

Orthoptera and Mantodea in fragments of seminatural habitats in lowlands of SE Slovakia and SW Transcarpathian Ukraine

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Abstract

During the period of 1997–2008 we found 70 mostly thermophilous Orthoptera species (33 Ensifera and 37 Caelifera) and *Mantis religiosa* (Mantodea) in 11 Slovak and seven Ukrainian sites. The 70 species found at the Slovak sites represented 56.5% of species known in Slovakia and 41 species found in Ukrainian sites 53.3% of species known in Transcarpathian Ukraine. Four species (*Xya variegata*, *X. pfaendleri*, *Tetrix bolivari* and *Stenobothrus crassipes*) are recorded here for the first time in the Ukraine. We recorded assemblages belonging to the five ecological groups: i) sand dunes (only in Slovakia), ii) wetlands, iii) salt marshes, iv) xerotherm forest steppes (only in Slovakia) and v) margins of floodplain forests along the Tisa and Latorica rivers. In sand dunes, the most frequent were *Dociostaurus brevicollis*, *Omocestus petraeus*, *Myrmeleotettix antennatus*, *Platycleis montana*, *Gampsocleis glabra*, rare were *Platycleis affinis*, *Oedaleus decorus* and *Acrida ungarica*. In wetlands occurred hygrophilous species *Conocephalus dorsalis*, *Pteronemobius heydenii*, *Xya pfaendleri*, *X. variegata*, *Tetrix bolivari*, *Stethophyma grossum*, *Mecostethus parapleurus*, *Chorthippus dichrous*, *Leptophyes discoidalis*. Salt marshes in both countries were fairly regularly occupied by *Aiolopus thalassinus*, *Omocestus rufipes*, *Chorthippus oschei* and *Stenobothrus crassipes*. Ecotones of xerotherm forest steppes (only in Slovakia) were characterised mostly by *Isophya kraussii*, *I. modesta*, *I. stysi*, *Poecilimon fussi*, *Poecilimon schmidtii*, and *Phaneroptera nana*. Floodplain forest margins along the Tisa River were occupied also by rare arboricole and thamnobiont species such as *P. schmidtii*, *L. discoidalis* and *Odontopodisma rubripes*. We make some remarks about the distribution, abundance and ecology of 13 rare species.

Zusammenfassung

Insgesamt 70 überwiegend thermophile Heuschreckenarten (davon 33 Ensifera und 37 Caelifera Arten) sowie eine Gottesanbeterin wurden in 11 slowakischen und sieben ukrainischen Studienflächen von 1997 bis 2008 gefunden. Die 70 Arten bilden 56,5% von allen 125 bekannten Arten in der Slowakei. Die 41, auf der ukrainischen Seite gefundenen Arten repräsentieren 53,3% aller 77 bekannten Arten der Transkarpathischen Ukraine. Vier Arten (*Xya variegata*, *X. pfaendleri*, *Tetrix bolivari* und *Stenobothrus crassipes*) wurden zum ersten Mal in der Ukraine registriert. Die Orthopterenzönosen gehören dort zu fünf Habitatgruppen: i) die Sanddünen (nur in der Slowakei), ii) Sumpfbiete, iii) die Salzböden, iv) xerotherme Forststeppen (nur in der Slowakei) und v) Ökotope von Auwäldern entlang der Flüsse Tisa und Latorica. In den Sanddünen waren die Charakter-

arten *Dociostaurus brevicollis*, *Omocestus petraeus*, *Myrmeleotettix antennatus*, *Platycleis montana*, *Gampsocleis glabra*, selten auch *Platycleis affinis*, *Oedaleus decorus* und *Acrida ungarica*. In Sümpfen kamen die hygrophilen Arten *Conocephalus dorsalis*, *Pteronemobius heydenii*, *Xya pfaendleri*, *X. variegata*, *Tetrix bolivari*, *Stethophyma grossum*, *Mecostethus parapleurus*, *Chorthippus dichrous*, *Leptophyes discoidalis* vor. Die Salzböden wurden in beiden Staaten ziemlich häufig von *Aiolopus thalassinus*, *Omocestus rufipes*, *Chorthippus oschei* und *Stenobothrus crassipes* besiedelt. Die Ökotonen der xerothermen Forststeppen waren insbesondere durch *Isophya kraussii*, *I. modesta*, *I. stysi*, *Poecilimon fussi*, *Poecilimon schmidtii* und *Phaneroptera nana* charakterisiert. Die Ökotonen von Auwäldern entlang der Tisa wurden von den seltenen arboricolen and thamnobionten Arten *P. schmidtii*, *L. discoidalis* und *Odontopodisma rubripes* besiedelt. Die Ergebnisse über Verbreitung, Abundanz und Biologie von 13 seltenen Arten werden diskutiert.

