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Original paper

Description of two new *Isophya* taxa (Orthoptera: Tettigonioidea: Phaneropteridae) from Serbia

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Summary. During field work conducted over the past few years, the author has found two new taxa of the bush cricket genus *Isophya* in Serbia, *I. modesta danubiensis* ssp. n. in Tumane near Golubac (eastern Serbia) and *I. modestior grebenschikovi* n. ssp. in Belgrade, Miljakovac and Mt. Avala. Comparisons were made by nominal taxa *I. modesta modesta* from Romania (Mehadia) and *I. modestior modestior* from the environs of Niš. The morphology of the new taxa, scanning electron microscope images of male stridulatory files, as well as ecology and phenology are presented.

Keywords: *Isophya*, new subpecies, Phaneropterinae, Serbia.

INTRODUCTION

The genus *Isophya* Brunner von Wattenwyl, 1878 contains 56 taxa (53 species), making it the second largest genus of the Phaneropteridae fauna of Europe, behind the genus *Poecilimon* (Pavićević 2017). On the mainland of the Balkan Peninsula, 29 taxa (27 species) of *Isophya* have been recorded (Chobanov et al. 2013; Pavićević 2017). The genus *Isophya* is one of the most problematic genera for species delimitation, because of the great morphological similarities between the included species. Thus, it is quite possible to overlook the existence of some taxa even in well investigated areas. Given the diversification and high degree of endemism of the genus, the existence of formerly undiscovered taxa is not unlikely. In the fauna of Serbia, to date we recognize 10 taxa (9 species) from the genus *Isophya* (Pavićević 2017).

Over the course of previous orthopterological research conducted in Serbia, the author has collected some *Isophya* specimens, for which it has been established that they belong to new subspecies. Two new taxa were discovered in regions relatively well-studied for its Orthoptera fauna. *Isophya modesta danubiensis* ssp. n. was found on *Rubus* shrubs along the banks of the Tumane river, close to the Monastery Tumane, which is situated in Golubac valley in Eastern Serbia not far from the Danube river. The second taxon, *Isophya modestior grebenschikovi* ssp. n., was collected after many years of research on Mt. Avala close to Belgrade, as well as in Belgrade at Miljakovac hill in dense *Rubus* and *Rosa* shrubs and weed vegetation at the edge of a deciduous forest. The distance by air between these two localities, Avala Mt.- Čarapićev Brest and Miljakovac hill, Belgrade is only 8 km. The nominal subspecies *Isophya modestior modestior* Brunner von Wattenwyl,

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1882 was described from Serbia. The specimens were collected by Brunner von Wattenwyl himself in forest clearings between Niš and Bela Palanka (at that time Ak Palanka) and described in his monograph on European Orthoptera (Brunner von Wattenwyl 1882).

MATERIALS AND METHODS

The specimens were collected by hand, prepared and dry pinned in the standard way. Scanning electron micrograph (SEM) images of male stridulatory files were recorded with an SEM (JEOL JSM 6460 LV) at the University Centre for Electron Microscopy – Novi Sad.

Abbreviations:

CDP- Private Collection of Dragan Pavićević, Belgrade, Serbia.

CIK –collection of Ivo Karaman

Isophya modesta danubiensis ssp. n.
(Figs 1-3)

Holotype (male): Serbia: Golubac, Tumane, 2 July 2015, leg. D. Pavićević (CDP).

Paratypes: Serbia: Golubac, Tumane.: 2 ♂, 5 ♀ *idem*, leg. D. Pavićević. (CDP); 1 ♂, 1 ♀ 6 July 2020, leg. I. Karaman (CIK).

Type locality: East Serbia, Golubac, Tumane, vicinity of Monastery Tumane.

Diagnosis: The new subspecies is similar to nominal *I. modesta modesta* Brunner von Wattenwyl, 1882, distributed in the Carpathian Basin: Hungary, its south-western (Mecsek Mts.) and north-eastern part (Matra Mt.); West Romania (Central Transylvania) (Orci and Heller 2004). It differs from nominal subspecies by a smaller body size, shorter pronotum and tegmina, and on average larger number of teeth on the stridulatory file. The male cerci are slender. The ovipositor is shorter and moderately curved upwards.

Description: Medium-sized taxon with males measuring 20-21 mm, females 20-22 mm. Fastigium verticis (0.41-0.45 mm) shallowly to deeply furrowed above, narrower than scapus (0.75-0.78 mm).

