

**Contribution to the knowledge of the Orthoptera
of the Special Nature Reserve Zasavica (S Vojvodina, Serbia)
with special emphasis on *Zeuneriana amplipennis***

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Abstract

The study aimed to contribute to the knowledge of the Orthoptera of the Special Nature Reserve Zasavica. During the fieldwork on 11 localities from August 1st to 10th 2013 we recorded 46 Orthoptera species (23 Ensifera and 23 Caelifera). This was the first systematic research of this insect group in the Reserve. The commonest species were *Chorthippus parallelus* and *Pezotettix giornae*. We recorded and discussed a few interesting species: *Zeuneriana amplipennis*, *Tettigonia cantans*, *Leptophyes discoidalis*, *L. boscii*, *Conocephalus dorsalis*, *Modicogryllus frontalis*, *Chrysochraon d. dispar*, *Stenobothrus crassipes*, *Chorthippus dichrous* and *Chorthippus oschei pusztaensis*. Results of an inventory and preliminary monitoring of Zeuner's Danube bush-cricket (*Zeuneriana amplipennis*) from 2005 to 2008 are presented. In addition to the species recorded during this fieldwork, five more species of Ensifera were found before by the second author. These are presented and discussed here.

Zusammenfassung

Diese Untersuchung dient dazu, das Wissen über die Orthopteren des Naturschutzgebietes Zasavica zu erweitern. Elf Untersuchungsflächen wurden vom 1. bis 10. August 2013 untersucht und insgesamt 46 Arten (23 Langfühlerschrecken - Ensifera und 23 Kurzfühlerschrecken - Caelifera) nachgewiesen. Hierbei handelt es sich um die erste systematische Untersuchung zu dieser Insektengruppe in diesem Reservat. Die häufigsten Arten waren *Chorthippus parallelus* und *Pezotettix giornae*. Des Weiteren fanden wir diverse interessante Arten: *Zeuneriana amplipennis*, *Leptophyes discoidalis*, *L. boscii*, *Conocephalus dorsalis*, *Modicogryllus frontalis*, *Stenobothrus crassipes*, *Chorthippus dichrous* und *Chorthippus oschei pusztaensis*. Die Ergebnisse eines vorläufigen Monitorings der Donau-Beißschrecke (*Zeuneriana amplipennis*) von 2005 bis 2008 werden vorgestellt. Zusätzlich zu den während des Feldaufenthaltes nachgewiesenen Arten, wurden fünf Ensifera-Arten bereits zuvor vom Zweitautor nachgewiesen. Diese werden hier ebenfalls diskutiert.

Резюме

Циљ овога истраживања био је да допринесе познавању правокрилаца (Orthoptera) Специјалног резервата природе Засавица. Током теренског рада на 11 локалитета од 1. до 10. августа 2013. забележили смо 46 врста правокрилаца (23 зрикавца и 23 скакавца). Ово је било прво систематично

истраживање ове групе инсеката у резервату. Најчешће су врсте биле *Chorthippus parallelus* и *Pezotettix giornae*. Забележили смо и расправили присуство неколико интересантних врста: *Zeuneriana amplipennis*, *Tettigonia cantans*, *Leptophyes discoidalis*, *L. boscii*, *Conocephalus dorsalis*, *Modicogryllus frontalis*, *Chrysochraon d. dispar*, *Stenobothrus crassipes*, *Chorthippus dishrour* и *Chorthippus oschei pusztaensis*. Резултати инвентаризације и прелиминарног мониторинга Цојнеровог дунавског коњица (*Zeuneriana amplipennis*) од 2005 до 2008 су презентовани. Уз врсте забележене током овог истраживања, други је аутор пре забележио још пет врста које су овде презентоване и расправљене.

