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An isolated dispersion of Sichel's bumblebee *Bombus sichelii* Radoszkowski, 1860 in northeast Poland

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Abstract: *Bombus sichelii* is a boreo-alpine species that has been previously regarded as extinct in Poland. The last Polish record of *B. sichelii* was before World War II, when it was recognized only in the Białowieża Forest. The species is characterized by a fragmented distribution in Europe, at least partially owing to specific climate preferences. During our studies of the Polish bumblebee distribution from the years 2004–2024, we have observed the species in the Suwalski Landscape Park. This region is distinguished by a cold continental climate that is referred to as the Polish Cold Pole. The nearest known populations of the species are quite distant, in northeast Russia and the Alpine Mountains. The presented field observations of *B. sichelii*, and the limited dispersal ability of this species, indicate that *B. sichelii* has been present for at least the last 20 years in northeastern Poland.

Key words: Apidae, bumblebees, occurrence changes, Poland

Introduction

Sichel's bumblebee (*Bombus sichelii*) belongs to a group of bees with strong habitat preferences, characterized by lower air temperatures and intense precipitation (Rasmont et al. 2021). It is widely distributed in the Palearctic realm, from western Europe through western and northern Asia. However, its geographic range is highly fragmented due to the limited dispersal ability of this species and its association with boreal and alpine-subalpine climatic conditions (Rasmont et al. 2021). Five subspecies have been distinguished that vary in colour patterns (Lecocq et al. 2015, Williams et al. 2020).

In northern Eurasia, *B. sichelii* is associated with boreal coniferous forest (Rasmont et al. 2021) and grassland (Potapov 2022) habitats. In the southern part of its range, the species is found only in subalpine mountain ranges, including the Pyrenees, Alps, Caucasus, Stara Planina and the mountains of northeastern Turkey and northern Iran (Rasmont et al. 2021). Historically, the species also occurred in European Russia near Moscow, where it is believed to now be extinct (Berezin et al. 1995). *Bombus sichelii* is classified as Least Concern (LC) on the European Red List of Bees (Nieto et al. 2014), but also as a high climate risk species that may be at significant risk in the future (Rasmont et al. 2021). In Poland, *B. sichelii* has only been reported from the Białowieża Forest before World War II (Bischoff 1925). Currently, this species is considered to be extinct before 1950 in Poland (Bogdanowicz et al. 2004, Kosior et al. 2007). Surprisingly, this species was spotted twice during recent field work. The purpose of this study is to report the

current occurrence of *B. sichelii* in Poland, plotted against the distribution of the species across the last two centuries.

Material and methods

Our studies included observational field-work in Suwalski Landscape Park, re-examination of preserved material collected in Poland in 2004, and a compilation of published bumblebee distribution datasets in Europe (Pawlikowski, 2008, Rasmont et al., 2015; internet databases and personal communications). The preserved specimen is located in the Laboratory Collection of T. Pawlikowski in Toruń. The registered data are presented on a topographic map with the UTM grid, with the chronology of species observations marked (Fig. 1). The determination of the photographed individuals was conducted following Pawlikowski & Pawlikowski (2012). The zoogeographical division of Poland (KFP) - Masurian Lake Region and Białowieża Forest, is presented according to Katalog Fauny Polski (Burakowski et al. 1973).

