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Distribution of *Platycleis grisea* Fabricius, 1781 (Orthoptera: Tettigoniidae) in Poland

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Abstract: *Platycleis grisea* is a bush-cricket species distributed on the southern side of the Alps and in Eastern Europe. In Western and Northern Europe *P. grisea* is replaced by its sister species *P. albopunctata*, the border between the two taxa in Eastern Europe is unknown. *Platycleis grisea* and *P. albopunctata* differ in the shape of the female subgenital plate and the male reproductive organs: titillators, however the differences are vague, and their systemic status is unclear. Historical localities of *P. grisea* in Poland are Middle Pieniny in the Carpathians and the Ojców National Park in the Kraków-Częstochowa Upland, more recently it was also recorded from the Wdżar Mountain in the Gorce mountains. In this study *P. grisea* is reported from four new localities and the morphology of *Platycleis* from the Carpathians, and the Kraków-Częstochowa Upland is presented. Subgenital plate morphology turns out to be variable, and thus not a reliable trait. Titillators of *Platycleis* from the Kraków-Częstochowa Upland do not match *P. grisea*, and titillators of *Platycleis* from the Carpathians clearly match *P. grisea* morphology. I conclude that in Poland *P. grisea* is restricted to the Carpathians and thus the historical record from the Kraków-Częstochowa Upland must considered erroneous.

Key words: grey bush-cricket, parapatry, sister species, taxonomy

INTRODUCTION

Platycleis grisea is a bush-cricket species occurring in Southern and Eastern Europe. In Northern and Western Europe it is replaced by a sister species *Platycleis albopunctata* Goeze, 1778 which occurs from Southern France to Northern Europe (Ragge 1990). Both species are morphologically similar (Harz 1969) and do not differ in stridulation (Heller 1988, Ragge 1990) hence their taxonomic status is unclear, sometimes treated as subspecies and sometimes as distinct species (Harz 1969, Ragge 1990, Kočárek et al. 1999, Massa & Fontana 2011). In Western and Central Europe *P. grisea* occurs only on the southern side of the Alps (Nadig 1981) and in the Pannonian Basin with its adjacent areas (Lechner 2017a). The border between the two taxa goes along the austro-german border and through Czech Republic where *P. albopunctata* can be found only in Bohemia (Kočárek et al. 1999). In Slovakia only *P. grisea* is known to occur (Krištín et al. 2020) and in Ukraine the range borders are unknown (Korsunovskaya 2016). Both species inhabit various dry open habitats with a fair amount of open ground such as heaths, old quarries, or sandy and rocky grasslands (Lechner 2017a, b) and no differences in habitat requirements between the two taxa are known. *P. grisea* and *P. albopunctata* are considered parapatric. In the Maritime Alps, where the ranges of the two taxa meet, morphologically intermediate populations were found (Nadig 1981, Ragge 1990). Thus, it is probable that the two taxa do not coexist like it is the case for other parapatric species (Szabó & Vörös 2014, Jablonski et al. 2017).

The two taxa differ only in two morphological traits. In *P. grisea* the edges of the female subgenital plate are parallel to each other creating a shape approaching a rectangle and side-sclerites are fused with the plate, while in *P. albopunctata* the subgenital plate edges are converging resulting in a shape resembling a triangle and side-sclerites are isolated from the subgenital plate (Harz 1969). However, the shape of the subgenital plate is variable and the state

of the fusion of side sclerites with the subgenital plate is often difficult to assess (Ragge 1990). The shape of the titillators (a sclerotized binate male reproductive organ, also called epiphallus) constitutes a more reliable trait. In *P. albopunctata* titillators are more robust having a thicker base while in *P. grisea* they are slender with a narrower basal part (Harz 1969).