Introduction

The Special Nature Reserve (SNR) Zasavica is situated in South-East Europe, Republic of Serbia, on the territory of South Vojvodina, south of the Sava River and downstream of the Drina River. It comprises territories of Sremska Mitrovica and Bogatić municipalities in lowland of northern Mačva area. The area is dominated by riverine wetlands along the Zasavica oxbow, covering a length of 33.1 km at an altitude of about 70 m a.s.l. It is a mosaic of aquatic and wetland ecosystems with fragments of flooded forests. The protected area covers 1825 ha with 675 ha in the first degree of protection regime according to Serbian classification. The backbones of the Reserve make Jovača and Prekopac canals, Batar creek and Zasavica oxbow, which is connected to the Sava River directly through the Bogaz canal. The Zasavica oxbow is also supplied by ground water from the Drina River. In the past, Zasavica was a branch of Drina River, and later of Sava River. The entire water system belongs to the Black Sea catchment area and it represents one of few authentic and preserved wetlands of the region. This calm flatland river system provides conditions for the survival of numerous and diverse wildlife species like the rare European mudminnow *Umbra krameri* (Actinopterygii) and the Danube crested newt *Triturus dobrogicus* (Amphibia) (STANKOVIĆ 2006; BARTULA et al. 2012).

There is only one paper concerning a single Orthoptera species from Zasavica – the finding of bush-cricket *Leptophyes discoidalis* (SKEJO & STANKOVIĆ 2013), and two preliminary communications concerning Zeuner's Danube bush-cricket – *Zeuneriana amplipennis* (STANKOVIĆ 2009, 2012). This paper presents the very first systematic study information on grasshoppers, crickets and bush-crickets of Zasavica and gives all known data on *Zeuneriana amplipennis* in the Reserve.

Material and methods

We collected Orthoptera using different methods. Besides the most common sweep netting we used visual and acoustic searching. Some species were easy to determine in the field (e.g. *Pezotettix giornae*, *Chorthippus parallelus*). Others were preserved in 69% or 96% ethanol and identified in laboratory. Voucher specimens are deposited in Josip Skejo Collection in Zagreb, Croatia and Mihajlo Stanković Collection in Sremska Mitrovica, Serbia.

Species were determined using the taxonomic keys of HARZ (1969, 1975), FONTANA et al. (2002), MASSA et al. (2012) and papers specialized in certain groups: for *Chorthippus albomarginatus* group VEDENINA & HELVERSEN (2009), *Chorthippus* with angled pronotal keels WILLEMSE et al. (2009) and *Leptophyes* KLEUKERS et al. (2009). We sampled Orthoptera on 11 localities in SNR Zasavica from August 1st to 10th 2013. All sites are listed in Table 1. with short description of locality. The map of the investigated area is given (Fig 1). Taxonomy in the paper follows Orthoptera Species File (OSF) version 5.0 (EADES et al. 2013) with the exception of *Chorthippus parallelus*. It is not sure if the new *Pseudochorthippus* for the genus including *Chorthippus curtispennis*, *Ch. montanus* and *Ch. parallelus* will be accepted by the International Commission for the Zoological Nomenclature (HOCHKIRCH, in. litt.). Until this issue is resolved, we use traditional generic placement of the species (genus *Chorthippus*).

Table 1: Localities in Zasavica Reserve (Vojvodina, Serbia) investigated with coordinates and short description of habitats.

N	Locality	Coordinates (decimal)	General habitat description
1	Visitors' center	N 44.95733 E 19.52528	Meadow with cultivars near Zasavica stream
2	Gajića ćuprija	N 44.93678 E 19.49472	Semiaquatic and hydrophilous vegetation
3	Batve	N 44.93640 E 19.47586	Non-flooded meadow with hydrophilous vegetation
4	Zovik	N 44.94174 E 19.45990	Meadows with semiaquatic vegetation, part with corn field
5	Poljane - Radenković	N 44.94138 E 19.48590	Flooded forest and non-flooded meadow
6	Batar	N 44.92184 E 19.46694	Flooded meadow and forest by the creek
7	Valjevac pasture	N 44.94916 E 19.52457	Hydrophilous vegetation with dry parts
8	Ravnjanske ćuprije	N 44.93676 E 19.43604	Forest, flooded and not-flooded meadow
9	Staniševac	N 44.93834 E 19.41012	Non-flooded forest
10	Banov Brod	N 44.91999 E 19.40428	Dry and wet meadow, humid forest near Sava levee
11	Pačija swamp	N 44.95571 E 19.48048	Partly flooded meadow and forest