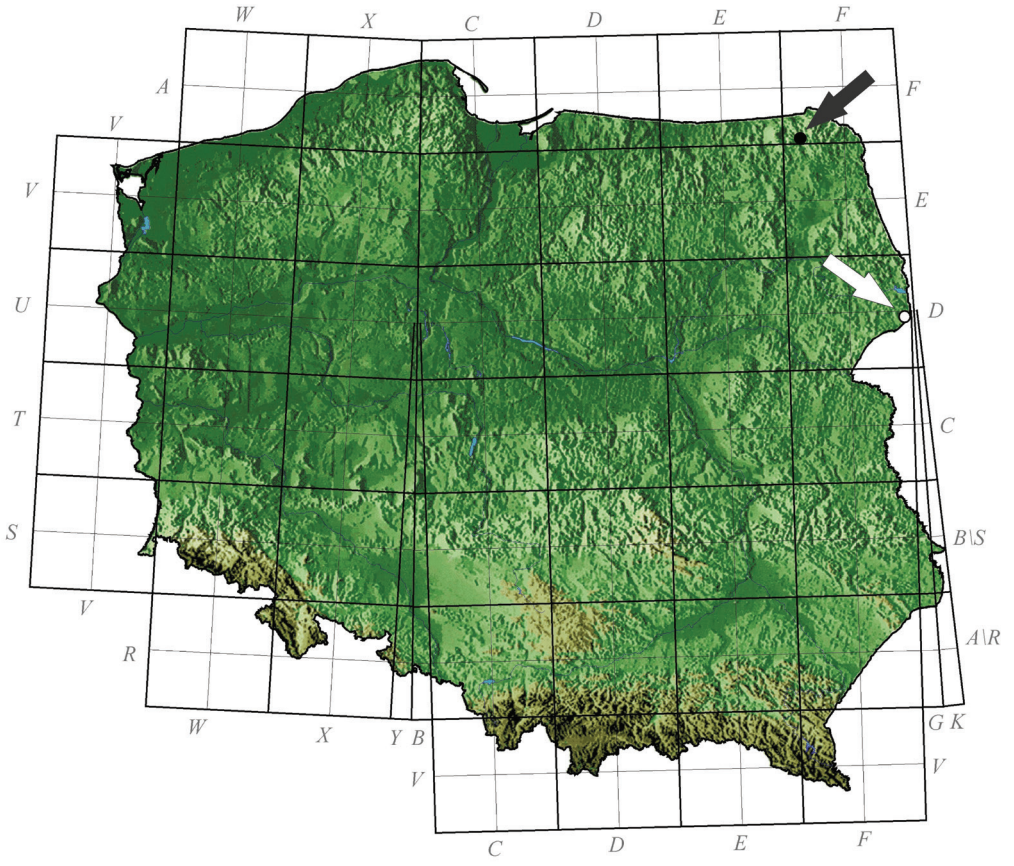

Fig. 1. Dispersion of *Bombus sichelii* Rad. in Poland from 1920-1993 (white arrow) and 2004-2024 (black arrow).

Results

Localities of *Bombus sichelii* Radoszkowski, 1860 in Poland

Podlaskie voivodeship, KFP Białowieża Forest

1) Puszcza Białowieska, Białowieża [FD94], 1920-1933 (Pawlikowski 2008, Rasmont et al. 2021).

Podlaskie voivodeship, KFP Masurian Lake Region

1) Kazimierówka [FF21], 31 May 2004 – 1 queen on *Lamium album* L., leg. E. Szałaszewicz (Fig. 2). Specimen in Pawlikowski's collection.
2) Szurpiły [FF21], 29 June 2024 – 2 living workers on *Anchusa officinalis* L. (Figs. 3a, b). The distance between the historical (Białowieża in 1920-1933) and current (Kazimierówka in 2004 and Szurpiły in 2024) Polish locations of this species is about 180 km.

Discussion

The genus *Bombus* includes 265 bee species, largely characterized by a high degree of adaptation to cool and temperate climate zones (Condamine & Hines 2015). The greatest species richness is found in the northern hemisphere, mainly in Europe, North America, and Asia (Michener 2007, Williams et al. 2008, Rasmont et al. 2021). Their occurrence in warmer regions is much rarer and is mainly associated with mountain ranges that provide suitable climatic conditions (Goulson 2010). At present, climate change highly influences the disappearance of bumblebee populations (Soroye et al. 2020), specifically through the negative impact of high temperatures on their development (Oyen et al. 2016, Wögler & Kurze 2025). Heat waves are known to contribute to their mortality (Zambra et al. 2020, Martinet et al. 2021). Climate change also affects mountain species (Biella et al. 2017, Ornosa et al. 2017), whose populations have begun to move to higher elevations in search of suitable habitats (Gerard et al. 2020, Marshall et al. 2020, Biella et al. 2024). The negative impact of climate change on bumblebees has been intensively studied in Europe (Kerr et al. 2015, Marshall et al. 2018) and North America, where high temperatures have been shown to be a determining factor of bumblebee range loss (Jackson et al. 2022).

Our new *B. sichelii* observations took place in Suwalski Landscape Park, located within the East Suwałki Lake District mesoregion (Fig. 1), part of the Lithuanian Lake District macroregion (Solon et al. 2018). The area largely consists of a rolling plain, diversified by a mosaic of well-preserved geomorphological forms such as kames, oases, moraines, and boulder fields (Pietrzak-Zawadzka et al. 2019). Compared to the Central Polish Lowlands to the west, the East Suwałki Lake District has a distinct climate, with clear continental characteristics, and is often referred to as the Polish Cold Pole. Despite this, its average summer temperatures are similar to other Polish regions. However, the growing season begins much later due to lower winter temperatures. Increased atmospheric precipitation in the spring and high average annual wind speeds of *ca.* 4 m/s have been noted (Lewoń et al. 2022). Suwalszczyzna is also uniquely characterized by the richness of its natural habitats and the relatively numerous groups of boreal floral species. Forests cover about 20% of the area and are dominated by hazel-spruce and pine-spruce mixed forests (Siudak et al. 2021).

