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The lichen family Parmeliaceae in Poland. II. The genus *Cetrelia*

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Abstract

In a study of the genus *Cetrelia* in Poland, four taxa have been identified, two of which, *C. chicitae* and *C. monachorum*, are reported for the first time from the country. All taxa differ in chemistry and subtle morphological characters. *Cetrelia monachorum* is the commonest member of the genus in Poland (237 records), whereas *C. chicitae* is known only from 6 records. All taxa are endangered, and three, *C. cetrarioides*, *C. chicitae* and *C. olivetorum*, appear to be critically so, thus deserving the category CR; although *C. monachorum* is the most frequent, it is not common and should be treated as endangered (EN). The distribution of all taxa, their habitat requirements, as well as morphology and secondary chemistry, are discussed.

Keywords: cetrarioid lichens, *Cetrelia cetrarioides*, *C. chicitae*, *C. monachorum*, *C. olivetorum*, chemotaxonomy, threatened species

Introduction

The genus *Cetrelia* W. L. Culb. & C. F. Culb. is characterized by its foliose, loosely attached grey thallus with laminal pseudocyphellae, prosoplectenchymatous upper cortex, at least partly black lower cortex with sparse rhizines, marginal pycnidia, ellipsoid ascospores and atranorin as the main cortical secondary metabolite; the species produce several depsidones as diagnostic medullary substances [1-3]. These characters separate *Cetrelia* from other morphologically similar genera such as *Parmotrema* A. Massal. and *Platismatia* W. L. Culb. & C. F. Culb. [1].

Currently, 18 *Cetrelia* species are known worldwide, with the greatest species diversity in eastern and southeastern Asia [1,2,4,5]. In Europe, only 4 taxa have been reported: *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. [1,3,4,6]. They differ mainly by the secondary chemistry, but also some thallus characters can be used to separate them (e.g., [3]). Due to their rather high morphological similarity the rank of species has not been always accepted and quite often taxa have been treated as chemotypes within the single species, *C. olivetorum* [7-13]. However, several papers have been recently published where the chemical races have been accorded species rank [3,14-21]; this has been confirmed by recent molecular studies [22,23].

In Poland, usually two species were recognized, *C. cetrarioides* and *C. olivetorum* (e.g. [24-27]), but in the recent list of Polish lichens Fałtynowicz [9] included only *C. olivetorum* with *C. cetrarioides* as its synonym. Both *C. cetrarioides* and *C. olivetorum* have been thought to be endangered in Poland [28], but as the genus was never studied with the aid of thin layer chromatography (TLC) in Poland (only spot test reaction with C was performed), the number of species as well as their status in Poland have remained unknown. Therefore a revision of all available material seemed to be urgently needed. In this paper, the second one dealing with the revision of selected genera of the family Parmeliaceae in Poland [29], we present the results of studies on the occurrence of the genus *Cetrelia* in the country, with notes on the chemistry, morphology and habitat requirements.

Material and methods

The present study is based on available collections from following lichen herbaria: KRA, KRAM, KRAP, KTC, LBL, LOD, OLS, OLTC, POZ, UGDA and herb. Szczepańska. The morphology was examined under a stereo microscope for thallus colour, and the shape and size of pseudocyphellae and soralia. Lichen substances were investigated by thin layer chromatography (TLC) in solvent C following the methods described by Culberson & Kristinsson [30] and Orange et al. [31]. Additionally, spot test reaction with C (commercial bleach) was applied separately or in combination with K (solution of 10% potassium hydroxide; KC test).

All examined localities are mapped according to the ATPOL grid square system [32](modified by Cieśliński & Fałtynowicz [33]; see also [29,34]).

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Results and discussion

Four species have been recognized in the Polish material of *Cetrelia*; two taxa, *C. chicitae* and *C. monachorum* are reported here for the first time for Poland.

Cetrelia monachorum is the commonest one in the country, but it has often been mistaken for *C. cetrarioides*, as both taxa have similar chemistry and spot test reaction with C and KC. On the other hand, most specimens of *C. olivetorum* have been correctly identified as it is the only taxon with very distinctive C reaction. *Cetrelia chicitae* appears to be the rarest member of the genus and critically endangered in Poland. All specimens of all taxa were found sterile, but sometimes pycnidia were observed.