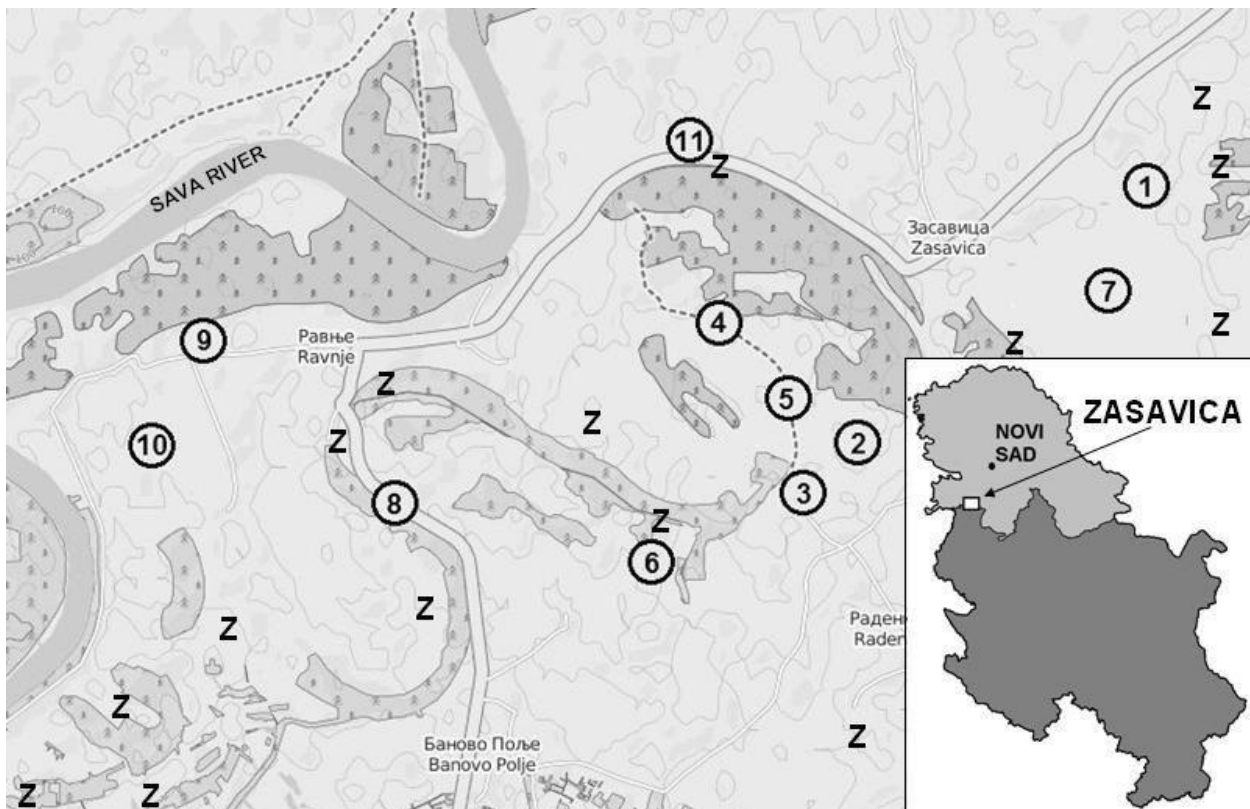


Figure 1: Map of the investigated area. Numbers in circles represent localities listed in table 1. Localities designated with **Z** represent localities where *Zeuneriana amplipennis* has been recorded during inventory and preliminary monitoring 2005-2008. In the down right corner map of Serbia is given: Vojvodina region is shaded with light grey. Empty rectangle represents Zasavica Reserve.

Results and discussion

A total of 46 Orthoptera (23 Ensifera and 23 Caelifera) species were recorded in the 11 sampling sites. All species found in the investigated localities (Fig. 1) are presented in the Table 2. The last row in the table presents the number of species per each locality.