Introduction

The diversity of insects in lowland habitats of the agricultural landscape in Central Europe is highly endangered. Hence patches of well preserved seminatural habitats serve a crucial role (DUELLI & OBRIST 2003). These habitat fragments (sand dunes, wetlands, forest ecotones, open floodplain forests) are critically important for the reproduction, roosting and overwintering of insects. Orthoptera indicate the favourable conservation status of these habitats, also in small refuges and plots with intensive land use (FAHRIG & JONSEN 1998). Fragments of seminatural habitats in lowland areas of SE Slovakia and SW Ukraine are good examples of such an environment. This area is located at the zoogeographic zone of the Pannonian flora and fauna with northern distribution limits of several xerophilous and Mediterranean species (LIKOVITCH 1957, 1959, GULIČKA 1967, KRIŠTÍN et al. 2004a, b, 2007a, b). Different agricultural management was applied for the recent 20 years in these two countries. However, the study area is only ca. 100–150 km from the well-preserved territories in the lowlands of E Hungary such as the National Park Hortobágy and the Nature Reserve Bátorliget, where the orthopterofauna has been investigated thoroughly (i.e. NAGY 1983, 1991).

Grasshoppers and crickets of the East-Slovakian lowland were studied already in the past, mostly in 1951–1962 (MAŘAN 1952a, b, 1954, GULIČKA 1967), later only in 1997–2003 (KRIŠTÍN et al. 2004a). From the adjacent area in SE Hungary originated orthopterological studies from the eastern part of the Tisza River (NAGY et al. 2008), while the Ukrainian fauna of Orthoptera has been studied only scarcely (STOROZHENKO & GOROCHOV 1992, NAGY 2005) and the recent papers treated mostly individual species (PUSHKAR 2005, VEDENINA & HELVERSEN 2009).

Therefore, the objective of this paper was i) to describe structure of Orthoptera and Mantodea assemblages in the best-preserved fragments of seminatural habitats (sand dunes, salt marshes, wetlands, ecotones of floodplain forests and xerotherm forest steppes) and ii) to enrich the knowledge of distribution and biology of rare species.

Material and methods

Orthoptera and Mantodea were collected in the catchments of Latorica/Latorycja River and Tisa/Tysa River. Altogether, 11 sites situated in East-Slovakian Lowland (Východoslovenská nížina) in SE Slovakia ($48^{\circ}21'–33'N$, $21^{\circ}47'–22^{\circ}09'E$) and seven sites in Transcarpathian Lowland (Zakarpatska nyzovyna) in SW Ukraine ($48^{\circ}21'–27'N$, $22^{\circ}09'–22^{\circ}20'E$, Fig. 1) were sampled. These lowlands are commonly called Tisa Lowland (Tiszamenti síkság in Hungarian) and belong to the lowest situated areas in Central Europe. Qualitative and quantitative survey concerning the assemblage structure was carried out in June–August in 1997, 1999, 2001, 2003, 2005–2008 in Slovakia and in 2008 in Ukraine. The material was sampled mostly by sweeping herbs and partially also the shrub vegetation. This method was supplemented with individual collection of specimens. We spent at least two hours of collection at each site. Altogether, more than 18 thousand specimens of orthopterans were identified.

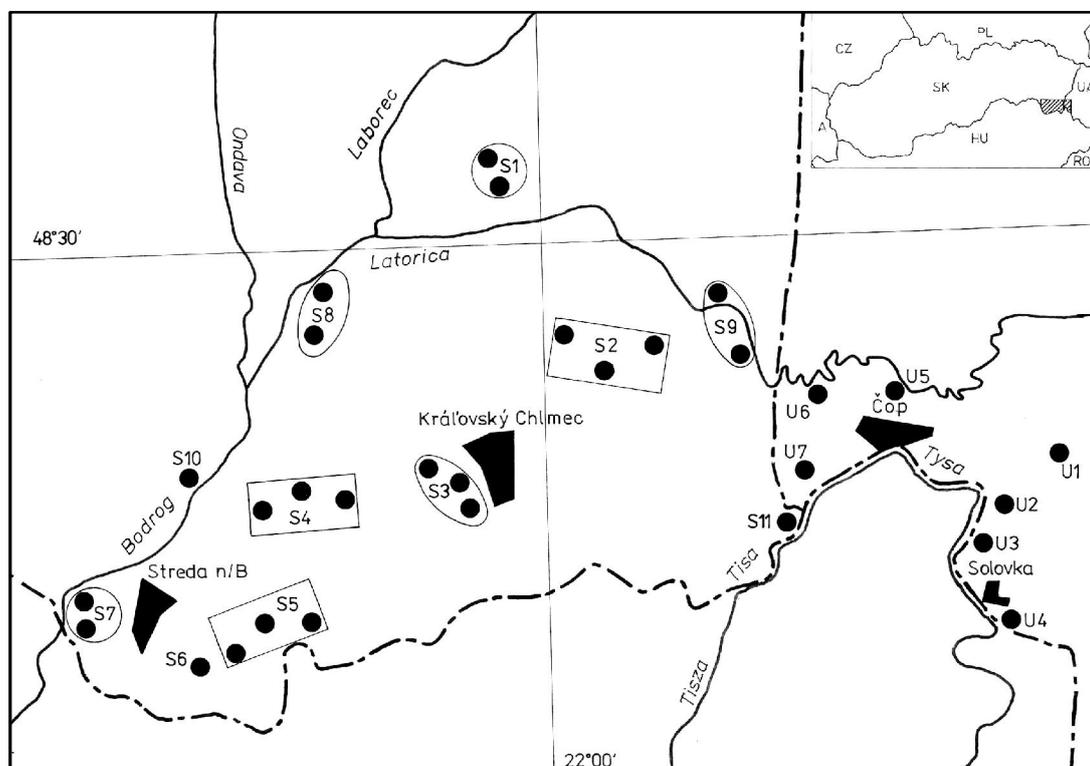


Fig. 1: Outline of 11 Slovak and 7 Ukrainian sites (black dots: sites; site numbers see Methods; dashed lines: country borders, full lines: rivers).

