



## Orthoptera of the peat bogs and wet mountain grasslands in Orava region (NW Slovakia)

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**Abstract:** Peat bogs are habitats of European importance, but only few data exists on crickets and grasshoppers living in these habitats. Altogether 22 species of Orthoptera (6 Tettigonioidea, 2 Tetrigoidea and 14 Acrididoidea) were found in 16 selected localities, in peat bogs and wet mountain meadows in the Orava region in 2008–2011. Only 16 species were registered in peat bogs (4 Tettigonioidea, 2 Tetrigoidea and 10 Acrididoidea) and 18 species in wet mountain meadows. Number of species per site varied between 2 and 14 (mean 9.5). The euryoecious species *Euthystira brachyptera* (F=100% of sites), *Metrioptera roeselii* and *Omocestus viridulus* (both 93.8%), *Chorthippus apricarius* (87.5%) and *Chorthippus parallelus* (75%) were the most frequent species. Mountain species *Miramella alpina* and *Metrioptera brachyptera* are indicators of specific mountain bilberry meadows and peat bogs. In this extremely cold area we expected wing dimorphic individuals (macropterism) in some brachypterous species. The highest number of macropters was found in *Chrysochraon dispar*, especially in peat bogs ecotones of the Rudné Nature Reserve (26.8%). Occurrence, distribution and macropterism in some brachypterous species are commented.

**Key words:** grasshoppers, crickets, peat bogs, macropters, Slovakia

### INTRODUCTION

Peat bogs and especially active raise bogs are habitats of European importance (Viceníková & Polák 2003). However, there is little data on occurrence and structure of Orthoptera living in these habitats (c.f. Detzel 1998, Hochkirch & Adorf 2007). We can find more information concerning Orthoptera from mountain meadows and their response to environmental factors and management (cf. Krištín & Hruz 2005, Fabriciusová et al. 2007, Marini et al. 2008, 2009).

Northern Slovakia is a region with very little known orthopterofauna. The orthopterocoenoses in this area are known mainly due to several research papers on Tatra Mts. (Ebner 1914, Chládek 1986, Krištín 2010). Some data on the orthopterofauna of NW Slovakia can be found in works from the Liptov region (Šušlík 1986), and the Chočské vrchy Mts. (Krištín 1996). There is comprehensive information from the adjacent area of southern Poland, Beskid Zachodni (Bazyluk & Liana 2000). The structure of orthopterocoenoses in peat bogs from Slovakia has been less investigated and the knowledge in this mountain habitats is mostly fragmental (Straka 1992, 1993). The studied areas exhibit characteristics of cold forest complexes, primarily spruce forests, fragments of mountain meadows and, particularly, specific peat bogs (Trnka 2000). It is known that factors such as high moisture content and low temperature can be effective triggers for the high proportion of macropterous individuals in some brachypterous species (e.g. *M. roeselii*, *M. brachyptera*, *E. brachyptera*, *Ch. dispar* – Ingrisch & Köhler 1998, Poniatowski & Fartmann 2011).

In this context, we have analysed the qualitative and quantitative structure of Orthoptera assemblages of mountain meadows and peat bogs of NW Slovakia, with focus on protected areas and sites of European importance. Another aim was to contribute to the knowledge of

relations between the individual Orthoptera species and the specific peat bogs habitats. Proportion of macropters in some brachypterous species in these cold habitats is also discussed.

#### MATERIAL AND METHODS

Orthopterans were registered in 16 sites in the Orava area, always in August, during 2008–2011 (Fig. 1). The study localities were 1–2 ha in size and the time spent on each locality was 2–3 hours/control. The individual species of orthopterans were recorded visually and acoustically, the sampling was made by sweeping and beating from tree and shrub branches. The sampled species were identified according to HARZ (1969, 1975), and KOČÁREK et al. (2005), from whom we adopted also the nomenclature. For the quantitative evaluation of particular species we used relative frequency (F%) and relative abundance. Percentage of macropters in short-winged (brachypterous) species was registered in all sites. As macropters we considered individuals with unworn tegmina and alae reaching or exceeding the length of postfemora (cf. Ramme 1931, Ingrisch & Köhler 1998). For relative abundance of individual species on the study plots, we used ordinal scale described in Table 1. The relative semiquantitative abundance values in the results represent the highest numbers of adult individuals per one locality and one control (Table 1).

