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THE LICHEN GENUS *CETRELIA* IN BELARUS: DISTRIBUTION, ECOLOGY AND CONSERVATION

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Abstract

Bely P., Golubkov V., Tsurykau A., Sidorovich E., 2014: The lichen genus *Cetrelia* in Belarus: distribution, ecology and conservation [Kerpių gentis *Cetrelia* Baltarusijoje: paplitimas, ekologija ir apsauga]. – Bot. Lith., 20(2): 69–76.

Two hundred and ten specimens of *Cetrelia* collected in Belarus in 1954–2012 were examined based on morphological and chemical characters. Three closely related species of *Cetrelia* (*C. cetrarioides*, *C. monachorum* and *C. olivetorum*) were identified in this study. The ecological notes and distribution maps of the detected species in Belarus were provided and their conservation status was discussed.

Keywords: chemotaxonomy, distribution, lichenized fungi, Parmeliaceae, Republic of Belarus.

INTRODUCTION

The genus *Cetrelia* W.L. Culb. & C.F. Culb. (*Parmeliaceae* Zenker, Lecanorales, Ascomycota) is characterized by large foliose and grey, loosely attached thalli with more or less punctiform pseudocyphellae on the upper cortex, at least partly black lower surface with sparse rhizines, marginal pycnidia, laminal, sometimes perforate apothecia, ellipsoid ascospores, and atranorin as the main cortical substance with various orcinol depsides and depsidones as diagnostic medullary substances (Culberson & Culberson, 1968, 1976; Randlane & Saag, 1991).

To date, the genus *Cetrelia* includes 18 species worldwide, of which most are distributed in eastern and south-eastern Asia (Culberson & Culberson, 1968, 1976; Randlane & Saag, 1991; Otnyukova et al., 2009). In Europe, only four species occur: *C. cetrarioides* (Duby) W.L. Culb. & C.F. Culb., *C. chicitae* (W.L. Culb.) W.L. Culb. & C.F. Culb., *C. monachorum* (Zahlbr.) W.L. Culb. & C.F. Culb. and *C. olivetorum* (Nyl.) W.L. Culb. & C.F. Culb. (Culberson & Culberson, 1968; Obermayer & Mayrhoffer, 2007; Hawksworth et al., 2008, 2011; Kukwa et al., 2012; Kukwa & Motiejūnaitė, 2012). These species have been differently treated in recent papers and floras (Randlane & Saag, 1991; Wirth, 1995; Bjelland et al., 1997; Santesson et al., 2004; Gilbert & Purvis, 2009; Thell & Kärnefelt, 2011). As the species of this genus seem to be rare almost everywhere, a thorough comparison of the DNA within the *C. olivetorum* group does not exist, however, a few sequences were presented by Thell et al. (2004) and Luo et al. (2007). Therefore, true taxonomic affinities of the species in the complex need to be studied further using molecular data.

The representatives of the genus are generally restricted to relatively moist, cool habitats and usually grow on the tree trunks or on bryophytes over shaded boulders (Culberson & Culberson, 1968). Within

Central Europe, the representatives of the genus are mostly epiphytic and inhabit deciduous trees mainly in old natural or seminatural forests (Obermayer & Mayrhoffer, 2007; Kukwa et al., 2012; Kukwa & Motiejūnaitė, 2012).

So far three species have been reported in Belarus, *Cetrelia cetrarioides*, *C. olivetorum* and *C. monachorum* (Kreyer, 1913; Ljubitskaja, 1914; Golubkov, 1986; Randlane & Saag, 1992; Bely, 2011), of which only the latter has been identified by means of thin layer chromatography (TLC) (Randlane & Saag, 1992). Thus, the revision of all available material was urgently needed to determine the distribution and habitat preferences as well as to assess conservation status of the species in Belarus.

