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The bush-cricket *Isophya kraussii* (Orthoptera: Phaneropteridae): bioacoustics, distribution and description of a new subspecies from Romania

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Abstract

Isophya kraussii Brunner von Wattenwyl, 1878, one of the widest spread bush–crickets within this genus, is confirmed to be present east of the Carpathian Mountains. Based on acoustic analysis and morphological characters, the populations from NE Romania are considered to belong to a different subspecies, *I. kraussii moldavica* **ssp. n.** A map with distribution of both subspecies is presented.

Key words: bush-cricket, *Isophya kraussii*, distribution, acoustic analysis

Introduction

After *Poecilimon*, *Isophya* is the second largest Phaneropteridae genus in Europe, comprising more than 45 species (we will treat Phaneropteridae as family, following Chobanov & Heller 2010). However, it is difficult regarding the identity of species, which have to be recognized mainly by oscillographic song analysis and by studying subtle morphological characters including shape of cerci, tegmina and ovipositor.

Described in 1878 by Brunner von Wattenwyl and synonymized with *Isophya camptoxypha* (Fieber) by same author (1891), *Isophya kraussii* was re–established by Heller (1988), based on different male song pattern and stridulatory organ. Its song has been characterized by many authors (a detailed review of papers in Ragge & Reynolds 1998) and was later compared with that of the other Central European species (Heller *et al.* 2004). The bush–cricket *Isophya kraussii* has one of the largest distribution areas known within this genus: Central Europe, reaching its easternmost limit in NE Romania.

In the past years, during several expeditions in the surroundings of Suceava (NE Romania), many individuals of *Isophya* were collected in order to determine if *Isophya kraussii* is present in Romania, as stated by Kis (1960), Kis & Vasiliu (1970) under the name *Isophya pyrenaea*. With the first songs recorded, we were able to determine that the species is clearly *Isophya kraussii*, and even more: the populations from NE Romania form a new subspecies.

Material and methods

Males from Romanian populations were transported in aerated containers and audio-recorded in the laboratory, using an Edirol R–09HR digital recorder, having the microphone frequency response of 0.02–40 kHz and sampling rate of 96 kHz. Songs of specimens from Central Europe have been recorded in laboratory, with a Racal tape recorder, Brüel & Kjaer 1/2" and 1/4" external microphones, and digitized using sampling rates of 125–250 kHz. Oscillographic and spectrographic analysis of sound was realized with software Audacity 2.

Song terminology: syllable—the sound produced by one complete up (opening) and down (closing) stroke of the forewings; impulse—the highly damped sound impulse arising as the impact of one tooth of the stridulatory file; after–click—click produced with considerable delay after the main impulse group. We used the abbreviations:

syllable duration (SD)—period from the beginning of first impulse to the end of last impulse of the main impulse series of a syllable; gap between successive syllables (GS)—period of time elapsed from the end of a syllable to the beginning of the next syllable; impulse period (IP)—time elapsed from beginning of an impulse to the beginning of the next one; number of impulses per syllable (NI)—number of impulses of the main impulse series of the syllable; delay of after-click (–s) (DAC)—time elapsed from the last impulse of the main impulse series of the syllable to the first after-click (–s); number of after-clicks (NAC).

The following morphological characters were measured: head width (HW); pronotum length (PL); pronotum width (PW); tegmen length (TL); tegmen width (TW); body length (BL); femur length (FL); cercus length (CL); ovipositor length (O) and number of teeth on male stridulatory file (S).

Photos of habitus and morphological details were taken with a Canon EOS 600D DSLR camera; photo-stacking technique was used in order to achieve the high depth of field in microphotographs. For morphology illustration, photos of freshly killed animals were made, in order to avoid changes in natural coloration. Imagery of stridulatory files in males and females was acquired with a scanning electron microscope. The map with distribution area was drawn using the altitude layer from Jarvis *et al.* (2008).

The dry, pinned type specimens are preserved in the collections of “Grigore Antipa” National Museum of Natural History, Bucharest.

Taxonomy

Order Orthoptera

Suborder Ensifera

Family Phaneropteridae

Isophya kraussii kraussii Brunner von Wattenwyl, 1878

(Figs. 1 a, b; 2 a, c, e, g, i, k, m, o, q; 3 a, b; 4 a, b, c, d, i, j, k, l, q; 5)

