

THE *CICADINEA* FAUNA OF SODIC ZONATIONS AT THE SOUTHERN LOWLANDS

GY. GYÖRFFY and I. KINCSEK

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Abstract

10 out of 51 *Cicadinea* species formed 90% of the occurring individuals demonstrated at three sodic zonations differing from each other in 10-15 cm ground level heights. Half of the larvae develops at the lowest level, the imagos, however, prefer dwelling in the middle zone. The fauna of the driest area is the best segregated, while for the vegetation this is observable at the periodically inundated third level. The distribution of the *Cicadinea* is determined by the dominance as well as the chemical state of the host-plants influenced by the underground water. The leafhopper fauna is segregated according to the aspects of spring, beginning of summer and late summer — autumn. The seasonal segregation between the species is much more expressed than that of according to zonations, which may change seasonally. The water perturbation affecting the 3. level exerts influence on the individual density, spatial differentiation of the *Cicadinea* fauna at all three zonations, as well as on the further aspects through the early spring aspect.

Key words: Leafhopper, zonation, seasonality, diversity, bionomic data.

Introduction

From faunistic point of view, only rather few studies have been performed at the Southern lowlands in many respects — thus in that of the *Hemiptera*. Data relative to this can be found in the manuscript of a lecture by G. HORVÁTH (1906) (mentioned of 56 *Cicadinea* species from Bácska) and a few concrete data can be found in the 3. volume of the Fauna Regni Hungariae, resp. (HORVÁTH, 1918). The more recent scanty literature is firstly pertaining to other areas of the Lowlands (KOPPÁNYI and WOLCSÁNSZKY, 1955; KOPPÁNYI, 1960; OROSZ, 1981; GYÖRFFY, 1982).

Preliminary surveys at the studied area have been carried out with Malaise trap, the results of which have partially been published (MÓCZÁR and GYÖRFFY, 1981). The present paper is a part of a large-scale undertaking, within the frame of which the *Arthropoda* fauna of the characteristic habitat-types at the Southern lowlands will be explored. The studied areas are firstly grass-types. Within this the sandy grasslands are dominating, and the grasses found at the sodic areas, being the subject of the present study, are also important. The significance of the leafhopper fauna is verified by the fact that it is the dominant insect-group both at the chalky and

Table 1. Percentage distribution of the material collected at the studied areas (without *Acari* and *Collembola*)

Groups	1982			1983		
	Areas					
	1(%)	2(%)	3(%)	1(%)	2(%)	3(%)
<i>Aranei</i>	6.94	5.11	8.24	8.27	7.56	8.28
<i>Auchenorrhyncha</i>	27.43	20.39	22.32	37.35	39.99	43.81
<i>Coleoptera</i>	2.71	3.67	2.89	2.44	3.39	2.86
<i>Diptera</i>	26.99	24.85	21.34	6.17	7.4	7.16
<i>Heteroptera</i>	5.62	5.06	14.03	9.98	15.05	7.93
<i>Hymenoptera</i>	10.42	19.85	15.53	19.01	18.39	15.71
<i>Physopoda</i>	1.24	0.5	2.97	4.98	0.73	4.25
<i>Sternorrhyncha</i>	18.3	29.48	13.06	5.62	5.73	7.78
Others*	0.35	2.09	0.61	6.16	1.75	2.22

* *Lepidoptera*, *Orthoptera*,
Psocoptera, *Neuroptera*, *Diplopoda*,
Gastropoda

acidic ground grasses (MORRIS, 1971; WALOFF and SOLOMON, 1973; WALOFF, 1980; DENNO, 1980; and others). The *Auchenorrhyncha* constituted the major part of our collected material, too (Table 1).

Studied area and methods

The studies were performed in the years 1982-1983 at Kiskundorozsma located 7 km from Szeged, at the nature conservancy area named „Dorozsmai Nagyszék”. The area has characteristically solonchak sodic soil where the height difference of 10-15 cm has developed a well recognizable level of three zonations. This is mainly caused by the ground level difference, influencing salt-accumulation and the more soluble or concentrated occurrence of salts, resp. (BODROGKÖZY, 1965, 1980). The area has hard ground, thus even less plant species find their essential conditions here than at similar sodic soil with looser structure.

During the course of our studies two dry and one watery sodic phytocenoses were segregated.

1. The highest located level, thus being the driest, with soil easily drying out even in summer. Its width is about 50 meters. Phytocenosis: *Festucetum pseudovinae* (MAGYAR 28) Soó 33. Besides the grass-forming short grassed *Festuca pseudovina* the dominating species at the area was the *Cynodon dactylon*. The average height of the grass is 10 cm. The total covering value was 110% owing to the relatively high quantity of the dicotyledons.

2. Level of good water-supply, drying out less easily and not inundated yet. Its width varies, generally being 10-15 meters. Phytocenosis: *Festucetum pseudovinae* (MAGYAR 28) Soó 33. The association has a coverage of 95-100%. The dominant grass is the *Festuca pseudovina*, which strongly raised the mean height of the grass level. Its species composition is rather close to that of the previous level, only the dominance-relations are changed by the more favourable water-supply. This cenosis was the freshest among the three.

3. Deepest level, being moister in spring (e.g. in 1982, too), and inundated till the beginning of summer. Even the summer rainwater may remain at this level long-lastingly, therefore it belongs to the category of the watery sodic soils. This is the widest zonation, being over 100 meters wide. Phytocenosis: *Puccinellietum limosae* (RAPAICS 27) SOÓ 30. The transition of the two and three associations into each other is manifested in certain cases. This is possible if the sodic-grade is relatively dry and the spring shallow inundation ceases or only lasts for a short period. At comparatively moister areas the *Puccinellia* may penetrate into the gaps of the *Festucetum* grass (VARGA, 1983). This could be found in the second cenosis where, though in blades, the *Puccinellia* was present.