MATERIALS AND METHODS

The present study is based on collections from the herbaria of GRSU, GSU, MSK, MSKH and MSKU. Herbarium acronyms follow Index Herbariorum (Thiers, continuously updated). Morphological features (thallus colour, shape and size of pseudocyphellae and soralia) of the samples were examined using a stereo microscope. All specimens were studied by means of thin layer chromatography (TLC) as well as microcrystal tests. TLC analyses were carried out according to the methods described by Culberson & Kristinsson (1970) and Orange et al. (2001). For the rapid screening of bulk specimens we found it sufficient to use solvent C (Obermayer & Mayrhoffer, 2007). Additionally, spot test reactions with calcium hypochlorite (C) were applied separately or in combination with solution of 10% potassium hydroxide (KC and CKC). Microcrystal tests were performed in GE (glycerol : glacial acetic acid, 3 : 1) according to the methods described by Asahina (1952).

RESULTS AND DISCUSSION

The species

Two hundred and three collections from Belarus were examined and all three previously reported species were identified: *C. cetrarioides*, *C. monachorum* and *C. olivetorum*. Almost 3.5% (7) of all collections were found to contain two species: *C. monachorum* and *C. olivetorum* (4), *C. cetrarioides* and *C. olivetorum* (2), and *C. cetrarioides* and *C. monachorum* (1).

Cetrelia olivetorum is the most common species in the country (51% of the studied specimens). Samples of this taxon could be easily identified by the very strong sanguineous red reaction with C of medulla and soralia due to the presence of olivetoric acid. It is also possible to identify olivetoric acid by using microcrystal tests. The crystals of olivetoric acid in GE solution crystallize slowly in the form of small, curved needles forming dense mat (Culberson & Culberson, 1968) and eventually uniting with each other in the form of treelike structures. Notably, a few specimens deposited at GRSU and MSK and originally labelled as *Parmotrema stuppeum* (Nyl.) Hale were found to be *Cetrelia olivetorum*.

No samples of *C. chicitae* were identified in the Belarusian material, however, it is expected to be found in the country as it has been reported from Białowieża National Park (Poland) close to the border with Belarus (Kukwa et al., 2012).

Only one specimen of *C. olivetorum* was found fertile with young and non-perforated apothecia. Pycnidia were found only in several samples of *C. cetrarioides* and *C. monachorum*.

Distribution in Belarus and neighbouring countries

Cetrelia cetrarioides is known only from 13 records in the northern and western parts of Belarus (Fig. 1). Among the neighbouring countries, the

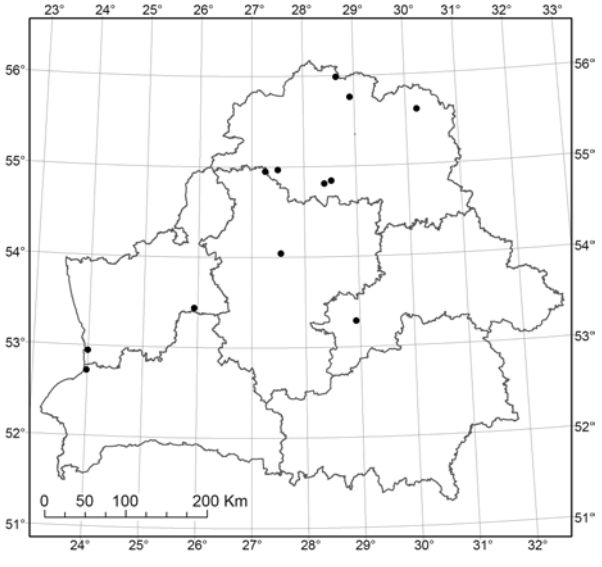

Fig. 1. Distribution of *Cetrelia cetrarioides* in Belarus

species is known from the Ukraine (Kondratyuk et al., 2010), Russia (Randlane & Saag, 1991) and Poland (Kukwa et al., 2012). It was not possible to evaluate the distribution of *C. cetrarioides* in Latvia as the *C. olivetorum* complex is regarded as one species in the country (Piterāns, 2001), including the former taxon.