The relative abundance of individual species on the studied plots was expressed by using the following classification scale: 1 – very rare (less than 3 adult specimens), 2 – rare (3–10 specimens), 3 – abundant (11–100 specimens), 4 – very abundant (more than 100 specimens). The relative semi-quantitative abundance values represented the highest values for adults recorded at one site within one control. The material was identified directly in the field; specimens which were difficult to identify were stored in 75% alcohol and identified in the laboratory using identification keys (HELLER et al 2004, KOČÁREK et al. 2005). The data about the zoogeographic origin and species area distribution were taken from INGRISCH & KÖHLER (1998) and HARZ (1969, 1975).

Description of localities

Slovak localities

S1 Beša: pastures (irregularly grazed) and meadows on saline soils and sand dunes with preserved psammophytic vegetation (*Verbascum phoeniceum*, *Jasione montana*, *Artemisia campestris*, *Tithymalus cyparissias*), depressions between the dunes are filled with wetland vegetation and small water pools; the locality is situated 0.5–3 km S from Beša village, in its adjacent territory (further a.t.) (99–107 m a.s.l., 12 ha), No. of the Slovak Fauna Databank square (further DFS) 7497.

S2 Leles: sand dunes with rather ruderalised vegetation (*Lotus corniculatus* agg., *Echium vulgare*, *Acosta rhenana*, *Poa pratensis*, *Galium verum*, *Chondrilla juncea*, *Berteroa incana*) and adjacent wetland patches in the vicinity of Leles, Kapoňa and Poľany villages, a.t. Leles and Poľany (102–114 m a.s.l., 8 ha), DFS 7598.

S3 Malý Horeš: xerotherm meadows on sand dunes with well preserved psammophytic vegetation (*Gypsophila paniculata*, *Pulsatilla hungarica*, *Pulsatilla zimmermannii*, *Achillea pannonica*, *Acosta rhenana*, *Arenaria serpillifolia*, *Artemisia campestris*, *Berteroa incana*), a.t. of Malý Horeš, Svätušie and Kráľovský Chlmec villages (102–263 m a.s.l., 12 ha), DFS 7597.

S4 Somotor – Svätá Mária: traditionally used meadows and pastures with preserved psammophytic vegetation (*Gypsophila paniculata*, *Achillea pannonica*, *Artemisia campestris*, *Berteroa incana*) on sand dunes with adjacent wetlands in inter-dune depressions with hygrophilous vegetation (*Allium angulosum*, *Juncus atratus*, *Alopecurus pratensis*, *Festuca pratensis*, *Elytrigia repens*, *Phalaroides arundinacea*, *Carex vesicaria*) and an extensive pasture land on saline soils in a.t. of Somotor, Svätá Mária and Věč villages (100–150 m a.s.l., 20 ha), DFS 7596, 7597.

S5 Strážne – Veľký Kamenec: irregularly grazed and mown grasslands on sand dunes with adjacent wetlands in inter-dune depressions with rare hygrophilous vegetation (*Beckmania eruciformis*, *Cirsium brachycephalum*, *Eleocharis ovata*, *Elatine alsinastrum*, *Ranunculus repens*, *Lysimachia nummularia*, *Glyceria fluitans*, *Carex riparia*) in a.t. of two mentioned villages (98–124 m a.s.l., 20 ha), DFS 7697.

S6 Tarbucka: blown sands and xerotherm forest-steppes on andesite substrate with up to the top preserved xeropsammophytic vegetation (*Pulsatilla zimmermannii*, *P. pratensis* subsp. *hungarica*, *Gypsophila paniculata*, *Jasione montana*, *Dianthus serotinus*, *Stipa capillata*, *Festuca vaginata*), a.t. Streda nad Bodrogom, Veľký Kamenec (140–278 m a.s.l., 5 ha), DFS 7696.

S7 Floodplain of the Bodrog River: embankments with xerotherm vegetation, dry and wet meadows (with *Leucanthemella serotina*, *Allium angulosum*, *Gratiola officinalis*, *Pseudolysimachion longifolium*) and the proper partly ruderalised banks (*Galium boreale*, *Arrhenatherum elatius*, *Dactylis glomerata*, *Pimpinella saxifraga*) of Bodrog River, a.t. Klin nad Bodrogom (the lowest situated site in Slovakia, 95–99 m a.s.l., 6 ha), DFS 7696.