In Poland *P. grisea* was reported for the first time by Władysław Bazyluk in 1957. He collected *P. grisea* in 1953 and 1955 in Pieniny Właściwe (Middle Pieniny), a mountain range of the Polish Carpathians, in Wąwóz Szopczański (Szopczański Gorge) (49.411, 20.408; coordinates of all historical records are estimative) and in 1954 on the slopes of Góra Zamkowa (Castle Hill) in Czorsztyn (49.435, 20.313) (Bazyluk 1957). Subsequently Bazyluk also found *P. grisea* on the southern slopes of Trzy Korony (Three Crowns) (49.412, 20.415), on Grabczychy (49.407, 20.423), and on Góra Zamkowa (Castle Hill) in Middle Pieniny (49.420, 20.422) (Bazyluk 1978). All the aforementioned localities are located in the Middle Pieniny mountains. Later Bazyluk also reported *P. grisea* from Grodzisko (50.228, 19.826) in the Ojców National Park in the Kraków-Częstochowa Upland, where *P. grisea* was supposed to co-occur with *P. albopunctata* on sunny and rocky slopes of the Prądnik valley (Bazyluk 1970). The last, most recent record, of *P. grisea* from Poland comes from Góra Wdżar (Wdżar Mountain) (49.456, 20.317), in Gorce, a range of the Carpathians (Liana and Armatys 2015). *P. albopunctata*, on the other hand, can be found all across Poland and is lacking only in the Carpathian Mountains (Żurawlew et al. 2021). In this study I present four new records of *P. grisea* in Poland and critically review the literature records in order to explain the distribution of this species in Poland

Materials and Methods

To search for *P. grisea* sites where this species was reported (Wdżar Mountain, Szopczańki Gorge) as well as sites in proximity to historical records (Mydlniki, Kamień, Biała Woda Nature Reserve) were visited. Sites outside of the described range of *P. grisea* were also visited to search for clear *P. albopunctata* individuals (Lipa, Szewce, Górno). Three records were also made accidentally while searching for other orthoptera species (Zyndranowa, Szczawne, Źródliska Jasiołki Nature Reserve). The sites were visited in August, September, and October as the imago of *P. grisea/albopunctata* appear rather late in the season (Lechner 2017a, b).

Platycleis individuals were found at the following sites (site, area, region, date, activity, number individuals found – morphological trait with the number of individuals assessed, habitat):

1. Mydlniki (50.09000, 19.84167), Kraków, Kraków-Częstochowa Upland, 21 Jul 2018, visual and aural search, 3 ind. (titillators 2 ind.), limestone rocky grasslands and screes in an old quarry.
2. Kamień (50.01611, 19.59361), Gmina Czernichów, Kraków-Częstochowa Upland, 21 Jul 2018: visual and aural search and collection of males to extract titillators, 4 ind. (subgenital plate 2 ind.), limestone rocky grasslands and screes in an old quarry.
3. Lipa (50.69528, 22.04833), Gmina Zaklików, Sandomierz Basin, 27 Jul 2018, visual and aurals search, 7 ind. (subgenital plate 2 ind.), warm heaths and sandy grasslands.
4. Szewce (50.59889, 22.51556), Gmina Janów Lubelski, Sandomierz Basin, 28 Jul 2018, visual and aural search, 5 ind. (subgenital plate 3 ind.), warm sandy grasslands at a forest edge.
5. Górno (50.27111, 22.15750), Gmina Sokołów Małopolski, Sandomierz Basin, 20 Jul 2019, visual and aural search, 6 ind. (titillators 2 ind.), warm sandy grasslands.
6. Wdżar Mountain (49.45583, 20.31806), Gorce, Carpathians, 2 Aug 2018, visual and aural search, 2 ind. (subgenital plate 2 ind.); 20 Oct 2019, 4 ind. (titillators 2 ind.), rocky grasslands and screes.

7. Szopczański Gorge (49.41056, 20.40750), Middle Pieniny, Carpathians, 2 Aug 2018, visual and aural search, 3 ind., rocky grasslands and screes of limestone.

8. Biała Woda Nature Reserve (49.40333, 20.57667), Małe Pieniny (Lesser Pieniny), Carpathians, 24 Aug 2020, visual and aural search, 7 ind., rocky grasslands and screes of limestone.

9. Zyndranowa (49.42472, 21.71833), Beskid Niski (Low Beskids), Carpathians, 10 Aug 2021, aural search for *Isophya* sp. with a bat detector *Platycleis* accidentally found, 1 male, dry to semi-dry meadows.