Material. 2 ♂, Germany: Bayern, Ailsbachtal, Fraenk. Schweiz, 49°48'N, 11°20'E, 1981.06.25 (CH1897, CH1898); 1 ♂, 3 ♀, Germany: Bayern, Altheim westl. Neustadt/Aisch, 49°33'N, 10°29'E, 1984.06.05 (CH1904–7.); 1 ♂, Germany: Bayern, Burg Frankenberg, Mittelfranken, 49°34'N, 10°15'E, 1985.05.26 (CH2339); 1 ♂ 2 ♀, Germany: Bayern, Obernesselbach, Mittelfranken, 49°35'N, 10°28'E, 1987.07.07 (CH2633–5.); 3 ♂ 3 ♀, Germany: Bayern, Pretzfeld östl. Forchheim, 49°45'N, 11°10'E, 1987.07.12 (CH2415–20.); 1 ♀, Germany: Bayern, Petersberg bei Bad Windsheim, 49°29'N, 10°27'E, 1987.07.16 (CH2632); 1 ♂, Germany: Bayern, Kaubenheim, Mittelfranken, 49°32'N, 10°27'E, 1987 (CH2414); 1 ♂ 1 ♀, Germany: Bayern, Spielberg bei Bad Windsheim, 49°31'N, 10°25'E, 1983.06.01 (CH0402, CH1903); 2 ♂ 1 ♀, Germany: Bayern 1986, CHX116–8; 1 ♂, Germany: Bayern, Ebermannstadt, 49°47'N, 11°11'E, 1986.05.01–31, coll. H. Kriegbaum (CH1285); 6 ♂ 4 ♀, Germany: Bayern, Würzburg, 49°47'N, 9°6'E, 1981.05.25–06.03, coll. R. Hess (CH0445–8, , CH0461–2, CH1899–, 1902.); 1 ♂, Germany: Bayern, Forchheim, 49°44'N, 11°5'E, 1996, coll. Ch. Voigt (CH4450); 4 ♂, Germany: Bayern, Forchheim, 49°44'N, 11°5'E, 1996.06.01–07.30, coll. Ch. Voigt (CH4451, CH4508–10.); 1 gynandromorph, Germany: Bayern, Münnerstadt, 1982.06.01–30 (CHY040); 2 ♂ 2 ♀, Germany: Hessen, Rhön, Bad Hersfeld, 50°52'N, 9°42'E, 1950–1970, coll. F. Merkel (CH7526–9.); 1 ♀, Germany: Bayern, Hammelburg, 50°7'N, 9°54'E, 1970.06.28, coll. F. Merkel (CH7534); 2 ♂, Slovenia: 20 km südwestl Ptuj or Kocara National Park, 46°15'N, 15°51'E, 1989.06.22 (CH2421, CH2553), all coll. Heller; 1 ♂, Czech Republic: Pod. Milesovkon, 1953.06.09 (CHX214); 1 ♀, Czech Republic: Altvater–Kenit?, 50°5'N, 17°14'E, 1932.07.28, coll. F. Merkel (CH7535); 2 ♂ 1 ♀, Hungary: Bükk–Miskolc, Gerepfalu, 48°4'N, 20°38'E, 1996.06.18, coll. von Helversen (CH4512–3, CH5071); 1 ♂ 1 ♀, Croatia: Krapina bei Ptuj, 46°9'N, 15°52'E, 1988.05.01–06.30, coll. O. v. Helversen (CH2907–8.); 1 ♂, Poland: Wotosate, Bieszczady National Park, 49°4'N, 22°41'E, 2000.07.01, coll. J. Theuerkauf (CH6323); 1 ♂ 1 ♀, Poland: Schlesien, Bolkenhain, 50°55'N, 16°5'E, 400 m, 1938.07.19–20, coll. F. Merkel (CH7530–1.); 1 ♂ 1 ♀, Poland: Schlesien, Sylsterwitzer Wiesen am Zobten, 50°51'N, 16°42'E, 340 m, 1933.06.03, coll. F. Merkel (CH7532–3.); 1 ♂, Poland: Schlesien, Hindenburgbaude bei Reinerz, 50°24'N, 16°23'E, 1934.06.30, coll. F. Merkel (CH7536); all in collection Heller, except CHX214, 16–8 and CHY040.



FIGURE 1. **a.** *Isophya kraussii kraussii* male (Germany, Bayern, Ailsbachtal, 1981.06.21, KGH); **b.** *I. kraussii kraussii* gynandromorph specimen (Germany, Bayern, Münnerstadt, 1982.06.30, KGH); **c.** *I. kraussii moldavica* ssp. n. male (Romania, Hilișeu-Crișan, 2012.06.25, IIS); **d.** *I. kraussii moldavica* ssp. n. female (Romania, Hilișeu-Crișan, 2012.06.25, IIS); **e.** habitat at Adâncata, Romania, 2011.06.24 (IIS); **f.** habitat at Arbore, Romania, 2011.06.24 (IIS).

Audio recordings. ISKR8101–6 (CH0445); ISKR8107–9, ISKR8112 (CH1900); ISKR8110–11 (CH1899); ISKR8401–8 (CH1904); ISKR8611–16 (CHX116); ISKR8617–18 (CHX117); ISKR8801–19 (CH2907) (KGH); Bellmann_61Arten_7_Plumpschrecke (Bellmann 1993); NPR Praděd, CHKO Jeseníky, 27.VII.2005, 30°C (Kočárek 2005); 003 *Isophya kraussii*_1–4_S.wav; 003 *Isophya kraussii*_5–7_US_S.wav; 003 *Isophya kraussii*_Os_a–b_S.wav (Roesti & Keist 2009).