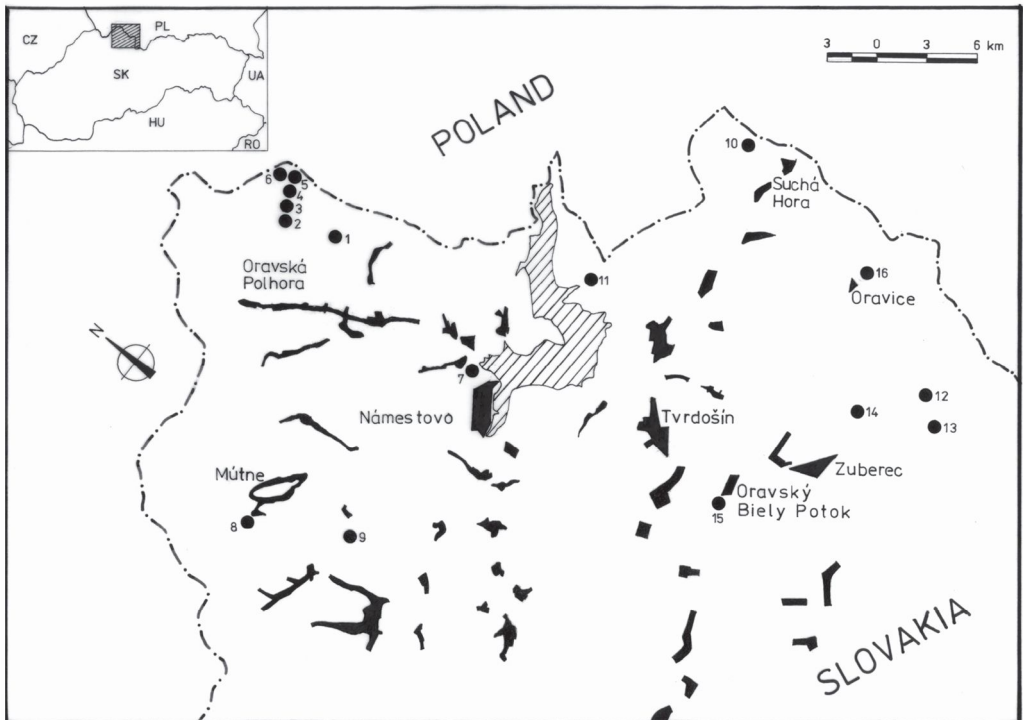


Fig. 1. Sketch of the 16 sites studied (black circles) in the Orava area with localisation within Slovakia (see numbers in chapter "Study sites"). Black patches indicate settlements, hatched plot – Orava Water reservoir, dash-dotted line – border between Poland and Slovakia).

Table 1. Relative abundance and frequency (F%) of Orthoptera in 16 sites of the Orava area (NW Slovakia); site numbers as in the chapter "Study sites"; habitats: G – wet grasslands, P – peat bogs, S – grasslands on ski slopes; abundance: 1 – very rare species (less than 3 individuals), 2 – rare (3–10 ind.), 3 – abundant (11–100 ind.), 4 – very abundant (101 and more ind.); \* – brachypterous species with macropterous morph – see text.

