1.9. Effects of regional perturbation on Orthopteran communities

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1.9.1. Introduction

The natural communities in the riverine wetland ecosystems are exposed to disturbances of both human activities (e.g. mowing, grazing) and physical forces (regural flood), all of them can be regarded as natural conditions, however the structure of the communities of the wetland sites have evolved in the presence of these disturbances. Nevertheless a regional perturbation interrupts the ecological processes developed under the influnece of so called natural conditions. The regional perturbation is ususally considered as a process that occurs on large geographical scale and cut across more than one ecosystem component (Bernstein *et al.* 1997). Two regional perturbations occured in the Szigetköz area during the last decade. One of them was the construction of a resevoir in the upper parts of the Szigetköz, which transformed significantly the natural landscape and the other one was the diversion of 90% of the original water regime of the river Danube into an artificial bypass channel on the Slovakian territory by the Slovakian government. The immediate conseqence of the later operation was a serious decrease in the water table in the upper pats of the Szigetköz. The Hungarian government to retrieve the water deficiency in Szigetköz area put down a small dam into bed of the main branch of the river in 1996.

The aim of this study to test the influence of landscape transforming, the decrease of the water table and water supplying on the ecological status of the Szigetköz area using monitoring investigation of the orthopteran communities on permanent sampling points in the flood plains and the protected areas along the river Danube. It has been demonstrated that the orthopteran communities have correlations with their habitats (Joern and Lawlor 1981, Gallé *et al.* 1985, Kemp et al 1990, Miller and Onsager 1991, Quinn *et al.* 1991, Fielding and Brusven 1995, Schell and Lockwood 1997, Varga 1997), and they might be good indicators of the environmental changes (Parmenther et al 1991, Kemp 1992, Fielding and Brusven 1993, Báldi and Kisbenedek 1997, Rácz 1998 a).

Only a few data about the presence of the orthopteran species in the Szigetköz area were previously the diversion of Danube river available for us, but they were not intensive (Aradi 1955). So we had to start the monitoring of the orthopteran communities lack of data suitable to comparison between the previous and later states of the diversion of the river Danube and we had to locate our control sites the they were based on our assuming and results of other investigations. These control sites were chosen on the sites of the low part of the Szigetköz area between villages of Ásványró and Nagybajcs, where water table did not change.

1.9.2. Materials and methods

The monitoring studies of the orthopteran communities were conducted in the Szigetköz region. The region is an elongated irregular-shaped geographical unit, which is

located between the river Mosoni-Danube and the river Old-Danube in the North-western part of Hungary (48°00'-47°40' N, 17°15'-17°45') with 375 km^2 extension. This unique landscape type of Hungary is composed of small islands, side-branches and meanders of the Danube. The botanical and fauna reviews of the area show that this region has special biological features, too (see e.g. Simon 1992, Báldi *et al.* 1995). The region can be divided into two main parts according to its heights above the see level, one part is the so called Upper Part (Felső-Szigetköz) with about 125-115 metres average height and the other is the Lower Part (Alsó-Szigetköz) with 115-110 metres height (Göcsei 1979).

The sampling sites were located partly on the flood plain and partly outside of the embankment on the so called protected side.

(In the below enumeration the villages are named near to which the sampling sites can be found, furthermore the grassland types and its management is given, too.) The following sampling sites were located on the flood plain: (1) Rajka, mown meadow. This site is found on the area of the planned artificial water-basin, so it was exposed to the highest superficial transforming human activity, namely the vegetation cover was totally removed at the beginning of the building of the water-plant. After the stoppage of the operations the vegetation recognised to the area and some part of it was regularly mown. (2) Dunakiliti, wet meadow. (3) Dunasziget, (Dunaköz), mown meadow. On the protected area: Dunaremete, mown wet meadow. The locations of the above mentioned sampling sites were unchanged during the whole length of time of the monitoring study. The locations of the sampling sites near to village Ásványráró and Nagybajcs needed to be changed from the flood plain to the protected site after 1996 because these sites had been frequently inundated. The frequent inundation were consequences of the laying down of a small dam into the bed of the river Old-Danube by the Hungarian Government in 1996. So the new sampling sites were the next: Ásványráró (Zsejkepuszta), mown wet meadow. Nagybajcs, grazed wet meadow.