M**ale** (Fig. 1A; Fig. 2A, C, D; Fig. 3A): Pronotum saddle-like, 4.50 mm long, constricted at mid-length in the transverse sulcus area, widening posteriorly and slightly raised toward end. Tegmina of the same length as pronotum, 4.50 mm. Stridulatory file weakly curved, with 139-141 teeth. Epiproct transverse, apico-lateral angles rounded. Cerci gradually narrowing toward apex, curved in apical third; apex transverse - truncate with a more dorsally inserted tooth. Subgenital plate narrowing before apex, incised in the middle. Postfemur 20-21 mm.

Female (Fig. 1B; Fig. 2B, E, F): Pronotum 4.80-5.00 mm, longer than tegmina, slightly widening posteriorly, lateral and dorsal margins substraight. Tegmina 2.00 mm. Cerci conical, apex subacute to subobtuse. Subgenital plate small, transverse-triangular**.** Ovipositor 9.0-10.0 mm, sabre-shaped, moderately up curved, apex dentate. Postfemur 18-21 mm.

Coloration: Green with poorly pronounced brownish dots. Two white lateral bands on vertex, discus of pronotum and ventral margins of pronotum. Pronotum with two red stripes medially of the white bands. Males tegmina with brown spot on discus between Media and Cubitus 2. Female tegmina green; Cerci yellowish.

Comparative note: *Isophya modesta danubiensis* ssp. n. differs from *Isophya modesta modesta* (Romania, Mehadia) by a smaller body (20-21 mm in male, 20-22 mm in female) vs. *modesta modesta* (23.5-26 mm in males, 23-27 mm in females), similar length of the tegmina and pronotum, in males, 4.50 mm) vs. *modesta modesta* (4.7-5.2 mm length of the pronotum against 5-6 mm length of tegmina), a larger number of stridulatory files (139-141) vs. *modesta modesta* (95-102), shorter postfemora (20-21 mm in males; 18-21 in females) vs. *modesta modesta* (19.6-21.9 mm in males; 20.7-24 in females) and in ovipositor length (9.0-10.0 mm) vs. *modesta modesta* (17.0-18.4 mm).

Etymology: The new subspecies is named after the Danube river, in the vicinity of which the new taxon was found.

Habitat and distribution: A mesophilic clearing overgrown with dense *Rubus* shrubs in a deciduous forest at the banks of Tumane creek, (near Monastery Tumane). The collected specimens were found in the shade of *Rubus* and *Urtica* leafs.

Stridulation unknown.

Isophya modestior grebenscikovi ssp. n.
(Figs 3-5)

Holotype (male): Serbia, Mt. Avala, Čarapićev Brest, 310 m, 7 July 1996, leg. D. Pavićević (CDP).

Paratypes: Serbia: 2 ♂, 2 ♀, same data as holotype, leg. D. Pavićević: 2 ♀, Belgrade, Miljakovac, 18 June 2016, leg. D. Pavićević (CDP); 1 ♂, 1 ♀, ibid. 2 July 2020, leg. D. Pavićević (CDP); 3 ♂, 3 ♀, ibid., 9 July 2020 (CDP).

Type locality: Mesophylic habitats on Čarapićev Brest, Avala Mt.

Diagnosis: The new subspecies is similar to the nominate *I. modestior modestior* Brunner von Wattenwyl, 1882 from which it differs by a smaller body, shorter postfemora and much shorter ovipositor in females.

Description: Medium-sized, males between 23-24 mm, females between 22-24 mm. Fastigium verticis (0.31-0.44