No. Habitat Altitude	Study site																Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
	G	G	G	G	G	G	P	P	P	P	P	S	S	G	G	G	F%
Orthoptera species:	Abundance																F%
<b>Ensifera</b>																	
<i>Isophya camptoxypha</i> (Fieber, 1853)			2	1								1	2				25
<i>Decticus verrucivorus</i> (Linnaeus, 1958)	3									3		1	1			2	32.8
<i>Metrioptera brachyptera</i> (Linnaeus, 1758)			1					3	2	2	2	4	2	3		2	56.3
<i>Metrioptera roeselii</i> (Hagenbach, 1822)*	3*	3*	2	2*	1		3	3*	3*	4*	3	3	2	4	2	4	93.8
<i>Pholidoptera griseoaptera</i> (Degeer, 1773)	1													1	1		18.8
<i>Tettigonia cantans</i> (Fussli, 1775)	3						3	3	3	3	3			3	2	2	56.3
<b>Caelifera</b>																	
<i>Tetrix bipunctata</i> (Linnaeus, 1758)								2									6.3
<i>Tetrix tenuicornis</i> Sahlberg, 1893										1					1	2	18.8
<i>Miramella alpina</i> (Kollar, 1833)			2	3													12.5
<i>Euthystira brachyptera</i> (Ocskay, 1826)*	4	4	4*	2*	1	1	4*	4*	4*	3*	3	2	1	4*	2	3	100
<i>Chorthippus albomarginatus</i> (Degeer, 1773)		3	2				4	4		4	2			1			56.3
<i>Chorthippus apricarius</i> (Linnaeus, 1758)	4	2	3	2			3	4	2	3	2	2	1	3	2	2	87.5
<i>Chorthippus biguttulus</i> (Linnaeus, 1758)	3	2		1	1	1	2	2	2							2	56.3
<i>Chorthippus brunneus</i> (Thunberg, 1815)																1	6.3
<i>Chorthippus dorsatus</i> (Zetterstedt, 1821)										2	2				1		18.8
<i>Chorthippus montanus</i> (Charpentier, 1825)			1	1			3	4		3		2	1	3	1	3	68
<i>Chorthippus parallelus</i> (Zetterstedt, 1821)*	4	2*					2	2	2	3*	2	2	2	4*	2	3	75
<i>Chrysochraon dispar</i> (Germar, 1834)*	1	3*						2	1	3*	3*			1	1		50
<i>Omocestus haemorrhoidalis</i> (Charpentier, 1825)	1				1												12.5
<i>Omocestus rufipes</i> (Zetterstedt, 1821)		1									2			1		1	25
<i>Omocestus viridulus</i> (Linnaeus, 1758)	3	3	4	3	2		3	4	2	3	3	4	4	4	3	2	93.8
<i>Stenobothrus lineatus</i> (Panzer, 1796)				1	1												12.5
No. of species	11	9	9	9	6	2	9	11	9	14	10	9	9	13	10	12	9.5

## STUDY SITES

The study sites were situated in NW Slovakia, in the following land surface units: the Oravské Beskydy Mts; Oravská kotlina basin; Podbeskydská brázda basin, Skorušinské vrchy Mts, Podtatranská brázda basin and Západné Tatry Mts. These localities are situated along a vertical gradient ranging from 645 to 1710 m a. s. l., in the alpine bioregion in basins and mountain chains in NW Slovakia (49°13'–34'N, 19°19'–19°42'E). They mostly represent abandoned fragmented mountain meadows in spruce forests (sites 1–6, 14, 15), peat bogs (7–11) and ski pistes (12, 13):

1. **Hviezdoslavova horáreň**, cadastral areas Oravská Polhora, Rabčice (890–900 m a.s.l., coordinates 49.32.27 N, 19.30.07E, Databank of Slovak Fauna, further DFS 6483) – mesophilous to waterlogged, partially mown mountain meadows by the gamekeeper's house surrounded by spruce forests and mixed forests with *Larix decidua*, *Salix* spp., *Fagus sylvatica*, at about 5 km distance N from the Rabča village. The first locality of the vertical gradient Babia Hora (i.e. localities 1–6).
2. **Mountain meadows on the southern boundary of the NNR "Babia Hora**, c.a. Oravská Polhora (1150–1170 m a.s.l., 49.33.37 N, 19.30.00E, DFS 6483) – at about 2 km distance from the first locality, this locality is a scattered mountain meadow area in spruce forests with abundant occurrence of *Vaccinium myrtillus* on S and SW facing slopes.
3. **Mountain meadows 1**, c.a. Oravská Polhora (1325 m a.s.l., 49.33.55 N, 19.30.28E, DFS 6483) – similar mosaic mountain meadows on the vertical gradient Babia Hora (Site of community interest, further SCI 0189), situated at about 700 m NE from the preceding locality, near the upper line of an open spruce forest, with abundant occurrence of *Vaccinium myrtillus* on S and SW facing slopes.
4. **Mountain meadows 2**, c.a. Oravská Polhora (1550 m a.s.l., 49.34.13 N, 19.31.07E, DFS 6483, SCI 0189) – another locality representing grassy-herbaceous stands on the vertical gradient Babia Hora, above the upper forest line in the dwarfpine and mountain-ash zone, at about 1000 m across spruce forest from the preceding site.
5. **Alpine meadows**, c.a. Oravská Polhora (1670 m a.s.l., 49.34.16 N, 19.31.43E DFS 6483, SCI 0189) – S facing alpine meadows on the vertical gradient of Babia Hora above the upper forest line and above the dwarfpine zone.
6. **Babia hora**, c.a. Oravská Polhora (1700–1710 m a.s.l., 49.34.21 N, 19.31.43E DFS 6483) – ridge rock habitats and dispersed grassy-herbaceous vegetation on SW facing slopes below the elevation point of the same name. The top of the regional vertical gradient of Babia Hora and NW Slovakia.
7. **Klinské rašelinisko National Nature Reserve**, c.a. Klin, Slanica (615 m a.s.l., 49.25.43 N, 19.29.48E, DFS 6582, SCI 0191) – it is a typical active peatbog with assemblages of the unions Sphagnion, Sphagno recurvi-Caricion canescentis, Sphagno-Utricularion. The N and NE parts of this peat bog are relatively dry, with evident manifestations of secondary succession in form of natural seedlings of pioneer plant species, primarily birch (*Betula* sp.). Some of the typical species associated with peat bogs occurring in the waterlogged S and W parts are: *Ledum palustre*, *Andromeda polifolia*, *Drosera rotundifolia*, *Oxycoccus palustris*, *Vaccinium uliginosum*, *Menyanthes trifoliata*, *Eriophorum* sp.
8. **Mútňanska pila Nature Reserve**, c.a. Mútne (780 m a.s.l., 49.28.01 N, 19.17.24E, DFS 6581, SCI 0191) – peat bog in the stream valley of the Mútňanka stream, at 300 m W from the Mútňanská Píla village, with stands of *Salix myrtilloides*, in the herb layer with

