



Rediscovery of *Isophya stysi* (Čejchan, 1957) (Orthoptera: Tettigonioidea: Phaneropterinae) in south-eastern Poland

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Abstract: *Isophya stysi* (Čejchan, 1957), a flightless bush-cricket is one of only two Orthoptera species under strict legal protection in Poland. It reaches its northernmost range limit in northern Slovakia and south-eastern Poland. So far, it has been recorded from Poland only once, 50 years ago. We found numerous individuals of *Isophya* sp. in the Źródlińska Jasiołki Nature Reserve (49°22'N, 21°54'E) already on 13 July 2011. However, only in 2019, we recognized that species as *Isophya stysi*. Later, we found it also at six other sites in SE Poland, five of which were located in the Beskid Niski Mountains and one near the town of Krosno.

Key words: Stys's plump bush-cricket, Beskid Niski mountains, distribution, insects, extensively used grasslands

INTRODUCTION

Isophya stysi (Čejchan, 1957) is endemic to the Carpathian Basin. The northern edge of its distribution reaches Slovakia (Krištín et al., 2019) and south-eastern Poland (Bazyłuk 1971). It was also found in Ukraine, Romania, and Hungary (Heller et al. 2004, Krištín & Iorgu 2014). Its EOO (extent of occurrence) is estimated to be 130 000 km² (Chobanov et al. 2016). The main threats are agricultural activities and vegetation succession that cause degradation or loss of habitats (Chobanov et al. 2016). This species is of European importance (Annex II of the Habitats Directive; Council Directive 92/43/EEC 1992, Consolidated version January 1, 2007) and is strictly protected in Poland (Act on Protection of Nature of April 16, 2004). *Isophya stysi* is listed as Least Concern in the IUCN Red List of Threatened Species (Chobanov et al. 2016).

Until now, *Isophya stysi* was recorded from Poland only once and only at one place in the Bieszczady mountains (SE Poland) during the survey that took place between 1964 and 1970 (Bazyłuk 1971). The exact date of the observation has never been published. Later its occurrence at that place has not been confirmed despite searches by Theuerkauf et al. (2005) and Liana (2010).

Since July 2011 we have known of one locality of *Isophya* sp. occurring in the Beskid Niski mountains (Źródlińska Jasiołki Nature Reserve), and in 2019 we recognized that population as *I. stysi* based on acoustic analysis. The place is located about 70 km from the only known *I. stysi* record from Poland, however, the nearest discovered population of this species lies only ~3 km to the south, in Slovakia (Krištín 2022). This discovery suggested that the distribution of *I. stysi* at the northern edge of its range is insufficiently known in Poland, which led us to this survey. In 2019, 2020, and 2021, we found several additional sites in SE Poland.

MATERIAL AND METHODS

The research covered open and semi-open habitats located in the southern part of Podkarpackie (SE Poland). We visited them on warm, windless evenings and nights from June to September. All specimens were found by searching for exposed individuals and by acoustic detection of male calling song in places similar to habitats reported in the literature, namely

extensively used or abandoned grasslands (Gavlas 2005), with a focus on mesophilous grasslands and forest clearings (Kis 1960, Pecsénye et al. 2003, Iorgu & Iorgu 2008). In 2021 we searched for stridulating males also with the support of a Magenta 4 Bat Detector, which is an electronic device that converts ultrasonic signals into sounds audible to the human ear.

Tools and devices used

We recorded stridulating males directly in the field by smartphones (Motorola Moto G 3, Xiaomi Mi Mix 3 5G). Due to technical constraints, recordings do not contain higher frequencies; however, they are good enough to allow species identification. We processed recordings with Audacity 2.3.2. The Magenta 4 Bat Detector that we used in 2021 is a heterodyne detector with a frequency range of 15–130 kHz and a bandwidth of ± 9 kHz. The field tests showed that *I. stysi* sound is best audible with the frequency set to 15–20 kHz, and we used this setting for our further research.

Identification method

Though identification of species of the genus *Isophya* from morphological characters is usually possible, it is a very difficult task. That caused a lot of confusion regarding the systematics of species within the genus *Isophya* Brunner v. W., 1878 (Heller et al. 2004). On the other hand, the acoustics signals of most species are distinct and usually allow for easy identification. In contrast to many *Isophya* species, the calling song of *I. stysi* is audible in the field even from a 5 - 10 m distance due to the relatively large portion of lower frequencies (in the range of 10 - 20 kHz). Bioacoustics of *Isophya* species (including *I. stysi*) with the proposed terminology for its description has been published by Heller et al. (2004) and Orzi et al. (2005). Some characteristics of the male calling song, e.g. the number of pulses and duration of syllables may vary slightly between populations and depends on atmospheric conditions, in particular, the duration of a single syllable gets longer with lower air temperature (Orzi et al. 2005). Example oscillograms of *I. stysi* observed in Poland are presented in Fig. 1. To explore the exact characteristics of the Polish *I. stysi* male calling song more research is needed.

