

The lichen genus *Sarcogyne* (Acarosporaceae) in Belarus

Andrei Tsurykau^{1,2}, Kerry Knudsen³, Vladimir Golubkov⁴, Pavel Bely⁵, Jana Kocourková³

¹Department of Biology, Francisk Skorina Gomel State University, Sovetskaja 104, 246028 Gomel, Belarus

²Department of Bioorganic Chemistry, Gomel State Medical University, Lange 5, 246000 Gomel, Belarus

E-mail: tsurykau@gmail.com

³Department of Ecology, Faculty of Environmental Sciences, Czech University of Life Sciences, Prague, Kamýcká 129, Praha – Suchbátka 16500, Czech Republic

⁴Independent researcher, Grodno, Belarus

⁵Laboratory of Ecological Physiology of Plants, Central Botanical Garden of the National Academy of Sciences of Belarus, Surganova 2B, 220012 Minsk, Belarus

Abstract: The lichen genus *Sarcogyne* in Belarus is revised. Three species are accepted as occurring in the country, namely *Sarcogyne belarusensis*, *S. hypophaea*, and *S. pruinosa*. Of these, *Sarcogyne belarusensis* is the most widely distributed and commonest species. *Sarcogyne pruinosa* and *S. hypophaea* are rare taxa known from two and one localities, respectively. Morphological characters of these species are provided in comparison with similar taxa.

Keywords: biodiversity, distribution, ecology, crustose lichens

INTRODUCTION

Despite the first lichen records from Belarus being from the 18th century (Gilibert, 1781), the diversity and distribution of many saxicolous lichens still remain unknown in the country. Certain attention has been paid to saxicolous macrolichens (Golubkov, 1996; Tsurykau et al., 2018), some of which are included in the current edition of the red data book of Belarus (Kachanovsky, 2015). Crustose saxicolous species were almost completely neglected until recently when Knudsen & Kocourková (2020) revised specimens of Acarosporaceae from Belarus using morphological taxonomy as funds were not available for sequencing during that study. During that study, three species of *Sarcogyne* were stated to occur in Belarus, namely *S. hypophaea* (Nyl.) Arnold, *S. hypophaeoides* Vain. ex H. Magn. and *S. regularis* Körb. However, the recent revision of the *Sarcogyne pruinosa* – *S. regularis* group in Europe and North America using an integrative taxonomy utilizing sequenced specimens has dramatically changed our knowledge about the taxonomy of these species (Knudsen et al., 2023a). Here we provide new data on the diversity and distribution of the *Sarcogyne* species in Belarus based on the published specimens in Knudsen & Kocourková (2020), Knudsen et al. (2023a) as well as freshly discovered material from Gomel region.

MATERIAL AND METHODS

Specimens were studied from GSU, MSK, MSKH, MSKU and private herbaria of J. Kocourková & K. Knudsen (hb. K&K). Morphology and anatomy of the specimens were studied by standard light microscopy. Anatomical measurements were made in water. Hymenial gel reactions were studied with IKI using the protocol in Knudsen & Kocourková (2018a). The presence of gyrophoric acid was tested with C and KC and for norstictic/stictic acid with K and P. Selected specimens were also studied by thin layer chromatography in solvent C (Orange et al. 2001). The sequences were made following protocols described in Knudsen et al. (2023a). The phylogeny of the species was published in Knudsen et al. (2023a).

RESULTS AND DISCUSSION

Three species were found in the examined material, namely *Sarcogyne belarusensis* K. Knudsen, Tsurykau, Kocourk. & Hodková, *S. hypophaea* and *S. pruinosa* (Schaer.) A. Massal. Of these, *Sarcogyne belarusensis* was the most widely distributed and commonest species in the country while *S. pruinosa* and *S. hypophaea* were rare taxa known from two and one localities, respectively.