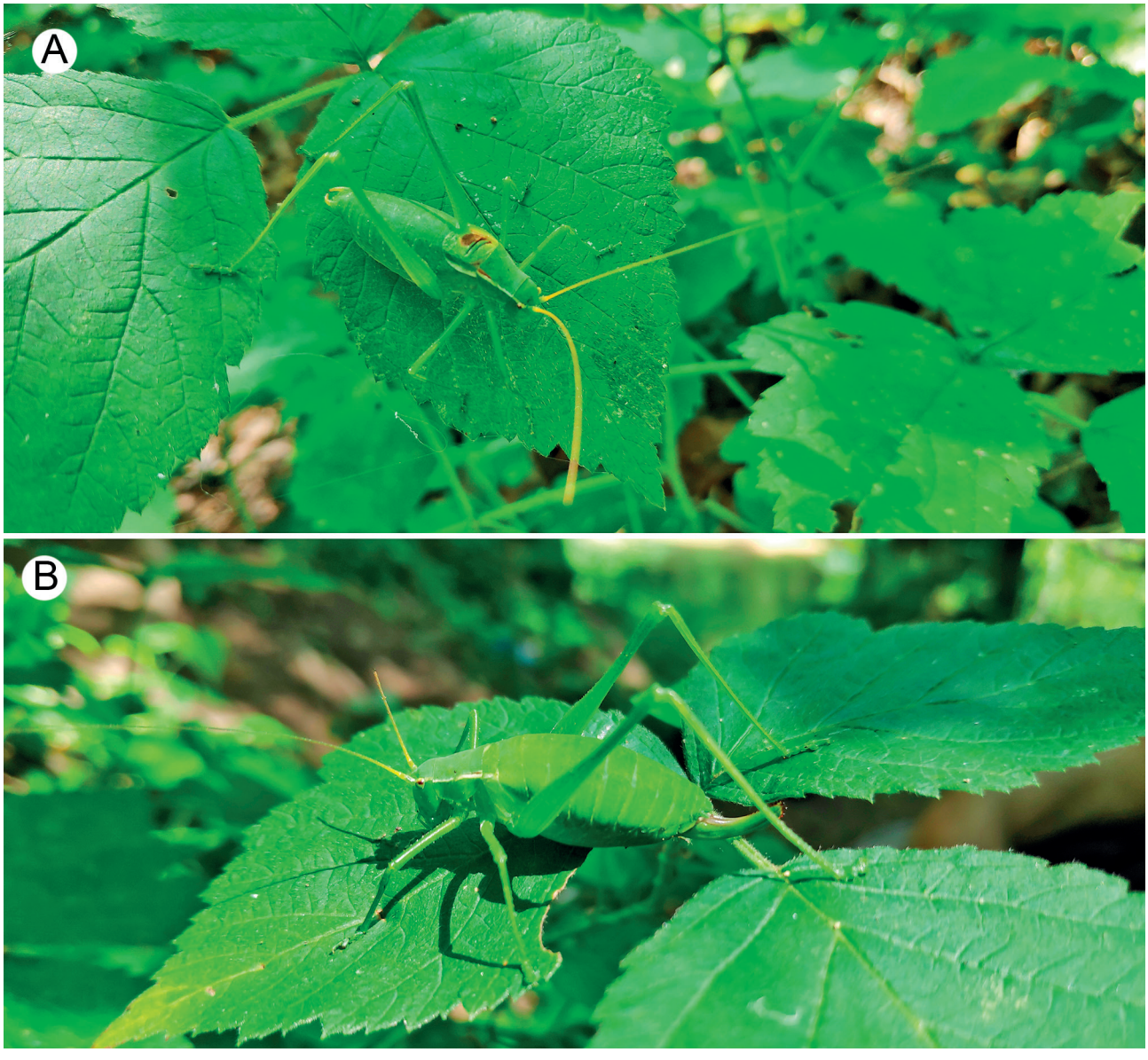

Fig. 1. *Isophya modesta danubiensis* ssp. n. **A**, male; **B**, female.

mm) shallowly to deeply furrowed above, narrower than scapus (0.66-0.84 mm)

Male (Fig. 3B, Fig. 4; Fig. 5A, C, D): Pronotum 4.5– 4.8 mm long, saddle-shaped, with lateral carinae nearly parallel in prozona, discontinuous at transverse sulcus, widened and diverging in metazona. Tegmina length 4.5-5.0 mm. Stridulatory file weakly curved, with 227-230 teeth. Eppiproct transverse, apicolateral angles rounded. Cerci gradually narrowing toward apex, curved in apical third; apex obtuse, with apicaly implanted strong tooth. Subgenital plate narrowing before apex, incised in the middle. Postfemur length 17-18 mm.

Female (Fig. 5B, E, F): Pronotum 4.5-5.0 mm, weakly widening and raised posteriorly, lateral and dorsal margins substraight. Tegmina 1.8-2.0 mm. Epiproct rounded to transversely rounded. Cerci conical, apex subacute to subobtuse. Subgenital plate small, transverse-triangular. Ovipositor 10.0-10.5 mm, sabre-shaped, moderately up curved, apex dentate. Postfemur length 18-21 mm.