10. Szczawne (49.40075, 22.10050), Low Beskids, Carpathians, 18 Jul 2022, aural search for *Isophya* sp. with a bat detector Platycleis accidentally found, 1♂, meadows.

11. Źródliska Jasiołki Nature Reserve (49.37583, 21.91389), Low Beskids, Carpathians, 4 Aug 2022, aural search for *Isophya* sp. with a bat detector *Platycleis* accidentally found, 1♂, dry meadows.

Three males were collected on the southern slopes of the Alps in Tessin (Switzerland) and their titillators were extracted to be compared with the titillators of the Polish populations.

Subgenital plates were photographed on live females in the field. Titillators were extracted and photographed with a stereo microscope in the lab. Titillators of 6 males and subgenital plates of 9 females were assessed.

Results

The shape of the subgenital plates of Polish specimens is highly variable and is not a reliable identification trait (Fig. 1). The fusion of side-sclerites with the subgenital plate may be indicative of the species but is also highly variable (Fig. 1). In the females from the Wdżar Mountain the side-sclerites are clearly fused with the subgenital plate (Figs 1a–b) while in the individuals from lowland Poland the side-sclerites are rather isolated (Figs 1e–g). However the side-sclerites seem to be rather fused in the females from Lipa (Fig. 1h–i), which is also a lowland location and should be occupied by *P. albopunctata* (Żurawlew et al. 2021). Females from Kamień, show clear *P. albopunctata* traits (Figs 1c–d).

The shape of the male titillators seems to constitute the only reliable identification trait of *P. grisea* in Poland. The titillators of all the individuals from the Polish lowlands and uplands exhibit clear *P. albopunctata* characters: titillators short, robust, with rather thickish basal part (Figs 2a–d). Only the titillators of the individuals from the Wdżar Mountain (Carpathian Mountains) are slender, more curved, and with a narrower basal part (Figs 2e–f) closely matching the morphology of *P. grisea* titillators from the southern slopes of the Swiss Alps (Figs 2g–i).

The titillators' morphology of the males found in the Biała Woda Nature Reserve and at the three sites in the Low Beskids was not assessed. However, due to the proximity of *P. grisea* sites (<31 km) and the remoteness of *P. albopunctata* sites (>86 km) (Fig. 3), these records are assigned to *P. grisea*.

Summarising, currently in Poland *P. grisea* is recorded from Middle Pieniny, the Wdżar Mountain, Lesser Pieniny, and the Low Beskids (Fig. 3) in the Carpathias, however the records from the two latter regions were not confirmed by the morphology of titillators. The historical record outside of the Carpathians from Grodzisko in the Ojców National Park is not reliable and could not be confirmed.

Discussion

I conclude that in Poland *P. grisea* is restricted to the Carpathians. Several facts indicate that *Platycleis* record from the Ojców National Park does not belong to *P. grisea*. First, the record from the Ojców National Park is not documented with drawings and, as shown here, the morphology of *Platycleis* in Poland is highly variable in terms of the female subgenital

plate (Fig. 1), and thus not always clearly identifiable to one of the species. Second, *P. grisea* is described as co-occurring with *P. albopunctata* which is rather improbable as the two species are described as parapatric from Southern Europe, thus should not co-occur but rather form hybridisation zones where they meet (Nadig 1981, Ragge 1990). This phenomenon, however, must be investigated in more detail in the region. Third, individuals collected in Mydlniki, in habitats like the ones described by Bazyluk (limestone screes), just 10 km from Grodzisko in the Ojców National Park from where Bazyluk reported *P. grisea*, clearly belong to *P. albopunctata* (Fig 2). This indicates that in Poland *P. grisea* inhabits only mountain grasslands in the Carpathian Mountains. In Gorce (Wdżar Mountain), Middle Pieniny, and Lesser Pieniny (Biała Woda Nature Reserve) it inhabits dry rocky grasslands, and in the Low Beskids it inhabits various rather dry grasslands.

