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FIRST FINDING OF STEPPE MOLE CRICKET *GRYLLOTALPA STEPPOSA* (ORTHOPTERA: GRYLLOTALPIDAE) IN CROATIA

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First finding of *Gryllotalpa stepposa* Zhantiev, 1991, a species typical of lowland steppe area of Eastern Europe, is documented for Croatia based on the shape of chitinized part of the epiphallus and the density of stridulatory teeth on male tegmen. All specimens from Valpovo, Podravina sample were brachypterous, which is usual for this species, morphologically very similar to the continental species *G. gryllotalpa.* Unusual variability is found in the appearance of veins on male tegmina, which should be investigated on a larger sample. This finding should encourage further research on mole crickets in Croatia, which will result in better understanding of their distribution and biogeography of this part of Europe in general.

Key words: *Gryllotalpa stepposa*, Croatia, morphological traits

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Na temelju oblika hitiniziranog dijela kopulatornog organa te gustoće stridulacijskih zubića na pokrilju mužjaka, po prvi puta je u Hrvatskoj dokumentiran nalaz stepskog rovca *Gryllotalpa stepposa* Zhantiev, 1991, vrste karakteristične za nizinsko stepsko područje istočne Europe. Sve jedinke u uzorku iz Valpova u Podravini bile su kratkokrile, što je česta pojava kod ove vrste koja je po morfološkim karakteristikama vrlo slična kontinentalnoj vrsti *G. gryllotalpa.* U izgledu žila na pokrilju mužjaka zabilježena je netipična varijabilnost koju treba istražiti na većem broju uzoraka. Ovim nalazom potiču se daljnja istraživanja rovaca u Hrvatskoj koja će pridonijeti boljem poznavanju njihove rasprostranjenosti te biogeografije ovog dijela Europe.

Ključne riječi: *Gryllotalpa stepposa*, Hrvatska, morfološke karakteristike

INTRODUCTION

Taxonomy of the genus *Gryllotalpa* Latreille, 1802 in Europe is far from final assessment. Only a partial distribution of 13 European taxa is currently known (Broza *et al*., 1998, IORGU *et al*., 2016), including several taxa described mostly on the basis of different chromosome number and with uncertain reproductive isolation. Apart from *Gryllotalpa gryllotalpa* (Linnaeus, 1758), Harz (1969) quotes three more species for Europe: *G. africana* Palisot deBeauvois, 1805 for S-Spain, *G. septemdecimchromosomica* Ortiz, 1958 for Spain and *G. unispina* Saussure, 1874 for the Black Sea coast of Ukraine. He considered that *G. Gryllotalpa* in Hungary and the southern part of its distribution exists as brachypterous morphas well (cf. *G. g.* forma *hungaria* Harz, 1993), while in the rest of Europe only macropterous

Fig. 1. Map of locality where *Gryllotalpa stepposa* was found.

morph is present. Bennet-Clark (1970) described Western European species *G. vineae* from France, and redescribed *Gryllotalpa gryllotalpa* after a specimen (probably a type specimen, not a Neotype) from Norwick (England), stored in the collection of Linnean Society in London. Precise location of the locus typicus of *G. gryllotalpa* is still uncertain, noted as „Europa" in Harz (1969) and Orthoptera Species File (Cigliano *et al.*, 2017).

Broza *et al*. (1998) published a review of European taxa from *G. gryllotalpa* group, citing the following species: northern species *G. gryllotalpa* with 12 chromosomes, sibling species or chromosome „races" with 15 to 23 chromosomes *G. cossyrensis, G. quindecim, G. sedecim, G. octodecim, G. viginti, G. vigintiunum* described from Italy and middle Mediterranean islands, including Pantelleria (Baccetti & Capra, 1978; Baccetti, 1991), and five other taxa outside Italy: *G. africana, G. septemdecimchromosomica* and *G. vineae* in W-Europe, the 14-chromosome taxon from Romania (= *G. stepposa* Zhantiev, 1991) and *G. krimbasi* in SE-Europe. However, *G. stepposa* is known to have polymorphic chromosome number, 2n= 14, 15, 16 (Fyodorova *et al*., 1991), and its southern possibly sibling allopatric taxon *G. krimbasi* has 19 chromosomes (Baccetti, 1992), but morphological examination of topotypic specimens was not performed. Zhantiev (1991) recorded small but constant differences between *G. stepposa*, *G. gryllotalpa* and *G. unispina* in SE Europe in the density of stridulatory teeth and the calling song characteristics of males. In comparison with *G. gryllotalpa, G. stepposa* has different epiphallus, lower density of stridulatory teeth in the central part of the stridulatory file (X=20,5 teeth/1 mm, min. 17 – max. 22) and higher peak frequency of calling signals, at 2,0 kHz (1,8 – 2,2 kHz) (Zhantiev, 1991; Zhantiev *et al*., 2003). Also, Zhantiev (1991) described distal part of the median vein adjacent to the radio-cubital vein and radial vein as strong and well visible in *G. stepposa*, while weak and poorly visible, or even absent, in *G. gryllotalpa*.