The spot test reaction with C and KC were of little diagnostic importance and misleading as all taxa often showed at least a slight colour reaction with all reagents. Only *C. olivetorum* can certainly be identified with this method due to strong red reaction with C when it was applied to the medulla.

Concerning the distribution of *Cetrelia* in Poland, with the exception of a single locality of *C. olivetorum* in Western Pomerania, records are lacking in western and north-western parts of the country. This is perhaps due to the lack of available material from those regions, but the total absence of *Cetrelia* species there cannot be excluded.

Cetrelia cetrarioides (Delise) W. L. Culb. & C. F. Culb. Contrib. U. S. Natl. Herb. 34: 498. 1968. ≡ *Parmelia cetrarioides* Delise, in Duby, Bot. Gall. (Paris) 2(2): 601. 1830.

DIAGNOSTIC CHARACTERS. In *C. cetrarioides* the pseudocyphellae are small to rather large on the upper cortex and are usually not raised (or only sometimes raised), whereas those on the lower cortex of sterile lobes are always small and flat, usually white, brownish, or in older parts of thallus grey-brown. The species often develops smooth and very convex soralia with small (usually up to 35 μm in diam.) soredia [1,3]. The chemistry of Polish material agrees with that reported by earlier authors, with atranorin (present in high concentration in soralia and low concentration in cortex) and perlatolic acid (major medullary compound) found; additionally, traces or minor amounts of 4-O-methylolivetoric and anziaic acids were easily detectable (see also [1,3]). Olivetoric acid as a minor constituent reported by Culberson and Culberson [4] was not detected in the studied material.

NOTES. The species can be readily distinguished from other members of the genus by the production of large amounts of perlatolic acid, often small soredia, and commonly the presence of large pseudocyphellae on the lower side of sterile lobes. *Cetrelia monachorum* is the most chemically and morphologically similar species, but differs in the production of large amounts of imbricaric acid, minor amounts of perlatolic acid (major secondary metabolite in *C. cetrarioides*) and trace (or minor) of 4-O-demethylimbricaric acid. Additionally, *C. monachorum* develops mostly somewhat raised pseudocyphellae on the upper cortex (flat pseudocyphellae may also occur), coarse soredia (usually exceeding 40 μm in diam.) and soralia which are often irregular in shape; the species usually lacks pseudocyphellae on the lower cortex [3].

In Poland, a few specimens originally determined as *C. cetrarioides* were found to be *Parmotrema perlatum* (Huds.) M. Choisy which develops cilia on the thallus margin and contains atranorin and stictic acid complex (e.g. [29]).

Cetrelia cetrarioides was considered as an endangered species (EN) in Poland [28]. This revision has shown it to be much rarer than previously known, as most records represented *C. monachorum*. On the basis of the number of known collections and the fact that only 12 specimens have been collected during the last two decades, it should be considered as critically endangered (CR).

HABITAT REQUIREMENTS. In Poland, *C. cetrarioides* is found mostly in deciduous forests, quite often in river or stream valleys, but some records also come from pine forests or avenues of trees. It is an epiphyte, growing predominantly on deciduous, very rarely coniferous, trees. It has been collected from *Acer pseudoplatanus* (10 specimens), *Fagus sylvatica* (10), *Alnus* spp. (5), *Fraxinus excelsior* (3), *Quercus* spp. (3), *Abies alba* (2), *Carpinus betulus* (2), *Malus domestica* (2), *Picea abies* (2), *Salix* sp. (2), *Sorbus aucuparia* (2), bark of unspecified tree (2) and bark of tree stump (1). Very similar substrate preferences were reported by Obermayer and Mayrhofer [3].

DISTRIBUTION IN POLAND. The species is a rare lichen in Poland, known mostly from southern part of the country, and with very few and most probably the only historical records from the northern part (Fig. 1). As most records came from mountainous areas, the species can be considered as mountainous taxon in the country.