S8 Latorica: an inter-embankment area, wet meadows with *Leucojum aestivum*, *Allium angulosum*, *Lysimachia nummularia*, *Lythrum virgatum*, *Alopecurus pratensis*, rather ruderalised, partially regularly mown, partially overgrowing with willow and poplar succession, in a.t. of Rad and Zatín villages (96–102 m a.s.l., 6 ha), DFS 7597.

S9 Latorický luh: embankments along the Latorica River with meso- and xerophytic grasslands; wet meadows and edges of riparian forests (with *Populus*, *Salix*, *Quercus*) in a.t. of Kapušianske Kľačany, Ptrukša and Boťany villages (98–109 m a.s.l., 6 ha), DFS 7498, 7598.

S10 Ladmovce: xerotherm forest steppes on limestones with well preserved xerophytic vegetation (e.g. *Cerasus fruticosa*, *Adonis vernalis*, *Pulsatilla zimmermannii*, *Pulsatilla pratensis* subsp. *hungarica*,) with different stages of successional overgrowing (oak, hazelnut, black locust and hedges), on the foot with vineyards, a.t. Ladmovce (140–208 m a.s.l., ca. 5 ha), DFS 7596.

S11 Tisa: mesophytic and hygrophytic meadows with scattered bushy and tree vegetation on the edges of floodplain willow-poplar forests on alluvial sands along the Tisa River, 2–3 km SE from Malé Trakany village, in a.t. of the same village, (98–108 a.s.l., ca. 4 ha), DFS 7698.

Ukrainian localities

U1 Demetchi: hygro- and mesophytic grasslands on embankments of Tcharonda and Koropec drains, covered densely by water plants (*Stratiotes aloides*), surrounded by traditionally used fields, on E edge of Demechi village (99–101 m a.s.l., ca. 3 ha), DFS 7599.

U2 Tysaujfalú: riparian hygro- and mesophytic grasslands on embankments of Charonda drain and surrounding grasslands regularly grazed by cattle, ca. 400–500 m SE of Tysaujfalú village (99–101 m a.s.l., ca. 3 ha), DFS 7599.

U3 Esen: meso- and hygrophytic grasslands, partially rather ruderalised with *Solidago*, *Rubus* spp. and edges of poplar-willow floodplain forests with *Clematis vitalba* and black locust, an embankment area of the Tysa River, at N edge of Esen village (102–106 m a.s.l., ca. 2 ha), DFS 7699.

U4 Solovka: meso- and hygrophytic grasslands, and edges of poplar-willow floodplain forests along an embankments of the Tysa River, partially with bare alluvial sands, at the W edge of Solovka village (102–106 m a.s.l., ca. 3 ha), DFS 7699.

U5 Chop (Tchop): mesophytic grasslands and partially ruderalised fields and riparian vegetation along gravel lake, at the N edge of Chop town (99–101 m a.s.l., ca. 2 ha), DFS 7599.

U6 Solomonovo North: an inter-embankment area of the Latorycja River, wetland depressions surrounded by pastures with xerotherm vegetation, 1–2 km N of Solomonovo village (99–101 m a.s.l., ca. 4 ha), DFS 7598, 7599.

U7 Solomonovo South: meso- and hygrophytic grasslands, and edges of poplar-willow floodplain forests along an embankment of the Tysa River, mesophytic grasslands in old apple orchards, plots are rather ruderalized with *Solidago gi-*

gantea, *Helianthus tuberosus*, *Rubus* spp., 300–500 m S of Solomonovo village (101–104 m a.s.l., ca. 2 ha), DFS 7598.

Structure of assemblages

Altogether 70 mostly thermophilous Orthoptera species (33 Ensifera and 37 Caelifera species) and one mantid species were identified in the investigated 11 Slovak and 7 Ukrainian localities (Table 1). All recorded species were found in the Slovak localities, and only 41 species (20 Ensifera, 21 Caelifera) in the localities of SW Ukraine. Species composition of Orthoptera is showing significant differences between Slovakia and the Ukraine. These differences are caused mainly due to larger area of Slovak localities and lower sampling effort in the Ukraine (see Methods), and also maybe because of the more favourable conservation status, higher variability and more diversified lowland habitats for Orthoptera in Slovakia (sand dunes, wetlands, xerotherm habitats).

The 70 Orthoptera species found in the Slovak sites represent 56.5% of the total number of 125 recorded in the country. Among these species, there were 15 (EN 1, VU 3, NT 3, DD 8) from 33 species listed in the National Red List in Slovakia (KRIŠTÍN 2001). The 41 species found in the Ukrainian part represented 53.3% of the total number of 77 species found in the Transcarpathian area of the Ukraine (STOROZHENKO & GOROCHOV 1992). On the study plots orthopteran assemblages were identified belonging to the five main ecological groups: i) sand dunes (only in Slovakia), ii) wetlands, iii) salt marshes, iv) xerotherm forest steppes (only in Slovakia) and v) margins of floodplain forests along the Tisa/Tysa and Latorica/Latorycja rivers.