The sampling of the orthopteran communities were carried out by sweepnetting in 10x10 metres quadrates during a standardised sampling time (15 minutes per quadrates) and the number of sweeps were standardised (300 sweeps per quadrates), too. At each sampling sites four quadrates were located in order to take samples of spatial variability of the habitat. The results of singling samplings of orthopterans by hand and hearing their calling sounds showed that locating four quadrates per sampling sites proved to be enough because the studied grasslands showed rather homogeneity than heterogeneity and few new orthopteran species come up by the singling sampling method. The samplings were carried out three times in each year in July, August and September.

To the calculation of the diversity profiles was used the Divord 1.0 program (Tóthmérész 1993).

1.9.3. Results

Altogether 17570 orthopteran individuals were caught during the 6 years of the monitoring study which belonged to 29 species (Table 1). The identification of the orthopteran nymphs is not possible therefore they were omitted from the analyses.

The changes of Rényi diversity values of the orthopteran communities among the years of the monitoring ranged from 0.1 to 2.7 at the sampling sites excluding the orthopteran community of Rajka, where the magnitude of the changes in the diversity

values ranged from 1.2 to 2.5. The curves of the diversity profiles intersected each other at the sampling sites of Rajka, Dunasziget, Dunaremete and Ásványráró what suggested that there had been no changes in the structure of orthopteran communities at these sites during the period of the monitoring studies. The diversity profiles separated into two groups at Dunakiliti, the first group composed of the diversity curves of the first half of the monitoring period (1994-1996) while the second group comprised the diversity curves of the second half of the monitoring period (1997-1999). There were no comparable differences among the diversities inside the groups but the diversity value of the second group was lower in than first group. The curves of the diversity profiles were segregated into three groups at Nagybajcs. The diversity was the highest in 1997-1998 years and the lowest in 1995, by 1999 the diversity values decreased to the level of years 1994 and 1996. The diversity-ordering methods gives the possibility of making comparisons separately between the diversity of the rare species and dominant species of two communities when

Table 1. The caught orthopteran species with theri ecological type in the Szigetköz area during the period of the monitbring.

species	ecological type
Tetrigidae	
Tetrix (Tetratetrix) bipunctata	hygrophilous
Tetrix (T.) subulata	hygrophilous
Tetrix nutans	hygrophilous
Terix undulata	hygrophilous
Acrididae	
Aiolopus thalassinus	hygrophilous
Calliptamus italicus	xerophilous
Chortippus albomarginatus	mesophilous-hygrophilous
Chortippus dorsatus	mesophilous-hygrophilous
Chortippus parallelus	mezofil
Chrysochraon dispar	hygrophilous
Euchortippus declivus	xerophilous
Euthystira brachyptera	mesophilous-hygrophilous
Chortippus (Glyptobothrus) apricarius	xeroterm
Chortippus (Gl.) biguttulus	xerophilous
Chorippus (Gl.) brunneus	xerophilous
Chortippus (Gl.) mollis	xerophilous-mesophilous
Mecosthetus grossus	hygrophilous
Oedipoda caerulescens	xerophilous
Parapleurus alliaceus	hygrophilous
Phaneropteridae	
Leptophyes albovittata	steppe
Phaneroptera falcata	xerophilous
Conocephalidae	
Conocephalus (Xiphidion) dorsalis	hygrophilous
Conocephalus (Xiphidion) discolor	hygrophilous
Tettigoniidae	
Pholidoptera fallax	forested steppe
Metrioptera (Bicolorana) bicolor	xerophilous
Metrioptera (Roeseliana) roeselii	hygrophilous
Tettigonia viridissima	forested steppe
Gryllidae	
Oecanthus pellucesn	steppe

the curves of diversity profiles are intersected and otherwise there is no significant differences between the diversity of two communities (Tóthmérész 1997). Considered this above mentioned eventuality and continued the analysis of the results of Dunasziget sampling on this way, a high decreasing in the diversity of the dominant orthopteran species could be found in this sampling after 1996 (Fig. 1).