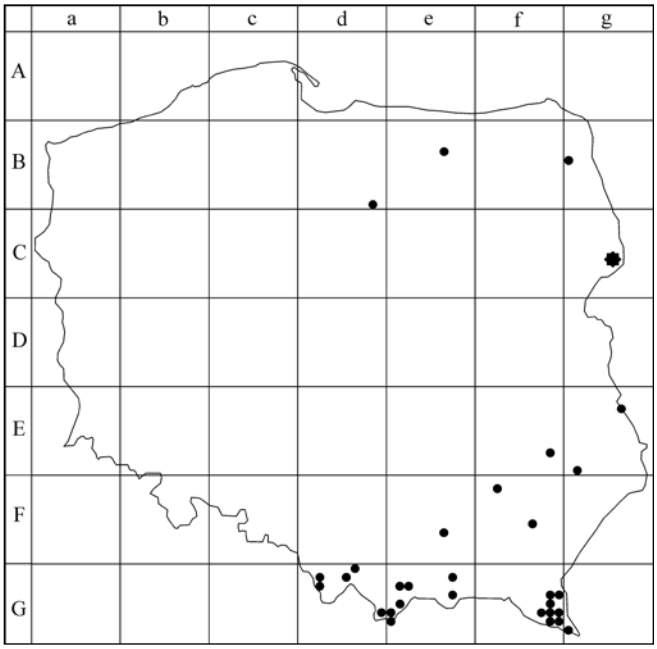

Fig. 1 Distribution of *Cetrelia cetrarioides* in Poland. Star – approximate location of record from Puszcza Białowieska Forest.

GENERAL DISTRIBUTION. *Cetrelia cetrarioides* is rather widely distributed in the Northern Hemisphere with only a few records from Southern Hemisphere [1,3,35]. In Europe it has been reported from Austria, Estonia, France, Germany, Great Britain, Italy, Montenegro, Norway, Portugal, Russia, Slovenia, Spain, Switzerland and Ukraine [1-3,7,12,14,17,36-39]. It was also reported from Armenia, Asiatic part of Russia, Azerbaijan Republic, Bhutan, Chile (Juan Fernández Islands), China, Georgia, Hawaiian Islands, Iran, Japan, Mexico, USA and Western Samoa [1,2,17,21,35,40-42]. Some additional records have been also published (see e.g. [6]), but there is no certainty whether the material represented *C. cetrarioides* s.str. as no data on chemistry are available, thus they are not cited here. The report of *C. cetrarioides* with imbricaric acid

in Diederich & Sérusiaux [43] and Diederich et al. [44] refers to *C. monachorum*.

NUMBER OF SPECIMENS EXAMINED – 47.