The first group of sand dunes consists of rare, so-called pseudo-psammophilous species (MAŘAN 1954), in Slovakia found mainly in sand dunes; however, in the Mediterranean area and other parts of S Europe these are occurring also on other substrates. Among these pseudo-psammophilous species, the most frequent was *Dociostaurus brevicollis* (frequency 72.7%), occurring relatively regularly were *Omocestus petraeus* (54.5%), *Myrmeleotettix antennatus* (36.4%), *Platycleis montana* (27.3%), rarely *Platycleis affinis* (18.2%), *Oedaleus decorus* and *Acrida ungarica* (each of them only in a single site 9.1%). Among the rare species occurring both on sand dunes and in wetlands were *Tettigonia caudata* and *Gampsocleis glabra* (see also KRIŠTÍN et al. 2007a). These and several others rarely found 50 years ago by MAŘAN (1954), or 40 years ago by GULIČKA (1967, 1992) in blown sands in E and S Slovakia may be still considered as indicators of well preserved sand dunes in this area. None of these species was found in our research in the Ukrainian sites, as this habitat is very rare in SW Ukraine.

Less frequent findings for wetlands in SE Slovakia were hygrophilous species such as *Conocephalus dorsalis*, *Pteronemobius heydenii*, *Xya pfaendleri*, *Xya variegata*, *Tetrix bolivari*, *Stethophyma grossum*, *Mecostethus parapleurus* and *Chorthippus dichrous*. *Leptophyes discoidalis* and *Ruspolia nitidula* occurred mostly as wetland species, but also in ecotones of xerotherm forest steppes and sand dunes. We found several of these so-called wetland species in Ukraine, indicating a good conservation status of remnants of the local wetland habitats

along rivers and irrigation channels (such as *C. dorsalis*, *P. heydenii*, *X. pfaendleri*, *X. variegata*, *T. bolivari*, *M. parapleurus*, *Ch. dichrous*). *X. variegata*, *X. pfaendleri* and *T. bolivari* are probably the first records for the Ukraine (STOROZHENKO & GOROCHOV 1992, NAGY 2005). Furthermore *R. nitidula* and *L. discoidalis* are worth mentioning, exhibiting only peripheral occurrence in the country.

Assemblages of meadows and pastures on salt marshes in Slovakia were fairly regularly presented by *Aiolopus thalassinus*, *Omocestus petraeus*, surprisingly frequent also by *O. rufipes* and *Stenobothrus crassipes*, very abundant *Polysarcus denticauda* and *Chorthippus oschei* (considered there as *C. albomarginatus* before 2009), occurring also in wetland habitats (Table 1). Rare occurrence in this habitat was observed in such species as *Platycleis vittata* (= *P. veyseli*) and *Eumodicogryllus burdigalensis*. In the Ukrainian sites only *C. oschei* (frequently) occurred, whereas *A. thalassinus* and *O. rufipes* were less frequent than in Slovakia. The species *S. crassipes* (now recorded for the first time in SW Ukraine; see NAGY 2005) belonged to the most abundant species in salt pastures near the Ukrainian village Tysaujalu.

Ecotones of xerotherm forest steppes were characteristic habitats only in several of the Slovak sites, characterised mostly with species of the genera *Isophya* (*I. kraussii*, *I. modesta*, *I. stysi*) and *Poecilimon* (*P. fussi*, *P. schmidtii*), furthermore *Phaneroptera nana*, *Ephippiger ephippiger*, *Melanogryllus desertus*, *Gomphocerippus rufus*.

Characteristic for floodplain forest margins along the Tisa River, both on the Slovak and Ukrainian side were arboricole and thamnobiont species *P. schmidtii*, *L. discoidalis*, *Odontopodisma rubripes* (a species of European-importance, Anex II), and *Meconema thalassinum*. Denudated banks of rivers and water plots were colonised by *P. heydenii*, *X. pfaendleri*, *X. variegata*, *T. bolivari* and *Gryllotalpa gryllotalpa*.

The most frequent orthopteran species in the studied sites across the whole East Slovakian lowland were xerothermophilous *Leptophyes albovittata*, *Phaneroptera falcata*, *Metrioptera roeselii*, *Gryllus campestris*, *Oecanthus pellucens*, *Calliptamus italicus*, *Chorthippus biguttulus* and *C. parallelus*. The situation in the Ukrainian sites was similar, however, with absents of the most frequent species *C. italicus*, *G. campestris* and *C. biguttulus*, and, unlike in Slovakia, the most frequent were the hygrophilous species *Conocephalus fuscus*, *Chrysochraon dispar* and *C. oschei*.

In each of the 11 sites in SE Slovakia were found 33–50 Orthoptera species (40.1 on average per site), the praying mantis *Mantis religiosa* was found in all the sites. The species number in individual sites was related to diversity in vegetation, diversity in mosaic of micro-habitat patches and the preservation status and/or isolation of the site. The richest in the species were sites comprising mosaic of sand habitats, salt marshes and wetlands Strážne – Veľký Kamenec (S5 = 50 species/ 20 ha) and a similar mosaic of habitats in the site Malý Horeš (S3 = 47 species/ 12 ha; Table 1). In each of the seven Ukrainian sites we found 16–28 species (20.4 on average per site), the praying mantis was found in four of them.