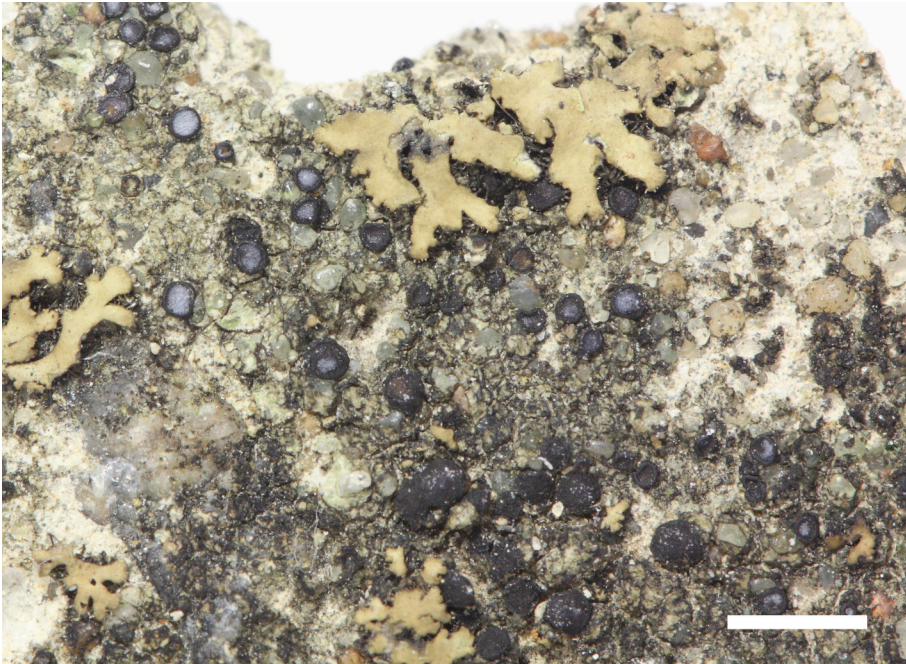


Fig. 1. A gray epilithic (chasmolith) thallus of *Sarcogyne belarusensis* growing on decaying concrete in Gomel region (scale = 2 mm).

The species

SARCOGYNE BELARUSENSIS K. Knudsen, Tsurykau, Kocourk. & Hodková

The species was recently described as new to science based on molecular studies of a selection of specimens previously identified as “*Sarcogyne regularis*” in Knudsen & Kocourková (2020). *Sarcogyne belarusensis* is characterized by having mainly pruinose, round, 0.2–0.7(–1.0) mm wide apothecia with usually convex disc and smooth margin, (80–)90–120 µm tall hymenium, (3.0–)3.7–4.7(–5.5) × (1.5–)1.7–2.2(–2.5) µm ascospores and hemiamyloid hymenial gel reaction (Knudsen et al., 2023a).

In the protologue, the thallus was described as endolithic (Knudsen et al., 2023a). Our recent study recovered one specimen of *S. belarusensis* growing on decaying concrete with a gray epilithic (chasmolith) thallus (Fig. 1). All endolithic *Sarcogyne* species can have a thin epilithic thallus on very hard rock or when the upper surface of rock is eroding exposing the endolithic thallus. A good example is *Sarcogyne hypophaea* (Nyl.) Arnold which on hard slate can form a thin gray epilithic thallus but usually

has an endolithic thallus (Knudsen et al., 2021). *Sarcogyne belarusensis* can at least rarely have an epilithic thallus like all *Sarcogyne* including *Sarcogyne pruinosa*.

The most similar species to *S. belarusensis* is *S. pruinosa* which clearly differs in having euamyloid vs. hemiamyloid hymenial gel reaction. *Sarcogyne pruinosa* rarely has an epilithic thallus, for instance in the synonym *Biatorella latericola* J. Steiner growing on a brick roof. Other European calciphyte *Sarcogyne* species with hemiamyloid hymenial gel and melanized margin are *S. distinguenda* Th. Fr., *S. fallax* H. Magn. and *S. nivea* Kremp. Both *S. distinguenda* and *S. nivea* always have an epilithic thallus. *Sarcogyne distinguenda* and *S. nivea* differ from *S. belarusensis* in having globose to broadly ellipsoid ascospores, 3.0–4.5 × 3.0–3.5 µm in *S. distinguenda* and 3–3.5 µm to 4 × 3 µm in *S. nivea* vs. (3.0–)4.2–4.7(–5.5) × (1.5–)1.7–2.0–2.2(–2.5) µm in *Sarcogyne belarusensis*. *Sarcogyne distinguenda* and *S. fallax* H. Magn. usually have a higher hymenium of 120–180 vs. (80–)90–120 µm tall in *S. belarusensis*. *Sarcogyne fallax* has never been reported

