	
							100	10.93		5.88				Su	Á
								100			6.45		8.00	Au	
									100	18.18	11.11	5.55		Sp	
										100	11.42			Su	F
											100		11.76	Au	
												100	4.00	Sp	B
													100	Au	

Cicadinea

Cicadinea is a trophically homogeneous group and it depends strongly on the host-plant relations and plant associations. This fact must be seen in the material collected by Malaise trap.

Family Cicadellidae is the richest in species in all aspects and areas (Table 7). Delphacidae and Cercopidae are also constant families but they have very few species in the areas investigated. The number of species is generally similar in spring and summer and the fewest species can be found in autumn. The sodic area is an exception because it has a summer maximum in species richness probably because of spring water coverage. The situation is different in the inundation area owing to the arboricolous species living there.

The species similarity (Table 8) is highest between spring and summer periods (23—26 p.c.). It is 18—23 p.c. between spring and autumn and 13—17 p.c. between summer and autumn.

Table 7. Family distribution of Cicadinea species

Familia	Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac	
	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au
1. Achilidae	—	—	—	—	—	—	1	1	—	—	—	—	—	—
2. Cercopidae	2	1	1	1	1	1	4	1	1	1	1	—	2	1
3. Cicadellidae	14	11	8	9	19	4	15	17	10	9	6	1	14	4
4. Cixiidae	—	—	—	2	2	—	1	—	—	—	2	—	—	—
5. Delphacidae	1	2	—	1	3	1	2	1	2	—	1	1	2	1
6. Dictyopharidae	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Sum total:	17	14	9	14	25	6	23	20	13	10	10	2	18	6

Table 8. Seasonal similarity of Cicadinea species

	Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac	
	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au
Sp	100	22.58	19.23	100	23.07	15.00	100	25.58	13.88	100	10.00	0.00	100	8.33
Su		100	17.39		100	12.90		100	15.15		100	0.00		
Au			100			100			100			100		100

The qualitative similarity between the areas in annual relations is shown in the Table 9. Since the differences are great between the areas the species similarity is low. It is caused by the psammophile species at Ásotthalom, Bugac and Fülöpháza and by the arboricolous species at Ásotthalom and the inundation area.

Table 9
Species similarity of Cicadinea between areas

K	D	Á	F	B	
100	13.79	12.50	17.39	14.58	K
	100	9.85	15.38	7.40	D
		100	15.25	13.11	Á
			100	9.52	F
				100	B

Table 10
Species similarity of Coleoptera between areas

K	D	Á	F	B	
100	17.47	16.49	12.85	7.14	K
	100	15.00	19.17	6.84	D
		100	20.89	11.94	Á
			100	15.00	F
				100	B

Coleoptera

Coleoptera takes only 5—6 p.c. of the total material collected and the species belonging to this order have inhomogeneous trophic pecularities but since the apperent differences in family and species richness can be characteristical for the areas investigated it is worth analysing this group in details (Table 11).

Characteristical families were in spring: Elateridae, Cantharidae, Dasytidae, Mordellidae, Melolonthidae and Lampyridae. Cerambycidae is the only typical summer family, but there is no any being characteristical for autumn. Families Coccinellidae, Curculionidae, Chrysomelidae and Carabidae being richest in species are represented in all aspects. Spring and summer species richness values are similar and the fewest species can be found in autumn.

18—23. p.c. similarity can be seen between spring and summer periods (Table 12). The similarity between spring and autumn is only 5—12 and between summer and autumn 3—8 p.c. only. The considerable similarity between spring and autumn may reflect two generations.

Comparing different areas (Table 10) the species similarity is generally 13—21 p.c. with the exception of the data originated from Bugac. The values of similarity indices at Bugac are about 7 p.c. because summer samples were not taken there.

Investigating the species similarity indices according to periods (Table 12) it turns out that these values are more extreme. The greatest differenes are in spring,

Table 11. Family distribution of Coleoptera species

Familia	Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac	
	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au
1. Alleculidae	—	1	—	—	—	—	1	1	—	—	—	—	—	—
2. Buprestidae	—	—	—	—	—	—	1	1	—	—	—	—	1	—
3. Cantharidae	2	—	—	1	—	—	—	—	—	—	—	—	—	—
4. Carabidae	—	3	5	5	14	—	1	—	—	—	—	—	—	2
5. Cerambycidae	—	—	—	—	—	—	—	1	—	—	1	—	—	—
6. Chrysomelidae	4	5	1	—	2	—	4	3	—	3	2	—	2	—
7. Coccinellidae	5	8	2	7	10	2	5	8	2	1	7	2	1	2
8. Curculionidae	5	2	2	2	1	1	4	4	1	—	2	—	2	—
9. Dasytidae	1	—	—	1	—	—	1	—	—	—	—	—	—	—
10. Dermestidae	—	—	1	—	1	—	—	—	—	—	—	—	—	—
11. Elateridae	2	1	—	1	3	—	2	1	—	—	—	—	1	—
12. Lagriidae	—	—	—	—	—	—	1	1	—	1	1	—	1	—
13. Lampyridae	—	—	—	1	—	—	1	1	—	—	—	—	—	—
14. Malachiidae	3	2	—	2	1	—	—	—	—	—	2	1	1	—
15. Meloidae	—	—	—	1	—	—	—	—	—	—	1	—	1	—
16. Melolonthidae	—	—	—	2	—	—	3	3	—	—	1	—	5	1
17. Mordellidae	1	—	—	1	—	—	1	2	—	—	—	—	1	—
18. Mylabridae	—	1	—	—	—	—	—	—	—	—	—	—	—	—
19. Oedemeridae	3	2	—	—	—	—	4	2	—	—	—	—	—	—
20. Phalacriidae	—	—	—	—	1	—	1	—	—	—	—	—	—	—
21. Staphylinidae	2	—	1	1	1	—	1	1	—	—	—	—	—	—
Sum total:	28	27	12	28	35	3	31	29	3	5	17	3	16	5