After the findings of *G. stepposa* in the neighbouring Hungary and Serbia, Iorgu *et al*. (2016, 2017) expected findings of this species in NE Croatia as well. Josip Skejo (pers. comm.) found a specimen of *G. stepposa* probably from Croatia in the entomological collection of the Faculty of Science in Zagreb, but with no label. Finally, first author found this species in Valpovo (Donja Podravina area in Osijek and Baranja County), south of the Drava River (Fig. 1).

MATERIAL AND METHODS

Brachypterous mole cricket specimens from Valpovo (Croatia) were found in May 2017 on two microlocations, Ćilimanka (45.673155 N, 18.393654 E, 87 m a.s.l) and Toplice (45.648107 N, 18.442755 E, 92 m a.s.l.), in a stabling and a greenhouse. From all specimens, tissue samples were taken and stored for future barcoding. Body colour was recorded in live specimens. External morphological traits of six specimens, three males and three females, were measured according to Bennet-Clark (1970). The following traits were taken into consideration: head and body length, pronotum length and width, tegmen (forewing/elytrae) length and width, alae (hindwing) length, cerci length and anntenae length. Epiphallus (dorsal titillator) was taken from two specimens and prepared using 10% potassium solution. Length of the central part of epiphallus and its width at apex were measured. Also, the length of the stridulatory file (pars stridens) on Cu2 vein of male tegmen was measured, stridulatory teeth were counted and their density in the central part of the stridulatory file was calculated per mm of the file. Distal part of the median vein on the upper tegmina of the males was photographed and compared with figures in Zhantiev (1991) and Iorgu *et al*. (2016). All measurements and photographs were taken using Zeiss Stemi 2000-C stereomicroscope with a ruler reticle.

RESULTS AND DISCUSSION

Body colour of specimens from Valpovo (Croatia) is brown dorsally, while yellowish/orange laterally and ventrally (Fig. 2). Alae reach mostly to the 5th tergite, only in a single male to the 8th tergite, but are never longer than abdomen. Anntenae are longer than pronotum. Other external measurements are more similar to *G. unispina* from Harz (1969) or *G. stepposa* (Iorgu *et al*., 2016), than to *G. gryllotalpa*. In this rather small sample, female measurements are slightly smaller than of males (Tab. 1). All specimens have four to five dorsal spines on hind tibia, typical for *G. gryllotalpa*/*G. stepposa*/*G. krimbasi* group (Zhantiev, 1991), and the spines gradually become slightly longer distally, as in *G. stepposa*/*G. krimbasi* (Iorgu *et al*., 2016).

Epiphallus (Fig. 3 A) is more slender and with a narrower apical half than in *G. gryllotalpa*, the same as in *G. stepposa* (Zhantiev, 1991; Iorgu *et al*. (2016) 2017: Fig.1 K) and *G. krimbasi* (Ingrisch *et al*., 2008; Iorgu *et al*., 2016). Epiphallus length: width near apex ratio

Fig. 2. A female of *Gryllotalpa stepposa* from Valpovo (Croatia).