Cetrelia monachorum is known from the southern (Pripyatsky National Park), south-western (Belovezhskaya Pushcha National Park) and northern parts of the country (Fig. 2). Regarding adjacent regions, the species has been reported from Lithuania (Kukwa & Motiejūnaitė, 2012), Poland (Kukwa et al., 2012) and the Ukraine (Kondratyuk et al., 2010). In Russia, *C. monachorum* earlier has been reported only from the Far East, southern Siberia and the Caucasus (Urbanavičius & Urbanavičienė, 2008), but currently the species has been noted also for the European part of Russia (Stepanchikova et al., 2011).

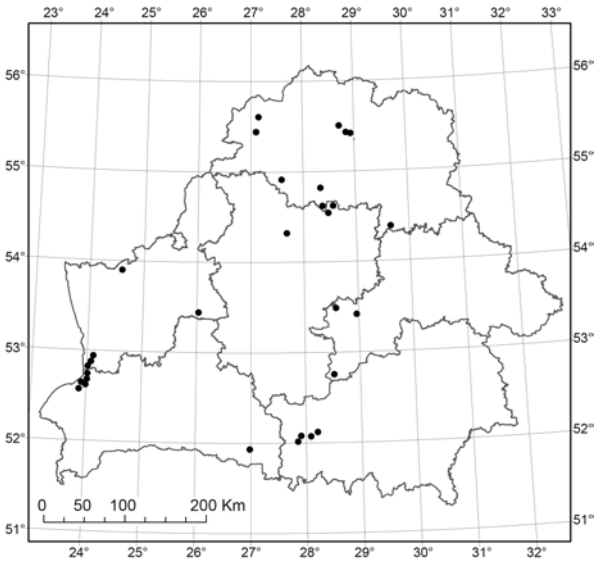

Fig. 2. Distribution of *Cetrelia monachorum* in Belarus

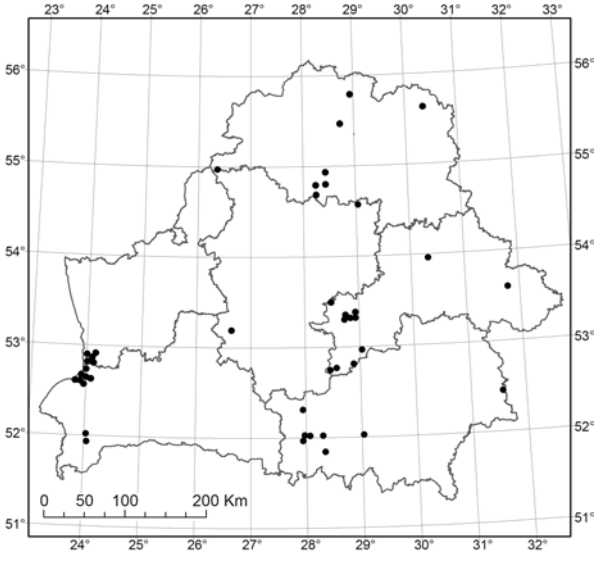

Fig. 3. Distribution of *Cetrelia olivetorum* in Belarus

Cetrelia olivetorum has quite similar distribution in Belarus to *C. monachorum*, but the latter taxon is less frequent in the south-eastern part of the country (Fig. 3). Regarding neighbouring countries, *C. olivetorum* is known from the Ukraine (Kondratyuk et al., 2010), Russia (Randlane & Saag, 1992; Urbanavičius & Urbanavičienė, 2008), Lithuania (Kukwa & Motiejūnaitė, 2012) and Poland (Kukwa et al., 2012).

Habitat requirements

In Belarus, all *Cetrelia* species are typical epiphytes confined to old natural or seminatural deciduous and coniferous forests with high humidity. In general, *Quercus* spp. (33%), *Alnus glutinosa* (26%) and *Carpinus betulus* (14%) are the most common substrates for *Cetrelia* species in Belarus (Fig. 4).