Table 1. Grasshoppers and crickets (Orthoptera) and mantids (Mantodea) in 11 SE Slovak and 7 SW Ukrainian lowland sites (sites, see Methods and Fig. 1, abundance: 1 very rare – less than 3 individuals, 2 rare – 3–10 ind., 3 abundant – 11–100 ind., 4 very abundant – more than 100 ind., f% – frequency within SK and UA sites).

Country	Slovakia											Ukraine								
	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11	f%	U 1	U 2	U 3	U 4	U 5	U 6	U 7	f%
ORTHOPTERA																				
Ensifera																				
Tettigoniodea																				
<i>Isophya kraussii</i>											1	9								
<i>Isophya stysi</i>											2	9								
<i>Isophya modesta</i>											2	9								
<i>Leptophyes albovittata</i>	3	3	4	3	2	3	2	2	2	3	2	100	3	3	1	3	3	2	3	100
<i>Leptophyes discoidalis</i>								2	2	2	2	45				2				
<i>Phaneroptera falcata</i>	2	2	3	2	2	4	2	2	3	4	3	100	2	2	2	3	2	2	2	100
<i>Phaneroptera nana</i>			1			2		1		2		36								
<i>Poecilimon fussii</i>											3	9								
<i>Poecilimon schmidtii</i>											2	18				2				14
<i>Polysarcus denticauda</i>				4	4			2	2			36								
<i>Meconema thalassinum</i>			2			2			1	2	1	45				1				14
<i>Conocephalus fuscus</i>	4	3	3	4	3		3	4	3		3	82	4	3	4	4	2	3	4	100
<i>Conocephalus dorsalis</i>	4	2	1	3	3		3	2	2		2	82	1		1	2	1	3	1	86
<i>Ruspolia nitidula</i>	2	2	2	2	3	2	2	2	2		2	91						1		14
<i>Decticus verrucivorus</i>		2	3	2	2	3		1	1			64	3	1			2	1		57
<i>Gampsocleis glabra</i>	3	3	3	2	4			2				54								
<i>Metrioptera bicolor</i>		3	3		3	3	2	1	1	2		73		3		2	3	1	1	71
<i>Metrioptera roeselii</i>	2	3	3	1	3	1	2	2	2	2	1	100	4	2	2	3	3	3	2	100
<i>Pholidoptera griseoaptera</i>		2	2			1	2	2	2	1	3	73				1			1	29
<i>Platycleis affinis</i>			3		2							18								
<i>Platycleis albopunc. grisea</i>		2	3	2	2	3	1	2	1	4		82					1			14
<i>Platycleis montana</i>			2	2		3						27								
<i>Platycleis vittata</i>			1	2	2				1			36								
<i>Tettigonia caudata</i>	2		2	2	4			2	2			54								
<i>Tettigonia viridissima</i>	2	1	2	1	2	1		1	2	1	1	91	2		1	1	1	3	1	86
<i>Ephippiger e. vitium</i>						1					3	18								
Grylloidea																				
<i>Gryllotalpa gryllotalpa</i>	2	2	2	1	2		2	1	1		2	82				1				14
<i>Pteronemobius heydenii</i>	1				1		1		1			36				4				14
<i>Eumodicogryllus bordigal.</i>				2	2		1				1	36								
<i>Gryllus campestris</i>	3	3	4	2	2	3	2	2	1	3	2	100	1				1			29
<i>Melanogryllus desertus</i>			1			1				1		27				1		1		29
<i>Modicogryllus frontalis</i>					2	2	3					27				3	1			29
<i>Oecanthus pellucens</i>	2	2	3	3	3	4	3	3	2	4	3	100	2	3	1	2	1	1	1	100
Caelifera																				
Tridactyloidea																				
<i>Xya pfaendleri</i>	4	4			4		4	1			3	54				3	2			29
<i>Xya variegata</i>	1	2			4		3	1			4	54				4	2			29
Tetrigoidea																				
<i>Tetrix bipunctata</i>			1				1	1			1	36		1	3	4		1		57
<i>Tetrix bolivari</i>	3				2		4	3	2			45					1			14
<i>Tetrix subulata</i>	1				3	1	2	2	2	1	1	73								
<i>Tetrix undulata</i>					2		2	2		1		36								