Coloration: Green with light or dark brownish dots. Two white lateral bands on vertex and disc and ventral margins of the pronotum. Pronotum with two red stripes on the median side of the white band. Male tegmina with a dark brown spot on the disc between Media and Cubitus 2. Cerci yellowish. Elytra in female green.

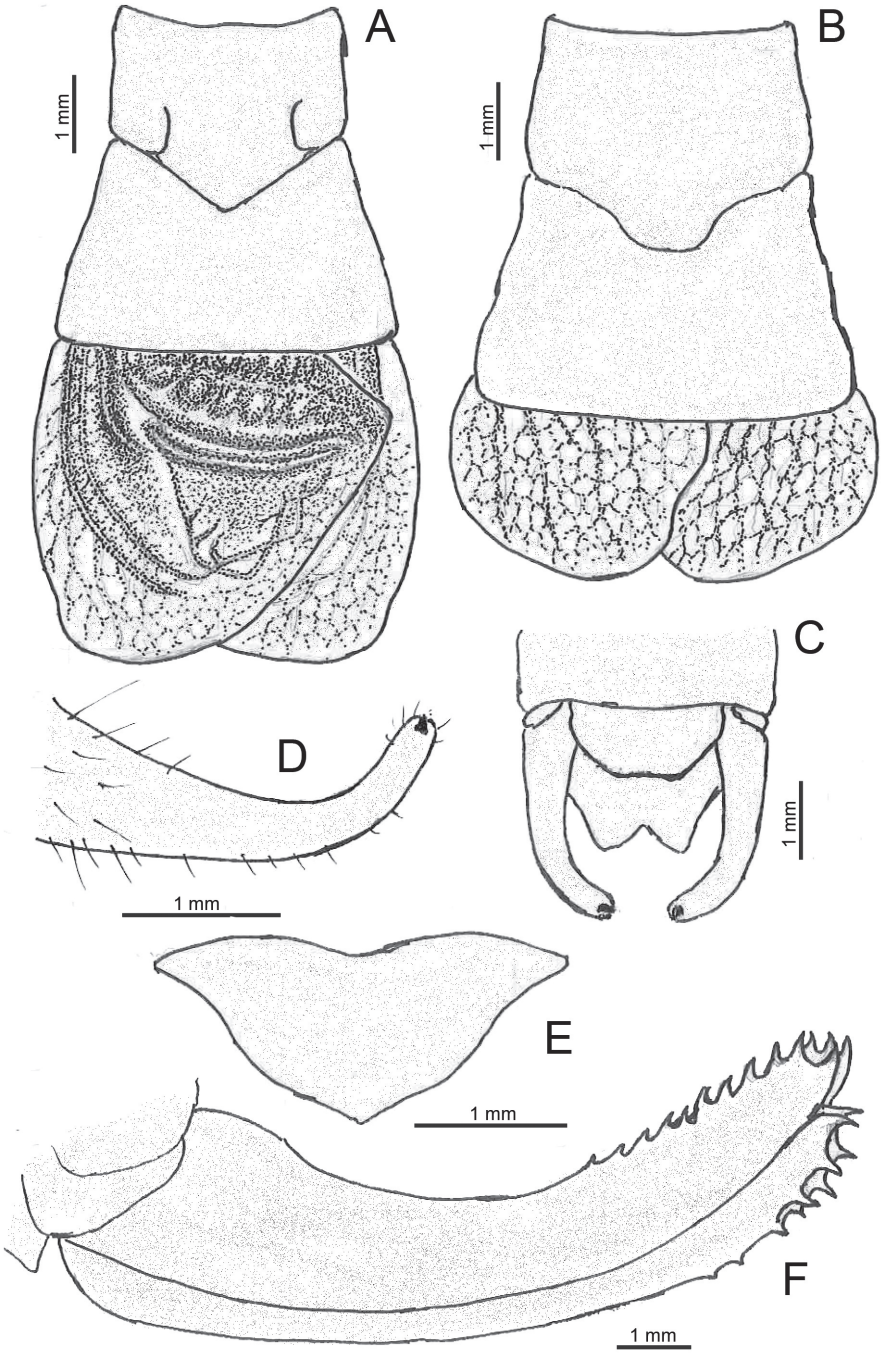

Fig. 2. *Isophya modesta danubiensis* ssp. n. Male (**A**, **C**, **D**) and female (**B**, **E**, **F**). **A**-**B**, dorsal view of pronotum and tegmina; **C**, dorsal view of male abdominal apex; **D**, left male cercus; **E**, ventral view female subgenital plate; **F**, ovipositor.