Specimens examined: **Bd-98** – Pojezierze Iławskie Lakeland, Niedźwiedzie Wielkie Nature Reserve, forest section No. 171a & d, on bark, 1957, J. Hutorowicz (OLS-L 551). **Be-36** – Pojezierze Mrągowskie Lakeland, Dębowy Nature Reserve, forest section No. 198b, beech forest, on *Fagus sylvatica*, 1957, J. Hutorowicz (OLS-L 552). **Bg-40** – Kotlina Biebrzańska Basin, 1 km NE of Balinka village, on *Fraxinus excelsior*, 1986, S. Cieśliński (KTC). **Ef-78** – Padół Zamojski Depression, Guzówka Forest, forest section No. 68, on *Carpinus betulus*, 1950, J. Rydzak (LBL). **Eg-26** – Beskid Niski Mts, Binczarowa village, near Grybów village, on *Alnus glutinosa*, 1923, J. Motyka (LBL). **Eg-91** – Roztocze Środkowe, Zwierzyniec village, forest section No. 109, on *Alnus glutinosa*, 1973, H. Chorążyczewska (LBL). **Fe-66** – Kotlina Sandomierska Basin, Nizina Nadwiślańska Lowland, Puszcza Niepołomicka Forest, Szujec village, 50°01′19″N, 20°49′21″E, pine forest, roadside, on *Quercus* sp., 1962, J. Kiszka (KRAP). **Ff-12** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Buda Stalowska village, forest section No. 256, on *Quercus* sp., 1981, J. Kiszka (KRAP). **Ff-56** – Podgórze Rzeszowskie Foothills, Puszcza Sandomierska Forest, near Łańcut town, Julin forest district (location not precise), beech forest, on *Fagus sylvatica*, 1963, B. Ordyczyńska (LBL). **Gd-06** – Beskid Żywiecki Mts, between Jałowiec and Lachów Groń Mts, alt. ca. 800 m, on *Acer pseudoplatanus*, 1965, J. Nowak (KRAM-L 15564). **Gd-12** – Beskid Śląski Mts, Hala pod Przysłopem alpine meadow, alt. 980 m, spruce forest, on *Fagus sylvatica*, 1962, J. Kiszka (KRAP). **Gd-15** – Beskid Żywiecki Mts, Janikowka by Koszarawa village, alt. ca. 415 m, on *Quercus* sp., 1964, J. Nowak (KRAM-L 16329). **Gd-32** – Beskid Żywiecki Mts, Wielka Racza Mt., 49°24′47″N, 18°58′06″E, alt. ca. 1200 m, forest, on *Sorbus aucuparia*, 1964, J. Nowak (KRAM-L 14147). **Gd-59** – Tatry Wschodnie Mts, Dolina Białego valley, on *Acer pseudoplatanus* and *Fagus sylvatica*, 1925, 1929 & 1949, J. Motyka (KRAM-L 10140, LBL); Tatry Zachodnie Mts, Dolina Strążyska valley, on *Abies alba* and *Picea abies*, 1926 & 1934, J. Motyka (KRAM-L 10142, LBL); Droga pod Reglami road, the end of Dolina Za Bramką valley, on *Acer pseudoplatanus*, 1957, T. Sulma (UGDA-L 16455); Dolina Kościeliska valley, alt. ca. 940 m, on *Sorbus aucuparia*, 1923, J. Motyka (LBL). **Ge-17** – Beskid Niski Mts, Chełm Mt. near Męcina railway station, on *Fagus sylvatica*, 1950, Z. Oleszczuk (LBL). **Ge-21** – Gorce Mts, Gorce National Park, S slopes of Kiczora Mt., Polana Zieleniec glade, way to Łopuszna valley, alt. 1080 m, on *Fagus sylvatica*, 1966, K. Glanc (KRAM-L 37057). **Ge-22** – Gorce Mts, Gorce National Park, by Kamienica stream, close to Gorc Mt., alt. 700 m, on *Fagus sylvatica*, 1961, K. Glanc (KRAM-L 37053). **Ge-37** – Beskid Sądecki Mts, Pasmo Radziejowej range, Wielka Roztoka stream valley, alt. 520 m, on *Acer pseudoplatanus*, 1990, L. Śliwa (KRA). **Ge-42** – Pasmo Spiskie Range, Łazy village, alt. 660 m, by the stream, on *Alnus glutinosa*, 1970, J. Kiszka (KRAP). **Ge-50** – Tatry Wschodnie Mts, Kuźnice settlement, on *Fraxinus excelsior*, 1924, J. Motyka (LBL); Krokiew Mt., alt. ca. 1350 m, on bark, 1927, J. Motyka (KRAM-L 786); Tatry Zachodnie Mts, Dolina Olczyska valley, Polana Olczyska glade, alt. 950 m, on *Acer pseudoplatanus*, 1998, U. Bielczyk (KRAM-L 44161). **Ge-60** – Tatry Zachodnie Mts, Dolina Białej Wody valley, near the junction with Rybi Potok stream, alt. 1100 m, on *Alnus* sp., 1956, K. Tatarkiewicz (LBL). **Gf-38** – Bieszczady Zachodnie Mts, Teleśnica Oszwarowa village, 49°23′N, 22°33′E, on *Acer pseudoplatanus*, 1997, R. Kościelniak (KRAP); NE slope of Żuków, by Zabłocie, on bark of tree stump, 1991, R. Kościelniak (KRAP). **Gf-39** – Bieszczady Zachodnie Mts, Daszówka settlement, near Bukowina, alt. 585 m, 49°22.04′N, 22°35.41′E, on *Salix* sp., 1996, R. Kościelniak (KRAP). **Gf-48** – Bieszczady Zachodnie Mts, Sokole village, 49°20.35′N, 22°32.39′E, on *Malus domestica*, 1996.06.24, R. Kościelniak (KRAP). **Gf-57** – Bieszczady Zachodnie, SW slope of Czerenina Mt., on *Fagus sylvatica*, 1991, R. Kościelniak (KRAP). **Gf-58** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Połonina Wetlińska mountain pasture, stream from Średni Wierch Mt. to Suche Rzeki former village, on *Fraxinus excelsior*, s.d., J. Kiszka (KRAP); Średni Wierch Mt., near Połonina Wetlińska mountain pasture, alt. 970 m, on *Fagus sylvatica*, 2005, R. Kościelniak (KRAP). **Gf-59** – Bieszczady Zachodnie Mts, SE slope of Stuposiańska Magura Mt., in forest above the road between Stuposiany and Bereżki villages, alt. 650 m, on *Fagus sylvatica*, 1958, K. Glanc (KRAM-L 37052). **Gf-68** – Bieszczady Zachodnie Mts, Wetlina village, on *Malus domestica*, 1956.07.18, K. Glanc (KRAM-L 37045); Bieszczadzki National Park, Czerteż Mt., alt. 930 m, on *Acer pseudoplatanus*, 2002, R. Kościelniak (KRAP); Dział Mt., glade near Wetlinka river, on *Salix* sp., 2001, J. Kiszka (KRAP). **Gf-69** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, unnamed mountains (with alt. 1140 m) near Wielka Semenowa Mt., 49°05′36″N, 22°36′02″E, alt. 1110 m, on *Acer pseudoplatanus*, 1997, R. Kościelniak (KRAP); Widełki, on *Acer pseudoplatanus*, 2001, J. Kiszka (KRAP). **Gg-70** – Bieszczady Zachodnie Mts, SE slope of Halicz Mt., by Halicz stream, alt. 1120 m, on *Alnus glutinosa*, 1957, K. Glanc (KRAM-L 27617, as admixture in specimen of *Platismatia glauca*). Records lacking precise data: Puszcza Białowieska Forest, oak-linden-hornbeam forest, on *Carpinus betulus*, 1948, J. Motyka (LBL); Białowieża National Park, on *Picea abies*, 1949, J. Rydzak (LBL).