Country	Slovakia											Ukraine									
	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11	f%	U 1	U 2	U 3	U 4	U 5	U 6	U 7	f%	
Acridoidea																					
<i>Calliptamus italicus</i>	2	2	3	3	3	3	1	2	2	3	2	100				3		1			29
<i>Odontopodisma rubripes</i>											3	9			1	3		2		43	
<i>Acrida ungarica</i>			3									9									
<i>Aiolopus thalassinus</i>	3		2	3	3		2	1	3		1	73					1	2		29	
<i>Mecostethus parapleurus</i>	4		1	4	3		3	4	2			82						2	2	29	
<i>Oedaleus decorus</i>			2									9									
<i>Oedipoda caerulescens</i>	4	2	4	2	3	4		2		2		73									
<i>Stethophyma grossum</i>	4			4	4		2	4	1			54									
<i>Dociostaurus brevicollis</i>	4	3	4	3	3	3	2	2				73									
<i>Euchorthippus declivus</i>	2	2	4	3	3	2		1	1	1	3	91	1	2			2	1		57	
<i>Euchorthippus pulvinatus</i>	1	1	2	1	1	2					1	64									
<i>Euthystira brachyptera</i>	1	1				1					2	36									
<i>Gomphocerippus rufus</i>											3	9									
<i>Chorthippus montanus</i>							1	1				18									
<i>Chorthippus oschei</i>	4	2	3	3	3	3	3	3	2		3	91	2	3	1	1	3	4	2	100	
<i>Chorthippus apricarius</i>	1	1	3	2	2	1	1	2	2		2	91	2	2			2	2		57	
<i>Chorthippus biguttulus</i>	2	2	2	2	1	3	2	2	1	2	2	100				2	1		1	43	
<i>Chorthippus brunneus</i>	3	3	4	3	3	3	3	2		3	2	91		1	2	4		1	2	71	
<i>Chorthippus dichrous</i>	2			1	1						3	36			1					14	
<i>Chorthippus dorsatus</i>	3	2	2	2	2	2	3	2	2		2	91	2		2	1	2	2	1	86	
<i>Chorthippus mollis</i>	2	2	2	2	1	2	1	1		1		82									
<i>Chorthippus parallelus</i>	2	2	3	2	3	2	2	3	2	2	3	100	4	1	3	3	4	4	4	100	
<i>Chrysochraon dispar</i>	1			2	2	2	3	2	1	1	2	82	4	3	2	2	2	2	2	100	
<i>Myrmeleotettix antennatus</i>	3		2	3	3							36									
<i>Myrmeleotettix maculatus</i>	2		2	2	2							36									
<i>Omocestus haemorrhoidalis</i>	1	2	3	2	2	3	2	2		3		82		1	3				1	43	
<i>Omocestus petraeus</i>	3	1	2	1	1	1						54									
<i>Omocestus rufipes</i>	2		3	2	4	2	2	2	1	1	2	91				1		1	1	43	
<i>Stenobothrus crassipes</i>	3	2	3	3	3	3		1		4	1	82		4			3	2		43	
<i>Stenobothrus lineatus</i>			3			2		1	1	3		45		1						14	
<i>Stenobothrus nigromac.</i>	2	3	4	2	1	3				2		64									
Total species 70	42	34	47	42	50	38	38	45	35	37	33		15	17	16	28	24	25	18		
MANTODEA																					
<i>Mantis religiosa</i>	2	2	3	2	2	3	2	3	1	3	2	100	2			1		1	1	57	
E/C index	0.4	0.8	0.9	0.9	0.7	0.8	0.7	0.7	1.3	1.1	0.8		1.5	0.7	0.8	1.3	1	0.8	1		

Notes to rare species

The most remarkable, in terms of faunistics and zoogeography are the species *Isophya stysi*, *I. modesta*, *L. discoidalis*, *Phaneroptera nana*, *Poecilimon fussi*, *P. schmidtii*, *Polysarcus denticauda*, *G. glabra*, *Platycleis affinis*, *P. montana*, *T. caudata*, *E. burdigalensis*, *O. rubripes*, *A. ungarica*, *O. decorus*, *M. parapleurus* and *M. antennatus*. For the Ukrainian side, there are the first, according to the accessible literature, records of four species (*X. variegata*, *X. pfaendleri*, *T. bolivari* and *S. crassipes* (TCHETYRKINA 1950, LIKOVITCH 1957, 1959, STOROZHENKO & GOROCHOV 1992, NAGY 2005).

Isophya stysi – a species of European importance (Annex II, Habitats Directive), rarely (2 males, further M) was found only in ecotones of xerotherm forest steppes near the village Ladmovce, is an extreme SE finding of this species in Slovakia (KAŇUCH et al. 2006). At the same site some zoogeographically important thamnobiont species were also found, such as *I. modesta* (3 M), *P. fussi* (>100 ind./ha/check in July), *P. nana* (3 M). None of these species was found on the Ukrainian side.

The thamnobiont species *L. discoidalis* (DD in the National Red List for Slovakia), is reaching its northern distribution limit in Europe in the study area, and was found in various habitats. On the Slovak side, it was mostly occurring in hygrophilous and shrubby vegetation in floodplain forest margins along the Bodrog, Latorica and Tisa rivers as well as in ecotones of xerotherm forest steppes. In these habitats, the species occurred together with the accompanying species *P. schmidtii* and *O. rubripes*. On the Ukrainian side, the species is rare, with the first record in Ukraine dated to August 1988 in the site Chernaya Gora by the Tysa River (STOROZHENKO & GOROCHOV 1992). We have found this species also in a new Ukrainian site situated in an ecotone of riparian forests along the Tysa River near the village Solovka (1M, 1 female, further F, July 14, 2008).