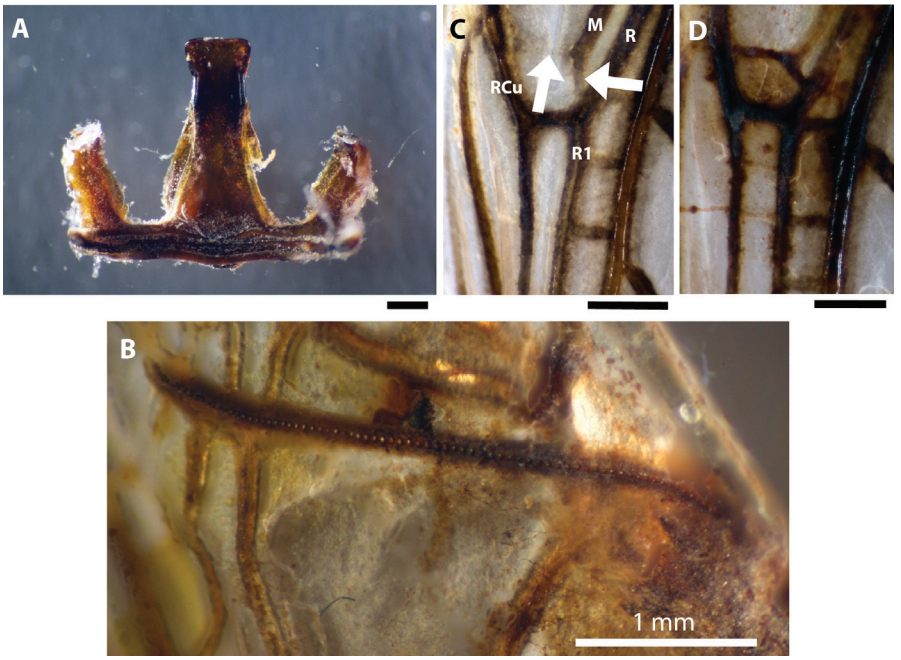

Fig. 3. Morphological traits of *Gryllotalpa stepposa* from Valpovo (Croatia): (A) Epiphallus; (B) Stridulatory file on Cu2 vein of male tegmen; (C, D) Distal part of the median vein of male tegmen. Scale bar 0.5 mm, except in (B).

is 3,2:1 and 3,6:1 (n=2), typical of *G. stepposa*/*G. krimbasi*, in which, according to Heller *et al*. (1998) and Iorgu *et al.* (2016), the value of this ratio is always higher than 3. On the other hand, in *G. gryllotalpa* the ratio is typically 2:1.

Tab. 1. Measurements, stridulatory teeth number and density, and tegmen identification type of *Gryllotalpa stepposa* from Valpovo, Croatia. All measurements are in mm. Media vein distal end type: (S) *stepposa* type; (G) *gryllotalpa* type.

			Valpovo, Croatia			*G. stepposa*		*G. gryllotalpa*
Gender	**m**	**m**	f	f	f	**m**	f	m
Specimen	**NT1/17**	**NT5/17**	NT3/17	NT4/17	NT6/17	SE Europe (ZHANTIEV 1991)		
Total length	**44**	**45.5**	42.1	42	42.4	**40 - 54**	35 -51	36 - 50
Pronotum length	**13.6**	**14.6**	14	13	14.2	**13,2 - 14,5**	11 -13,5	12,5 - 16,5
Pronotum width	**10.9**	**11.2**	10	9.5	9.4			
Tegmen length	**13.4**	**14.3**	13.1	11.8	11.7	**9,5 - 14**	8,0 - 22	13,8 - 18
Tegmen width	**9.7**	**8.9**	7.2	5.5	6.7			
Alae length	**23.4**	**24.1**	22.5	16.5	19	**19 - 44**	15 - 40	25 - 40
Cerci length	14.8	16.2	13.8	12.4	12			
Antennae length	17	17.2	14.5	14.2	14.3			
Pars stridens length	3.5	3.2	/	/	/		/	
No stridulatory teeth	**70**	**69**	/	/	/	**67 - 89**	/	85 - 96
No strid. teeth/1 mm	**20**	**21**	/	/	/	**17 - 22**	/	22 - 23
Epiphalus length	2.9	3.2	/	/	/		/	
Epiphalus width (apex)	0.9	0.9	/	/	/		/	
Epiphalus l/w ratio	**3.2**	**3.6**	/	/	/	**> 3,2**	/	1,6 - 1,7
Distal part of the M vein	? G	S	/	/	/	S	/	G

Total number of stridulatory teeth is 69 and 70 (Fig. 3 B), less than in *G. gryllotalpa* (85 – 96 in Zhantiev, 1991). However, Ingrisch *et al*. (2006) warned about the difference between macropterous and brachypterous specimens found in *G. isfahan* sample, higher number of teeth being found in the long-winged morph. Density of stridulatory teeth in the central part of the stridulatory file is 20 and 21 teeth per mm, which fits the variability range of this trait for *G. stepposa* in SE Europe (17 – 22 in Zhantiev, 1991). On the other hand, *G. krimbasi* has 25,7 teeth per mm (Ingrisch *et al*., 2008). The appearance of distal part of the median vein (M) and its connections with the radio-cubital and radial veins of male tegmina shows some variability in our sample. Namely, it was strong and clearly visible only in a single male specimen, while in the other it was weak and hardly visible, as in *G. gryllotalpa* (Fig. 3 C D). Whether it is a case of possible hybridisation or regular geographical variability will be known after further research on a larger sample from a broader area. In conclusion, according to the characteristics of the epiphallus and the density of stridulatory teeth on male tegmen, our record from Valpovo is the first documented finding of *Gryllotalpa stepposa* Zhantiev, 1991 in Croatia.

After the last published regional list (Us & Matvejev, 1967), in the former Yugoslavia (including Croatia) only *G. gryllotalpa* was known. Distribution pattern of *Gryllotalpa stepposa* and *G. gryllotalpa* in NE Croatia is still unclear, but we expect more *G. stepposa* findings along Drava and Danube Rivers. The status of brachypterous populations in Croatia, especially along the Adriatic coast and islands (unpublished data), is of particular zoogeographic interest. Namely, those populations could be between morphologically similar S Balkan endemic *G. krimbasi* in Greece (Iorgu *et al*., 2016) and some brachypterous taxa, likely *G. sedecim* and *G. octodecim* in the lowlands of NE Italy (Fontana *et al*., 2002). However, at this moment a possibility of the broader distribution of *G. stepposa* should not be excluded.