Localities Gajića ćuprija (2.), Batve (3.), parts of Zovik (4.) and Pačija swamp (11.) share some common characters. On all localities semiaquatic and hydrophilous vegetation predominates (except cultivated part of Zovik) and are partly flooded in one part of the year. All sites are habitat of *Zeuneriana amplipennis* (Brunner von Wattenwyl, 1882) which is discussed below. Zeuner's Danube bush-cricket (*Zeuneriana amplipennis*) was described from Beograd and Zemun (Semlin) surroundings by BRUNNER VON WATTENWYL (1882). PANČIĆ found the species in Makiš near Beograd one year later (1883). ADAMOVIĆ (1967a) reported 6 additional localities (Obedska swamp, Grabovačka swamp, Zatreške grasslands, Ada Huja, Pančevački rit and Zabrani near Obrenovac), all in Sava and Dunav alluvial flatland near Beograd. The same year ADAMOVIĆ (1967b) reported new locality for the species: Tekija swamp in Đerdapska klisura, near Serbian-Romanian border. It was considered the easternmost locality for the species until recently, when IORGU (2011) found the species in Balta Ialomiței and LUPU (2011) in Danube Delta Biosphere Reserve near Maliuc, both in SE Romania.

The Lupu's record represents the eastern border of the distribution of the species for now. General distribution of the species is shown in Fig 2.

Table 2: Orthoptera species found in Zasavica (Vojvodina, Serbia) with record localities grey shaded).

	1	2	3	4	5	6	7	8	9	10	11
<i>Phaneroptera falcata</i>	•	•						•	•		•
<i>Phaneroptera n. nana</i>			•	•		•		•	•		
<i>Leptophyes albovitatta</i>				•				•			•
<i>Leptophyes boscii</i>				•		•					
<i>Leptophyes discoidalis</i>			•		•			•	•		
<i>Poecilimon schmidtii</i>			•						•		
<i>Barbitistes serricauda</i>										•	
<i>Conocephalus dorsalis</i>			•								•
<i>Conocephalus fuscus</i>	•	•						•		•	•
<i>Ruspolia nitidula</i>	•	•			•	•	•	•	•	•	
<i>Tettigonia viridissima</i>		•	•							•	
<i>Tettigonia cantans</i>	•										
<i>Roeseliana r. roeselii</i>			•	•				•			
<i>Zeuneriana amplipennis</i>		•	•	•							•
<i>Pholidoptera griseoaptera</i>					•	•		•	•		•
<i>Pachytrachis gracilis</i>					•	•				•	
<i>Gryllus campestris</i>									•		
<i>Acheta domesticus</i>	•										
<i>Melanogryllus desertus</i>	•	•			•		•	•	•		•
<i>Modicogryllus frontalis</i>	•	•		•							
<i>Pteronemobius heydenii</i>	•										•
<i>Oecanthus p. pellucens</i>	•						•		•		
<i>Gryllotalpa cf. gryllotalpa</i>	•				•	•					
<i>Tetrix subulata</i>	•	•			•		•	•	•		•
<i>Tetrix tenuicornis</i>					•			•	•		•
<i>Pezotettix giornae</i>	•	•	•	•	•		•	•	•	•	•
<i>Odontopodisma schmidtii</i>		•	•	•	•	•		•	•		•
<i>Calliptamus i. italicus</i>				•	•	•		•	•	•	
<i>Acrida ungarica</i>										•	
<i>Stenobothrus crassipes</i>				•							
<i>Omocestus h. haemorrhoidalis</i>		•								•	
<i>Omocestus rufipes</i>	•				•		•		•	•	
<i>Chorthippus d. dorsatus</i>					•				•		
<i>Chorthippus dichrous</i>										•	•
<i>Chorthippus oschei pusztaensis</i>	•				•		•			•	
<i>Chorthippus parallelus</i>	•	•	•	•	•	•	•	•	•	•	
<i>Chorthippus brunneus</i>				•	•	•	•	•	•	•	•
<i>Chorthippus m.mollis</i>				•							
<i>Gomphocerippus rufus</i>		•			•						•
<i>Euchorthippus declivus</i>				•	•		•	•	•	•	
<i>Chrysochraon d. dispar</i>		•	•								
<i>Euthystira b. brachyptera</i>			•		•					•	
<i>Mecostethus p. parapleurus</i>			•								•
<i>Aiolopus th. thalassinus</i>									•	•	
<i>Aiolopus strepens</i>								•	•		
<i>Oedipoda c. caerulescens</i>						•				•	
Σ (species)	15	14	13	14	19	11	10	18	21	18	16