The Ponto-Pannonian species *P. fussi* (DD in the National Red List) requires a special attention from the viewpoint of zoogeography and ecology. The population of this species in the site Ladmovce is the well-recognised vital population in Slovakia, distinctly isolated from similar insular populations in Poland, Hungary and Ukraine (NAGY 2005). The abundance of *P. fussi* in oak forest steppes ecotones (site Ladmovce) on July 13, 2005 approached to >100 ind./200 m long transect of herbaceous and shrubby vegetation in ecotone of a xerotherm forest steppe (also from stands of *Cerasus fruticosa*, *Rosa* sp., *Salvia* sp., and similar). The occurrence of this species in Slovakia has not been confirmed for as long as 50 years. In July 1951 this species, under the name *Poecilimon matisi*, was described by MAŘAN (1952b) from the Piliš hill (at about 6 km W from the site Ladmovce). At present this taxon is considered a subspecies of *P. fussi* (HARZ 1969, NAGY 2005). It is adult early in the season, from mid-June to the end of July, and associated with ecotones of xerotherm oak forest steppes. In the Ukraine we did not find this species.

The closely related Pontic species *P. schmidtii* is found more frequently, both in Slovakia and in the Ukraine. In Slovakia, about 25 sites in open forests and forest ecotones are known, eastward from 21° 20' E. The northern limit is near to border with Poland, where the species has not been found yet. In the south the range is connected with the populations in Hungary; in the east with the Ukraine (own unpublished data). In one site, we found this species together with *P. fussi*, but only at a much lower abundance (e.g. on July 13, 2005, together only 3 F, 2 M/2 ha, all at nymphal stage of the 6th instar). On the Ukrainian side, we found the species together with *L. discoidalis* and *O. rubripes* in margins of riparian forests along the Tisa River near the village Solovka (1M, 1 F).

Polysarcus denticauda, one of the largest central-European bushcrickets, is very abundant in grassland sites in SE Slovakia. Adults occur very early (May 25–

June 30) in wet meadows and adjacent ruderal vegetation and sand dunes (the most abundant e.g. in sites Strážne, Veľký Kamenec, Somotor, Leles). The species regularly occurs associated with the rare *Gampsocleis glabra* and *Tettigonia caudata*. On the Ukrainian side, the species was not found even in suitable sites (evidently also due to late-dated survey).

Gampsocleis glabra (VU in National Red List in Slovakia) has been found till now only on Slovak side, in warm lowland habitats at altitudes 98–150 m a.s.l. It prefers desiccating wet meadows and sand dunes along wet depressions, but also ruderal vegetation along similar well-preserved habitats. The species was found mostly as adult in July (e.g. Veľký Kamenec, July 14, 2005, >100 stridulating males/ha; KRIŠTÍN et al. 2007a). It has not been found yet in the Ukraine, but its nearest Slovak localities are only 8 km from the Ukrainian border.

Odontopodisma rubripes – a species of European importance (Annex II, Habitats Directive) occurred regularly (>50 adults/ha in mid July) in margins of floodplain forests along the Tisa River, both in Slovak and in Ukrainian sites. Hence, this distribution area is adjacent to the connected distribution area of this species in Hungary and Romania (NAGY 1991).

A special group of rare species in the studied sites consists of so-called pseudo-psammophilous species. The typical pseudo-psammophilous species of Afro-tropic origin *A. ungarica* (in the National Red List VU) was caught near Somotor village already in the 19th century by CHYZER (1897), and still in 1951–1962 was found abundant by Mařan (1952a) and GULIČKA (1992, in litt.). In the sand dunes along the Slovak part of the Danube River, the species is surviving in several sites (KRIŠTÍN et al. 2004b). A small isolated population (<20 adults/ha) is surviving in sand dunes in the site Malý Horeš in E Slovakia, together with rare *Oedaleus decorus*, *M. antennatus*, *P. affinis*, *P. montana* and others. These species have not been reported from the Ukrainian part of Transcarpathians (NAGY 2005).

The Mediterranean species *Platycleis affinis* was identified quantitatively only for two sand-dune sites (Malý Horeš and Strážne, e.g. >10 ind. August 25, 2006), while we may suppose its occurrence also in other sites. To this date, the species has not been found in Ukraine. It may be hypothesised that in E Slovakia, the species is reaching the northern limit of its distribution range in Europe.

The E-European species *Platycleis montana* was found rather regular in sand dunes and xerotherm habitats of SE Slovakia, while its occurrence in the Ukraine is unsure (NAGY 2005).

O. decorus and *Myrmeleotettix antennatus* are associated with well-preserved sandy plots with scarce herbaceous vegetation. Their local abundance does not exceed 20 adults/ha, with *O. decorus* found, equally as *A. ungarica*, in one site only (Table 1).

Four pseudo-psammophilous species (*Calliptamus barbarus*, *Celes variabilis*, *Acrotylus insubricus*, *A. longipes*) were not found again in 1997–2008 in the East-Slovakian lowland, while they were present 50 (MAŘAN 1954) or 40 years ago (GULIČKA 1954, 1967, 1992). These species supposedly have the northern

limit of their European distribution range in Slovakia. For the occurrence of these species as well as possible causes of their current absence in the study area see KRIŠTÍN et al. (2004a, b). The knowledge of the species diversity of Orthoptera on the Ukrainian side is still showing several gaps, and we may suppose that, in spite of relatively homogeneous habitats in the lowland landscape, more thorough research should result in recognising higher species diversity.

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