The collections were performed from March–April till the middle of October. 5–5 quadrat-samples of 1/4 m² area were taken at every zonation level with the help of „Suction-trap” (GYÖRFFY, 1980). The *Arthropoda* samples were obtained from the debris with the method of MARSTON–HENNESSEY (1978), then stored in 70% alcohol following selection under microscope. RENKONEN's similarity index, CZEKANOWSKI's similarity index, and SHANNON's diversity value were applied for evaluations further to those of the faunistic data, and in cases dendrograms were prepared from the similarity matrix with the help of Cluster analysis.

Results

I. Faunistic characterisation

HORVÁTH (1918) mentions altogether 6 species from the Dorozsma site, from which only two could be found in the material collected by us (*Delphax minuscula* HORV., *Euryssa clypeata* HORV.). Unfortunately their closer site cannot be identified.

The representatives of 37 identified species were collected during the course of the two years (Table 2). Four of these were only found in larval form (*Chanithus pannonicus* GERM., *Eupelix cuspidata* F., *Ommatidiotus dissimilis* FALL., *Trypetimorpha fenestrata* COSTA). Besides these, the following species were collected during the course of the Malaise-trap studies on the flying insect fauna (MÓCZÁR and GYÖRFFY, 1981), — not reported on as yet: *Allygus atomarius* FABR., *Cicadella viridis* L., *Cicadula placida* HORV., *Delphacodes audrasi* RIB., *Dictyophara europaea* L., *Empoasca affinis* NAST., *Lepyronia coleoptrata* L., *Macropsis marginata* H.S., *Oliarus quinquecostatus* DUF., *Opsioides stactogalus* FIEB., *Paramesus obtusifrons* STAL., *Philaenus spumarius* L., *Reptalus panzeri* LÖW., *Streptanus aemulans* KBM. So far a total of 51 *Cicadinea* species have been demonstrated at the area. Compared with the species number found at other grasses (PRESTIDGE, 1982; MORRIS and PLANT, 1983; ANDRZEJEWSKA, 1965; etc.), and in the knowledge of the extreme relations of the collecting site as well as the species number- and architectural flatness of the vegetation, this number seems to be rather high. If, however, it is taken into consideration that the majority of the occurring animals were probably only temporarily staying at the area, flying over it, i.e. they presumably originated from the neighbouring places — this being manifested by the very low dominance-percentages as well as by the lack of host-plants — the number of species which can be rendered probably characteristic to the area forthwith decreases. More than 90% of the occurring individuals belonged to about only 10 species.

Table 2. Dominance-relations of the *Cicadinea* populations in the 3 zonations

	1982			1983		
	l(Dp.c.)	2	3	1	2	3
<i>Agallia laevis</i> RIB.	0.57	0.43	-	-	0.49	0.26
<i>Anaceratagallia ribauti</i> OSS.	1.72	0.43	-	-	0.98	0.80
<i>Aphrodes albiger</i> GERM.	-	-	-	1.61	0.24	0.26
<i>Aphrodes serratulae</i> F.	-	-	-	-	0.24	-
<i>Arocephalus languidis</i> FLOR.	-	-	0.74	2.41	-	-
<i>Artianus interstitialis</i> GERM.	-	-	0.59	-	0.49	0.26
<i>Balclutha punctata</i> FABR.	-	-	-	-	-	0.26
* <i>Chanithus pannonicus</i> GERM.	-	-	-	-	-	-
<i>Deltocephalus pulicaris</i> FALL.	6.03	1.13	0.59	2.41	0.73	0.53
<i>Doratura heterophylla</i> HORV.	0.86	-	-	7.25	0.24	-
<i>Doratura homophylla</i> FLOR.	1.72	0.92	0.59	4.93	0.24	1.07
<i>Doratura stylata</i> BOTH.	-	-	-	1.61	0.98	0.26
<i>Dryodurgades dlabolai</i> WAGN.	0.28	-	-	-	-	-
* <i>Eupelix cuspidata</i> F.	-	-	-	-	-	-
<i>Eurya clypeata</i> HORV.	6.99	5.09	11.80	-	22.54	21.50
<i>Kelisia guttula</i> GERM.	-	-	-	0.80	-	-
<i>Kybos hungarica</i> RIB.	0.28	0.81	-	-	-	-
<i>Kybos</i> sp.	0.57	-	-	-	-	-
<i>Laodelphax striatellus</i> FALL.	0.86	0.27	1.79	-	-	-
<i>Limotettix striola</i> FALL.	0.57	0.21	1.34	-	-	-
<i>Macrosteles laevis</i> RIB.	0.86	1.19	1.79	-	-	-
<i>Macrosteles sordidipennis</i> STAL.	-	0.21	-	-	-	-
<i>Mendrausis pauxillus</i> FIEB.	0.86	-	-	22.58	0.49	0.26
<i>Metadelphax propinqua</i> FIEB.	9.76	2.16	-	-	-	-
<i>Neophilaenus campestris</i> THUNB.	0.28	0.21	1.19	-	0.24	-
<i>Neophilaenus minor</i> KBM.	-	0.54	-	-	0.24	-
* <i>Ommatidiotus dissimilis</i> FALL.	-	-	-	-	-	-
<i>Paluda vitripennis</i> FLOR.	3.44	0.54	-	16.12	0.24	0.26
<i>Psammotettix confinis</i> DHLB.	6.60	27.11	2.39	-	-	-
<i>Psammotettix provincialis</i> RIB.	-	-	-	-	-	0.53
<i>Psammotettix hungaricus</i> OROSZ	20.67	59.16	70.40	16.93	70.83	72.57
<i>Recilia schmidgeni</i> WAGN.	18.95	4.01	0.74	7.25	0.24	-
<i>Struebingianella palliceps</i> HORV.	-	-	1.19	-	-	0.53
<i>Toya minuscula</i> WAGN.	16.15	18.70	-	15.32	0.24	-
* <i>Trypetimorpha fenestrata</i> COSTA.	-	-	-	-	-	-
<i>Ulopa lugens</i> GERM.	-	-	-	-	0.24	-
<i>Weidnerianella pellucida</i> FABR.	-	0.21	-	-	-	-
<i>Zyginidia pullula</i> BOH.	0.86	0.75	4.78	-	-	-
Others	0.57	-	-	-	-	-
ΣN^{-m^2}	278.6	368.8	133.8	396.8	1305.6	1190.4

* : found only in larval stage

II. Segregation of the Cicadinea fauna according to zonations

Even from the data of Table 2. it is evident that the various species do not occur with the same dominance at all three levels. The three areas were compared on this basis with the help of the RENKONEN and CZEKANOWSKI indexes (Table 3), according to which the most segregated fauna is that of the 1. level. This segregation is to a smaller extent in 1982 owing to the spring water-perturbation. The faunas at the 2. and 3. levels are rather similar in the undisturbed year of 1983, not only in respect to species-dominances, but also that of the absolute individual numbers.