*Oxycoccus palustris*, *Andromeda polifolia*, *Menyanthes trifoliata*, *Carex dioica*, and *Vaccinium uliginosum*.

9. **Beňadovské rašelinisko Nature Reserve**, c.a. Beňadovo, Breza (695 m a.s.l., 49.25.12N, 19.19.46E, DFS 6581, SCI 0191) – peat bog with character similar to the preceding one, in the valley of the Mútňanka stream, at about 6 km SE from the preceding locality. Apart from the species common for the all Oravian peat bogs, this locality exhibits rare sedges like *Carex chorrodorhiza*, *C. lasiocarpa* and *C. limosa*.
10. **Rudné Nature Reserve**, c.a. Suchá Hora (754 m a.s.l., 49.23.21 N, 19.46.49E, DFS 6684, SCI 0057) – peat bog degraded in its major part due to draining effects. In the preserved parts we found: *Rhynchospora alba*, *Ledum palustre*, *Andromeda polifolia*, *Oxycoccus palustris*, *Calla palustris*, *Vaccinium uliginosum*, and *Empetrum nigrum*. The lack of precipitations causes removal of the peat substrate cover which becomes slowly grown with *Eriophorum vaginatum* and *Calluna vulgaris*. A part of this locality exhibits ecotonal character with sufficient cover of dispersed shrubs and tree vegetation (willow, birch, pine).
11. **Jelešňa National Nature Reserve**, c.a. Trstená (640–654 m a.s.l., 49.24.40 N, 19.37.52E, DFS 6583, SCI 0057) – transitory peat bogs and raised bogs in open spruce forests and waterlogged spruce forests (Vaccinio-Piceion, Bazzanio-Piceetum, Leucobryo-Piceetum).
12. **Spálená 1**, c.a. Zuberec (1080 m a.s.l., 49.14.14 N, 19.42.48E, DFS 6784) – permanent grasslands on the foothills of a ski slope.
13. **Spálená 2**, c.a. Zuberec (1400 m a.s.l., 49.13.25 N, 19.42.08E, DFS 6784) – permanent grasslands and forest meadows around the summit stop of the ski slope.
14. **Zuberec**, c.a. Zuberec (800 m a.s.l., 49.15.40 N, 19.37.55E, DFS 6783) – waterlogged mountain meadows in the valley of the Studený potok, stream with riparian willow vegetaion at about 1 km V from the village of Zuberec.
15. **Oravský Biely Potok**, c.a. of the same name (640 m a.s.l., 49.17.09 N, 19.31.41E, DFS 6783) – meadows bordering spruce forests and riparian stands of the equally named stream with irregular gravel terraces.
16. **Oravice**, c.a. Vitanová (820–840 m a.s.l., 49.24.40 N, 19.37.52E, DFS 6784) – mezophilous mown meadows and pastures bordering W facing spruce forest stands above the village of the same name.