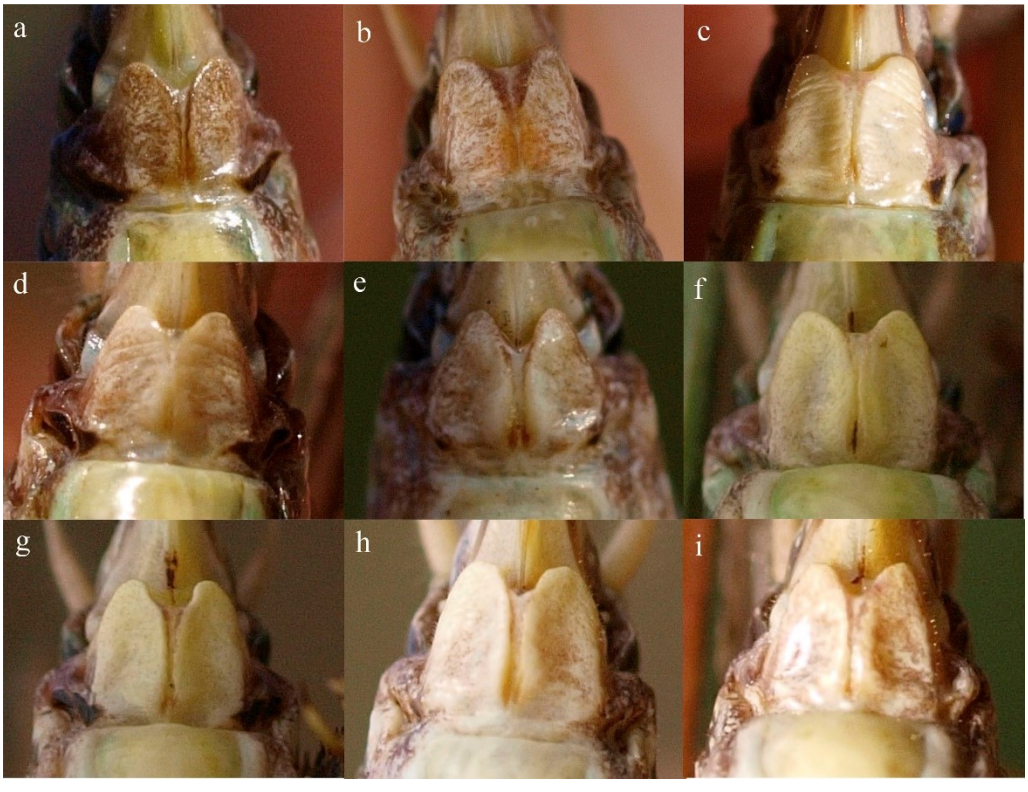

Fig. 1. Morphology of female subgenital plates of *Platycleis* individuals from Poland: a & b – Wdżar Mountain; c & d – Kamień; e, f & g – Szewce; h & i – Lipa. Note the shape of the subgenital plate (rectangular to triangle like) and the fusion of the side sclerites with the subgenital plate.

The border between *P. grisea* and *P. albopunctata* in Poland follows the Carpathians. *P. grisea* is restricted to the Carpathian Mountains and *P. albopunctata* can be found north to the Carpathian range, occupying most parts of the country (Fig. 3). The densely forested Carpathian Foothills, also visible as a range discontinuity in some thermophilous species like *Bicolorana bicolor* Philippi, 1830 (Żurawlew et al. 2021), may constitute a natural border between these two taxa in Poland.

