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ARTYKUŁ / ARTICLE

Ilybius wasastjernae (SAHLBERG, 1824) in Poland – a relict species of Dytiscidae (Coleoptera) with unique habitat preferences

Ilybius wasastjernae (SAHLBERG, 1824) w Polsce – reliktowy gatunek Dytiscidae (Coleoptera) o unikalnych wymaganiach środowiskowych

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ABSTRACT: *Ilybius wasastjernae* is a rarely collected member of a genus displaying unique habitat preferences. To date, there have been four records in Poland, always of single or just a very few individuals. Here, we are report four additional localities where this species was found in recent years; at one of them, more than ten individuals were seen. The southernmost of these localities was in the Świętokrzyskie Mts., far beyond the geographical range of this species in Poland, hitherto assumed to be restricted to the Baltic Coast and the Pomeranian Lake District regions in the northern part of the country. The majority of records come from pools formed in pits where root masses of uprooted trees used to be. Our observations show that the species occurs in small numbers (only a single individual was collected in one pool), and prefers cold, shaded water.

KEY WORDS: diving beetles, new records, faunistics, bogs, boggy forests.

Introduction

There are currently 16 species of the genus *Ilybius* ERICHSON, 1832 known from Poland (NILSSON & HÁJEK 2021). *Ilybius wasastjernae* (SAHLBERG, 1824) is one of the rarest diving beetles recorded in this country (Fig. 1). It used to be included in the genus *Agabus* LEACH, 1817 but was transferred quite recently to *Ilybius* (NILSSON 2000).

Ilybius wasastjernae is a circumboreal, Holarctic species, occurring in northern and central Europe, Siberia, Alaska, Canada and the northern United States (Michigan, Wisconsin) (NILSSON & HOLMEN 1995, LARSON & al. 2000).

European records of *Ilybius wasastjernae* come from Austria, Belarus, the Czech Republic, Denmark, Finland, Germany, Great Britain, Italy, Latvia, Norway, Poland, Russia, Sweden and Ukraine (NILSSON & HÁJEK 2021). A detailed overview of the German localities and data on the general distribution of *I. wasastjernae* in Europe was published by DETTNER & MOOS (2004). Since then, several new localities of this species have been found in central Europe: in Germany (Bavaria – BUSSLER 2005, the southern Black Forest – MÜLLER-KROEHLING 2013, Mecklenburg-Vorpommern – FRASE 2011), in Austria (SCHUH 2007), in Poland (Białowieża Forest – BIGGS & al. 2004, Białogóra nature reserve – BUCZYŃSKI & al. 2012), and recently in northern Italy, its southernmost locality in the Western Palaearctic (TOLEDO & CARLIN 2019).

Before now, *Ilybius wasastjernae* was recorded in only three regions of Poland: the Baltic Coast, where it was known from the Gdańsk area – Sobieszewo, Stogi, Westerplatte, Wisłoujście (KNIEPHOF 1935) – and the Białogóra nature reserve (BUCZYŃSKI & al. 2012), the Pomeranian Lake District, where it was recorded at Lake Krzemno near Czaplinek (KORDY-

LAS 1990), and the Białowieża Forest (BIGGS & al. 2004).

Owing to its specific habitat preferences and its rarity, *I. wasastjernae* is considered an endangered species in all the European countries where it occurs. Its status on the Polish red list of animals is vulnerable (VU) (PAWŁOWSKI & al. 2002). In most publications it is regarded as a glacial relict, a boreal-alpine, tyrphophilous/tyrphobiontic species (DETTNER 2004, BUSSLER 2005, TOLEDO & CARLIN 2019), characteristic of boggy woodlands, an EU-protected habitat (91D0*) (BUSSLER 2009). Subfossil remains of *I. wasastjernae* are numerous in deposits, which is why the present-day populations of this species are assumed to be relict ones (OWEN et al. 1992).

The aim of the present paper is to report new findings of *Ilybius wasastjernae* in Poland and to summarize knowledge on its habitat requirements in central Europe.