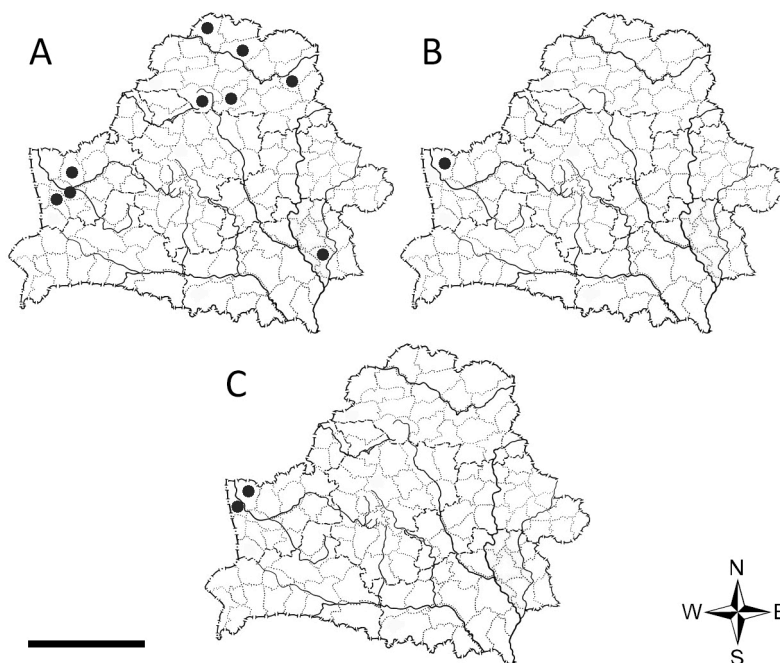


Fig. 2. Distribution of *Sarcogyne belarusensis* (A), *S. hypophaea* (B) and *S. pruinosa* (C) in Belarus (scale = 200 km).

with an epilithic thallus and also has ascospores globose to broadly ellipsoid ($4 \times 3 \mu\text{m}$).

Habitat. In Belarus, the species inhabits mainly concrete and other anthropogenic calcareous substrata, less often sandstone outcrops which are extremely rare in the country. *Sarcogyne belarusensis* is apparently confined to low elevations (<300 m) in Europe.

Distribution. *Sarcogyne belarusensis* is the most widely distributed member of the genus in Belarus (Fig. 2). It has also been reported from Germany, Italy (Knudsen et al., 2023a) and France (Lichens..., 2023). The species is anticipated to be discovered in other European countries in collections of "*Sarcogyne regularis*".

Material examined. Gomel region, Gomel district, Chenki recreation area, $52^{\circ}20'N$, $30^{\circ}57'E$, on concrete, A. Tsurykau, 16.09.2018 (GSU); Grodno region, Mosty district, 0.5 km SW Lunno village, on concrete, V. Golubkov, 27.06.1994 (hb K&K, GSU, MSK-L); Schuchin district, close to Kostenevo village, Kostenevka river floodplain, on boulder, V. Golubkov, 04.07.1999 (hb K&K, GSU, MSK-L); Volkovyssk district, close to Krasnoselsk village, ravine slope, on concrete,

A.I. Leonova, 24.07.2014 (hb K&K, MSK-L); Vitebsk region, Dokshytsy district, Berezinsky Biosphere Reserve, 1.8 km NNW of Osetische village, meadow, on lime-containing rocky substrate, P. Bely, 13.06.2007 (hb K&K, MSKH-6555); Lepel district, 1.5 km NE of Borovka village, on concrete, P. Bely, 19.05.2010 (hb K&K, GSU, MSKH-6554); Polotsk district, 0.5 NNW of Gomel village, $55^{\circ}17'N$, $28^{\circ}46'E$, 170 m, on moss-covered pill box, V. Golubkov, 29.08.1989 (GSU, holotype; PRM, isotype); Verhnedvinsk district, on island in Osveja lake close to Sukali village, V. Golubkov, 13.06.1986 (hb K&K, MSK-L); Vitebsk district, 2 km SW of Ruba village, right bank of the Western Dvina river valley, in shade of bushes and trees, sandstone outcrop on a steep coastal slope, G.V. Vynaev, 15.06.1982 (hb K&K, GSU, MSK-L).

SARCOGYNE HYPOPHAEA (Nyl.) Arnold

Sarcogyne hypophaea is a common species previously reported as *Sarcogyne privigna* (Ach.) A. Massal. (Magnusson, 1935; Knudsen et al., 2013). It is characterized by having sessile, often angular (0.4–)0.5–1 mm wide apothecia with deeply incised, segmented margin and red-brown

to dark red, epruinose disc, 60–120 µm tall hymenium, $3.5\text{--}5 \times 1\text{--}1.5(-2)$ µm ascospores and euamyloid hymenial gel reaction (Fletcher & Hawksworth, 2009; Knudsen & Kocourková, 2011).