The species was found in the Zasavica Reserve in 2005 for the first time on site Valjevac (STANKOVIĆ 2009). From 2005 to 2008 inventory and preliminary monitoring of the species was done and species was recorded on 14 new sites (near Batar creek south of Radenković village, Noćaj, Salaš Noćajski, Sadžak, Ostrovac, Pačija swamp, Banovo Polje, Poljansko, Crna swamp, Jovača canal, Bitva, Bostanište, Široka swamp and Prekopac) (sites in the map marked with Z, Fig. 1). STANKOVIĆ (2012) gave preliminary communications on finding of the species on localities mentioned. Zasavica is now regarded the westernmost locality for the species.

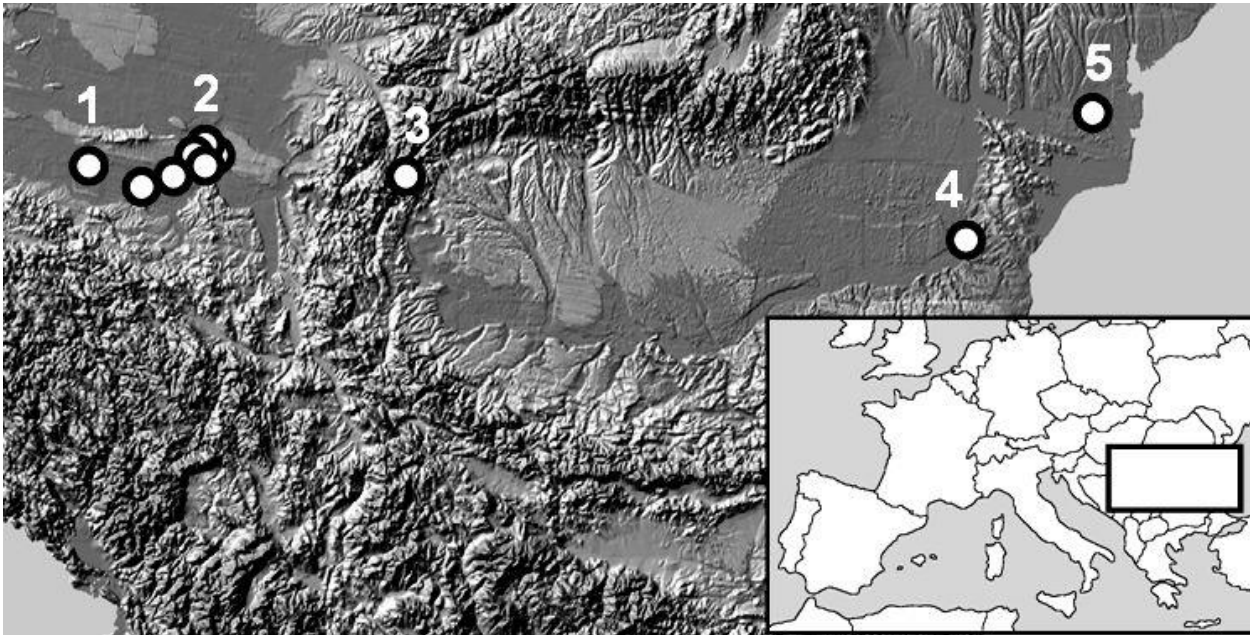


Figure 2: General distribution map of Zeuner's Danube bush-cricket (*Zeuneriana ampli-pennis*). Localities are presented with empty circles, and five isolated populations are designated with numbers (1-5). The westernmost circle represents Zasavica (Vojvodina, Serbia) (1), the easternmost Danube Delta Biosphere Reserve (near Maliuc, Romania) (5).