Table 12. Similarity of Coleoptera species

Körtvélyes			Dorozsma			Ásotthalom			Fülöpháza			Bugac			
Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Su	Au	Sp	Au		
100	18.18	10.00	17.85			8.47			3.12			4.54		Sp	
	100	7.69		17.74			14.28			20.45				Su	K
		100			13.33			13.33			13.33		0.00	Au	
			100	19.04	6.45	11.86			3.03			4.54		Sp	
				100	7.89		10.93			15.38				Su	D
					100			16.66			33.33		12.50	Au	
						100	23.23	5.88	11.11			10.63		Sp	
							100	3.12		21.73				Su	Á
								100			33.33		12.50	Au	
									100	18.18	12.50	9.52		Sp	
										100	15.00			Su	F
											100		12.50	Au	
												100	4.76	Sp	B
													100	Au	

smaller in summer and in autumn they increase in some areas (sodic area — sandy area, Fülöpháza — Ásotthalom, Fülöpháza — sodic area) or decrease elsewhere (inundation area — sandy area, inundation area — sodic area, inundation area — Fülöpháza relations). The inundation area and sodic meadow have qualitatively most differenciated Coleoptera fauna.

References

ANDÓ M. (1958): A Tisza-ártér mikroklima hatásainak eredményei (Results of microclimatical effects of the flood area of river Tisza). — Acta Geogr. Szeged. *4*, 3.

ANDÓ M. (1959): Mikroklima sajátosságok a Tisza-ártér déli szakaszán (Pecularities of microclimate in the southers part of the flood area of river Tisza). — Földr. Ért. *8*, 309—336.

ANDÓ M., BODROGKÖZY GY. és MARIÁN M. (1974): A Mártély—Sasér Tájvédelmi Körzet társadalmi hasznosításának biológiai és természeti földrajzi alapjai (Biological and physicogeographical foundations of the social exploitation of the Mártély—Sasér Region Conservation District). — Manuscript, a Competition Essay.

BARANYAI G. (1979): Gyepökoszisztémák repülő rovarközösségeinek összehasonlító vizsgálata (Comparative investigations in insect communities of grassland ecosystems). — Manuscript.

BODROGKÖZY, GY. (1957): Die Vegetation der Weispappel-Haine in dem Reservat "Emlékerdő" bei Szeged—Ásotthalom. — Acta Biol. Szeged. *3*, 127—140.

BREELAND, S. G. and PICKARD, E. (1965): The Malaise trap — an efficient and unbiased mosquito collecting device. — Mosquito News *25*, 19—21.

CHANTER, D. O. (1965): The Malaise trap. — Entomol. Rec. *77*, 224—226.

CLARK, J. T. (1979): Psocoptera activity as monitored by a Malaise trap. — Entomol. Monthly Mag. *114*, 94—95.

GEIJSKES, D. C. (1968): Insect collecting in Suriname with the help of "Malaise" traps. In: Studies on the fauna of Suriname and other Guyanas, no. 39. — Natuurwetensch. Studierking Suriname Ned Antillen *18*, 101—109.

GRESSITT, J. L. and GRESSITT, M. K. (1962): An improved Malaise trap. — Pacific Insects *1*, 87—90.

GUNSTREAM, S. E. and CHEW, R. M. (1967): A comparison of mosquito collecting by Malaise and miniature light traps. — J. Med. Entomol. *4*, 495—496.

JERMY T. (1977): A szárazföldi ökoszisztémák hazai kutatásának néhány kérdéséről (On some problems of terrestrial ecosystem research in Hungary). — MTA Biol. Oszt. Közl. *20*, 447—450

KASZAB, Z. (1966): Ergebnisse der zoologischen Forschungen von der Dr. Z. Kaszab in der Mongolei 107. Liste der Fundorte der IV. Expedition. — Folia Ent. Hung. *19*, 559—620.

MALAISE, R. (1937): A new insect-trap. — Entomol. Tidskrift *58*, 148—160.

MARSTON, N. (1965): Recent modification in the design of Malaise insect traps with a summary oJ the insects represented in collections. — J. Kansas Entomol. Soc. *38*, 154—162.

MATTHEWS, R. W. and MATTHEWS, J. R. (1970): Malaise trap studies of flying insects in a New York mesic forest. I. Ordinal composition and seasonal abundance. — J. N. Y. Entomol. Soc. *67*, 52—59.

MATTHEWS, R. W. and MATTHEWS, J. R. (1971): The Malaise trap: its utility and potential for sampling insect populations. — The Michigan Entomol. *4*, 117—122.

MÓCZÁR, L. (1967): Trap automatic for capture of flying insects. — Folia Entomol. Hung. *20*, 213—221.

OWEN, D. F. (1969): Species diversity and seasonal abundance in tropical Sphingidae (Lepidoptera). — Proc. R. Entomol. Soc. London (A) *44*, 162—168.

TOWNES, . (1962): Design for a Malaise trap. — Proc. Entomol. Soc. Wash. *64*, 253—262.

Address of the authors:
Prof. Dr. L. MÓCZÁR
Dr. GY. GYÖRFFY
Department of Zoology, A. J. University,
H—6701 Szeged, P. O. Box 428. Hungary