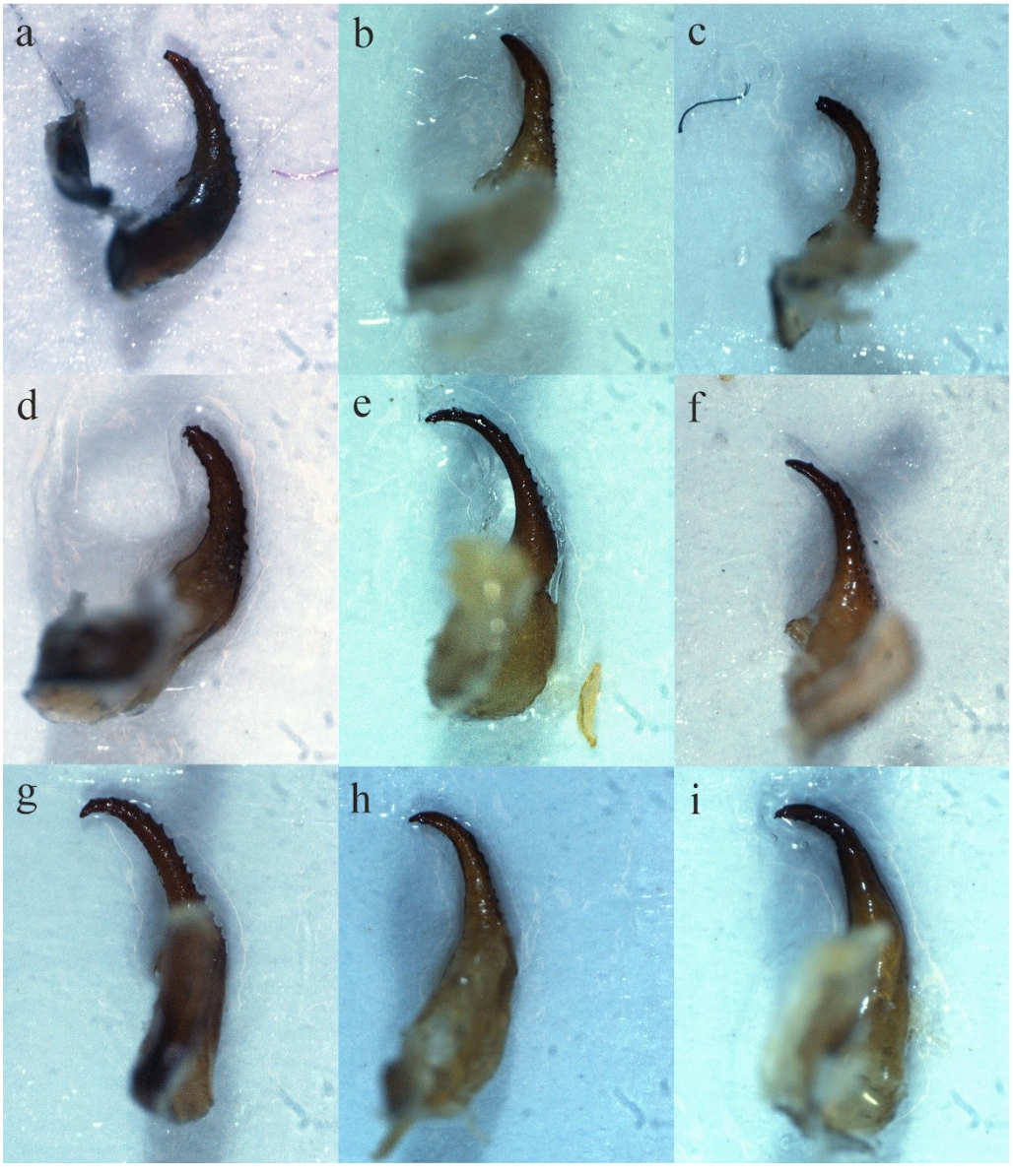

Fig. 2. Morphology of titillators of *Platycleis* individuals from Poland: a & b – Mydlniki, c & d – Górno, e & f – Wdżar Mountain, and of *Platycleis grisea* from Tessin (Switzerland) for comparison (g–i). Note the shape of the apical and basal part of the titillators. Only right titillators are shown. All pictures are in the same scale.