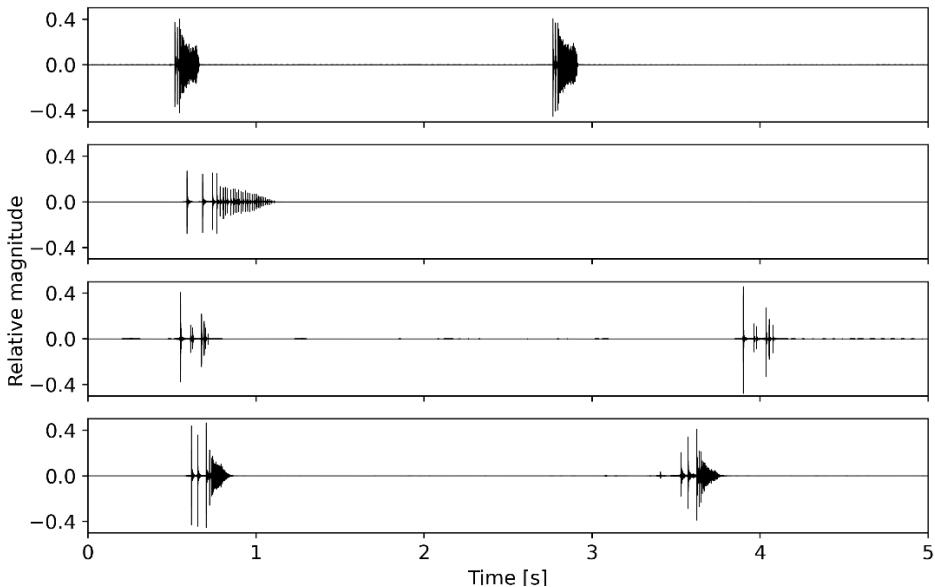


Fig. 1. Oscillograms of *Isophya stysi* recorded in Beskid Niski Mts.

RESULTS

We found *I. stysi* at 110 locations (see Fig. 3) in four large areas and three isolated sites (see Fig. 2), covering a total of eleven different UTM coordinates in SE Poland. The majority of the sites, excluding those located at latitudes <49.4° N (see Fig. 2 and 3), are now the northernmost known sites. All of the places were located at elevations between 290 and 650 m a.s.l. The habitat of *I. stysi* in Beskid Niski is similar to that described from Slovakia (Gavlas 2005), Romania (Iorgu & Iorgu 2008), or Hungary (Pecsenye et al. 2003). It was found mainly on mesophilous herbaceous grasslands and their surroundings - either on dry meadows, scrubs near river valleys, or in overgrown clearings along forest roads. They were feeding on various plant species, such as *Hypericum sp.*, and *Mentha sp.* but also *Prunus spinosa* (see Fig. 4.). Imagines were observed from VII-1 to IX-3, with abundances highest in July and then steadily declining.

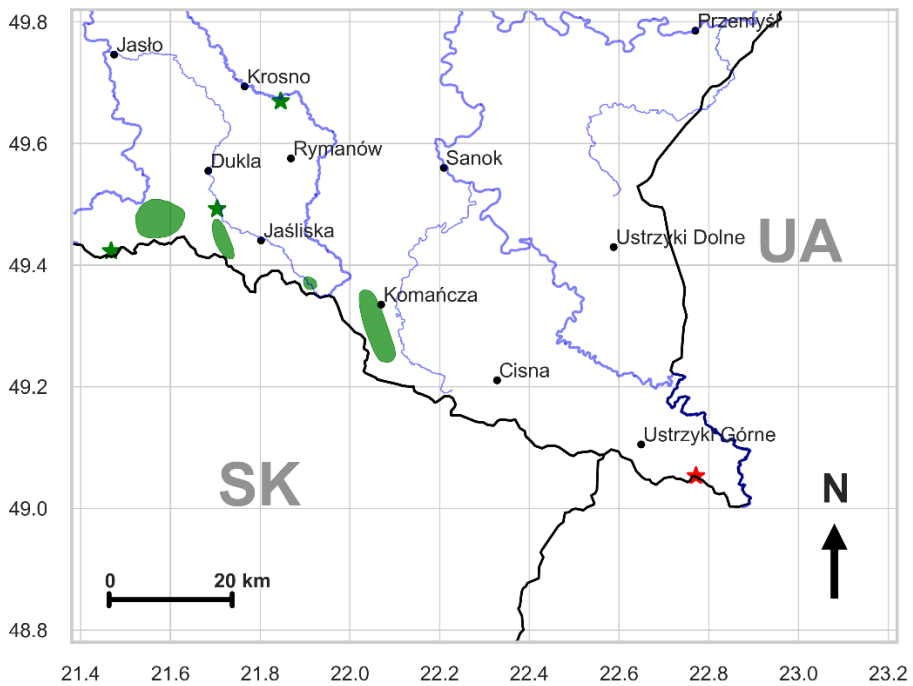


Fig. 2. Distribution of *Isophya stysi* in Poland. The red star shows the only historical record from Bieszczady (Bazylik 1971). Green represents new sites reported in this work. Shaded ovals denote large areas of occurrence where *Isophya stysi* was present at the majority of late-mown grasslands while green stars indicate small isolated sites.