Comparative note: *Isophya modestior grebenscikovi* ssp. n. differs from the more robust nominal *Isophya modestior modestior* by smaller body size, shorter postfemora, and shorter ovipositor (Table 1).

The stridulation file in the nominal *modestior modestior* is strongly curved while in *I. modestiror grebenscikovi* ssp. n. it is weakly curved. The number of stridulatory teeth vary in the nominal subspecies from 228 (Bancarevo and Kamenički vis) to 270 (Čamurlija) (localities from the area of the type locality) vs. *modestior grebenscikovi* ssp. n. from 227-239 (Avala Mt. and Miljakovac - Belgrade). Females of the nominate subspecies have a much longer ovipositior, 14-15 mm than those

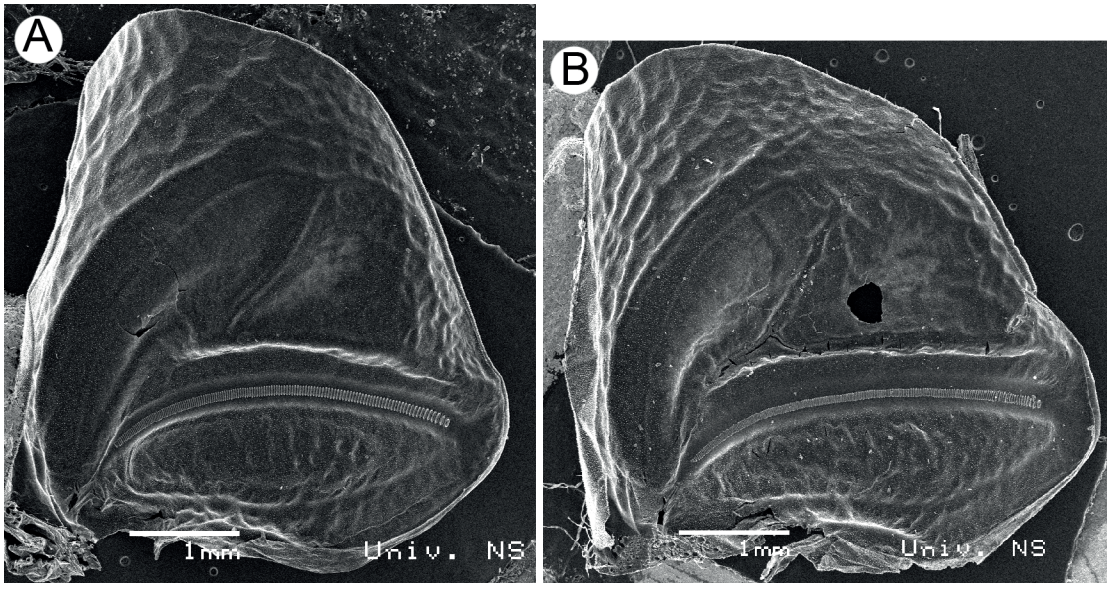

Fig. 3. Male stridulatory file (SEM). **A**, *Isophya modesta danubiensis* ssp. n.; **B**, *Isophya modestior grebenscikovi* ssp. n.

of *I. modestior grebenscikovi* ssp. n., 10.0-10.5 mm.

Etymology: The new subspecies is named in honour of a Serbian orthopterologist of Russian origin, Oleg Sergijevič Grebenščikov (1905–1980), who researched Serbian Orthoptera fauna during the nineteen fifties.

Habitat, distribution and chorology: The new taxon was found in mesophylic habitats with dense shrubs (mostly *Rubus* sp.) and high weeds in deciduous forest edges and clearings at an altitude between 250 m (Miljakovac) and 310 m (Avala Mt.). It is only known from Avala Mt. and Belgrade (Miljakovac) so far. Adults were found from May to end of July.

Stridulation unknown. Ingrisch and Pavićević (2012) noted that males from Mt. Avala used a rather long song, while the song from those from south-western populations was distinctly shorter.

DISCUSSION

Species of the genus *Isophya* prefer medium-humid grassland as meadows with dense grass and herbaceous vegetation, shady forest edges and forest clearings, both in lowland and mountainous areas up to 2000 m (Pavićević 2017).