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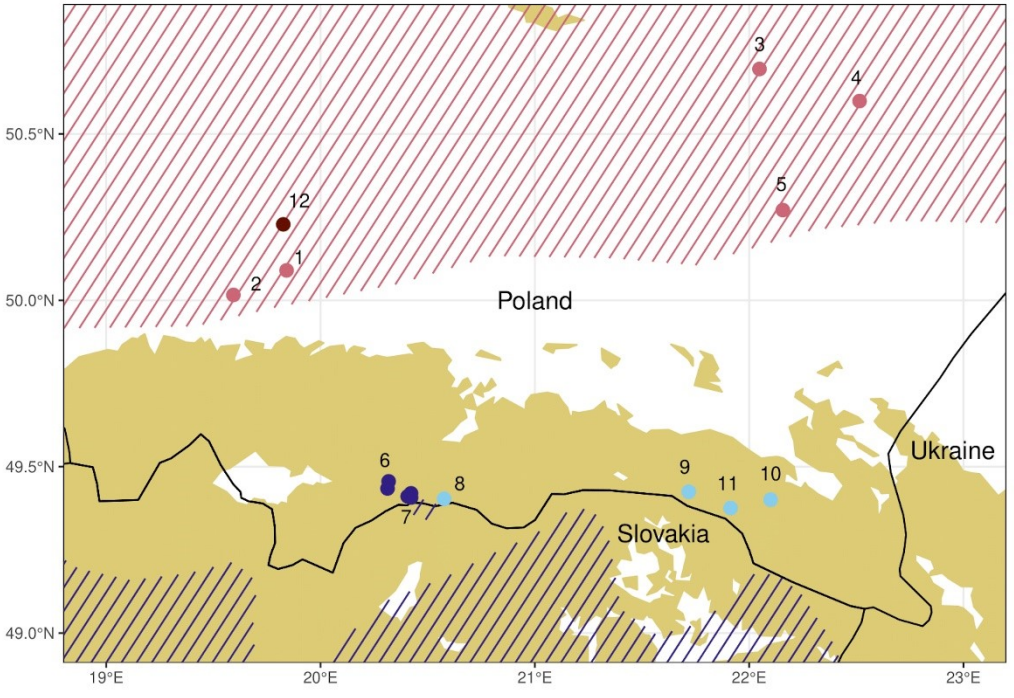

Fig. 3. Distribution of *Platycleis grisea* in Poland. Dark-blue points: *Platycleis grisea* sites confirmed by titillators morphology; light-blue points: sites with *P. grisea* occurrence but unconfirmed by titillators morphology; pink points: sites were *P. albopunctata* was collected; crimson point: site where *P. grisea* was historically erroneously reported; blue hatching: *P. grisea* distribution in Slovakia after Krištín (orthoptera.sk); pink hatching: *P. albopunctata* distribution after Żurawlew et al. 2021. Sites are numbered in the same way as in the Methods sections. Mountain areas are shown in yellow while country borders are shown as black lines.

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STRESZCZENIE

[**Występowanie *Platycleis grisea* Fabricius, 1781 (Orthoptera: Tettigoniidae) w Polsce**]

Platycleis grisea to gatunek z rodziny pasikonikowatych zasiedlający południową i wschodnią Europę. Na północ od Alp zastępuje go podobny gatunek bliźniaczy *Platycleis albopunctata*. Na wschód od Alp granica zasięgu obu gatunków przebiega przez Czechy, natomiast ze Słowacji znany jest jedynie *P. grisea*. Najpewniejszą cechą odróżniającaą oba gatunki jest kształt titillatorów, zesklerytyzowanej części aparatu genitalnego. U *Platycleis grisea* titillatory charakteryzują się wąską i delikaną częścią apikalną natomiast u *P. albopunctata* są bardziej przysadziste. W Polsce *P. grisea* pierwszy raz został podany przez Bazyluka (1957) z Pienin Właściwych. Później Bazyluk podał ten gatunek jeszcze z Ojcowskiego Parku Narodowego, natomiast najnowsze doniesienie pochodzi z Góry Wdżar w Gorcach. Niniejsza praca przedstawia morfologię osobników *Platycleis* z Góry Wdżar, okolic Ojcowskiego Parku Narodowego oraz niżowych populacji należących do *P. albopunctata* oraz podaje cztery nowe stanowiska *P. grisea* z Karpat Polskich. Jedynie morfologia titillatorów osobników z Góry Wdżar zgadza się z kształtem opisywanym dla *P. grisea*. Osobniki z Mydlnik, niedaleko Ojcowskiego Parku Narodowego, wykazywały cechy *P. albopunctata*. Z tego względu doniesienie o występowaniu *P. grisea* w Ojcowskim Parku Narodowym należy uznać za błędne. Podsumowując, zasięg *P. grisea* jest w Polsce ograniczony do Karpat, gdzie zasiedla Gorce, Pieniny Właściwe i Małe oraz Beskid Niski.

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