Below we shortly describe the localities in which we found *I. stysi*. We give exact coordinates for small, isolated sites and approximate centers of the four large areas.

1. Radoszyce (49°18'N 22°03'E, UTM: EV75, EV76) – probably the largest site with an estimated area of ~30 km², covering various types of meadows, herbaceous grasslands, and pastures in the southern part of Czystogarb, Komańcza, Osławica, Nowy Łupków and Łupków (1 male found independently by Marcin Kutera and Cyryl Tusiński on 12 August 2020, private communication). Stridulating males were present on most of the checked grasslands that were not mown before July. The highest densities (locally up to 1 male per 100 m²) were observed in herbaceous grasslands and unmown meadows.

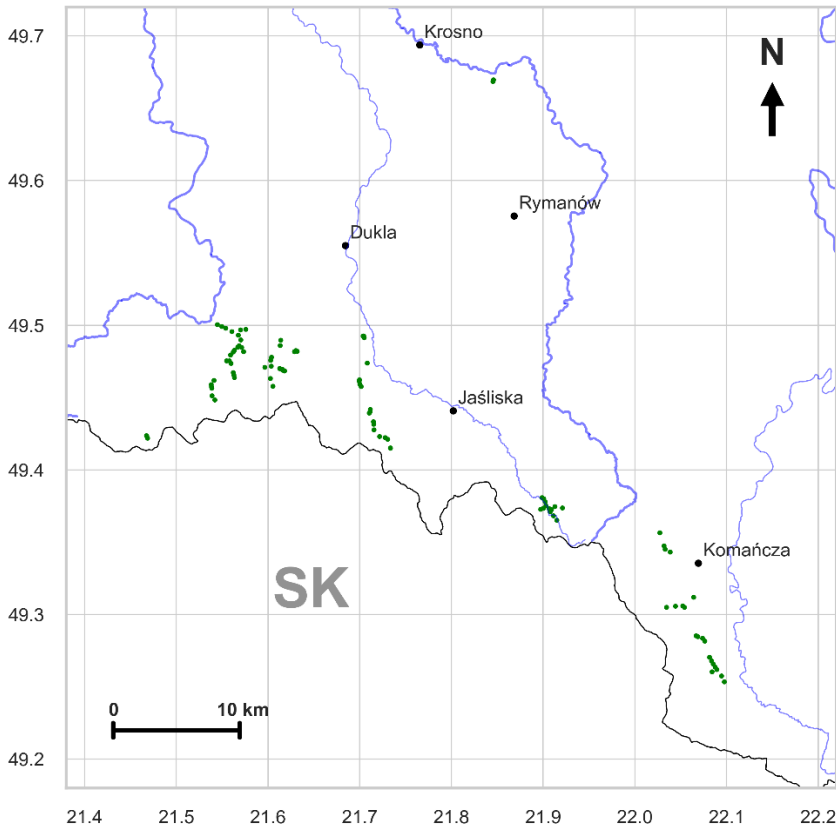


Fig. 3. Distribution of *Isophya stysi* in Poland.

2. Źródliśka Jasiołki Nature Reserve (49°22'N 21°54'E, UTM: EV66, EV67) – various types of meadows and herbaceous grasslands in nature reserve (see Figure 4). This is the only protected area in Poland where *I. stysi* occurs. We found first *Isophya* sp. (later identified as *I. stysi*) at that site in 2011. The area covers ~2 km². Though not the largest, this site is probably the most densely populated with densities locally reaching 1–5 stridulating males per 100 m² in wet meadows and herbs in early July.

3. Zydranowa (49°26'N 21°43'E, UTM: EV57) – meadows in the valley of the river Panna, located on the premises of Zydranowa and Tylawa, extending possibly up to ~20 km², highest densities (>0.1 male per 100 m²) were observed in wet unmown meadows and herbaceous grasslands.

4. Trzciana (49°29'31"N 21°42'15"E, UTM: EV58) – an isolated site, a small meadow 1.7 ha, unmown for at least a year, with edges overgrown with *Prunus spinosa*, located next to the forest, at the northern slope, close to the peak of the local elevation. We found this site on 10 August 2021, when most of the nearby grasslands had been already mown, thus the overall extent of this *I. stysi* population may be significantly larger. At that time, 10–20 stridulating males were present. This site will probably soon cease to exist as it is partially located at the planned express road S19 (“Via Carpatia”). Given its small extent, the whole meadow will be significantly affected during the construction of the road, although the road will cover only a part of it.