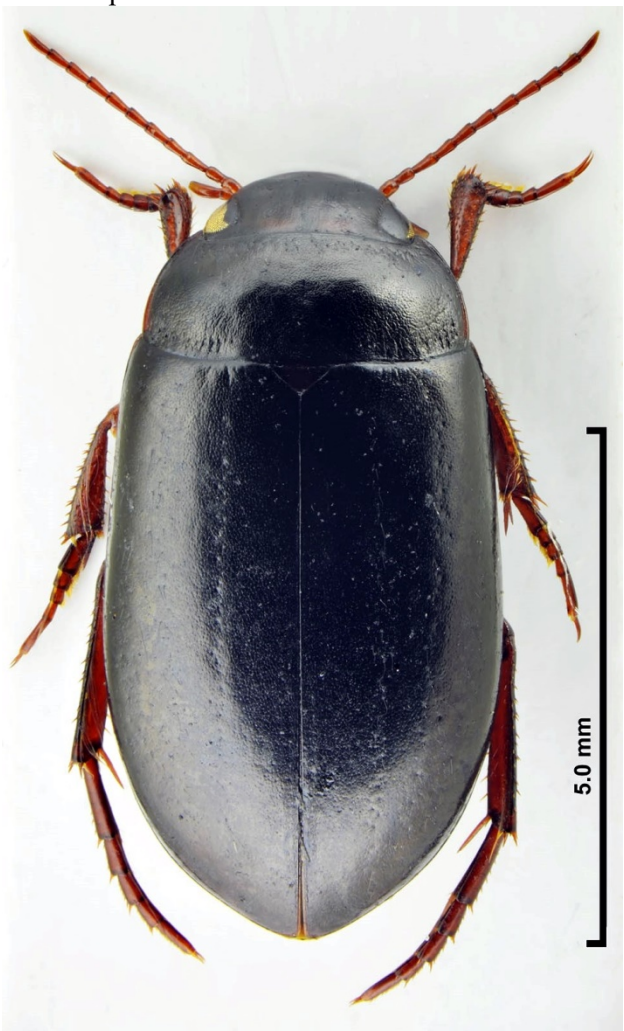

Fig. 1. *Ilybius wasastjernae*, a habitus of a specimen collected in the Słowińskie Błota nature reserve (photo R. RUTA).

Ryc. 1. *Ilybius wasastjernae*, okaz zebrany w rez. Słowińskie Błota (fot. R. RUTA).

Study areas and methods

Individuals of *Ilybius wasastjernae* were collected during four independent field surveys performed in the Baltic Coast, Pomeranian Lake District, Podlasie and the Świętokrzyskie Mountains. The techniques used in each region are summarized in Table 1. The relevant research permits were obtained for all the areas studied. The voucher specimens are deposited in the authors' collections.

The Słowińskie Błota nature reserve protects one of the best-preserved raised bogs of the Baltic type in Poland. The central part of the bog supports dwarf Scots pines *Pinus sylvestris* L. and is surrounded by a complex of boggy woodlands that has two zones: one with scattered, short Scots pines and birches, the other with a denser, darker stand of taller Scots pines and spruces *Picea* sp.

The Bagno Kusowo nature reserve is a large Baltic raised bog over 300 ha in area, covered with *Sphagnum* carpet and boggy forest. It is regarded as one of the best-preserved bogs of this type in Poland (HERBICHOWA & al. 2007). Peat used to be extracted from the southern part of the bog, but nowadays there is a complex of regenerating peat excavation pits and ditches in the area. In contrast, in the northern part of the bog, where *I. wasastjernae* was trapped, a typical, well-developed cupola is preserved with an open *Sphagnum* sp. surface in the central part.

In the Jesionowe Góry nature reserve, there is a vast depression covered with Machnacz raised bog with just a few, short Scots pines. Within the forests surrounding the bog there are numerous pools of water that have formed in the pits where the root masses of uprooted spruces used to be.