## RESULTS AND DISCUSSION

### Qualitative and quantitative structure of Orthoptera assemblages

In 16 sites in the Orava area (NW Slovakia,) we recorded altogether 22 Orthoptera species (representing only 17.9 % of the Slovak orthopterofauna), comprising 6 Tettigonioidea, 2 Tetrigoidea and 14 Acrididoidea. Five peat bogs exhibited only 16 species (4 Tettigonioidea, 2 Tetrigoidea and 10 Acrididoidea) and the mountain meadows 18 species. These numbers are very low compared to some other mountain localities with dry pastures, meadows and more favourable habitats (such as the Poľana Mts., Krištín & Hruz 2005, Fabriciusová et al. 2007). In Orava mountain grasslands and peat bogs, we observed the absence of xerophilous and thermophilous species. Consequently, the low species number in Orava may be reasoned by the cold climate in this area, and by the low preference of the Orthoptera species for peat bogs and mountain meadows situated at higher altitudes. It is well known that low temperature, high soil moisture content, high air humidity, insufficient amount of solar radiation and long lasting winters with severe frost periods have negative impacts on the number of Orthoptera species and individuals, especially in peat bog habitats (Nadig 1981, 1997, Detzel 1998).

The species number *per site* fluctuated between 2–14 (on average 9.6 species/ site) correlated with the habitat type and altitude. The highest number, 14 species were identified in the peat bog Rudné; the lowest (2 species) in extreme cold grass stands around the summit of the Babia Hora Mt (1710 m a.s.l.). Grasshoppers (Caelifera) were dominant and more frequent than crickets (Ensifera) in all sites, due to the grassy – herbaceous character of vegetation structure in all sites (Fig. 2). The most frequent were the euryoecious species *Euthystira brachyptera* (F = 100 % localities), *Metrioptera roeselii* and *Omocestus viridulus* (both 93.8%), *Chorthippus apricarius* (87.5%) and *Chorthippus parallelus* (at 75%, Table 1). More than 50% frequency exhibited the grasshoppers *Chorthippus montanus*, *Chorthippus albomarginatus*, *Chorthippus biguttulus*, *Chrysochraon dispar* and the mountainous bush-crickets *Metrioptera brachyptera* and *Tettigonia cantans*. Even rarer were the mountainous species *Miramella alpina* and *M. brachyptera*. Surprisingly rarely, we found the bush-cricket *Pholidoptera griseoptera*, widespread in forest ecotones of Central Europe and *Chorthippus brunneus*, *Omocestus haemorrhoidalis*, typical species of grasslands (Table 1). At the highest altitudes the species *E. brachyptera* and surprisingly also *Ch. biguttulus* were found. None of the species found was either protected or belonged to the Red List of Threatened Species in Slovakia (Krištín 2001).

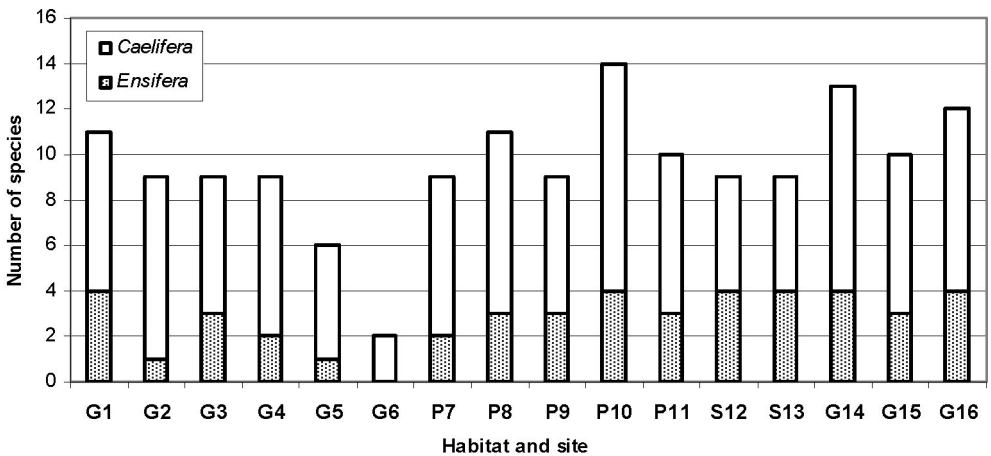


Fig. 2. Species numbers of Ensifera and Caelifera on 16 sites and three habitats (G – mountain grasslands, P – peat bogs, S – grasslands on ski slopes) within Orava region (NW Slovakia).