Bioacoustics. Males produce a soft song (at least for the human ear) by tegmino–tegmina stridulation, consisting of a long sequence of syllables (Fig. 4 a–d, i–l; table 2). A syllable is formed of a compact series of 80–125 impulses, lasting for about 250–443 ms (up to 600 ms in recordings from Roesti & Keist 2009), followed after 41–183 ms by one (rarely 2–7) after–clicks (n=200 syllables from 9 males). The relatively short syllables recorded in the song of some males from Jeseníky Mountains (N Morava) may be the effect of the high temperature (30°C) during recording (Kočárek 2005). The impulse interval is highly variable, 2–9 ms. The following syllable begins after 58–297 ms. During pair formation, females may respond acoustically to males with simple clicks (Heller 1990). Spectrographic sound analysis reveals frequencies between 20–40 kHz (Fig. 4 q).



FIGURE 2. Morphological details. *Isophya kraussii kraussii*: **a.** male head, pronotum and wings (dorsal view); **c.** male pronotum and wings (lateral view); **e.** male cerci; **g.** male subgenital plate; **i.** female head, pronotum and wings (dorsal view); **k.** female pronotum and wings (lateral view); **m.** female cerci; **o.** female subgenital plate; **q.** ovipositor; *Isophya kraussii moldavica* ssp. n.: **b.** male head, pronotum and wings (dorsal view); **d.** male pronotum and wings (lateral view); **f.** male cerci; **h.** male subgenital plate; **j.** female head, pronotum and wings (dorsal view); **l.** female pronotum and wings (lateral view); **n.** female cerci; **p.** female subgenital plate; **r.** ovipositor. Scale unit: 1 mm.

***Isophya kraussii moldavica* Iorgu and Heller, subsp. nov.**

(Figs. 1 c, d, e, f; 2 b, d, f, h, j, l, n, p, r; 3 c, d, e; 4 e, f, g, h, m, n, o, p, r; 5)

Type material. Holotype, male, Romania: Suceava, Adâncata, 47°42'17.87"N, 26°18'54.88"E, 400 m, 2007.07.13.

Paratypes: 1 ♂, Romania: Suceava, Călinești, 47°42'02.86"N, 26°18'35.13"E, 410 m, 2007.07.14; 3 ♂ 2 ♀, Romania: Suceava, Adâncata, 47°42'02.86"N, 26°18'35.13"E, 420 m, 2008.07.24; 5 ♂ 2 ♀, Romania: Suceava, Adâncata, 47°42'33.57"N, 26°17'32.21"E, 450 m, 2011.06.24; 2 ♂, Romania: Suceava, Vârfu Dealului, 47°36'56.39"N, 25°56'00.68"E, 500 m, 2011.06.24; 3 ♂ 1 ♀, Romania: Suceava, Arbore, 47°42'53.12"N, 25°52'33.38"E, 430 m, 2011.06.24; 5 ♂ 3 ♀, Romania: Suceava, Putna, 47°53'55.52"N, 25°36'48.09"E, 520 m, 2011.06.24; 7 ♂ 3 ♀, Romania: Suceava, Adâncata, 47°42'25.50"N, 26°17'26.63"E, 450 m, 2012.06.25; 1 ♂ 1 ♀, Romania: Suceava, Botoșana, 47°39'44.08"N, 25°55'33.18"E, 400 m, 2012.06.25; 2 ♂, Romania: Botoșani, Hilișeu-Crișan, 48°00'59.36"N, 26°15'25.31"E, 210 m, 2012.06.25; 3 ♂ 2 ♀, Romania: Botoșani, Lozna, 47°56'48.14"N, 26°18'21.40"E, 300 m, 2012.06.25; 2 ♂ 1 ♀, Romania: Botoșani, Gorovei, 47°52'49.38"N,

26°21'07.64"E, 350 m, 2012.06.25, leg. I. Ş. Iorgu, all in coll. "Grigore Antipa" National Museum of Natural History, Bucharest.

Audio recordings. 3 ♂, Adâncata, 2009.07.04, temperature 26°C; 2 ♂, Adâncata, 2010.07.03, temperature 20°C; 5 ♂, Adâncata, 2011.06.24, temperature 24°C; 2 ♂, Vârful Dealului, 2011.06.25, temperature 22°C; 4 ♂, Arbore, 2011.06.25, temperature 17°C; 4 ♂, Putna, 2011.06.26, temperature 22°C; 10 ♂, Adâncata, 2012.06.25, temperature 19°C (IIŞ).

Etymology. The name derives from the historical province of Moldavia, region where the bush-cricket was found.

Diagnosis. Male song consists of long sequences of syllables, each syllable formed of 30–58 impulses and lasting for 89–200 ms. After 60–113 ms, the syllable is usually followed by 1 (extremely rare 2–3) after-clicks. In male, fastigium verticis narrower than scapus, tegmina widened, shorter than pronotum, the right margin of left tegmen forms an angle of about 90° at distal end of Cu2. Stridulatory file with 195–229 pegs. Cerci slightly curved in distal 1/4. Ovipositor upcurved, 10.9–12.1 mm long.