B. sichelii observations from the Suwałki region, together with archived and published data, indicate that the species is consistently found in northeastern Poland. The habitats preferred by the species vary considerably in terms of the available food base, consistent with the polylectic food requirements of *B. sichelii* (Macior et al. 2001, Demidova et al. 2018, Williams et al. 2020). The species also feeds on cultivated plants, as noted by studies in China where *B.*

Fig. 2. Queen of *Bombus sichelii* Rad. Kazimierówka, 31 May 2004, Photo by M. Sikora.

sichelii frequently visited the crop *Brassica napus* L. (Chang et al. 2023). It appears that climatic conditions may determine the current limited distribution of *B. sichelii* (Rasmont et al. 2021). However, this species has not been observed from Feno-Scandinavia (Hallmen 2024), which has similar climatic conditions to common *B. sichelii* habitats. Interestingly, the Alpine bumblebee *Bombus alpinus* L., which similarly prefers cool areas and has a fragmented range, is found also in high mountain ranges (the Alps), but also in the taiga and tundra of Feno-Scandinavia (Biella et al. 2017), the latter of which lacks representatives of *B. sichelii*.

It is very likely that microhabitat features, such as the availability of food base and nesting sites, can play a key role in bumblebee conservation and can buffer the effects of climate change on these insects (Biella et al. 2024). As such, the Suwałki region is a key area for the preservation of current species diversity (Beaumont et al. 2019, Brambilla et al. 2024). This area has a rich variety of xerothermic vegetation, whose species composition is considered to be uniquely characteristic of this region. As emphasized by numerous entomological studies, the xerothermic meadows found in this area are important due to their abundance of xerothermic insects (Dawidowicz et al. 2012, Marczak & Lasecki 2012, Gutowski et al. 2020). In addition, a large part of the area is covered by numerous meadows and plant edge communities that provide a rich source of food for pollinating insects (Lewoń et al. 2022).

Protecting and maintaining high-quality habitats in these areas, which currently have high species richness and will serve as future species refugia, is the first pillar of any sensible conservation plan (Biella et al. 2024). Therefore, these regions require attention and the introduction of a specific conservation scenario.

Fig. 3a–b. Worker of *Bombus sichelii* Rad. Szurpiły, 29 June 2024, visiting *Anchusa officinalis* L., Photo by A. Dubicka-Czechowska.

Potential threats to the persistence of *B. sichelii* population in the Suwałki region include: (1) increasing climate warming, which will result in local droughts and heat waves; (2) changes

in the state of grassland and meadow habitat conservation due to secondary succession by the reduced intensity or abandonment of livestock grazing; (3) industrial expansion, especially the exploration of polymetallic ores, and (4) over-intensification of tourism.

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Streszczenie

[Izolowane występowanie trzmiela żółtopasego *Bombus sichelii* Radoszkowski w północno-wschodniej Polsce]

Trzmiel żółtopasy *Bombus sichelii* Radoszkowski jest gatunkiem borealno-alpejskim, który do niedawna był uważany za gatunek wymarły na terenie Polski. Ostatnie stwierdzenia *B. sichelii* pochodziły sprzed II wojny światowej i dotyczyły jedynie Puszczy Białowieskiej. Gatunek ten charakteryzuje się fragmentarycznym rozmieszczeniem w Europie i Azji co wynika prawdopodobnie z jego preferencji do obszarów charakteryzujących się chłodnym klimatem. Podczas badań rozmieszczenia trzmieli w Polsce w latach 2004–2024, dwukrotnie wykazano ten gatunek na terenie Suwalskiego Parku Krajobrazowego (31 maja 2004 – 1 królowa i 29 czerwca 2024 – 2 robotnice). Region ten wyróżnia się chłodnym klimatem kontynentalnym i określany jest mianem polskiego bieguna zimna. Najbliższe obszary stałego występowania gatunku znajdują się daleko na wschodzie, w północno-wschodniej Rosji oraz na zachodzie w Alpach. Przedstawione obserwacje wskazują na stabilne występowanie *B. sichelii* na obszarze północno-wschodniej Polski co najmniej przez ostanie 20 lat.

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