In four primarily brachypterous species, we found macropterous morphs in some sites (Table 1). In Orthoptera, wing length and macropters can be important for the dispersal of individuals from a population located in extreme or new colonized habitats (Gardiner 2009; Poniatowski & Fartmann 2011). It is known that currently macropters occur significantly more frequently than in past (Gardiner 2009) and populations with more than 20% macropters are no longer a rarity (Poniatowski & Fartmann 2011). We registered general proportions of macropters under 5% out of all the checked individuals in most of the species (e.g. *M. roeselii* 2.8% from 438 checked individuals, *E. brachyptera* 3.1% from 356, *Ch. parallelus* 5.1% from 116). However, in *Chrysochraon dispar* we found much higher proportions of macropters (11.8% from 98 individuals), and even 26.8% from a total of 41 checked individuals at Rudné peat bog. There are only few data on macropterism in this species (e.g. Weidner 1955). Furthermore, we found no macropters in other registered brachypterous species, in which macropters are well known (e.g. *M. brachyptera*, *Ch. montanus*, cf. Ingrisich & Köhler 1998).

**Notes to occurrence and ecology of selected species**

*Isophya camptoxypha* – species registered in four sites, on boundaries between mountain meadows and spruce forests and in ecotones of grasslands covering ski pistes. The maximum abundance, represented by 4 males and 3 females, was found in a mountain meadow in Babia Hora (1325 m n.m.).

*Metrioptera brachyptera* – characteristic species for Oravian peat bogs and most of typical mountain and alpine meadows. It is an indicator species for peat bogs in various parts of Slovakia (Fabriciusová et al. 2007) and in Europe (Hochkirch 1997, Detzel 1998, Nielsen 2000).

*Metrioptera roeselii* – one of the most abundant and most frequent species in the studied area, in Babia Hora ascending up to 1625 m a.s.l.

*Pholidoptera griseoptera* – low-in number and unexpected rare species in the studied habitats and localities.

*Tettigonia cantans* – regular and abundant species of peat bogs (> 10M/ 2ha).

*Tetrix bipunctata* and *Tetrix tenuicornis* – less abundant species in the studied area. Another regular species in peat bogs, *Tetrix undulata*, has been reported from Germany (Hochkirch 1997, Detzel 1998) and is to be expected also in study area.

*Miramella alpina* – surprisingly, we found this species only in two sites situated in mountain bilberry meadows on the vertical gradient Babia Hora at altitude 1325–1550 m a.s.l.. It is a characteristic mountainous species of the altitudinal gradient of the Tatra Mts as ascending as high as 2200 m a.s.l. (Krištín 2010).

*Chorthippus montanus* – an abundant species in several peat bogs (Table 1), similarly as in Veľká Fatra Mts. (Straka 1992, 1993). For example, the highest abundance and dominance was found in the Mútnianské rašelinisko peat bog (> 100 ex/ ha). The species was frequent on several mountain meadows in this area.

*Omocestus viridulus* – one of the most abundant and characteristic mountainous species of the study area, occurring regularly up to 1625 m a.s.l. (Babia Hora).

The prior faunistic works do not mention any more Orthoptera species than we have observed either in the Orava region or in the peat bogs of the Turiec region and the Veľká Fatra Mts. Straka (1992, 1993) recorded 6 and 7 euryoecious species in two peatbogs of the Veľká Fatra Mts. and 6 common species in Oravský Podzámok hill (Straka 1998). Apart from the hitherto recorded species (see Table 1), we expect other species occurring in the neighbourhood mountain ranges, such as bushcrickets from the genus *Isophya*, *Polysarcus denticauda* (Charpentier, 1825) (on preserved mountain meadows in June–August), *Barbitistes constrictus* Br. v. Wattenwyl, 1878 (on spruce forest ecotones), *Metrioptera bicolor* (Philippi, 1830), *Pholidoptera aptera* (Fabricius, 1793), *Tettigonia viridissima* Linnaeus, 1758 (adjacent Tatra Mts), crickets *Gryllotalpa gryllotalpa* (Linnaeus, 1758) and *Gryllus campestris* Linnaeus, 1758 (Karaska D., in litt.), grasshoppers *Podisma pedestris* (Linnaeus, 1758), *Gomphocerippus rufus* (Linnaeus, 1758), *Stethophyma grossum* (Linnaeus, 1758), *Stenobothrus stigmaticus* (Rambur, 1838) (adjacent mountain ranges Liptov, Chočské vrchy, and Tatry, Šušlík 1986, Krištín 1996, 2010). Consequently, the orthopterofauna of the entire Orava region may involve more than 40 species, as only 54 localities in the Tatra Mts. exhibited altogether 45 species (Krištín 2010), and 8 localities in the Chočské vrchy Mts. and their surroundings 26 species (Krištín 1996). The data for the adjacent extensive area in Poland (Beskid Zachodni) have been summarised by Bazyluk & Liana (2000) who identified there 42 species (16 Tettigonioidae, 2 Grylloidea and 24 Acridoidea).