Table 3. Similarity values between the *Cicadinea* faunas of the zonation levels (R: Renkonen; Cz: Czekanowski).

1982			1983				
	2	3		2	3		
1	R	56.84	35.30	1	R	20.57	20.10
	Cz	54.87	43.06		Cz	12.78	12.90
2	R		71.41	2	R		95.42
	Cz		49.50		Cz		92.82

The area most used for larva development and the position of imagos can be concluded from the tendency per level of the annual average individual numbers (Table 4). It can be seen from the data of the year 1983 which can be regarded as undisturbed, that about 50% of the larvae develops at the 3. zonation level. In 1982 this was only 7%. The differences in the imago:larva ratios refer to the fact (in 1983) that the imagos developing at the two extreme areas stay for longer periods

Table 4. *Cicadinea* annual mean individual-number ($\bar{N}m^{-2}$) at the three zonation levels

		1.	2.	3.
1982	imago	19.90	26.34	9.55
	larva	49.71	83.77	17.44
1983	imago	30.52	100.43	91.56
	larva	88.61	188.30	260.67

at the middle zone, than at the place of their development (if considering the larva-mortality as identical). Due to the obvious great larva-mortality in 1982, the 3. level must have become repopulated again almost completely from the first two.

Since from the viewpoint of larva-development the 3. area is rather important in the case of both the *Delphacidae* and *Cicadellidae* families (Figs. 1-2.), the effect of the 1982 spring inundation could be felt throughout the whole year. According to the figures, it was the first developing larva generation that became the victim of this, therefore the second larva-maximum could not be developed in 1983.

A more precise figure could be gained than the annual average similarity if studying the similarity values calculated for the collection time-points in the course of the season (Table 5). The relative segregation of the 1. area is observable throughout the season, its similarity shows changes identical with both the 2. and 3. areas. Several maximums can be found in this respect, although these, too, hardly reach the value of 50%. The maximums follow each other cc. every two months. The fauna at the 1. level shows the highest level of evenness in the early spring,

Table 5. Similarity according to collection time-points of the leafhopper communities at the zonation levels (R: Renkonen; Cz: Czekanowski)

1982		05.20.	06.07.	06.25.	07.06.	07.20.	08.03.	08.17.	09.01.	09.16.	09.30.	10.14.
1-2	R	0.00	13.32	3.44	41.57	14.71	49.10	5.00	9.25	46.66	58.96	30.35
	Cz	0.00	10.00	0.76	11.32	7.20	28.81	2.43	5.39	13.02	22.88	13.88
2-3	R	-	-	7.69	20.52	87.09	86.66	85.38	73.59	90.32	80.00	39.93
	Cz	-	-	1.05	6.38	35.52	28.12	39.39	30.41	40.44	13.48	12.82
1-3	R	-	-	80.35	15.38	12.96	38.34	0.00	18.50	46.66	47.72	25.00
	Cz	-	-	29.83	10.00	8.23	19.56	0.00	12.34	16.27	22.03	10.52
1983		04.22.	05.06.	05.26	06.09.	06.22	07.07.	07.22.	08.12.	08.30.	09.29.	10.14.
1-2	R	3.57	0.00	38.46	3.47	0.00	10.00	0.00	61.89	33.33	11.96	50.00
	Cz	2.63	0.00	7.46	1.35	0.00	6.66	0.00	27.27	5.88	3.27	2.32
2-3	R	92.85	71.42	96.29	48.68	63.41	20.00	87.50	75.75	99.99	90.19	96.15
	Cz	27.50	35.71	57.14	20.37	28.76	6.25	41.17	37.93	50.00	35.93	43.01
1-3	R	0.00	0.00	38.46	7.68	0.00	0.00	11.11	63.95	33.33	13.88	50.00
	Cz	0.00	0.00	10.00	3.26	0.00	0.00	10.00	25.00	5.88	2.29	1.85

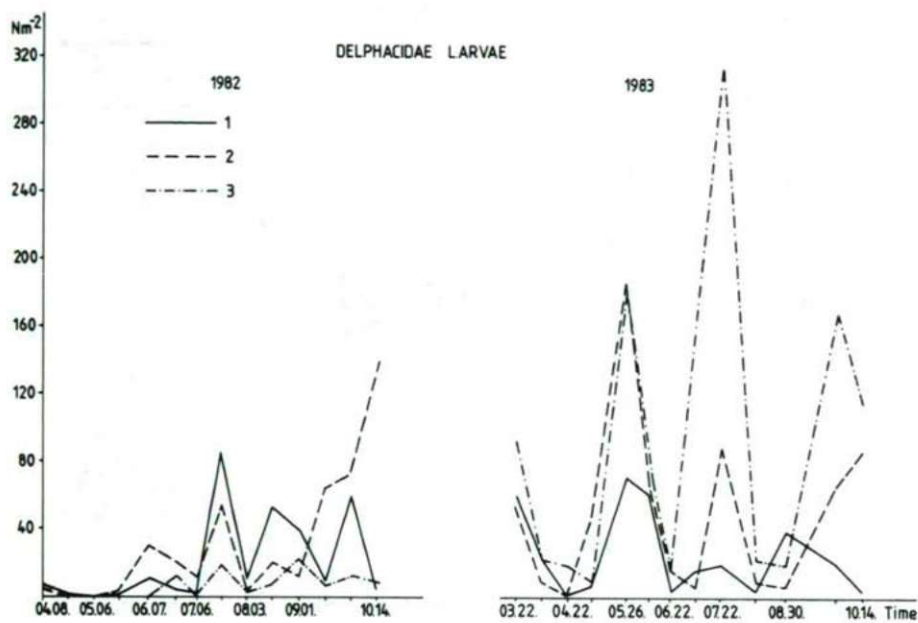


Fig. 1. Changes in individual-density of *Delphacidae* larvae in 1982–1983.