The *Isophya modesta* species group includes 14 taxa in 10 species distributed on the Balkan Peninsula (from southern Central Europe to northeastern Greece) with one species reaching Central and Eastern Europe, and an isolated distribution of *I. yaraligozi* Unal, 2003, in Northwestern Anatolia (Chobanov et al. 2013).

Species of the *Isophya modesta* group have mostly large, plump bodies of dark green colour with long hind legs and a long ovipositor. The stridulatory file contains between 55-160 teeth. The apical tooth of the male cerci is pointed, short and wide (Chobanov et al. 2013). The *Isophya modesta* group includes 8 taxa in 5 species (Chobanov et al. 2013; Pavićević 2017).

Three taxa of the *I. modesta* group were known from Serbia to date: *Isophya clara clara* Ingrisch & Pavićević, 2010 (Western Serbia), *I. clara orientalis* Pavićević, 2017 (environs of Belgrade) and *I. miksici* Peshev, 1985 from Mt. Beljanica (Eastern Serbia). All of these mentioned taxa have stridulation files that are quite different from that found in *I. modesta*.

The species *I. modesta* (Frivaldszky, 1864) has two subspecies distributed in the southeastern part of Central Europe, the Carpathian basin and an area from southern Ukraine to the southwestern parts of European Russia. The nominal subspecies, *I. modesta modesta* is known from Slovakia, Hungary,

Table 1. Comparison of *Isophya modestior grebenscikovi* ssp. n. and *Isophya modestior modestior*.

	I. m. grebenscikovi ssp. n	*I. m. modestior*
Body size ♂ / ♀	22-24 mm / 22-24 mm	24-26 mm / 25-26 mm
Postfemora ♂ / ♀	17-18 mm / 18-21 mm	19-21 mm / 21-22 mm
Ovipositor	10-10.5 mm	14-15 mm

Fig. 4. *Isophya modestior grebenscikovi* ssp. n. Male.

Romania, Western and Central Ukraine and possibly also occurs in Moldova. This subspecies prefers lowlands and hilly regions. Nymphs appear from March to May, adults from May to August (Chobanov et al. 2013).

The discovery of *I. modesta* in Serbia was expected because it was found in adjacent countries, such as Hungary and Romania. *Isophya modesta danubiensis* ssp. n. was found at the edge of a deciduous forest in dense *Rubus* shrubs and *Urtica* stands along the banks of Tumane creek in the vicinity of Monastery Tumane. The monastery is located in Golubac valley (Eastern Serbia) about 7 km by air from the Danube river. This locality does not represent a typical habitat for *I. modesta*, which prefers stepicolous terrains. At first sight it looks like *I. modestior* because of its size and habitus, but all other morphological characters, including male stridulation file provide evidence that it belongs to the species *I. modesta*. It is the smallest *Isophya modesta* taxon so far.

The species *Isophya modestior* Brunner von Wattenwyl, 1882, described from Serbia (Pavićević 2017), belongs to the *Isophya costata* species group presently known with 6 species distributed in the Northern Balkan Peninsula, Central Europe (Austria, Hungary and NE Italy), the Carpathian Basin and