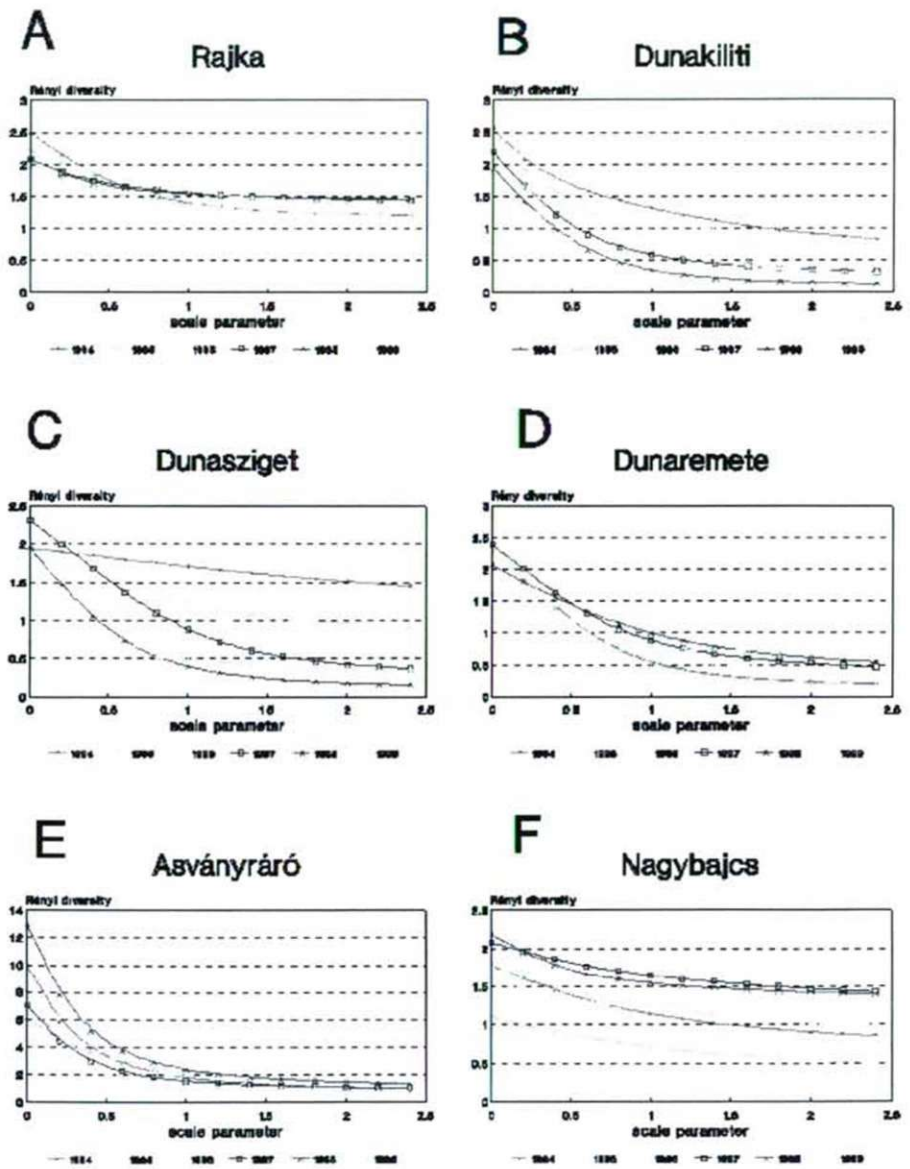

Fig. 1. a-f. Diversity profiles of the orthopteran communities at the different sampling sites.

Table 2. The presence and absence of the hygrophilous species in the Szigetköz area.