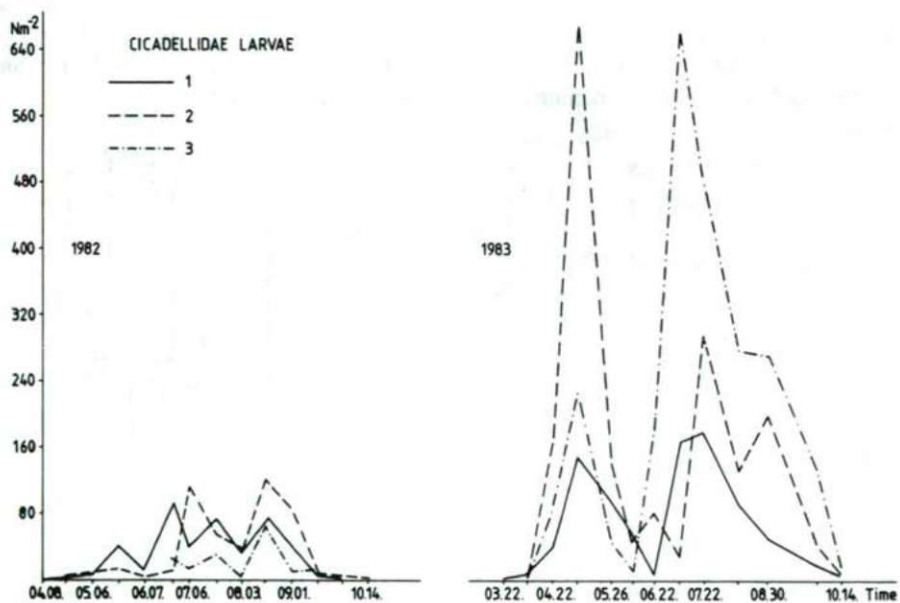


Fig. 2. Changes in individual-density of *Cicadellidae* larvae in 1982–1983.

Table 6. Percentage distribution of the 8 dominant leafhopper species per level

Species	1982			1983		
	1	2	3	1	2	3
1 <i>Deltocephalus pulicaris</i>	77.06	19.26	3.66	37.50	37.50	25.00
2 <i>Doratura homophyla</i>	53.33	37.77	11.25	54.54	9.09	36.36
3 <i>Eurysa clypeata</i>	35.68	34.94	29.36	0.00	53.48	46.51
4 <i>Mendraus paxillus</i>	100.00	0.00	0.00	90.32	6.45	3.22
5 <i>Paluda vitripennis</i>	82.75	17.24	0.00	90.90	4.54	4.54
6 <i>Psammotettix hungaricus</i>	15.46	58.97	25.45	3.62	49.82	46.55
7 <i>Recilia schmidtgeni</i>	76.96	21.57	1.45	90.00	10.00	0.00
8 <i>Toya minuscula</i>	39.47	60.52	0.00	95.00	5.00	0.00

beginning of summer and autumn aspects. The faunas at the 2. and 3. levels are rather similar in both years, the RENKONEN indexes near the value of 100% on many occasions. The one single minimum value is at the beginning of July.

Among the occurring species, the abundance of 8 is great enough to study their distribution per level separately. Considering the total individual number as 100%, the percental distribution at the various areas is comprised in Table 6. Forming similarity matrix from this, and subjecting it to cluster analysis, the obtained dendrograms can be seen in Fig. 3. According to this the *Mendraus paxillus*, *Paluda vitripennis*, *Recilia schmidtgeni*, furthermore the *Doratura homophyla*, *Eurysa clypeata* and *Psammotettix hungaricus* form two separate groups, which are only combined at low level. The former are the characteristic species of the 1. area, while

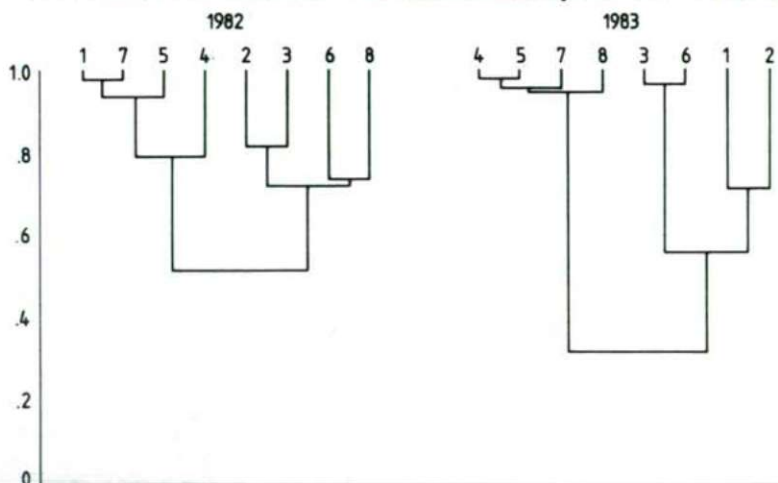


Fig. 3. Dendrogram of the 8 most frequent *Cicadinea* species on the basis of their distribution according to zonations. (The names of the species indicated by numbers are found in Table 6).

the latter occur at all three areas in varying ratio. The *Doratura homophyla* prefers the 1. area, the *Eurysa clypeata* and the *Psammotettix hungaricus* the 2. and 3. areas. The water perturbation did not give possibility for differentiation of such degree as in 1983, it developed between the species by means of the clearing the 3. level.