In Europe, the species can easily be recognized by its deeply incised and segmented margin and often angular apothecia. It also has discs that always turn red when dampened (Knudsen & Kocourková, 2011).

Habitat. *Sarcogyne hypophaea* inhabits siliceous and calcareous rock. It was reported from Belarus from a single poorly developed specimen growing on concrete fortifications from World War I (Knudsen & Kocourková, 2020).

Distribution. In Belarus, *S. hypophaea* is known from a single locality close to the city of Grodno (Fig. 2). The species is common in Europe, northern Asia, North America and Antarctica (Magnusson, 1935; Seppelt et al., 1998; Urbanavichus 2010; Knudsen & Kocourková, 2011).

Material examined. Grodno region, Grodno district, close to Gibulichy village, 8th fort of the Grodno fortress, 53°36'N, 23°52'E, a bushy forest in the middle of a field, on a mossy concrete shard, V. Golubkov, 20.11.2007 (MSK, GSU, hb. K&K).

SARCOGYNE PRUINOSA (Schaer.) A. Massal.

In Europe, *Sarcogyne regularis* was a recent name for this common species however Knudsen et al. (2023a) reduced this name to synonymy with *Sarcogyne pruinosa*. *Sarcogyne pruinosa* is characterized by being variable in its pruinosity with 0.2–1.0(–1.5) mm wide apothecia with usually flat, rarely convex to hemispheric discs, 90–100(–130) µm tall hymenium, (2.0–)3.1–4.9 (–6.0) × (1.0–)1.3–2.1(–2.5) µm ascospores and euamyloid hymenial gel reaction (Knudsen et al., 2023a).

In Europe, *Sarcogyne pruinosa* resembles some other *Sarcogyne* species with euamyloid hymenial gel, namely *S. lecanorina* K. Knudsen, Kocourk. & Hodková, *S. oceanica* K. Knudsen & Kocourk., *S. platycarpoides* Anzi. and *S. praetermissa* K. Knudsen & Kocourk. *Sarcogyne lecanorina* differs in having smaller apothecia (0.3–0.4 µm wide) which are lecanorine, and lower hymenium (70–80 µm tall) (Knudsen et al., 2023b). *Sarcogyne oceanica* and *S.*

praetermissa are mainly similar in their anatomical and morphological features and clearly differ from *S. pruinosa* in having a smooth margin raised above the disc and curving inward (Knudsen & Kocourková, 2018b; Knudsen et al., 2023b). *Sarcogyne platycarpoides* differs in having a usually wider margin (100–150 vs. 30–110 µm) and sometimes algae in the lower part of apothecia (Knudsen et al., 2023a).

Habitat. In Belarus, this species was collected in anthropogenic habitats in the forest park “Rumlevo” in the city of Grodno and on concrete fortifications from World War I. In Europe, the species is common on anthropogenic substrata at a variety of elevations (Knudsen et al., 2023a) as well as on calcareous rocks.

Distribution. In Belarus, *Sarcogyne pruinosa* appears to be an extremely rare species known from two localities in the city of Grodno and its vicinity (Fig. 2). World distribution of the species requires verification. Despite being stated to be cosmopolitan (Fletcher & Hawksworth, 2009), recent studies did not recognize *S. pruinosa* as occurring in North America (Knudsen & Standley, 2007; Knudsen et al., 2023a). Obviously, specimens of this species need to be revised from outside Europe.

Material examined. Grodno region, Grodno district, close to Kemenka village, 6th fort of the Grodno fortress, on calcium carbonate crust on granite pebble, A.J. Leonova, 24.07.2013 (hb. K&K, GSU, MSK-L); the city of Grodno, Rumlevo park, near department store “Brest”, slope of a ravine, on sandstone, V. Golubkov 23.08.2008 (hb. K&K, GSU, MSK-L).

The two specimens of *Sarcogyne pruinosa* were determined as *S. hypophaeoides* because of inspersed hypothecium and euamyloid hymenial gel (Knudsen et al. 2020). However, the hypothecium was not as black as in *S. hypophaeoides*. This type of inspersation can be seen in a picture of *S. pruinosa* in Knudsen et al. (2023a). When Knudsen et al. (2023a) finally sequenced the Belarusian specimens, they were able to identify them as *S. pruinosa*. After further study of *S. hypophaeoides* we are of the opinion that the dark black hypothecium is a consistent character unlike for instance the hypothecium of *Sarcogyne clavus* which varies in density of the inspersation and is rarely completely black.

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