	1995	1997	1999
Aiolopus thalassinus	+	-	-
Chrysocraon dispar	+	+	-
Mecosthetus grossus	+	-	-
Parapleurus alliaceus	+	+	+
Conocephalus discolor	+	+	+
Conocephalus dorsalis	+	+	+
Metrioptera roeselii	+	+	+

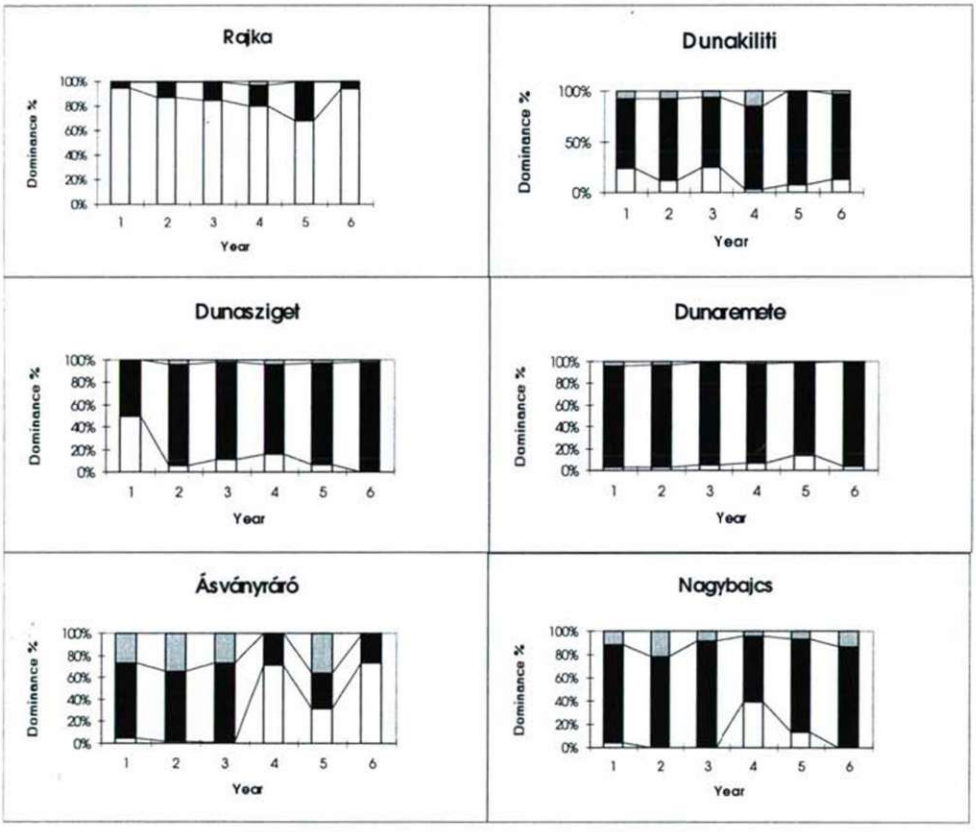

Fig. 2. a-f. Percent proportion of dominance values at the different sampling sites. The white coluor: xerophilous species, black colour: mseophilous species, grey colour: hygrophilous species.

The caught orthopteran species, according to their ecological types, can be ranked into three groups (see Table 2). The individual groups contain (a) xerophilous, (b) mesophilous or (c) hygrophilous species. Fig. 2 (a-f) presents the changes of the percentage proportion of the dominance values of the ecological groups in the different orthopteran communities. While in the habitats of Rajka and Ásványráró (after the fourth year of the monitoring) the xerophilus species till then in the other ones the mesophilous species were dominant. The average dominance values of the hygrophilous species were higher than 5% only in the habitats of Ásványráró and Nagybajcs during the length of time of our monitoring study. A slight changes were observable in the proportion of the groups in all sampling sites. While

the proportion of the mesophilous group increased as long as the proportion of the hygrophilous group decreased. The dominance structures of the orthopteran community of the new study site, which had been chosen in 1997, and the former study site at Ásványráró was entirely different from each other.

The decreasing in the percentage proportion of the hygrophilous group went with disappearance of *Aiolopus thalassinus, Chrysocraon dispar* and *Mecosthetus grossus* from entire region of the Szigetköz by 1999 (Table 2).