Since the *Cicadinea* is a uniform herbivorous group, it is necessary to study the vegetation at the three zonations for the explanation of the previously discussed distributions. The share in total coverage of the species found in the phytocenoses of the levels was regarded as a prime base for this (Table 7). Calculating RENKONEN index from this, it becomes evident that the vegetation of the 1. and 2. levels is similar in 63.7%, that of the 1. and 3. levels in 3%, and of the 2. and 3. in 3.2%. The high similarity of the first two levels is caused by the great dominance of the *Festuca pseudovina*, while the autonomy of the 3. level is due to the outstanding ratio of the *Puccinellia limosa* occurring elsewhere only in blades.

The similar values manifest in the case of the *Cicadinea* indicate the segregation of the very 1. level, thus the distribution of the *Cicadinea* cannot simply be explained by the distribution-relations of the plant species.

Table 7. Quantity of the various plant species from the total coverage at the three zonation levels

Species	Ratio of participation in total coverage		
	1.(D%)	2.(D%)	3.(D%)
<i>Festuca pseudovina</i> HAECKEL ap. WIESB.	50.0	75.0	—
<i>Cynodon dactylon</i> (L) PERS.	10.0	11.0	—
<i>Trifolium campestre</i> SCHREB.	20.0	4.0	—
<i>Vicia lathyroides</i> L.	4.0	0.5	—
<i>Rhinanthus angustifolius</i> GMEL. em. SOÓ	4.0	3.0	—
<i>Lotus corniculatus</i> L.	2.0	—	—
<i>Allium vineale</i> L.	0.5	—	—
<i>Taraxacum officinale</i> F. WEBER ex WIGGERS	0.5	—	—
<i>Plantago lanceolata</i> L.	3.0	—	—
<i>Trifolium repens</i> L.	1.0	—	—
<i>Juncus gerardi</i> LOIS.	2.0	—	1.5
<i>Juncus compressus</i> JACQ.	2.0	—	1.5
<i>Poa bulbosa</i> f. <i>vivipara</i> KOELER.	0.5	—	—
<i>Muscari racemosum</i> (L.) LAM. et DC.	0.5	0.2	—
<i>Melandrinum album</i> (MILL.) GARCKE.	—	0.2	—
<i>Cerastium dubium</i> (BAST.) O. SCHWARZ.	—	1.5	—
<i>Spergularia marina</i> (L.) GRISEB.	—	0.2	—
<i>Plantago maritima</i> L.	—	0.8	—
<i>Puccinellia limosa</i> (SCHUR.) HOLMBG.	—	1.2	93.0
<i>Lepidium crassifolium</i> W. et. K.	—	2.0	—
<i>Veronica prostrata</i> L.	—	0.2	2.0
<i>Ornithogallum umbellatum</i> L.	—	0.2	—
<i>Aster pannonicus</i> SOÓ	—	—	0.2
<i>Carex distans</i> L.	—	—	0.8
<i>Eleocharis palustris</i> (L.) R. et SCH.	—	—	0.2
<i>Schoenoplectus tabernaemontani</i> GMEL. PALLA	—	—	0.8

Now let's examine the development of the diversity values both in the case of the vegetation as well as the *Cicadinea* (Tables 8. and 9.).

Table 8. *Cicadinea* diversity-relations at the 3 zonation levels (spN: number of species; H'S: Shannon diversity value; J:evenness).

	1982			1983		
	1	2	3	1	2	3
spN	23	20	14	13	18	15
H'S	2.3525	1.4890	1.2045	2.1349	0.9296	0.8697
J	0.7503	0.4970	0.4564	0.8316	0.3216	0.3211

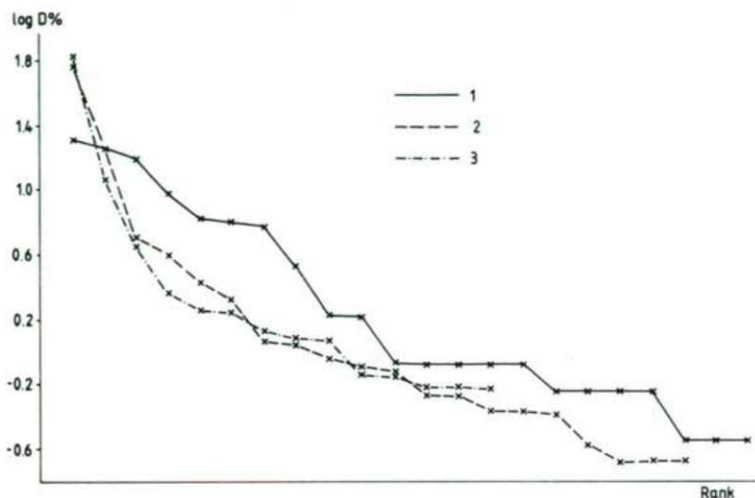
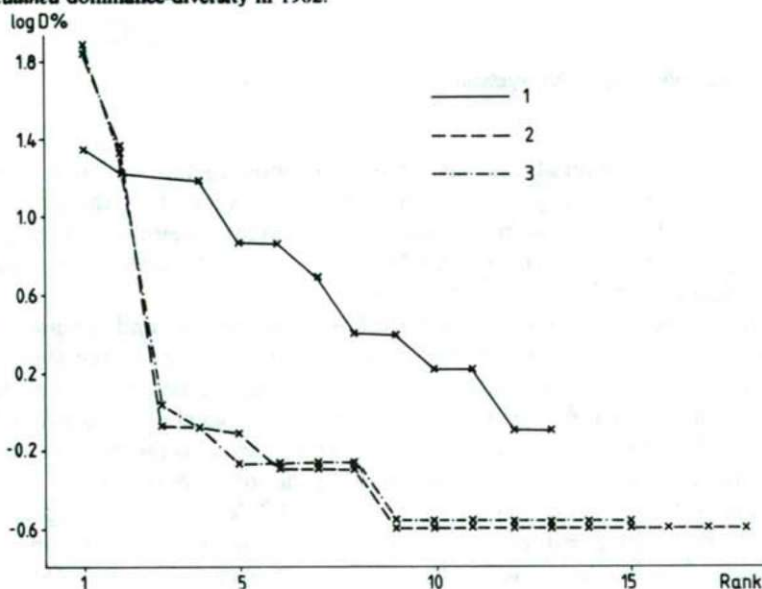
Table 9. Vegetation diversity-relations at the 3 zonation levels (spN: number of species; H'S: Shannon diversity value; J:evenness).