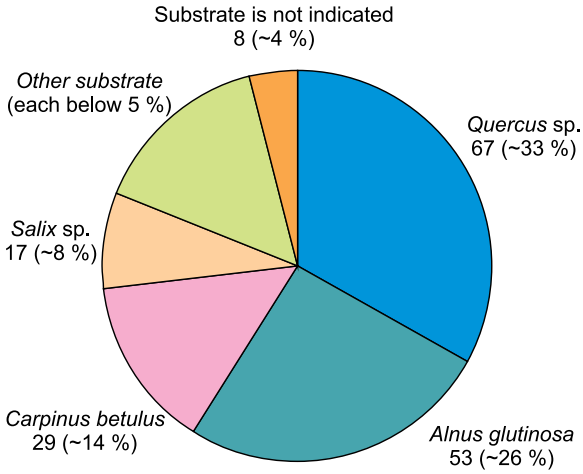

Fig. 4. Substrate preference of *Cetrelia* species in Belarus

Cetrelia cetrarioides was most commonly found in mixed forests, predominantly on deciduous trees. It was collected on *Alnus glutinosa* (3 specimens), *Betula* spp. (2), *Populus tremula* (2), *Carpinus betulus* (1), *Juniperus communis* (1) and *Quercus robur* (1). In three collections the information on the substrate was not reported.

Cetrelia monachorum usually grows in decidu-

ous forests (almost always in humid places). In case of four specimens no information about the vegetation type was provided on the labels. The species was collected on *Quercus* spp. (34 specimens), *Alnus glutinosa* (22), *Carpinus betulus* (15), *Fraxinus excelsior* (6), *Acer platanoides* (4), *Salix* spp. (4), *Populus tremula* (3) and decaying wood (1). Two collections did not provide any information about the substrate.

Cetrelia olivetorum was usually found in deciduous forests (mostly in humid situations) (73 specimens), and only rarely in coniferous forests (9); once it was found also in the village park. The labels of twenty three specimens did not provide any ecological data. *Cetrelia olivetorum* was found exclusively on deciduous trees: *Quercus robur* (32 specimens), *Alnus glutinosa* (28), *Carpinus betulus* (13), *Salix* spp. (13), *Betula* spp. (6), *Fraxinus excelsior* (3), *Acer platanoides* (2), *Populus tremula* (2), and bryophytes over fallen tree (1). Labels of six specimens did not give any detailed information about the substrate.

According to Obermayer & Mayrhoffer (2007), *Cetrelia* species prefer mostly *Acer pseudoplatanus*, *Fagus sylvatica*, *Alnus* spp. and less frequently *Quercus* spp., *Salix* spp. and *Fraxinus excelsior* in Central Europe. Kukwa et al. (2012) noted similar substrate preferences, but only for *C. cetrarioides* and *C. monachorum*. The same substrates are typical for *Cetrelia* species in Lithuania (Kukwa & Motiejūnaitė, 2012). In Belarus, substrate selectivity of *Cetrelia* species does not coincide with those in Central Europe. It seems to be related to the phytogeographical differences in phorophyte species diversity. Belarus is outside the natural range of *Acer pseudoplatanus* and *Fagus sylvatica* (Walters, 1968; Tuttin & Akeroyd, 1993), which leaves its mark on the substrate preferences of *Cetrelia* species.

In Belarus, most *Cetrelia* thalli grew among bryophytes (~70% of the investigated specimens) or on corticolous bryophytes (~6%) that has also been pointed out by Obermayer & Mayrhoffer (2007). Perhaps this is partly due to better moisture conditions in association with bryophytes.