In the Świętokrzyski National Park, at the boundary of forest compartments 261c/262c, patches of boggy woodland with Scots pine and spruce have been preserved. There are numerous uprooted trees in the area.

Results

New localities of *Ilybius wasastjernae* are reported below. The following data are given for each locality: UTM code (10×10 km square), physiographic region (according to the Catalogue of Polish Fauna, BURAKOWSKI & al. 1976), and the name of the protected area where the locality is situated.

Baltic Coast: Słowińskie Błota nature reserve [WA92], 17.06.2017, 1 ex., in a pool (54.3591 N, 16.4816 E) under an uprooted tree in a boggy forest with Scots pine and spruce (Fig. 2), leg. Rafał RUTA; 11.06–10.07.2017, 1 ex., in a pitfall trap in a boggy forest with Scots pine and birch *Betula* sp. (Fig. 2), leg. Paweł SIENKIEWICZ; 10.07.2017, 1 ex., in a pool (54.3581 N, 16.4766 E) under an uprooted tree in a boggy forest with Scots pine and birch, leg. Rafał RUTA.

Fig. 2. Two different pools under uprooted trees where *I. wasastjernae* was collected; Słowińskie Błota nature reserve (photo R. RUTA).

Ryc. 2. Dwa zbiorniczki pod wykrotami, w których złowiono *I. wasastjernae*; rez. Słowińskie Błota (fot. R. RUTA).

Table 1. Collecting techniques used during the field surveys in the various study areas

Study area	Date of survey	Collecting techniques
Słowińskie Błota nature reserve	4.05 – 10.07.2017	– 3 sets of pitfall traps: 1) boggy forest with dominant spruce (11 traps); 2) boggy forest with dominant birch (11 traps); 3) open bog (33 traps); – direct search with aquatic net
Bagno Kusowo nature reserve	5.05 – 11.07.2017	– 4 sets of pitfall traps: 1) regenerating post-excavation area in the southern part of the reserve (11 traps), 2) boggy forest in the central part of the reserve (11 traps), 3) open carpet bog (33 traps), 4) on the shore of Lake Brzeźno in the eastern part of the reserve (5 traps); – direct search with aquatic net
Jesionowe Góry nature reserve	16.05.2020 – 9.05.2021	– direct search with aquatic net and tea sieve (20 cm diameter)
Świętokrzyski National Park	05.2020, 05.2021	– direct search with aquatic net and tea sieve (20 cm diameter)

Fig. 3. A pool under an uprooted tree, Jesionowe Góry nature reserve; the arrow indicates the deep, shaded part of the pool, where an individual of *I. wasastjernae* was collected (photo Cz. GREŃ).

Ryc. 3. Zbiorniczek pod wykrotem, rez. Jesionowe Góry; strzałka wskazuje głęboką, zacienioną część zbiorniczka, gdzie złowiono osobnika *I. wasastjernae* (fot. Cz. GREŃ).

Pomeranian Lake District: Bagno Kusowo nature reserve [XV06], open carpet bog, 10.06–11.07.2017, 2 exx., in pitfall traps, leg. Paweł SIENKIEWICZ.

Podlasie: Puszcza Knyszyńska forest, Machnacz, Jesionowe Góry nature reserve, 53.328829 N 23.305650 E [FE51], 9.05.2021, 9 exx., in pools under uprooted trees, each in a different pool, leg. Renata & Czesław GREŃ (Fig. 3); 4 exx., in pools under uprooted trees, each in a different pool, leg. Krzysztof LUBECKI; 53.331944 N 23.300 E [FE51], 16.05.2020, 1 ex., in a pool under an uprooted tree, leg. Czesław GREŃ.

Świętokrzyskie Mts.: Świętokrzyski National Park, Pasmo Klonowskie, comp. 261c/262c, 50.9329 N 20.8180 E [DB84], 15.05.2021, 2 exx., in a pool under an uprooted tree, leg. Czesław GREŃ.