	1	2	3
spN	14	14	8
H'S	1.6481	1.0140	0.37358
J	0.6245	0.3842	0.179

Although the number of *Cicadinea* species are rather divergent at the various zonation levels in both studied years, the diversity and evenness relations showed similar development. At the highest relief the determinant factor of diversity is the even dominance-distribution. This may be in conformity with the similar composition of the vegetation. The low vegetation, the lack of shadowing effect, the higher salt-concentration of the host-plants caused by the more considerable withering result low average individual number.

The diversity of the vegetation at the middle area is smaller compared to the previous one, since the high dominance of the *Festuca pseudovina* decreases evenness. Therefore, — though the average individual number is the highest here, — the determinant role of the vegetation is seen from the medium diversity value.

With its lower plant-coverage, few plant species and periodical inundations, the lowest area provides the essential conditions for practically two leafhopper populations. The high dominance-ratio of these causes the lowest diversity value.

Fig. 4. *Cicadinea* dominance-diversity in 1982.Fig. 5. *Cicadinea* dominance-diversity in 1983.

The dominance-diversity relations at the 2. and 3. areas are rather similar in the case of the *Cicadinea* (Figs. 4. and 5.). The dominating character of the 3. level is referred to by the fact that the two leafhopper species dominant here are also the dominant species at the 2. area, and when the structure of the 3. level was disturbed (in 1982), similar changes took place at the 2. level, too.

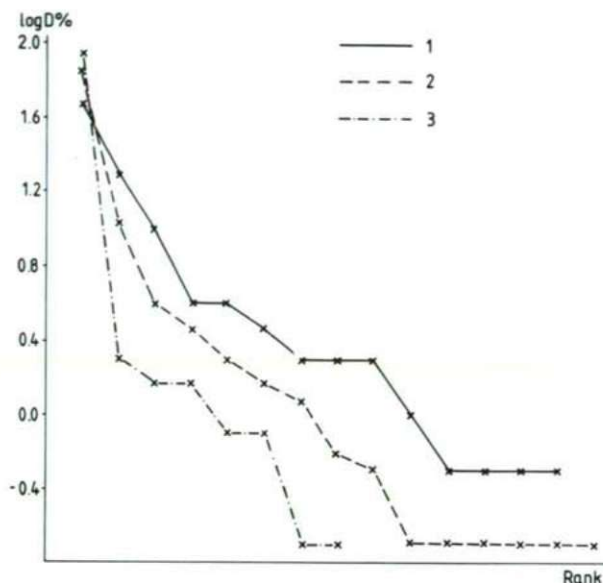


Fig. 6. Dominance-diversity of the vegetation.

The dominance-diversity curves only correspond to the similar curves of the vegetation in their tendency (Fig. 6). In the case of vegetation the ground water level appears to have significance as segregating factor. Therefore, it is not the 2. and 3. levels, but rather the 1. and 2. which stand closer to each other, similarly to those experienced for the RENKONEN index.

On the basis of the above, the *Cicadinea* distribution and diversity are not exclusively determined by the distribution and diversity, resp., of the vegetation. In our case — presuming it is partly the dominance, partly the chemical state of the host-plants, the latter influenced by the ground water level. This is proved by the fact that the *Cicadinea* communities of the 2. and 3. levels stand close to each other both regarding diversity and species-dominance-identity, despite that in the vegetation, the *Festuca pseudovina* dominant at the 1. and 2. levels would not give grounds for this. It is therefore presumable that the *Puccinellia limosa* may come into account as host-plant, besides the *Festuca pseudovina* — at least in the case of the *Eurysa clypeata* and *Psammotettix hungaricus*.

III. Seasonality study

To decide whether the leafhopper community living at the studied area forms seasonally segregated groups, dendrograms were prepared from the similarity matrix between collecting time-points with the help of cluster analysis (by weighted average method).

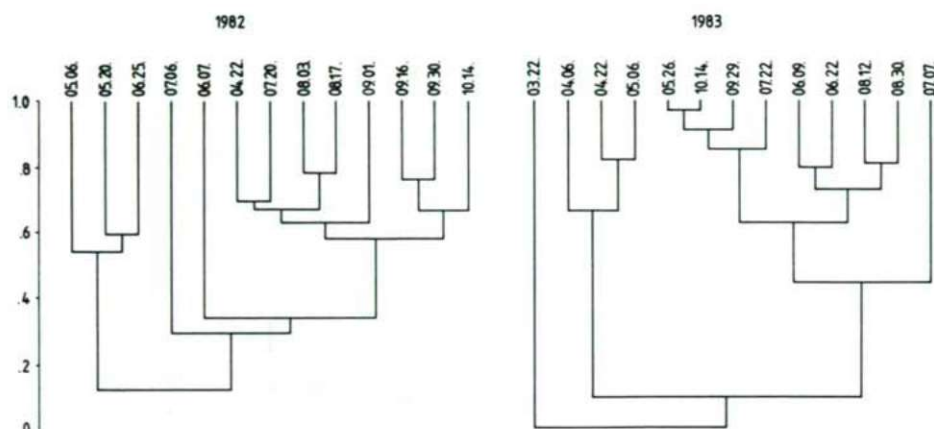


Fig. 7. Seasonality dendrogram of the *Cicadinea* fauna at the 3 zonations in 1982-1983.