Conservation status

The problem of chemical races and cryptic species has become an arduous task for conservationists. In Estonia, for example, *Cetrelia olivetorum* and *C. cetrarioides* are treated as two separate taxa in the Red List and are considered as vulnerable (Randlane et al., 2008). In Germany, *Cetrelia cetrarioides*, *C. chicitae* and *C. olivetorum* are also separated although they have different status: *C. cetrarioides* is listed as endangered, while the others are vulnerable (Hofbauer & Matzke-Hajek, 2011). On the other hand, in Lithuania, *Cetrelia* are regarded as one species complex for conservation purposes, while segregates are used for ecological and geographical studies only (Kukwa & Motiejūnaitė, 2012). This concept is justified by the similar substrate requirements of *Cetrelia* species and by their frequent co-occurrence (Obermayer & Mayrhoffer, 2007). Furthermore, chemical characters as a definitive tool in species recognition for practical conservation purposes were criticized by Lõhmus et al. (2003) for leprarioid lichens.

The current version of the Red Data Book of Belarus lists only *Cetrelia cetrarioides* s.l. as a vulnerable (VU) species (Khoruzhik et al., 2005). Our revision has shown that of the three recorded *Cetrelia* species, *C. cetrarioides* is the least frequent one in Belarus. Due to the fact that only two specimens of *C. cetrarioides* have been collected during the last two decades, the species merits the category "critically endangered" (CR). *Cetrelia monachorum* is little less common than *C. olivetorum* (43%). Additionally, as more than 80% of the specimens of *C. monachorum* and *C. olivetorum* were collected before 1990, both taxa are proposed to be treated as endangered (EN) in Belarus.

The splitting of the *C. olivetorum* complex into four taxa may be rational in case of reinforcing environmental protection measures in Belarus. The presence of species with a higher threat status helps conservationists to isolate specially protected sites during forest management activities in protected areas. Furthermore, it could optimize the environmental activities within existing protected areas as well as help to justify the creation of new ones.

Specimens examined

***Cetrelia cetrarioides*: Brèst region**: Pružany district, near Xvojnik village, Xvojnik forest district, 52° 43' N, 23° 59' E, 13 07 1984, V. Golubkov (MSK); **Hrodna region**: Navahrudak district, near

Valeŭka village, Svitjazjanskae forest district, 53° 25' N, 25° 55' E, 26 06 1987, V. Golubkov (MSK); Svislač district, 2 km W of Broŭsk village, Broŭsk forest district, 52° 51' N, 23° 57' E, 25 09 1984, V. Golubkov (MSK); **Minsk region**: Minsk district, near Slabodščyna village, 54° 01' N, 27° 48' E, G. Antonov, V. Golubkov, O. Maslovskii (MSK); Mjadzel district, the valley of the Mjadzelka river, 54° 58' N, 26° 51' E, 05 08 1986, V. Golubkov (MSK); **Mahilëŭ region**: Asipoviči district, 6.5 km SE of Lipen village, Asipoviči forest district, 53° 22' N, 28° 54' E, 10 06 1987, G. Antonov (MSK); **Vitebsk region**: Haradok district, Vjarèčča forest district, 55° 36' N, 30° 19' E, 12 10 1957, N. Gorbach, (MSK); Dokšycy district, near Vjalikija Sitcy village, 54° 55' N, 27° 31' E, 21 07 1985, V. Golubkov (MSK); Lepel' district, 2.5 km SE of Barsuki village, 54° 45' N, 28° 30' E, 15 07 2010, P. Bely, (2583 MSKH); Lepel' district, Bjarèzinski Biosphere Reserve, near Domžarycy village, 54° 44' N, 28° 18' E, 14 09 2008, A. Yatsyna (MSK); Rasony district, 3 km S of Tofeli village, 55° 45' N, 28° 55' E, 03 09 1988, V. Golubkov (MSK); near Juxaviči village, 56° 00' N, 28° 39' E, 03 09 1987, V. Golubkov (MSK).