Zeuneriana ampli-pennis is a stenovalent bush-cricket whose habitat sites are severely fragmented along the Sava River and the Danube River in south-east border of Pannonian lowland and in Dacian lowland to the mouth of the Danube. We can talk of five disjunct populations of this rare species (Fig. 2) from west to east: Zasavica (1), Beograd surroundings (Obedska bara-Beograd) (2), Tekija (3), Balta Ialomiței (4) and Danube Delta Biosphere Reserve (5) population. After own observations we can say the species is very shy, as previously stated (IORGU 2011, LUPU 2011). Males are singing on the top of 0.2–1.3 m high bushes (Fig. 3). Their characteristic song can be heard from a long distance (20–40 m). When they hear something approaching, they drop down and hide in the bush or surrounding grasses making their catching very difficult. Only one male and two females were captured out of 11 males and 6 females tracked in August, 2013. Habitat vegetation types on the localities where the species was recorded could be divided into five types: swamp vegetation between reed and willow forest, swamp meadow with domination of *Phalaris arundinacea*, swamp meadow

with domination of *Carex* spp., mesophilous grasslands with *Alopecturus pratensis* and undergrowth vegetation on the forest edge of *Populus* sp. All localities where the species was present are flooded in the spring, as indicated by the presence of genera *Glyceria*, *Mentha*, *Sparganium* and *Typha*.



Figure 3: Male of Zeuner's Danube bush-cricket (*Zeuneriana amplipennis*) singing on the top of high bush in Zasavica (Vojvodina, Serbia).

Only on sites with *Z. amplipennis* we found some species typical for wet habitats: *Conocephalus dorsalis*, *Chrysochraon d. dispar* and *Mecostethus p. parapleurus*. *Conocephalus dorsalis* was present on the places with minimal or none human activity in the Reserve. On Gajića ćuprija and Batve we found stable population of *Chrysochraon d. dispar* (a lot of males, females and nymphs), rare species in Eastern Europe. This is, with Đerdapska klisura and Beljanica Mt. (ADAMOVIĆ 1975), third locality for the species in Serbia. *Mecostethus parapleurus* has been found all along Sava and Dunav wet meadows and swamps. The species is good indicator of very wet habitat.

Of other interesting species there were *Leptophyes discoidalis* – for which this is one of the westernmost localities in distributional area (SKEJO & STANKOVIĆ 2013), and *Leptophyes boscai* – one of few localities for the species in Serbia (following ADAMOVIĆ 1975, PAVIĆEVIĆ & KARAMAN 2001). *Modicogryllus frontalis* was found on 4 localities in Serbia before (following ADAMOVIĆ 1975, PAVIĆEVIĆ & KARAMAN 2001), so this is the fifth locality for the species. The record of *Stenobothrus crassipes* on a little drier 'island' of with corn (*Zea mays*) cultivated area in Zovik is very instructive since this is dry habitat and steppe species (PANČIĆ 1883, GREBENŠČIKOV 1949, ADAMOVIĆ 1975).

Around Visitors' Centre (1.), where cultivars predominate, 15 species were recorded. *Modicogryllus frontalis* was found on this locality too. Presence of *Tettigonia cantans* is very interesting. This is a peculiar record because in this part of Europe the species is usually montane or submontane (ADAMOVIĆ 1975) what Zasavica is not, so this is with GREBENŠČIKOV (1949) record from Košutnjak near Beograd the lowest locality for this species in Serbia.

On Valjevac pasture (7.) the smallest number of species (10) has been recorded. It is probably due to overgrazing by donkeys, autochthonous cows (*podolsko goveće*) and sheep. For the great amount of livestock mentioned vegetation of this pasture is the main source of food and the majority of grasshoppers do not prefer such type of habitat. Thus, the locality is a subject to biological homogenization. Only 11 species were recorded on Batar creek (6). It is because in the major part of Orthoptera season (May to September) this locality is fully or at least partly flooded, mostly because of the beaver (*Castor fiber*) dam nearby. On the part of this locality near to water, *Phaneroptera nana*, *Leptophyes boscii*, *Ruspolia nitidula*, *Pholidoptera griseoaptera* and *Odontopodisma schmidtii* were present on bushes and grasses. *Gryllotalpa* cf. *gryllotalpa* specimens were digging into soft and wet soil. On the remote part *Pachytrachis gracilis* was found walking on and beneath fallen leaves and stems. *Calliptamus italicus*, *Chorthippus brunneus*, *Oedipoda caerulescens* and *Chorthippus parallelus* were jumping in the grass, the latter predominating.