Cetrelia chicitae (W. L. Culb.) W. L. Culb. & C. F. Culb.

Contrib. U. S. Natl. Herb. 34: 498. 1968. ≡ *Cetraria chicitae* W. L. Culb., Bryologist 68: 95. 1965.

DIAGNOSTIC CHARACTERS. This species is characterized by its not raised, large and flat pseudocyphellae on upper cortex, coarse soralia present on strongly distorted lobes, soredia usually exceeding 40 μm in diam., and the absence of pseudocyphellae on lower side of sterile lobes. Secondary metabolites include atranorin (high concentration in soralia and low concentration in cortex) and alectotonic and α-collatolic acids (present in medulla and also soralia) as major compounds, together with 4-O-methylphysodic and physodic acids as minor substances [1,3,45]. Polish specimens perfectly fall into the characteristics of the species.

NOTES. *Cetrelia chicitae* is a very easily recognizable species due to the large pseudocyphellae on the upper cortex and the presence of alectotonic and α-collatolic acids (e.g. [1,3]).

In Poland, similar medullary chemistry is known only in one foliose lichen, *Parmotrema arnoldii* (Du Rietz) Hale, which is also sorediate, but lacks pseudocyphellae, and additionally differs in the soralia developing mostly on laciniae; the presence of rhizines in the central part of thallus and ciliate (sometimes only sparsely) thallus margin are also diagnostic in case of *P. arnoldii* [29,46].

Cetrelia chicitae has been collected only 6 times in Poland, the most recent record being 1998. It seems to be critically endangered and should therefore be considered as CR in the future red list of threatened lichens in Poland.

HABITAT REQUIREMENTS. *Cetrelia chicitae* has been collected always in forest conditions in Poland. Five collections originate from trees and one from a mossy log.

DISTRIBUTION IN POLAND. The species is very rare in Poland (Fig. 2; one poorly localized record not mapped), being known only from 6 records.