Cetrelia monachorum **(selected specimens only, total number of specimens examined – 91): Brèst region**: Belavežskaja Pušča National Park, 29 09 1954, N. Gorbach (MSK); Baranaviči district, 1 km S of Tartaki village, natural landmark "Ručaj", 53° 01' N, 25° 43' E, 25 08 2009, P. Bely (MSKH 720); Kamjanec district, Belavežskaja Pušča National Park, Karalëŭ Most forest district, 52° 36' N, 23° 46' E, 17 10 2009, P. Bely (MSKH 2020); Pružany district, Belavežskaja Pušča National Park, Peraroŭ forest district, 3.5 km NW of Peraroŭ village, 52° 39' N, 23° 52' E, 22 06 1983, V. Golubkov (MSK); Stolin district, 5 km NW of Stolin town, 51° 55' N, 26° 49' E, 06 08 2010, P. Bely (MSKH 3009); **Homel' region**: Petrykaŭ district, Prypjacki National Park, Snjadzin forest district, 10.8 km NW of Tarhošyn village, 52° 06' N, 28° 12' E, 17 08 2010, V. Golubkov (GRSU); Žytkaviči district, 4 km SW of Bečy village, Azjarany forest district, 51° 59' N, 27° 51' E, 18 08 2010, V. Golubkov (GRSU); **Hrodna region**: Hrodna district, 6 km N of Jakubaviči village, Novy Dvor forest district, 53° 54' N, 24° 29' E, 16 08 1999, V. Golubkov (MSK); Navahrudak district, near Valeŭka village, Svitjazjanskae forest district, 53° 25' N, 25° 55' E, 24 06 1987, V. Golubkov (MSK); Svislač district, Belavežskaja Pušča National Park, 0.5 km W of Broŭsk village, Broŭsk forest district, 52° 51' N, 23° 58' E, 20 07 1984, V. Golubkov (MSK); **Minsk region**: Barysaŭ district, Bjarèzinski Biosphere Reserve, Palik forest district, 54° 31' N, 28° 21' E, 18 07 2008, P. Bely (MSKH 4615); Lahojsk district, near Januškaviči village, 54° 17' N, 27° 35' E, 30 05 1989, Yu. Poleschuk (MSK); Mjadzel district, Naračanski National Park, Mjadzel forest district, 54° 47' N, 26° 52' E, 18 08 2011, P. Bely (MSKH 4617); **Mahilëŭ region**: Hlusk district, Slaŭkaviči forest district, 52° 44' N, 28° 22' E, 27 07 2011, A. Yatsyna (MSK 7834); Asipoviči district, 1 km SE of Lipen' village, 53° 24' N, 28° 50' E, 15 05 1990, V. Golubkov (MSK); **Vitebsk region**: Dokšycy district, Bjarèzinski Biosphere Reserve, Rožna forest district, 54° 48' N, 28° 14' E, 22 02 2008, P. Bely (MSKH 4618); Lepel' district, Bjarèzinski Biosphere Reserve, Cjarèški forest district, 54° 38' N, 28° 25' E, 15 05 2008, P. Bely (MSKH 4616); Braslaŭ district, Braslaŭ Lakes National Park, Braslaŭ forest district, near Dubki village, 55° 36' N, 27° 05' E, 13 06 2011, A. Yatsyna (MSK 7600); Polack district, 2.5 km SW of Ksty village, Navapolack forest district, 55° 27' N, 28° 40' E, 30 08 1989, V. Golubkov (MSK); Taločyn district, 5 km SW of Taločyn town, 54° 23' N, 29° 38' E, 25 09 1987, V. Golubkov (MSK).