Description. Male. Head with fastigium verticis slightly tapering frontward, narrower than scapus, dorsal sulcus present (Fig. 2b). Pronotum saddle-like, disc constricted in the transverse sulcus area, with lateral carinae widen in metazona. Dorsal margin of paranota slightly concave, anterior edge straight, posterior and ventral margins moderately convex (Figs. 2b, d). Tegmina shorter than pronotum, angle between cubital veins is about 70°, length of Cu2 vein about 4/5–5/6 posterior border of pronotum, mirror large and quadrangular. At distal end of Cu2, the right margin of left tegmen forms an angle of about 90° (Fig. 2b). Stridulatory file length about 2.8–3.1 mm, counting 195–229 teeth (Fig. 3c, d). Cercus hairy, gradually narrowing towards tip, curved in apical 1/4. Terminal denticle triangular, positioned in middle of cercus apex; epiproct about 1.7 times as wide as long (Fig. 2f). Subgenital plate elongated and narrowed apically, with triangular apical shaped incision (Fig. 2h). Hind femur about 4.4–4.8 times pronotum length, without ventral spines (Table 1). Coloration green, with fine dark green spots. In rare cases, males have two dorsal bilateral stripes from pronotum to end of abdomen, dark red or orange colored. Antennae greenish or reddish-brown, with light green scapus. Femora, tibiae and tarsi green, brownish or reddish. A white band begins behind the compound eye and ends at posterolateral area of tegmina. A brown band is present above the white one in metanotum. Tegmina brown, rarely dark green, apical area green and costal margin yellowish-white. Cerci brown or reddish-brown, rarely green.

TABLE 1. Comparative morphological characters in *Isophya kraussii* subspecies.

			HW	PL	PW	TL	TW	BL	FL	CL	S	O (mm)
			(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
<i>Isophya kraussii kraussii</i>	male (n=7)	Max.	3.3	4.18	4	3.59	3.97	23.9	15.39	2.39	274	–
		Min.	3.13	3.9	3.81	3.44	3.75	19.3	14.55	2.27	296	–
		Mean	3.24	4.01	3.90	3.5	3.88	21.57	15	2.32	287	–
		S. D.	0.08	0.12	0.09	0.07	0.10	1.39	0.43	0.06	8.79	–
	female (n=3)	Max.	3.72	4.51	4.35	1.91	3.23	23.4	16.4	1.29	–	11.88
		Min.	3.31	4	3.5	1.35	2.9	19.71	15.09	1	–	9.32
		Mean	3.57	4.25	3.94	1.68	3.11	21.7	15.66	1.15	–	10.69
		S. D.	0.23	0.26	0.43	0.30	0.18	1.86	0.67	0.15	–	1.29
<i>Isophya kraussii moldavica</i> ssp. n.	male (n=15)	Max.	3.69	3.92	3.96	3.56	3.72	25	17.8	2.74	229	–
		Min.	3.27	3.3	3.85	3.33	3.57	22.3	15.9	2.24	195	–
		Mean	3.49	3.63	3.89	3.43	3.64	23.62	16.66	2.42	201.93	–
		S. D.	0.12	0.19	0.03	0.07	0.05	0.70	0.55	0.13	8.15	–
	female (n=15)	Max.	4.1	4.76	4.25	1.98	3.4	24.95	17.55	1.35	–	12.1
		Min.	3.85	4.29	4.14	1.5	3.11	23.3	16.8	1.19	–	10.9
		Mean	3.94	4.49	4.19	1.73	3.23	24.15	17.15	1.25	–	11.59
		S. D.	0.07	0.15	0.03	0.14	0.09	0.44	0.22	0.06	–	0.52

TABLE 2. Comparative acoustic elements in male song of *Isophya kraussii* subspecies (T=temperature).

		SD (ms)	IP (ms)	NI	DAC (ms)	NAC	GS (ms)	T (°C)
<i>Isophya kraussii kraussii</i> (n=200 syllables, 9 males)	Min.	250	2	62	41	1	58	21.5–27
	Max.	443	9	134	183	7	297	
	Mean	313.97	4.48	96.97	92.27	1.43	140.27	
	S. D.	39.5	1.37	22.09	33.78	1.18	57.94	
<i>Isophya kraussii moldavica</i> ssp. n. (n=200 syllables, 30 males)	Min.	89	2	30	60	1	69	17–26
	Max.	200	4	58	113	3	292	
	Mean	114.96	3.08	48.24	89.26	1.09	171.74	
	S. D.	34.87	0.71	9.42	14.53	0.35	69.2	