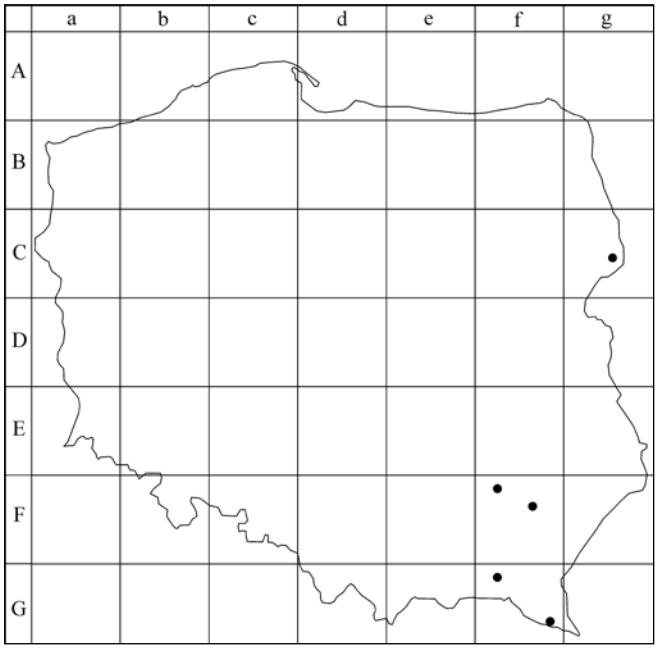

Fig. 2 Distribution of *Cetrelia chicitae* in Poland.

GENERAL DISTRIBUTION. It is a widely distributed species, thought to be usually rare in most regions. In Europe *C. chicitae* has been reported from Austria, France, Germany, Great Britain, Italy, Slovenia, Spain, Switzerland and Ukraine [1-3,12,14,17,36,40,47,48]. Outside Europe it has been recorded from Canada, China, Hawaiian Islands, Indonesia (Java), Japan, South Korea, Malaysia (Sabah), Papua New Guinea, Philippines, Taiwan, USA [1-3,17,22,35,42,45,49,50].

NUMBER OF SPECIMENS EXAMINED – 6.

Specimens examined: **Cg-55** – Równina Bielska Plain, Białowieża National Park, forest section No. 370, on mossy log, 1998, M. Kukwa (UGDA-L 9843). **Ff-12** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Krawce forest district, forest section No. 70, on *Quercus* sp., 1982, J. Kiszka (KRAP). **Ff-36** – Płaskowyż Kolbuszowski Plateau, Puszcza Sandomierska Forest, Brzóza forest district, on *Fagus sylvatica*, 1960, B. Ordyczyńska (LBL). **Gf-12** – Beskid Niski Mts, Potok Przysłup stream, alt. 410 m, on an old *Alnus glutinosa*, 1971, M. Olech (KRA). **Gf-68** – Bieszczady Zachodnie Mts, Puszcza Bukowa Forest, E slope of Paportna Mt., alt. 810 m, on *Fagus sylvatica*, 1956, K. Glanc & Z. Tobolewski (POZ, Lichenoth. Polon. 174). Poorly localized specimen: Białowieża National Park, on *Carpinus betulus*, 1949, J. Rydzak (LBL, as admixture in specimen of *C. olivetorum*).

Exsiccates examined: Kashiwadani, Lich. Minus Cogn. Exs. 103 (KRAM); Tobolewski, Lichenoth. Polon. 174 (POZ, sub *Parmelia cetrarioides*); Weber, Lich. Exs. 315 (KRAM); Wetmore, Lich. Exs. Min. 102 (KRAM); Wetmore, Lich. Exs. Min. 137 (KRAM).

Cetrelia monachorum (Zahlbr.) W. L. Culb. & C. F. Culb.

In C. F. Culb. & W. L. Culb.Syst. Bot. 1(4): 326. 1977 [1976]. ≡ *Parmelia monachorum* Zahlbr., in Handel-Mazzetti, Symb. Sin. 3: 180. 1930.

DIAGNOSTIC CHARACTERS. Pseudocyphellae on the upper cortex are usually small and raised, sometimes associated with large ones (similar to those in *C. chicitae*) and small, but not raised (as in *C. cetrarioides*). Older thalli or only their central parts may lack pseudocyphellae (in Poland all individuals possessed pseudocyphellae). Soralia are often coarse and irregular in shape with soredia usually exceeding 40 µm in diam. The lower cortex often lacks pseudocyphellae. Chemically *C. monachorum* is characterized by the production of imbricaric (major medullary compound), 4-O-demethylimbricaric (minor or trace) and anziaic (trace) acids. Perlatolic acid always occurs in minor amounts. Atranorin is present in soralia in high concentration and in the cortex in low concentration [3]. A few Polish specimens also contained fatty acids as previously reported by Obermayer and Mayrhofer [3]. Other substances reported by Randlane and Saag [2] were not detected in Polish material.