If examining the whole area, i.e. considering the average of the three levels (Fig. 7), similar dendrograms are gained on the whole for both years. The fauna of the early spring, spring and (in 1982) the beginning of summer shows a loose, low-leveled linkage to the more uniform group of the end of June–November.

Since the similarity of the three levels to each other is rather divergent during the course of the year (Table 5), it is worth studying which is the most constant fauna among them, furthermore, what changes the fauna shows per level in the course of the season. For this, the values per level of the RENKONEN similarity indexes between the consecutive collections are presented, as the indicator of the fauna-constancy (Figs. 8-9).

In 1982, due to the long-lasting inundations there was no durable spring aspect either at the 3., or at the 2. areas (Fig. 8). This did not affect the driest 1. level to such a degree. Later, however, the faunas of the 2. and 3. levels are more constant, the summer and autumn aspects almost unite.

In 1983 the disturbing effect of the water did not prevent the development of the early spring, short, but highly continuous aspect at all three levels (Fig. 9). At the 1. level this is followed by the sharply segregated aspects of the beginning of summer and end of summer — autumn, with a slightly decreasing constancy level. The beginning of summer and end of summer — autumn aspects hardly show any segregation from each other at the 2. and 3. levels. The fauna at the 3. area is the most constant.

In order to learn whether the identical seasonality behaviour is the consequence of the identity of the fauna-composition, it is worthwhile to compare the previous presentation with the earlier discussed changes of the similarities found between the areas. It can be seen that according to the species-dominance-similarity the 1. area is only slightly similar to the other two, thus, e.g. it reaches the high spring aspect-constancy with an almost completely different fauna-composition than the

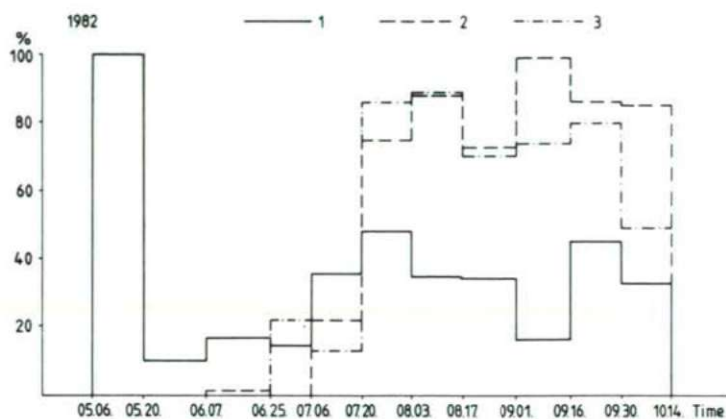


Fig. 8. Fauna-constancy of the *Cicadinea* fauna at the 3 zonations in 1982.

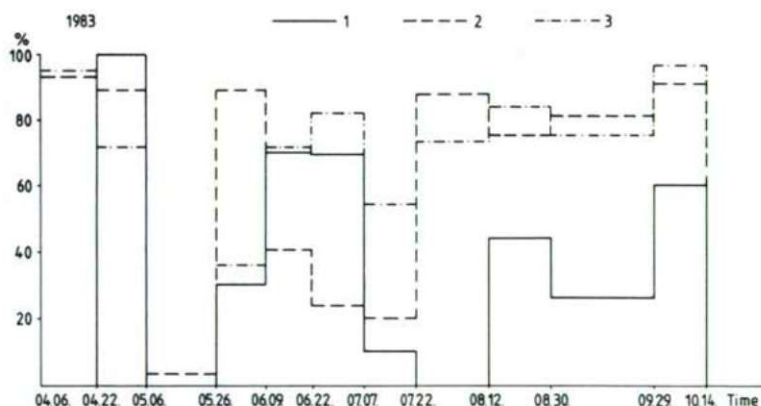


Fig. 9. Fauna-constancy of the *Cicadinea* fauna at the 3 zonations in 1983.

2., and 3. levels. On the contrary, the faunas of the 2. and 3. areas are very similar in the periods of April–May and August–October, when this is caused by the similar behaviour according to aspects, while the faunas of the beginning of summer aspect are dissimilar.

In order to study the seasonal segregation of the 8 most frequent species a dendrogram was constructed from the similarity matrix of their seasonal occurrence by cluster analysis (Fig. 10). It is clear from this that the seasonal segregation between

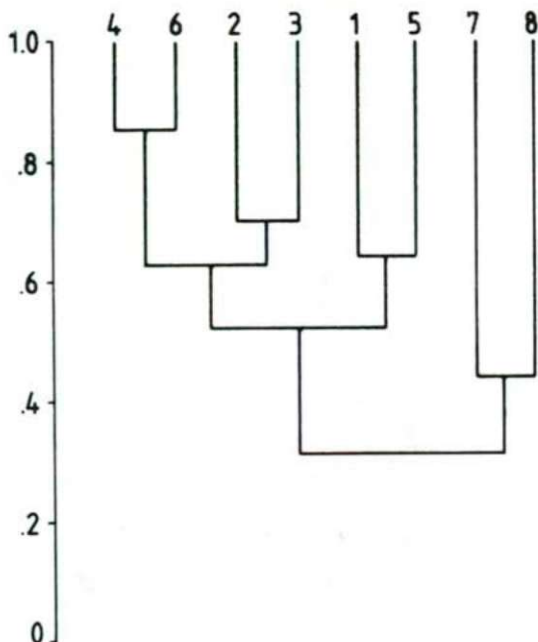


Fig.10. Seasonality dendrogram of the 8 most important *Cicadinea* species in 1983. (The names of the species indicated by numbers are found in Table 6).

the species is much more characteristic than the segregation according to zonations (Fig. 3). The species dividing the area in similar manner (e.g. 4, 5, 7, 8) are much farther from each other in respect to seasonality.