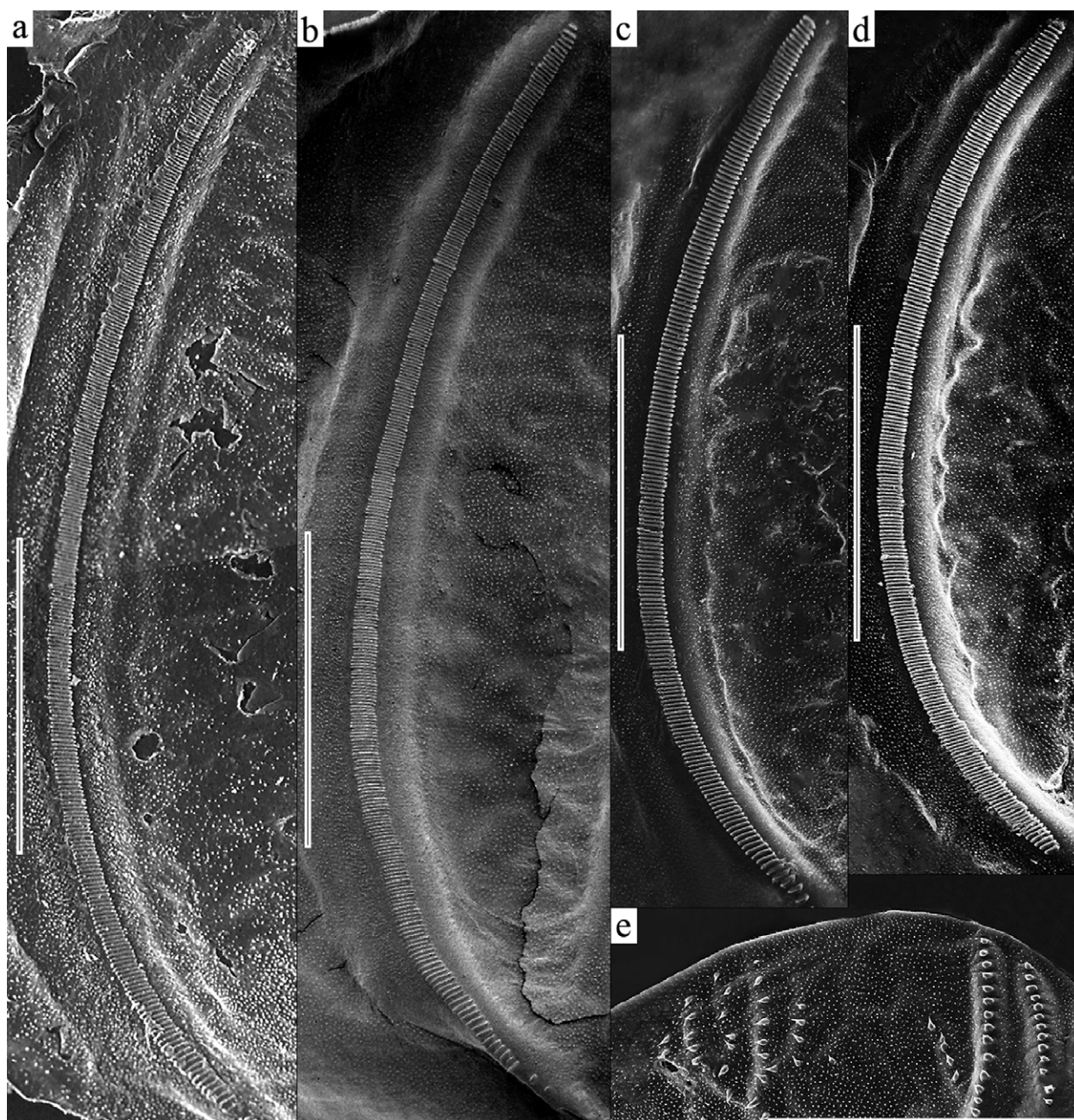


FIGURE 3. Scanning electron microscope photos of stridulatory file: **a.** *Isophya kraussii kraussii* male (ch1907); **b.** *Isophya kraussii kraussii* male (chx214); **c.** *Isophya kraussii moldavica* **ssp. n.** male (Putna); **d.** *Isophya kraussii moldavica* **ssp. n.** male (Adâncata); **e.** *Isophya kraussii moldavica* **ssp. n.** female (Adâncata). Scale 1 mm.

Female. Fastigium narrower than scapus (Fig. 2j). Pronotum with lateral carinae straight, disc marginally enlarged in posterior part and paranota slightly as in males, with ventral margin straight (Figs. 2j, l). Tegmina about 1/3 pronotum length, reaching the posterior margin of first abdominal tergite. Right tegmen with stridulatory bristles located on and near cubital veins (Fig. 3e). Cercus short, hairy, tapering; epiproct about 1.4 times as wide as long (Fig. 2n). Subgenital plate rounded, triangular, about 2.7 times as wide as long (Fig. 2p). Ovipositor 2.4–2.7 times pronotum length, upcurved, upper margin with 8–9 denticles and lower margin with 7–8 denticles (Fig. 2r). Hind femur 3.6–3.9 times pronotum length, without ventral spines (Table 1). Coloration of body as in males, ovipositor green.

Bioacoustics. Males produce their song usually at dusk and during the night, a long sequence of simple syllables. A syllable is formed of a compact series of 30–58 impulses, impulse interval 2–4 ms, and lasts for about 89–200 ms ($n=200$ syllables from 30 males). Usually a syllable is followed after 60–113 ms by an after-click, rarely 2–3. The following syllable begins 69–292 ms later (Figs. 4 e–h, m–p; table 2). Both parts (compact series of impulses and after-click) are the result of one closing stroke of tegmina. So far, we did not record any female acoustic response to male song. Sound frequency ranges from 15–20 kHz up to 40–45 kHz (Fig. 4 r).