NOTES. *Cetrelia monachorum* is morphologically and chemically very similar to *C. cetrarioides* and for a long time it was considered as its chemical race [1]. Both taxa can be readily distinguished by the content of secondary metabolites, since *C. monachorum* contains imbricaric acid as the major medullary metabolite, whereas *C. cetrarioides* produces perlatolic acid [1,3]. For more differences see under the latter species.

About 45% of the specimens of *C. monachorum* were collected during 1950-1970, but it is also rather commonly represented (ca. 30%) in collections from the last two decades, which may suggest that their populations are still well represented in nature; nevertheless, it is probably endangered due to changing environments, and should be treated as such in the next red list of Polish lichens.

HABITAT REQUIREMENTS. *Cetrelia monachorum* is found most commonly in deciduous or mixed forests, rather often in stream valleys or in humid places. A few records are from roadside or free-standing trees. The species has been almost exclusively found on deciduous trees (often on bryophytes covering trunks), but once it was find on spruce and once on wood. Phorophytes supporting *C. monachorum* include: *Fagus sylvatica* (90 specimens), *Acer pseudoplatanus* (33), *Carpinus betulus* (27), *Quercus* spp. (24), *Fraxinus excelsior* (20), *Alnus glutinosa* (13), bark of unspecified trees (8), *Abies alba* (5), *Salix* sp. (5), bark of log (2), *Betula* sp. (2), *Populus tremula* (2), *Acer platanoides* (1), *Malus domestica* (1), *Picea abies* (1), *Sorbus aucuparia* (1) and *Tilia cordata* (1). Similar substrate preferences were reported by Obermayer & Mayrhofer [3], but the species was noted with different frequencies on particular tree species.

DISTRIBUTION IN POLAND. This is the most widely distributed and commonest species of the genus in the country. Numerous localities are known from north-eastern and central Poland, but it has been much more frequently collected in mountains (Fig. 3).

The species has been reported as occurring in Poland by Culberson & Culberson [1] (see under "specimens of *C. cetrarioides* sens. lat., the imbricaric acid-producing race"); the locality was reported as "Mont. Carphatica, Mont. Gorganae", but this is currently in Ukrainian territory.

GENERAL DISTRIBUTION. *Cetrelia monachorum* is not a rare species in Europe; moreover, in some countries (e.g. Austria and Poland) it appears to be the commonest member of the genus. To date it has been recorded from Austria, the

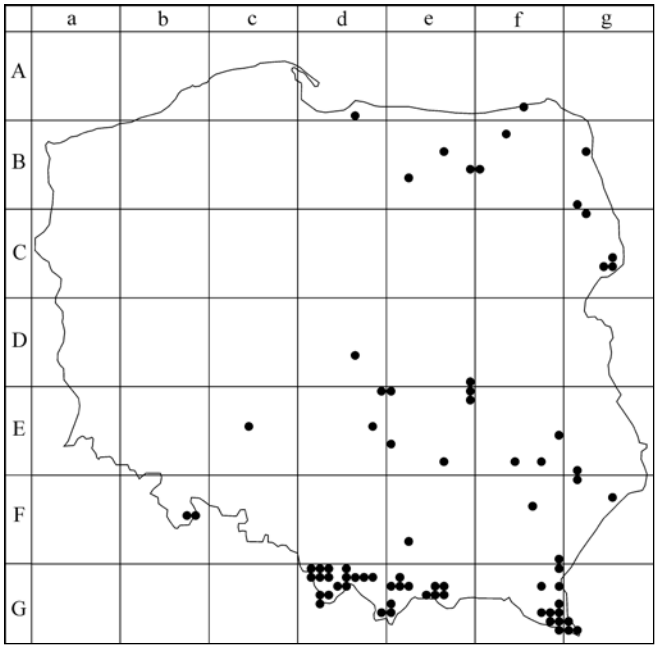

Fig. 3 Distribution of *Cetrelia monachorum* in Poland.

Czech Republic, France, Germany, Great Britain, Italy, Montenegro, Norway, Portugal, Romania, Slovakia, Slovenia, Spain and Ukraine [1,3,12,14,39,40]. The records of *C. olivetorum* s.l. with imbricaric acid in Diederich and Sérusiaux [43] and Diederich et al. [44] refer to *C. monachorum* (see also under *C. cetrarioides* and *C. olivetorum*). The species is also known from Canada, China, Georgia, Hawaiian Islands, India (Sikkim), Japan, Mexico, Russia and USA [1-3,17,21,35,40,42].