In the Słowińskie Błota nature reserve a single specimen was collected in each of two pools under uprooted trees in a boggy forest. Another specimen was found in a pitfall trap installed close to one of those pools. In the Bagno Kusowo nature reserve two specimens were collected in pitfall traps deployed in the open part of the bog. All the specimens collected in the Jesionowe Góry nature reserve and the Świętokrzyski National Park were collected with a tea sieve from small pools, most of them in pits once filled by the root masses of larger or smaller uprooted trees.

The weather conditions differed significantly in 2020 and 2021. In 2020, there was very little rainfall, which was reflected in both the Jesionowe Góry nature reserve and the Świętokrzyski National Park. The peat bog in the former area dried out almost completely in 2020. As a result, several hours of exploration yielded just two water-filled pits: an 0.8 m wide pit dug in a bog, containing water to a depth of 1 m below ground level, and a pit under an uprooted tree containing a small puddle, where one specimen of *I. wasastjernae* was found. In 2021, after heavy spring rainfall, the peat bog was now well watered, and all the holes under uprooted trees, pits and other depressions in the ground were filled with water. During some 5 hours of intensive exploration of the area by three coleopterists, as many as 13 specimens of *I. wasastjernae* were collected. In the Świętokrzyski National Park not a single specimen was collected in 2020, but in 2021 two were found in water-filled pits under uprooted spruces.

Surprisingly, the beetles always occurred in small numbers in a single pool. Each time (number of observations: 15) just a single beetle was collected. This is in striking contrast to the records of other species of *Agabus* and *Ilybius*, larger numbers of specimens of which are often collected in appropriate microhabitats. Another important field observation is the fact that these beetles were found in deeper, cooler and shaded waters, never in the warmer, shallow parts of pools containing submerged vegetation.

Discussion

As already mentioned, *I. wasastjernae* is regarded as a taiga species (in the northern part of its range) or a species associated with bogs (in the southern part of its range). In Scandinavia, the species occurs in small pools in bogs and spruce forests, often shaded, with cold water (NILSSON & HOLMEN 1995), and in northern Germany it was found in post-excavation pits on a bog (FRASE 2011). It was recorded in pools that formed under the roots of uprooted trees in Russia (ZAITSEV 1972) and in Belarus (RYNDEVICH & al. 2014). According to DETTNER (1974), this is also the main microhabitat of the species in central Europe. Similar habitat preferences of *I. wasastjernae* were reported from Italy (TOLEDO & CARLIN 2019), but the authors also found the species on an open raised bog, not covered with forest. It seems that especially in southern and lowland areas *I. wasastjernae* needs shaded, cold-water water bodies, such as pools under uprooted trees, mainly spruces and pines, that can act as cold-water refugia. The biotopes where the present authors collected *I. wasastjernae* match surprisingly well the descriptions of the microhabitats of this species given by other coleopterists. It may be the case that during those parts of the season when these pools dry out or contain water that is not cold enough, the beetles can survive on land or migrate to other water bodies; this would explain their presence in pitfall traps. The abundance of *I. wasastjernae* varies from one year to another. This correlates with the hydrological conditions (see above) and had already been reported as a result of a 7-year study of the dytiscid community structure in a seasonal pond in northern Sweden, during which the species was collected only in three of those years (NILSSON 1986).

Before now, data on the biology and habitat preferences of *I. wasastjernae* in Poland were scarce and differed conspicuously from those gathered in other parts of the species' range. According to GALEWSKI & TRANDA (1978), this beetle is collected in "pools on a sea coast and in debris accumulated on the seashore", which appears to repeat data from KNIEPHOF (1935). KORDYLAS (1990) collected a single individual in the littoral of the oligotrophic, lobelia Lake Krzemno. BIGGS & al.

(2004) reported *I. wasastjernae* from two "forest ponds" in Białowieża Forest but without giving any further details on the microhabitat. According to GALEWSKI & TRANDA (1978), these beetles have never been seen to fly, a statement contradicted by other authors (NILSSON & SVENSSON 1995, DVOŘÁK & ŠŤASTNY 1998).