Since *Gryllotalpa* genus is not well studied in Europe and a lot of questions arise every day about the validity of certain species, we made preliminary determination of mole-cricket specimens as *Gryllotalpa* cf. *gryllotalpa* because morphologically they look similar to the nominate species of the genus, but future taxonomical investigations and analysis of this genus are necessary to determine species with certainty (e.g. BENNET-CLARK 1970, WHITE 1977).

Around 20 species were found on Poljane – Radenković (5.) (19), Ravnjanske ćuprije (8.) (19) Banov Brod (10.) (18) and Staniševac (9.) (21). *Ph. nana* and *Ph. falcata* occurred syntopically on Ravnjanske ćuprije and Banov Brod, but *Ph. nana* was more numerous on both localities. *Leptophyes discoidalis* was recorded on Radenković, Ravnjanske ćuprije and Banov Brod as well. The only locality for *Barbitistes serricauda* was Banov Brod, where we found the species singing on *Populus* sp. near Sava levee.

Tetrix subulata and *T. tenuicornis* were also recorded syntopically on Radenković, Ravnjanske ćuprije and Staniševac, *T. subulata* being more numerous, contrary to Pačija bara, where we also recorded both species, but *T. tenuicornis* was more abundant.

Very large population (nymph, adult males and females) of *Acrida ungarica* was recorded all along dry slopes of Sava levee on Banov Brod. After preliminary comparison of Zasavica *A. ungarica* specimens (geographically *A. u. ungarica*) with Dalmatian specimens (geographically *A. u. mediterranea*) no morphological difference was found. Thus, the species is there designated as *Acrida ungarica* only. Lack of differentiable characters was already stated by HARZ (1975). Morphological and molecular analysis is necessary in future.

One more interesting species was found on Banov Brod – *Chorthippus dichrous*. Two males and one copulating pair were found. This species will be more intensively investigated in future and should be investigated in all Vojvodina region, since it could sometimes be misidentified with *Ch. d. dorsatus*, as it was case with *Ch. loratus* too, (also member of *Ch. dorsatus* group) in Macedonia (CHOBANOV & MIHAJLOVA 2010).

Chorthippus oschei pusztaensis was recorded on 4 localities (Visitors' Centre, Poljane, Valjevac pasture and Banov Brod). This species replaces northern *Chorthippus albomarginatus* in this region, hybride zone occurring in Southern Slovakia (VEDENINA & HELVERSEN 2009, VEDENINA et al. 2009), so *Ch. albomarginatus* should be probably omitted from the list of Serbian Orthoptera.

In addition to the species recorded during this fieldwork, five more species of Ensifera were found before by the second author and are deposited in his collection. These are presented here.

Poecilimon fussii (Prekopac canal 04.08.2009.)

Pholidoptera aptera (Drenova Greda 08.08.2008.) (Fig. 4A, B)

Pholidoptera frivaldskyi (Batar creek 24.08.2005.) (Fig. 4C)

Ephippiger ephippiger (Bitva 08.08.2008., Drenova Greda 07.08.2011.)

Decticus verrucivorus (Lug 01.08.2006., Ribnjača swamp 24.05, 2007., Batar 03.08.2010.)

Record of *Pholidoptera aptera* (Fig. 4A, B) from Zasavica (Drenova Greda) is the first record of this species for Vojvodina region and the lowest record in the country. All previous records were related to central and southern Serbian mountains (ADAMOVIĆ 1975). Record of *Pholidoptera frivaldskyi* (Fig. 4C) is also very interesting since the species prefers mountains and hills (IORGU & IORGU 2008), habitat type that is not present in Zasavica. For this species this is one of the lowest records at all.

Population size and ecology of high-altitude montane and submontane species like *Pholidoptera aptera*, *Ph. frivaldskyi* and previously mentioned *Tettigonia cantans* in low-altitude swamp locality what Zasavica is will be briefly investigated in future.