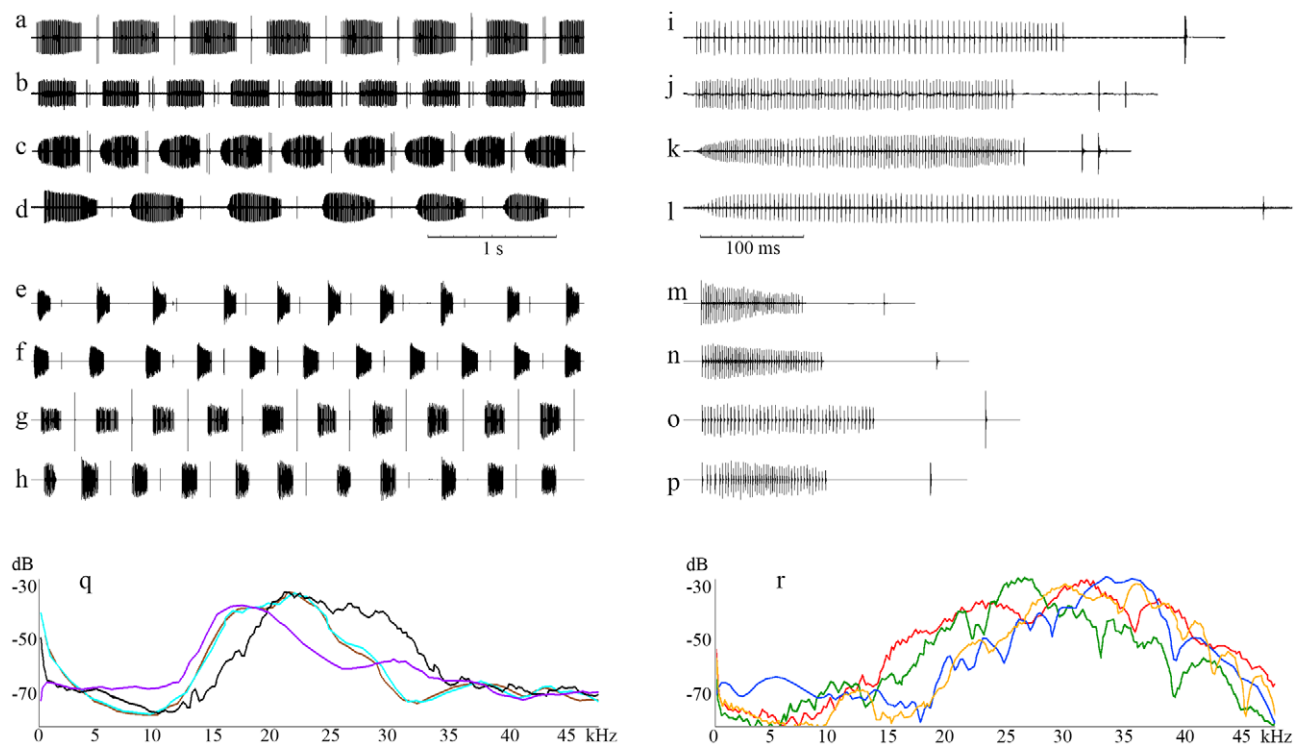


FIGURE 4. Sound analysis in *Isophya kraussii kraussii* (a–d, i–l, q) and *Isophya kraussii moldavica* ssp. n. (e–h, m–p, r): a–h, male song oscillogram; i–p, detailed syllable oscillogram; q, r, spectrum (a, i, light blue line, Würzburg, Germany, 23.5°C (ISKR8109); b, j, brown line, Altheim W Neustadt/Aisch, Germany, 21.5°C (ISKR8401); c, k, black line, Nordbayern, Germany, 27°C (ISKR8613); d, l, purple line, Krapina, Ptuj, Croatia, 26°C (ISKR8813); e, m, red line, Adâncata, Romania, 24°C; f, n, green line, Arbore, Romania, 17°C; g, o, dark blue line, Putna, Romania, 22°C; h, p, orange line, Vârfu Dealului, Romania, 22°C).

Comparative note. *Isophya kraussii moldavica* ssp. n. differs from *Isophya kraussii kraussii* mainly in acoustics and less in morphology. The song of males from the Moldavian populations consists of shorter syllables, formed of 30–58 impulses (mean±SD: 48.24±9.42) and lasting for about 89–200 ms (mean±SD: 114.96±34.87), while males of the nominal subspecies produce longer syllables, formed of 80–125 impulses (mean±SD: 96.97±22.09) and lasting for about 250–443 ms (mean±SD: 313.97±39.5), sometimes up to 600 ms (Roesti & Keist 2009). After-clicks are produced in a similar time window in the 2 subspecies, after 60–113 (mean±SD: 89.26±14.53) in Moldavian individuals and after 41–183 (mean±SD: 92.27±33.78) in Central European specimens. Male stridulatory file is shorter and contains 195–229 teeth in *I. kraussii moldavica* ssp. n., compared with 260–305 teeth in *I. kraussii kraussii*. Some other minor morphological variations were noticed in the two subspecies: male wing with longer and triangular posterior lobes in *I. kraussii kraussii* and shorter and rounded lobes in *I.*

kraussii moldavica ssp. n., longer pronotum and wings in males of *I. kraussii kraussii* and stubbier cercus in males of *I. kraussii moldavica* ssp. n. Females of the new subspecies have somewhat longer ovipositor: 10.9–12.1 mm, compared with 9.32–11.88 mm in nominal subspecies.