The low number of species found in the studied habitats in the Orava region (representing only 17.9 % from the total species number for Slovakia), as well as the above discussed cold tolerating indicator species of peat bogs and mountainous habitats document the cold climate of this region that does not meet requirements of the most Orthoptera species. The species

protection also needs to consider problems associated with habitat endangering and with changes in their management. The primary case is the abandonment of traditional grazing and mowing practices, the secondary succession on mountain meadows on Babia Hora and, to some extent, also draining and former excavation of peat bogs in Orava (such as Rudné, Klin). One alternative of anti-successional protection is reintroduction of extensive sheep and goat grazing or periodical cleaning of the above-mentioned localities from natural seedlings of woody plants by mechanical cutting (min. at 5–10 year intervals).

#### SUMMARY

Peat bogs are habitats of European importance, but there exists only few data on orthopterans living in these habitats. In total 22 species of Orthoptera (6 Tettigonioidea, 2 Tetrigoidea and 14 Acrididoidea) were found in peat bogs and wet mountain meadows in 16 selected localities in the Orava region during 2008–2011. Only 16 species were registered in peat bogs (4 Tettigonioidea, 2 Tetrigoidea and 10 Acrididoidea) and 18 species in wet mountain meadows. Number of species per site varied from 2–14, with a mean of 9.5 species per site. Euryoecious species *Euthystira brachyptera* ( $F = 100\%$  of sites), *Metrioptera roeselii* and *Omocestus viridulus* (both 93.8%), *Chorthippus apricarius* (87.5%) and *Chorthippus parallelus* (75%) were the most frequent species. Mountain species *Miramella alpina* and *Metrioptera brachyptera* were indicators of specific mountain bilberry meadows and peat bogs. In this extremely cold area we expected wing dimorphic individuals (macropterism) in some brachypterous species. The highest number of macropters was found in *Chrysochraon dispar*, especially in ecotones of peat bogs at the Rudné Nature Reserve (26.8%). Occurrence, distribution and macropters in some brachypterous species are commented.

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## STRESZCZENIE

**[Prostoskrzydłe (Orthoptera) torfowisk i mokrych łąk górskich w rejonie Orawy (półn. zach. Słowacja)]**

W pracy przedstawiono wyniki badań nad zasiedleniem cennych przyrodniczo torfowisk i mokrych łąk górskich przez prostoskrzydłe – szarańczaki i pasikoniki. W sumie na 16 stanowiskach w Orawie znaleziono 22 gatunki, w tym 16 na torfowiskach a 18 na mokrych górskich łąkach. Liczba gatunków na stanowisku wahała się od dwóch do czternastu. Szarańczak *Euthystira brachyptera* o szerokiej tolerancji ekologicznej występował na wszystkich stanowiskach. Z pozostałych gatunków o dużej frekwencji *Metrioptera roeselii* i *Omocestus viridulus* były notowane na 93.8% stanowisk, *Chorthippus apricarius* na 87.5% a *Chorthippus parallelus* na 75% stanowisk. Dwa górskie gatunki *Miramella alpina* i *Metrioptera brachyptera* są gatunkami wskaźnikowymi dla górskich łąk z *Vaccinium myrtillus* i torfowisk. W tym zimnym środowisku spodziewano się osobników z dwoma rodzajami skrzydeł (makropteryzm) i bezskrzydłych. Największą liczbę takich osobników stwierdzono u gatunku *Chrysochraon dispar*, szczególnie w strefie ekotonu torfowiska w rezerwacie 'Rudné' (26.8%). Analizowano występowanie i rozmieszczenie form z dobrze rozwiniętymi skrzydłami (f. makroptera) i ze skróconymi skrzydłami (f. brachyptera). Najwięcej form makropterycznych (26.8%) stwierdzono u gatunku *Chrysochraon dispar* w strefie ekotonowej torfowiska Rezerwatu Przyrody Rudné.

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