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REFERENCES

Baccetti, B., 1991: Ricerche zoologiche della nave oceanografica Minerva (C.N.R.) sulle isole circumsarde. X. Insetti ortotteroidei. Annali del Museo Civico de Storia Naturale 'G.Doria', **88** (1990), 403–479.

Baccetti, B., 1992: Notulae ortopterologicae 50. Su alcuni ortoptteroidei del Mediterraneo orientale. Fragmenta entomologica, **23** (2), 247-246 (In Italian only).

Baccetti, B. & Capra, F., 1978: Notulae orthopterologicae 34. Le specie italiane del genre Gryllotalpa L. Redia, **61**, 401-464 (In Italian only).

Bennet-Clark, H.C., 1970: A new French mole cricket, differing in song and morphology from *Gryllotalpa gryllotalpa* L. (Orthoptera: Gryllotalpidae). Proceedings of the Royal Entomological Society of London, b. **39**, 125-132.

Broza, M., Blondheim, S. & Nevo, E., 1998: New species of mole crickets of the *Gryllotalpa gryllotalpa* group (Orthoptera: Gryllotalpidae) from Israel, based on morphology, song recordings, chromosomes and cuticular hydrocarbons, with comments on the distribution of the group in Europe and the Mediterranean region Systematic Entomology, **23**, 125–135.

Cigliano, M.M., Braun, H., Eades, D.C. & Otte, D., 2017: Orthoptera Species File. Version 5.0/5.0. <http://Orthoptera.SpeciesFile.org>. Accessed on 27 March 2017.

Fontana, P., Buzzetti, F.M., Cogo, A. & Odé, B., 2002: Guida al riconoscimentzo e allo studio di cavallette, grylli, mantidi e insetti affini del Veneto. Museo Naturalistico Archeologico di Vicenza, Vicenza, 951 pp.

Fyodorova, M.V., Zhantiev, R. D. & Gokhman, V. D., 1991: Karyotypes of the mole-crickets (Orthoptera, Gryllotalpidae) of the Europeam part of the former Soviet Union and Caucasus (In Russian). Zoologicheskiĭ zhurnal, **70** (7), 43-49.

Harz, K., 1969: The Orthoptera of Europe, Vol. 1, Ensifera. Dr. W. Junk N.V. Publishers, The Hague,749 pp.

Heller, K.-G., Zhantiev, R., Korsunovskya, V., Ragge, D. R. & Willemse, F., 1998: Identification key to European Orthoptera. Taxonomy and Bioacustics of European Grasshoppers, Bushcrickets and Crickets (Insecta, Orthopera), INTAS-94-2854 project 1995-1998, University of Erlangen (unpublished manuscript).

Ingrisch, S., Nikouei, P. & Hatami, B., 2006: A new species of mole crickets *Gryllotalpa* Linnaeus, 1758 from Iran (Orthoptera: Gryllotalpidae). Entomologische Zeitschrift (Stuttgart), **116** (5), 195-2002.

Iorgu, I.Ș., Iorgu, E. I., Puskás, G., Ivković, S., Borisov, S., Gavril, V. D. & Chobanov, D.P., 2016: Geographic distribution of *Gryllotalpa stepposa* in south-eastern Europe, with first records for Romania, Hungary and Serbia (Insecta, Orthoptera, Gryllotalpidae). ZooKeys, **605**, 73-82.

Iorgu, I. Ș., Iorgu, E. I., Puskás, G., Ivković, S., Borisov, S., Gavril, V. D. & Chobanov, D. P., 2017: Corrigenda: Iorgu IȘ, Iorgu EI, Puskás G, Ivković S, Borisov S, Gavril VD, Chobanov DP (2016) Geographic distribution of*Gryllotalpa stepposa* (Insecta, Orthoptera, Gryllotalpidae) in South-eastern Europe, with first records for Romania, Hungary and Serbia. ZooKeys, **671**,155-156.

Us, P. A. & Matvejev, S.D., 1967: Orthopteroidea. Catalogus Faunae Jugoslaviae III/6, ASA, Ljubljana, 47 pp.

Zhantiev, R.D., 1991: Mole crickets (Orthoptera, Gryllotalpidae) from the European part of the USSR and Caucasus. Zoologicheskiĭ zhurnal, **70** (6), 69 – 76.

Zhantiev, R.D., Korsunovskaya, D. S., Sorokin, N. N. & Chukanov, V. S., 2003: Sound signals in mole crickets (Orthoptera, Gryllotalpidae) from Eastern Europe. Zoologicheskiĭ zhurnal, **82** (1), 1339-1346.