Distribution. *Isophya kraussii kraussii* is known to occur in Central and Southern Germany, Czech Republic, Slovakia, Southern Poland, Eastern Austria, Eastern Slovenia, Northern Croatia, Western and Northern Hungary. According to Strätz & Königsdorfer (2003) there are a few isolated localities in Bavaria south of the river Danube, where the species is mentioned to have been recorded by three authors before 1950. However, in one of the papers (Kühlhorn 1953), the species (and genus) is not mentioned at all (possibly a mix-up with *Tetrix* (as *Acrydium*) *kraussi* which is mentioned exactly and only for these localities listed by Strätz & Königsdorfer). In another locality (Höllriegelskreuth) mentioned by Knoerzer (1942) (and based on Knoerzer by Fischer 1950), besides two nymphs, the only adult specimen was beaten from a tree, a quite atypical place for an *Isophya*. Here possibly an unusually coloured female of *Barbitistes* was involved. In the same paper, Knoerzer (1942, p. 629) mentions indirectly a previous exchange between *I. kraussii* (as *I. pyrenaica*) and *B. serricauda*. Therefore these southern Bavarian records are mostly wrong, with one doubtful locality, and they are not shown in the map (Fig. 5). In Czech Republic and Slovakia, *Isophya kraussii kraussii* is locally common across entire territory, within altitude range 100–1800 m (Kočárek *et al.* 2005, Holuša *et al.* 2013, A. Krištín and P. Kočárek pers. comm. 2012).