By examining the season-dynamics according too species not only newer bionomic data are gained, but in the present case the seasonal changes in the attachment to the habitat can also be followed. According to the knowledge so far, from the dominating 8 species 6 winter in the form of eggs. Among them the *Recilia schmidtgeni*, *Deltocephalus pulicaris* and *Paluda vitripennis* are known as being of 2 generations; the *Toya minuscula*, *Doratura homophyla* and *Mendrausis pauxillus* as of 1 generation (SCHIEMENZ, 1969). Contrary to this, 2 generations were observable in the case of the latter species at the studied area (Fig. 11). The first generation developing from the overwintering eggs reaches its maximum at the beginning of June, the second at the end of September. It almost exclusively prefers the first level, only being found in low numbers at the other two areas as well in the period of the maximal individual density. Its host-plant, the *Festuca sulcata* (EMELJANOV, 1964), does not occur at the area, therefore it presumably consumes the *Festuca pseudovina* as well.

The *Paluda vitripennis* (Fig. 11) is quite similar to the former species both in respect to overwintering (MÜLLER, 1957) and generation-number (REMANE, 1958), but also regarding segregation per relief. Its host-plant is not known.

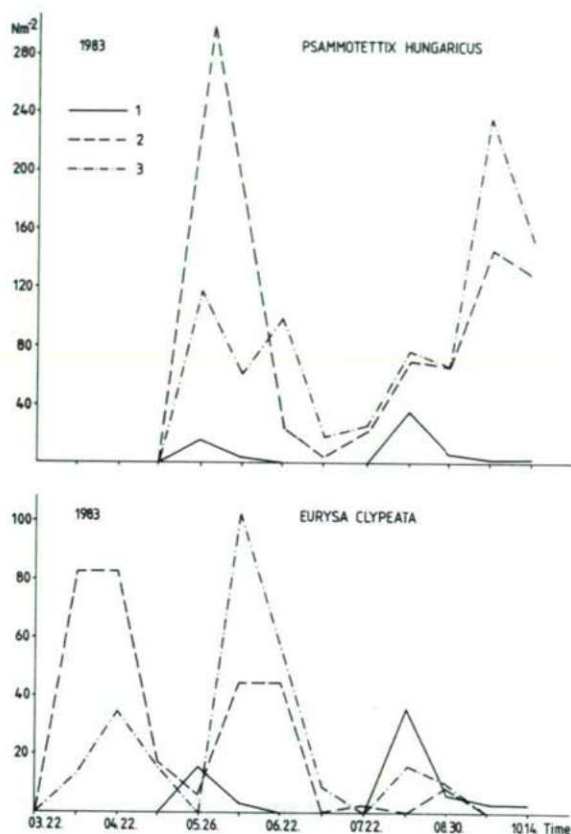


Fig.11. Changes in individual-density of the *Mendrausis pauxillus* and *Paluda vitripennis* in the 3 zonations in 1983.

In the case of the *Eurysa clypeata* and *Psammotettix hungaricus* neither the seasonal segregation, nor that of according to habitats are too significant in the annual average. The *Eurysa clypeata* (Fig. 12) is probably of 3 generations and overwinters in larval stage. Its first, early spring generation forms a maximum at the 2. area, the second, beginning of summer one at the 3. area. Its distribution greatly depends on the humidity relations. The *Festuca pseudovina* and *Puccinellia limosa* are with all certainty among its host-plants.

The *Psammotettix hungaricus* (Fig. 12) is of 2 generations, winters in the form of eggs. This is the species reaching the highest individual density. The maximum of its first generation partially coincides with the 2. generation of the *Eurysa clypeata*, only it is not dominant at the 3. area, but rather at the 2. one. The individual density of the second generation, however, is higher at the 3. area. Its host-plants are the *Puccinellia limosa* and *Festuca pseudovina*, as well.

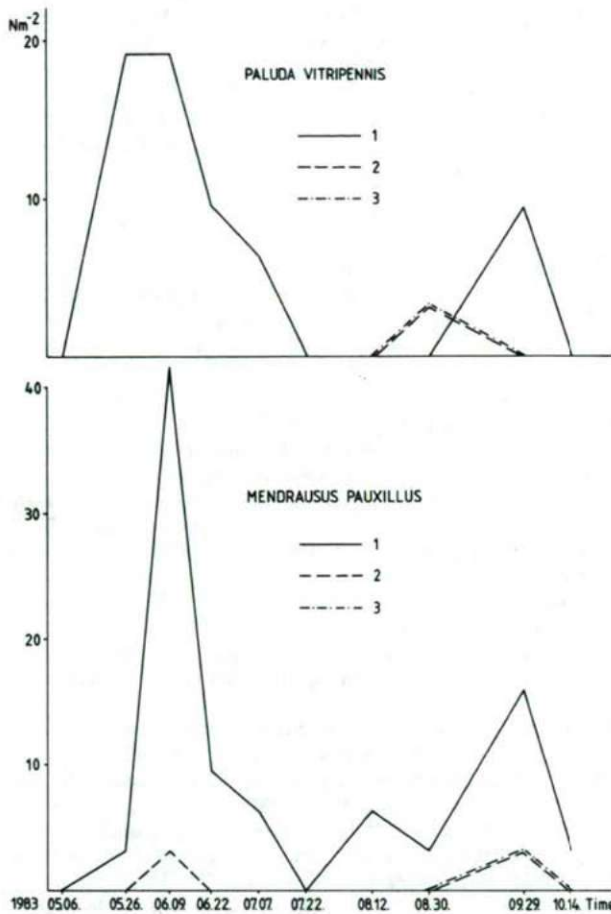


Fig.12. Changes in individual-density of the *Eurysa clypeata* and *Psammodettix hungaricus* in the 3 zonations in 1983.

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Addresses of the authors:

GY. GYÖRFFY
 Department of Biology
 Attila József University
 H-6722 Szeged, P.O. Box 659
 Hungary
 I. KINCSEK
 Department of Zoology
 Gyula Juhász Teacher's Training
 College
 H-6701 Szeged, P.O. Box 396
 Hungary