Conclusions

The study aimed to contribute to the knowledge of Orthoptera of Special Nature Reserve Zasavica. During the fieldwork on 11 localities from August 1st to 10th 2013 we recorded 46 Orthoptera species (23 Ensifera and 23 Caelifera). This was the first systematic research of this insect group in the Reserve. The commonest species were *Chorthippus parallelus* and *Pezotettix giornae*, as expected. We found some species with very few records in Serbia before (*Zeuneriana amplipennis*, *Tettigonia cantans*, *Leptophyes discoidalis*, *L. boscii*, *Conocephalus dorsalis*, *Modicogryllus frontalis*, and *Chrysochraon d. dispar*). During inventory and preliminary monitoring of Zeuner's Danube bush-cricket (*Zeuneriana amplipennis*) from 2005 to 2008 the species was recorded on 15 microlocalities in the Reserve. This is now considered the western border of the distribution

of the species. In addition to the species recorded during this fieldwork, five more species of Ensifera were found before by the second author and are presented here. Of them, *Pholidoptera aptera* is recorded for the first time in Vojvodina, this being the lowest record of the species in Serbia. Record of high-altitude species *Pholidoptera frivaldskyi* is one of the lowest records for the species at all. Orthoptera fauna of Zasavica now counts 51 species (28 Ensifera and 23 Caelifera). We expect more species to be found in our future research in the Reserve.

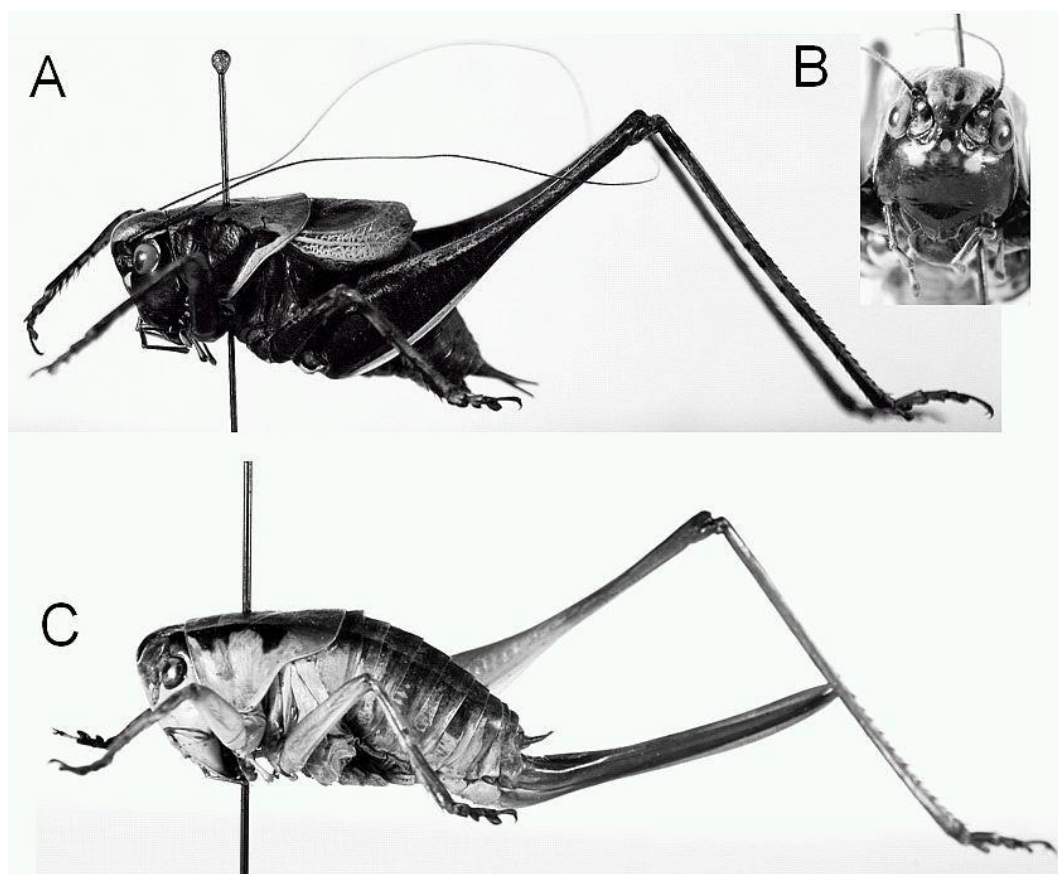


Figure 4: *Pholidoptera aptera* male lateral habitus (A) and head (B); *Pholidoptera frivaldskyi* female lateral habitus (C).

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