Cetrelia olivetorum **(selected specimens only, total number of specimens examined – 106): Brèst region**: Belavežskaja Pušča National Park, 28 09 1954, N. Gorbach (MSK); Kamjanec district, Belavežskaja Pušča National Park, Karalëŭ Most forest district, 4 km E of Viskuli village, 52° 36' N, 24° 00' E, 20 07 1984, V. Golubkov (MSK); Malaryta district, 12 km N of Malaryta town, 51° 53' N, 24° 06' E, 14 09 1984, V. Golubkov (MSK); Pružany district, Belavežskaja Pušča National Park, Peraroŭ forest district, 3 km S of Peraroŭ village, 52° 40' N, 23° 55' E, 10 06 1984, V. Golubkov (MSK); Žabinka district, near Mel'niki village, 52° 06' N, 24° 06' E, 22 06 1997, V. Golubkov (MSK); **Homel' region**: Dobruš district, 4 km N of Uborak village, 52° 25' N, 31° 35' E, 26 07 2010, P. Bely (MSKH 2728); Lel'čycy district, 1 km N of Lel'čycy town, 51° 48' N, 28° 19' E, 18 09 2009, P. Bely (MSKH 1865);

Mazyr district, near Xomički village, Maiseeŭka forest district, 52° 04' N, 29° 04' E, 22 05 1981, V. Golubkov (MSK); Žytkavičy district, Prypjacki National Park, Peraroŭ forest district, 52° 02' N, 28° 09' E, 27 08 1982, V. Golubkov (GRSU); **Hrodna region**: Svislač district, Belavežskaja Pušča National Park, 1 km ENE of Broŭsk village, Broŭsk forest district, 52° 51' N, 24° 00' E, 25 09 1984, V. Golubkov (MSK); **Minsk region**: Krupki district, near Pasemkavičy village, 54° 37' N, 29° 03' E, 06 07 1961, N. Gorbach, I. Koneva (MSK 6526); Mjadzel district, Ol'šèva village, 54° 56' N, 26° 21' E, 28 06 2006, A. Yatsyna (MSKU 1171); Njasviž district, forest cottage "Al'ba", 53° 12' N, 26° 38' E, 23 07 1960, N. Gorbach (MSK 7545); **Mahilëŭ region**: Babrujsk district, 3.5 km SW of Makaravičy village, 52° 54' N, 29° 03' E, 01 06 2011, P. Bely (MSKH 4619); Hlusk district, Slaŭkavičy forest district, 52° 46' N, 28° 33' E, 29 04 2011, A. Yatsyna (MSK 7280); Klimavičy district, natural landmark "Budzjanščyna", 53° 33' N, 31° 46' E, 27 01 2005, P. Borisenko (MSKU 813); Mahilëŭ district, near the city of Mahilëŭ, 11.07.1961, N. Gorbach, I. Koneva (MSK 7550); Asipovičy district, near Brycalavičy village, 53° 22' N, 28° 50' E, 21 05 2004, A. Yatsyna (MSKU 817); **Vitebsk region**: Dokšycy district, Bjarèzinski Biosphere Reserve, Bjarèzino forest district, 54° 54' N, 28° 22' E, 12 06 2007, P. Bely (MSKH 4614); Haradok district, Vjarèčča forest district, 55° 36' N, 30° 19' E, 12 10 1957, N. Gorbach (MSK 7543); Lepel' district, Bjarèzinski Biosphere Reserve, Krajcy forest district, 08 09 1983, V. Golubkov (MSK); Polack district, 2.5 km of Ksty village, Navapolack forest district, 55° 27' N, 28° 41' E, 30 08 1989, V. Golubkov (MSK); Rasony district, 3 km S of Tofeli village, 55° 45' N, 28° 55' E, 03 09 1988, V. Golubkov (MSK).

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KERPIŲ GENTIS *CETRELIA* BALTARUSIJOJE: PAPLITIMAS, EKOLOGIJA IR APSAUGA

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Santrauka

Du šimtai dešimt kerpių genties *Cetrelia* pavyzdžių, surinktų Baltarusijoje 1954–2012 metais buvo revizuoti remiantis morfologiniais ir cheminiais požymiais. Tyrimo metu buvo nustatytos trys tarpusavyje artimos *Cetrelia* genties rūšys – *C. cetrarioides*, *C. monachorum* ir *C. olivetorum*. Pateikiami Baltarusijoje rastų rūšių paplitimo žemėlapiai ir pastabos apie jų ekologiją bei aptariamas jų apsaugos statusas.