1.9.4. Discussion

The main traits of the orthopteran communities of the wet grasslands can be given in the next points: (1) they occurrence with relatively low species number (Table 3 and 2) relatively high abundance (Table 4 and 3) one or two dominant species, these are usually the *Chortippus parallelus* and *Chortippus albomarginatus* species, are present with 50-90% dominance values in a given community, (4) besides the dominant mesophilous species the characteristic hygrophilous species (e.g. *Aiolopus thalassinus*, *Conocephalus discolor*, etc.) are stable part of this communities.

Table 3. The species number of the individual orthopteran communities in the Szigetköz during the monitoring period.

Sampling years/ Sampling sites	1994	1995	1996	1997	1998	1999
Rajka	11	7	9	8	8	9
Dunasziget	7	9	11	9	11	4
Dunakiliti	7	10	11	9	7	6
Dunaremete	10	10	12	11	8	3
Ásványráró	12	7	8	9	12	8
Nagybajcs	6	3	4	7	14	6

Table 4. The abundance values of the individual orthopteran communities in the Szigetköz during the monitoring period.

Sampling years/ Sampling sites	1994	1995	1996	1997	1998	1999
Rajka	844	346	386	465	1272	535
Dunasziget	42	106	249	108	730	356
Dunakiliti	1228	410	1087	689	693	239
Dunaremete	729	619	698	350	495	324
Ásványráró	910	88	219	339	368	413
Nagybajcs	248	89	218	452	1079	147

Under the influence of the perturbations the above mentioned structure of the orthopteran communities of the wet grasslands changed. The orthopteran communities in the Szigetköz region can be divided into four groups. The first group contains the community of the considerably damaged site (Rajka) in the Upper Part inside the flood plain, the second comprises the communities of the flood plain in the Upper Part (Dunakiliti, Dunasziget), the third group contains community of the lower wetland on the protected side of the Upper Part (Dunaremete), and the fourth group contains the communities of the Low Part (Ásványráró, Nagybajcs). The divison into groups of the

orthopterans properly follows the configurations of the terrain of the area. 10-20 cm difference between the heights above the sea levels is enough to that the water table drops off and in consequence of that different vegetation associations can be found a few metres distance from each other.

The effect of the landscape transforming got on limited and increased the proportion of the xerophilous orthopteran species in the community. The effect of the decrease of the water table got on in the entire Szigetköz area and caused decrease dominance of the hygrophilous species and while the mesophilous species had become dominant. The water supplying had no effect on the orthopteran communities in the middle and upper part of the Szigetköz.

The retreat of the hygrophilous species and the pushing forward of the mesophilous species, under influence of decrease of water table, consistent with results of Lisicky *et al.* (1997), Báldi *et al.* (1998) and Rácz (1998b) who found that with decreasing humidity and changes of the vegetation structure the characteristic hygrophilous species disappear and the mesophilous species become more dominant stated in his study of the succession of the wet grasslands.

Monitoring studies of orthoperan communities (Orthoptera) was conducted for six years (1994-1999) in Szigetköz region. During our investigation the changes of structure parameters of orthopteran communities, such as number of species, dominance, diversity and abundance, and the proportion of hygrophylous, mesophilous and xerophylous orthopteran species were monitored on fixed sampling points. According to our expectations from the results of these monitoring methods conclusions might be draw in relation to ecological state of the Szigetköz area.

Our results showed that the orthopteran communities can be divided into two main parts which was corresponding to the differences in the elevations above the sea level between the upper part (125-115 m) and lower part (115-105 m) of the Szigetköz and we could separated the orthopteran communities of the flood plains and the protected side. The beginning of our monitoring investigations the more humid wet grasslands could be characterised by the presence of some hygrophilous orthopteran species from which three species (*Ailopus thalassinus, Mecosthetus grossus* and *Chrysocraon dispar*) disappeared from the study sites by 1999. We found significant effect of the landscape transforming and the decreasing of the water table on the structure of the orthopteran communities but the water supplying had no demostrable effect.

1.9.5. SUMMARY

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1.9.6. Acknowledgement

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1.9.7. References

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