The majority of contemporary records from Poland show that pools which formed in pits under uprooted trees in boggy areas are the major microhabitats of the species. When the specific microhabitat of *I. wasastjernae* is taken into account, it becomes perfectly obvious that leaving uprooted trees in forests that enable such unique microhabitats to develop is essential for the conservation of this interesting diving beetle, at least in the climatic zone of central Europe.

These new distributional data (Fig. 4) have greatly enhanced our knowledge of the distribution of *I. wasastjernae* in Poland. Its presence in eastern Poland is not surprising, but it is interesting that the species was found in the Świętokrzyskie Mts. in southern Poland, as the species had earlier not been recorded in that part of the country.

The microhabitat requirements of *Ilybius wasastjernae* fully justify placing this species in the "Vulnerable" category on the Polish red list of endangered animals (PAWŁOWSKI & al. 2002).

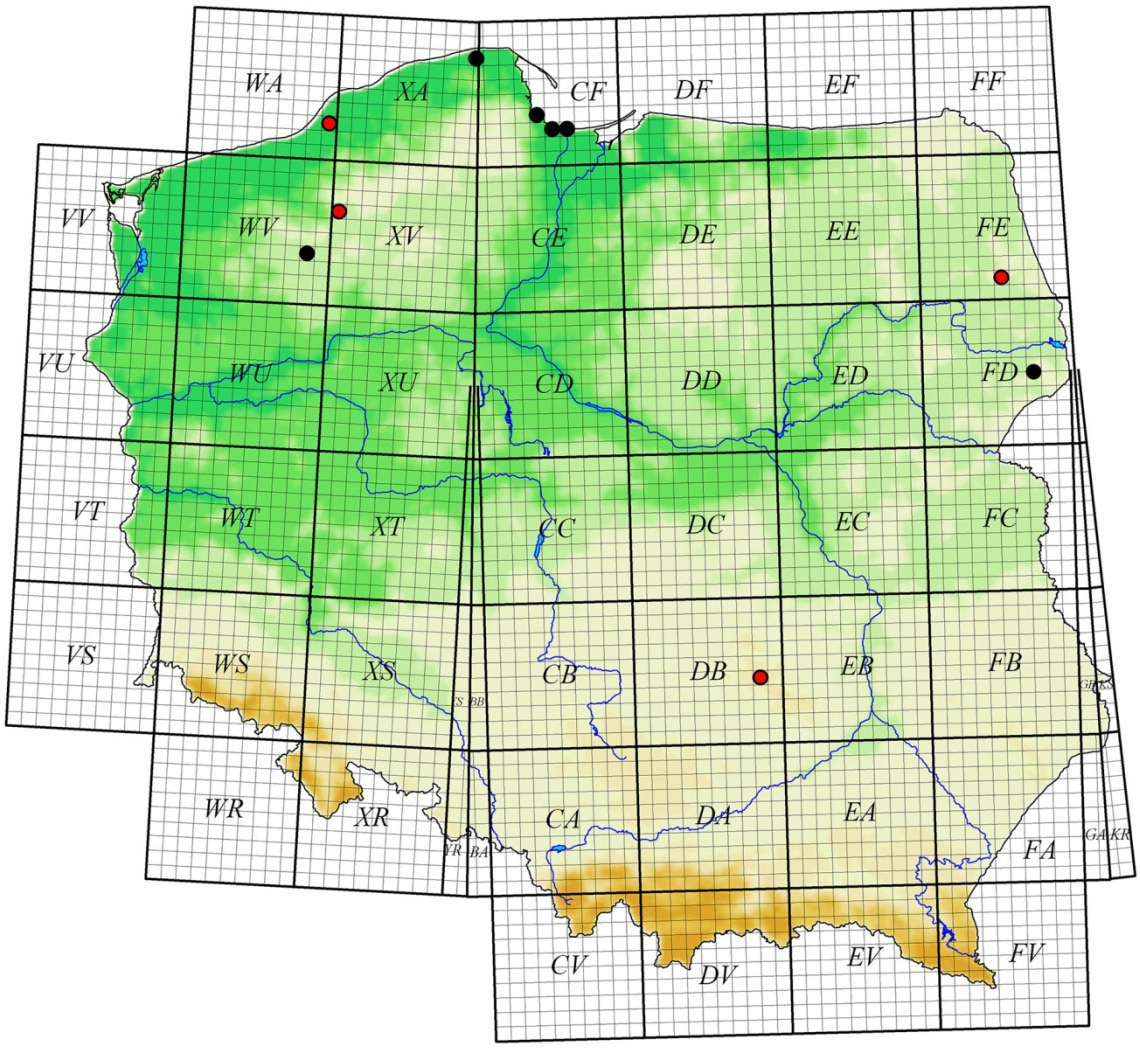

Fig. 4. Distribution of localities of *Ilybius wasastjernae* in Poland.
Black circles – literature data, red circles – localities reported in the present paper.

Ryc. 4. Rozmieszczenie stanowisk *Ilybius wasastjernae* w Polsce.
Czerne kółka – dane literaturowe, czerwone kółka – stanowiska opisane w bieżącej pracy.

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STRESZCZENIE

Ilybius wasastjernae to cyrkumborealny gatunek występujący w północnej i środkowej Europie (na południu sięgający do Włoch), na Syberii, Alasce, w Kanadzie i północnej części Stanów Zjednoczonych. Rzadkość występowania i specyficzne wymagania mikrosiedliskowe sprawiają, że omawiany gatunek jest uznawany za zagrożony we wszystkich europejskich krajach, w których go stwierdzono. Na czerwonej liście chrząszczy Polski posiada status VU (narażony). Uznawany jest za relikt glacjalny, gatunek borealno-górski, tyrfofilny bądź tyrfobiontyczny.