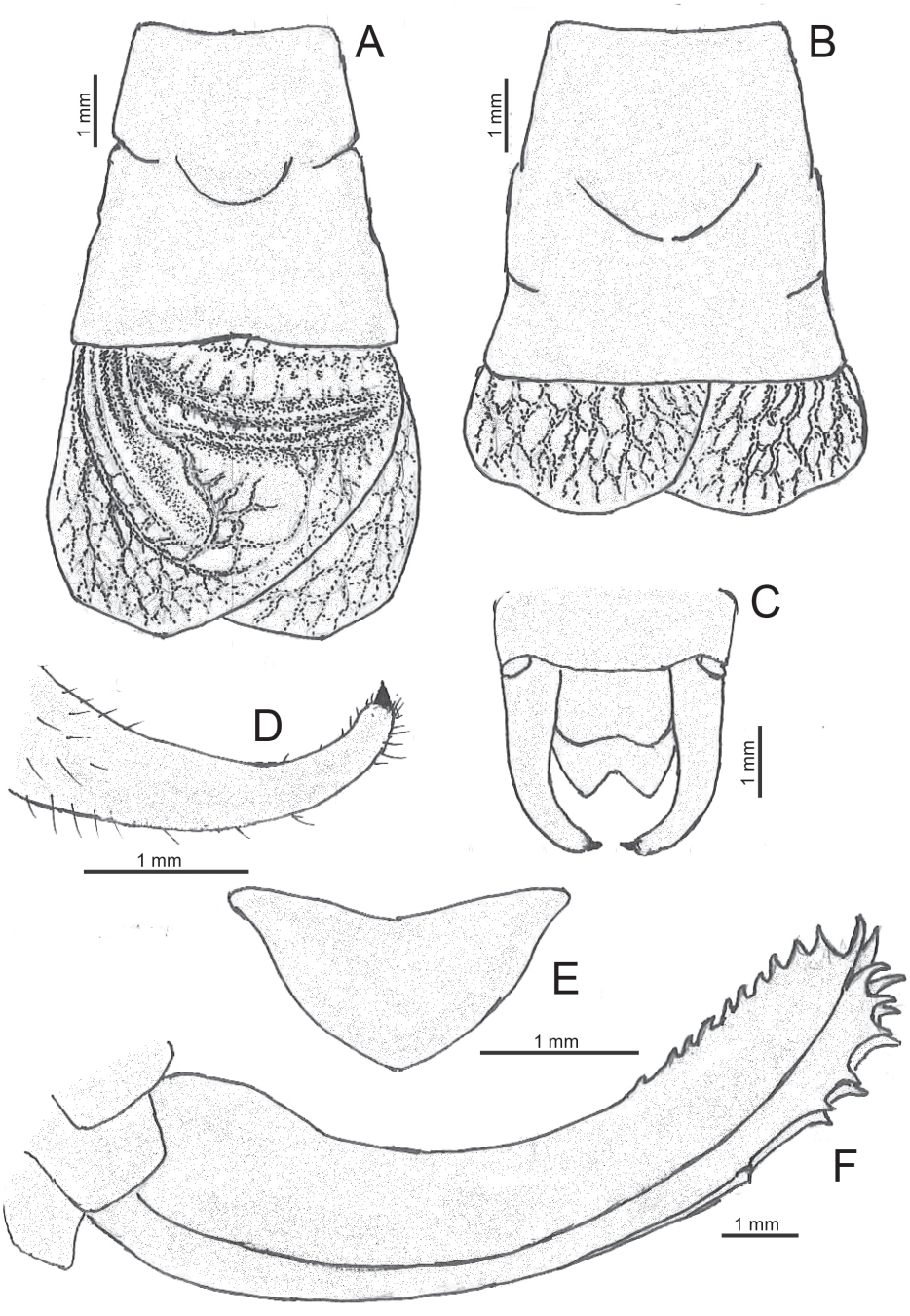

Fig. 5. *Isophya modestior grebenscikovi* ssp. n. Male (**A**, **C**, **D**) and female (**B**, **E**, **F**). **A-B**, dorsal view of pronotum and tegmina; **C**, dorsal view of male abdominal apex; **D**, left male cercus; **E**, ventral view of female subgenital plate; **F**, ovipositor.

Eastern Europe through the steppe belt eastwards to Volga Upland in the region of Saratov (Chobanov et al. 2013). *Isophya modestior* is distributed from the Northwestern Balkan Peninsula and the neighboring parts of Central Europe (SW Romania, NW Bulgaria, N. Macedonia, Montenegro, Bosnia and Hercegovina, Serbia, Croatia, Slovenia, NE Italy, Austria, Hungary and possible Slovakia (Heller et al. 2004; Szövényi and Puskás 2012). I also share the opinion that over such huge distribution area, and bearing in mind the very low dispersal ability of *Isophya*, some sibling or cryptic species remain hidden under the name *I. modestior*. The nominal subspecies (Fig. 6) inhabits the steppe terrains in Nišava valley (Eastern Serbia) where adults are very common from the beginning of June until the end of July. It also lives in hilly