5. Polany (49°29'N 21°34'E, UTM: EV38, EV47, EV48) – a third major area of occurrence, covering ~10 km² of meadows, pastures, and other grasslands overgrown with *Prunus spinosa* in Polany, Huta Polańska, Olchowiec, and Ropianka. The highest densities (up to 1 male per 100 m²) were observed in herbaceous grasslands and unmown meadows.

6. Ożenna (49°25'20"N 21°28'06"E, UTM: EV37) – an isolated site covering ~1.5 ha of unmown meadow and shrubs with 10–20 stridulating males. Other nearby grasslands had already been mown when we found this site (13 July 2021).

7. Krościenko Wyżne (49°40'08"N 21°50'43"E, UTM: EA60) – the northernmost and smallest site ~0.5 ha, with >10 stridulating males at the beginning of July. We did not find *I. stysi* at other, nearby grasslands (most of which had been already mown). This site will soon cease to exist as it is located at the planned express road S19 (“Via Carpatia”).



Fig. 4. Top: *Isophya stysi*: left: male feeding on *Prunus spinosa*; right: female. Bottom: typical habitat of *Isophya stysi* in Beskid Niski mountains (SE Poland). All photos by W. Guzik.

DISCUSSION

Historical observation of *I. stysi* reported from Poland concerned one isolated site, where only 6 individuals were found (Bazyluk 1971). In this survey, we reveal a significant population of *I. stysi* within south-eastern Poland, moving the northern range limit of this species. We note, that *I. stysi* prefers there the same types of habitat as those reported from other parts of central Europe, i.e. extensively used grasslands, mesophilous meadows, and forest clearings (Kis 1960, Pecsénye et al. 2003, Gavlas 2005, Iorgu & Iorgu 2008). Although in most of the reported sites, *I. stysi* appears to be an abundant species, more research is needed to properly assess the actual population size and trend.

The presented discovery opens up the discussion on the conservation of this threatened and protected species. Only one of the reported sites (Źródlińska Jasiołki Nature Reserve) is located in a protected area. Even at this site, the favorable habitat of *I. stysi* appears to be slowly decreasing due to secondary succession. The process is however efficiently slowed-down by active conservation (mainly late mowing of the grasslands). Given the fact that most of the revealed sites are located on private lands and the establishment of new protected areas or nature reserves is almost impossible within current conditions in Poland, we doubt that any of these places will be protected within the foreseeable future, being possibly threatened by agricultural changes, mainly grazing intensification and earlier mowing, or secondary succession of abandoned grasslands. Moreover, two of the three isolated sites (Krościenko Wyzne and Trzciana) are threatened by the construction of express road S19 and will probably be destroyed in the near future.

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STRESZCZENIE

[Ponowne odkrycie zrówieńki bieszczadzkiej *Isophya stysi* (Čejchan, 1957) (Orthoptera: Tettigonoidea: Phaneropterinae) w południowo-wschodniej Polsce]

W pracy opisano pierwsze od 50 lat obserwacje zrówieńki bieszczadzkiej *Isophya stysi* w Polsce. Stanowiska tego gatunku zostały odkryte w latach 2011–2021 na terenie Beskidu Niskiego oraz w pobliżu Krosna. W czasie trwania badań obecność *I. stysi* potwierdzono w 11 kwadratach UTM (10x10 km), na czterech większych obszarach o powierzchni 2–30 km² oraz na trzech izolowanych stanowiskach. Siedliska w których występuje ten gatunek to głównie bujne łąki i ziołorośla w niższych położeniach górskich.

Owady identyfikowano bezpośrednio w terenie na podstawie analizy głosu strydulujących samców, przy użyciu detektora ultradźwięków. Jest to metoda umożliwiająca szybką i skuteczną determinację gatunku, nie wymagająca pozyskania okazu.

Isophya stysi jest gatunkiem ściśle chronionym w Polsce, uwzględnionym w załączniku II i IV Dyrektywy Siedliskowej UE. Tylko jedno z odkrytych stanowisk zlokalizowane jest na terenie objętym ochroną rezerwatową. Dwa izolowane stanowiska zagrożone są budową drogi S19 "Via Carpatia". Do głównych zagrożeń gatunku zaliczyć należy zanikanie siedlisk spowodowane sukcesją wtórną oraz zmianami w prowadzonej gospodarce rolnej, głównie intensyfikacją i nieodpowiednim terminarzem koszenia łąk. Jedyne znane do tej pory stanowisko *Isophya stysi* w Polsce znajdowało się w Bieszczadach, współcześnie nie udało się tam jednak potwierdzić występowania tego gatunku.