Ilybius wasastjernae jest jednym z najrzadziej spotykanych Dytiscidae Polski, znanym dotąd z nielicznych stwierdzeń w kraju. Znajdowano go do tej pory na Pobrzeżu Bałtyku, na Pojezierzu Pomorskim i w Puszczy Białowieskiej. W czasie badań terenowych prowadzonych w ostatnich latach w różnych rejonach Polski odnaleźliśmy szereg nowych stanowisk *I. wasastjernae*, których dokładne lokalizacje podajemy w bieżącej pracy, uzupełniając je o dane dotyczące preferencji środowiskowych.

Ilybius wasastjernae odnaleźliśmy na czterech nieznanych dotąd stanowiskach: w rez. Słowińskie Błota (Pobrzeże Bałtyku), w rez. Bagno Kusowo (Pojezierze Pomorskie), w rez. Jesionowe Góry (Podlasie) i w Świętokrzyskim Parku Narodowym (Góry Świętokrzyskie). Na większości wymienionych stanowisk *I. wasastjernae* łowiliśmy w zbiornikach wody tworzących się pod wykrotami, przy czym chrząszcze występowały zawsze pojedynczo i wyłącznie w głębszych, zacienionych partiach zbiorniczków, w chłodnej wodzie. Wyjątkiem był rez. Bagno Kusowo, gdzie dwa osobniki zostały złowione do pułapek Barbera na otwartym torfowisku. W rez. Słowińskie Błota oprócz dwóch okazów złowionych w zbiorniczkach pod wykrotami, trzeci został złowiony w pułapkę Barbera niedaleko jednego z wykrotów. Bardzo podobne obserwacje płyną z większości publikacji dotyczących występowania omawianego gatunku w Europie – jest to chrząszcz związany przede wszystkim ze zbiorniczkami tworzącymi się pod wykrotami, rzadziej spotykany jest na otwartych torfowiskach. Dane te wskazują na konieczność zachowania podobnych mikrosiedlisk w lasach na obrzeżach torfowisk i w borach bagiennych, jako warunkujących występowanie tego rzadkiego i zagrożonego gatunku.

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