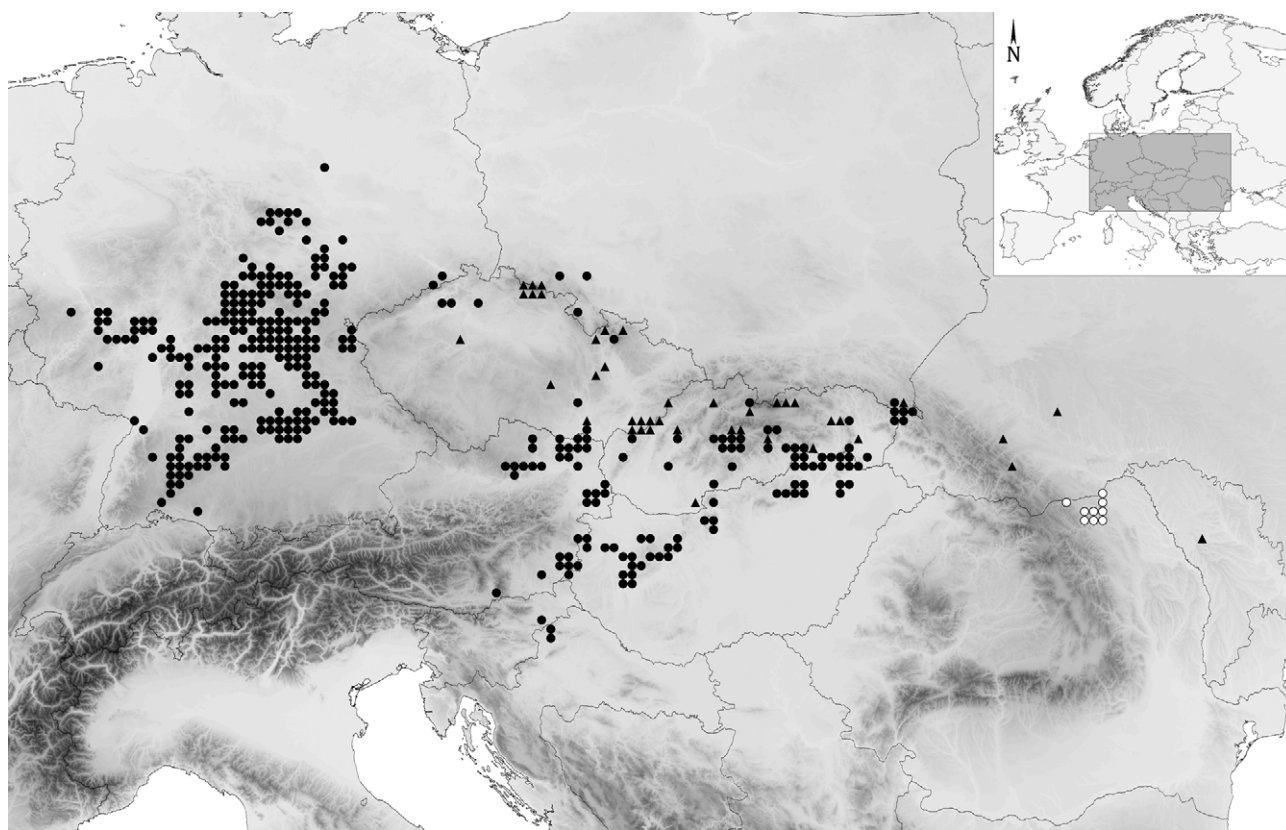


FIGURE 5. Distribution map of *Isophya kraussii kraussii* (black circles), *Isophya kraussii moldavica* ssp. n. (white circles) and *Isophya pyrenaica* (old literature data, most probably = *Isophya kraussii*, black triangles), based on original and literature data (Bauer & Kenyeres 2006, Bedjanič 2009, Bey-Bienko 1954, Buchweitz 1993, Chládek 1984, Chládek 1986, Chládek 1988, Chládek 1995, Chládek 2001, Čejchan 1955, Čejchan 1959, Čejchan 1986, Čejchan 1987, Čejchan 1988a, Čejchan 1988b, Čejchan 1989, Čejchan 1993, Čejchan 1994, Derbuch & Berg 1999, Fikáček 2012, Grzywacz & Warchałowska-Śliwa 2008, Heller 1988, Heller *et al.* 2004, Holuša 2006, Ingrisich 1991, Kenyeres *et al.* 2009, Krištín 2001, Krištín & Hružík 2005, Krištín & Mihál 2000, Krištín & Kaňuch 2007, Krištín & Kaňuch 2013, Krištín *et al.* 2009, Krištín *et al.* 2011, Laußmann 1993, Maas *et al.* 2002, Merkel 1941, Nagy *et al.* 1998, Nagy *et al.* 2003, Nagy *et al.* 2007, Pecsénye *et al.* 2003, Rácz 1998, Schreiber 1996, Steglich & Müller 2011, Theuerkauf *et al.* 2005, Warchałowska-Śliwa *et al.* 2008, Zacher 1917, Zechner & Fachbach 2001, Zuna-Kratky *et al.* 2009).

Isophya kraussii moldavica **ssp. n.** is known so far only from the hilly meadows in NE Romania, but a record of *I. pyrenaea* from Central Moldavia by Bey-Bienko (1954), based on two females with unusually long ovipositor, may indicate this subspecies. For the old records of *I. pyrenaea* from western Ukraine (Łomnicki 1878, 1879 *vide* Bey-Bienko 1954; Ramme 1951) it is impossible to decide to which subspecies they may belong, if they refer to *I. kraussii* at all. In 1970, Kis and Vasiliu discussed that most of the early mentions of *Isophya pyrenaea* in Romania are erroneous, e.g. specimens from “Siebenbürgen Karpaten” (Transylvanian Carpathians) in coll. A. Müller, Brukenthal National Museum, Sibiu. The authors indicate that *Isophya pyrenaea* is found in Romania only in N Moldavia and the individuals from other regions most probably belong to *I. brevipennis* Brunner von Wattenwyl (= *I. camptoxypha*) or *I. modestior* Brunner von Wattenwyl. Specimens mentioned by Ramme (1951) from “Königstein bei Braşov” (Piatra Craiului Mountains) may belong to *Isophya harzi* Kis (Iorgu *et al.* 2012).

Ecology. In Germany, *Isophya kraussii kraussii* is found in a variety of habitats. Common to most of them is a vegetation structure dominated by high grasses or tall herbs and shrubs (Strätz & Königsdorfer 2003). In southern Germany (Bavaria) the species inhabits altitudes between 300 and 900 m (Strätz & Königsdorfer 2003). In Czech Republic and Slovakia, this bush-cricket is considered a submountain and mountain species (Krištín & Kaňuch 2007), occurring in shrubs, taller herbs (Kočárek *et al.* 2005, Holuša 2006) and steppic xerothermic forest ecotone (Krištín *et al.* 2011). In Hungary, *Isophya kraussii kraussii* prefers meso-xerophytic grasslands and forest clearings, ecotone, forest steppe and rocky shrublands with mainly low-shrub species (Rácz 1998, Rácz 2001, Bauer & Kenyeres 2006). In the Bieszczady Mountains from Poland, it was reported from valley, subalpine meadows and clearings (Theuerkauf *et al.* 2005). Mesophytic ecotone and meadow vegetation with *Centaurea*, *Urtica*, *Rubus*, *Rumex*, *Senecio*, *Galium*, *Stachys*, *Lamium* etc. represent the habitat of *Isophya kraussii moldavica* **ssp. n.** in Romania. A rich Orthoptera fauna occurs in these types of biotope: *Phaneroptera falcata* (Poda), *Leptophyes albobittata* (Kollar), *Tettigonia viridissima* (Linnaeus), *Decticus verrucivorus* (Linnaeus), *Metrioptera roeselii* (Hagenbach), *Metrioptera bicolor* (Philippi), *Pholidoptera griseoptera* (De Geer), *Gryllus campestris* (Linnaeus), *Euthystira brachyptera* (Ocskay), *Chrysochraon dispar* (Germar), *Omocestus rufipes* (Zetterstedt), *Stenobothrus lineatus* (Panzer), *Chorthippus apricarius* (Linnaeus), *Chorthippus biguttulus* (Linnaeus), *Chorthippus dorsatus* (Zetterstedt), *Chorthippus parallelus* (Zetterstedt) etc. The syntopic occurrence of *Isophya* species remains an interesting subject, *I. kraussii kraussii* and *I. pienensis* (Mařan) being found together in Bieszczady Mountains, Poland (Theuerkauf *et al.* 2005). The occurrence of *Isophya kraussii moldavica* **ssp. n.** syntopic with *I. pienensis* in the Eastern Subcarpathians and with *I. zubowskii* (Bey-Bienko) in the Moldavian plane W of Prut river are not to be excluded, although we have not found these associations so far.

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