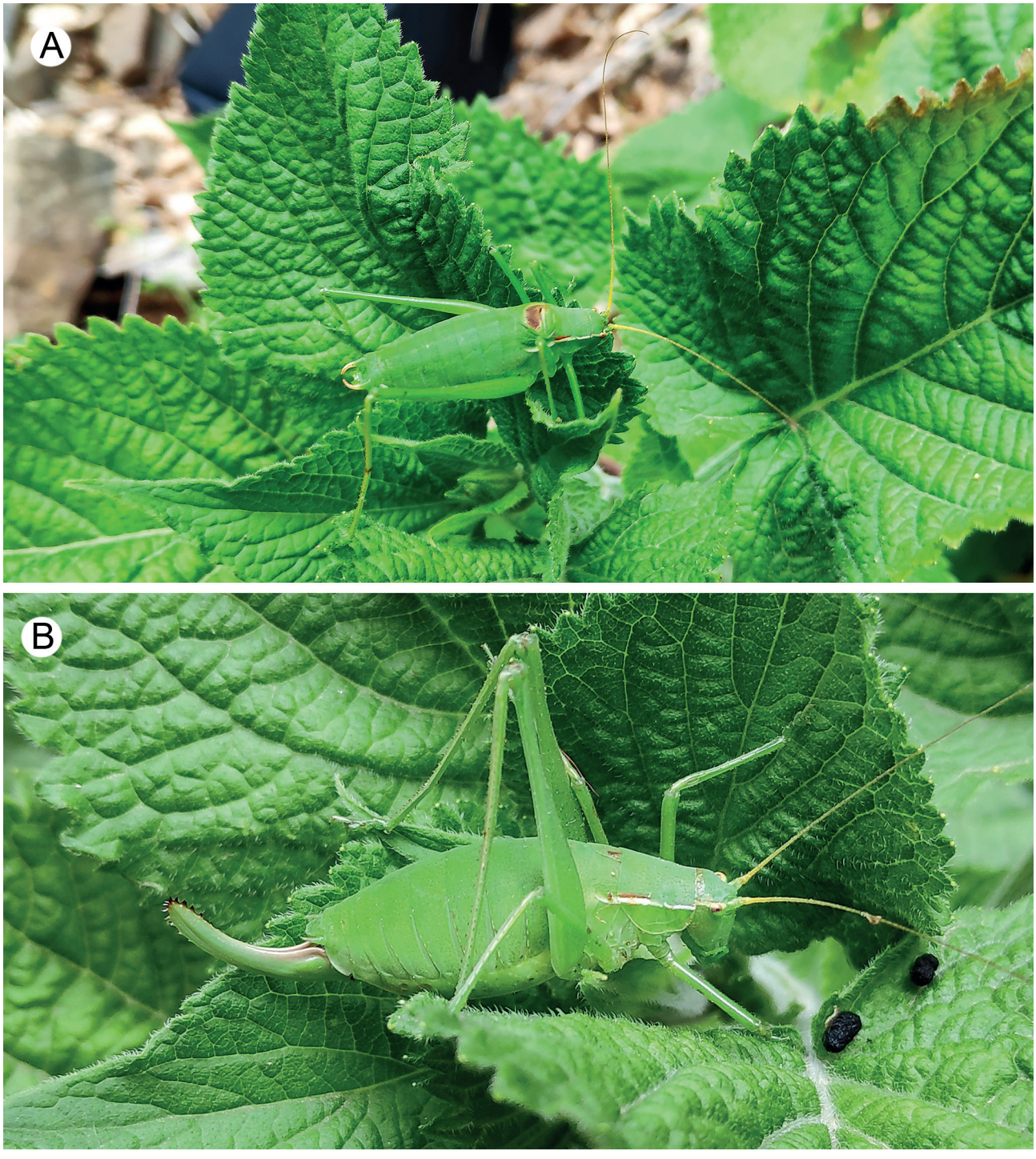

Fig. 6. *Isophya modestior modestior* from Bancarevo between Niš and Bela Palanka (Serbia). **A**, male; **B**, female.

regions along forest edges and clearings between Niš and Bela Palanka (loc. typ.) and Suva planina Mt. The new taxon, *I. modestior grebenscikovi* was collected on Mt. Avala close to Belgrade, as well as in Belgrade at Miljakovac hill in the dense shrubs of *Rubus* sp. and *Rosa* sp. and weedy vegetation at the edge of a deciduous forest. The distance by air between those two localities, Avala Mt.- Čarapićev Brest and Miljakovac hill, Belgrade is approximately 8 km. Some literature reports referring to this area, such as Košutnjak (Pančić 1883), Miljakovac, Rakovica, Železnik, Avala Mt. (Grebenščikov 1949) and Avala Mt. (Ramme 1951) likely refer to *modestior grebenscikovi*. All of the above-mentioned localities are today part of the city of Belgrade, except Mt. Avala.

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