NUMBER OF SPECIMENS EXAMINED – 237.

Specimens examined (selected): **Ad-96** – Wysoczyzna Elbląska High Plain, Kadyny village, by Zalew Wiślany bay, on *Fagus sylvatica*, 1956, T. Sulma (UGDA-L 15001). **Af-85** – Puszcza Romnicka Forest, forest section No. 88, on *Carpinus betulus*, 1985, S. Cieśliński & Z. Tobolewski (KTC). **Be-36** – Pojezierze Mrągowskie Lakeland, Dębowy nature reserve, forest section No. 198b, on *Fagus sylvatica*, 1957, J. Hutorowicz (OLS-L 552, as admixture in specimen of *C. cetrarioides*). **Be-59** – Pojezierze Mazurskie Lakeland, Krutynia nature reserve, forest section No. 86, by Krutynia river, 53°41′59″N, 21°25′56″E, on *Carpinus betulus*, 2008, D. Kubiak (OLTC-L). **Be-62** – Pojezierze Olsztyńskie Lakeland, Las Warmiński nature reserve, forest section No. 705a, on *Carpinus betulus*, 2008, D. Kubiak (OLTC-L). **Bf-13** – Pojezierze Ełckie Lakeland, Puszcza Borecka Forest, forest section Nos. 131, 132, on *Fraxinus excelsior*, 1987, Z. Tobolewski (KTC); Borki nature reserve, forest sections Nos. 172, 173, on *Carpinus betulus*, 1987, Z. Tobolewski (KTC). **Bf-50** – Równina Mazurska Plain, Ruciane-Nida town, 53°38′2″N, 21°32′40″E, on *Alnus glutinosa*, 1952, T. Sulma (UGDA-L 2456). **Bg-32** – Równina Augustowska Plain, Puszcza Augustowska Forest, forest section No. 128, by the road between Rubcowo and Gruszki villages, on *Salix* sp., 1986, S. Cieśliński (KTC). **Bg-91** – Wysoczyzna Białostocka High Plain, Puszcza Knyszyńska Forest, near Czarna Białostocka, on *Carpinus betulus*, 1987, W. Fałtynowicz (UGDA-L 4249). **Cg-02** – Wysoczyzna Białostocka High Plain, Puszcza Knyszyńska Forest, Budzisk nature reserve, on *Carpinus betulus*, 1999, S. Cieśliński, K. Czyżewska, J. Motiejūnaitė & K. Kolanko (KTC). **Cg-55** – Równina Bielska Plain, Puszcza Białowieska Forest, Białowieża National Park, forest section No. 373B, on *Carpinus betulus*, 1981, Z. Tobolewski & S. Cieśliński (KTC). **Cg-64** – Równina Bielska Plain, Puszcza Białowieska Forest, vicinity of Topiło village, by Perebel stream, 52°38′37″N, 23°37′46″E, on *Populus tremula*, 2006, D. Kubiak (OLTC-L). **Cg-65** – Równina Bielska Plain, by the road to Pogorzelce village, on *Carpinus betulus*, 1951, J. Rydzak (LBL). **Dd-66** – Wzniesienia Łódzkie Heights, Łódź town, Wzniesienia Łódzkie Landscape Park, Las Łagiewnicki Forest, forest section No. 16w, on *Quercus* sp., 1997, B. Kośmider (LOD-L 11997). **De-99** – Puszcza Kozienicka Forest, Zagożdżon nature reserve, on *Carpinus betulus*, 1975, S. Cieśliński (KTC). **Ec-44** – Rychtal village, 51°08′42″N, 17°50′52″E, on *Quercus* sp., 1934.06.16, F. Krawiec (LBL, LOD, Lichenoth. Polon. 88). **Ed-09** – Puszcza Pilicka Forest, Smardzewice forest district, Kompleks Główny range, forest section No. 248, on *Quercus* sp., 1976, K. Czyżewska (LOD-L 3502). **Ed-48** – Wzgórza Radomszczańskie Hills, uroczysko Bąkowa Góra range, forest section No. 40, Kobiele Wielkie forest inspectorate, on *Quercus* sp., 1971, K. Czyżewska (LOD-L 1126). **Ee-00** – Równina Piotrkowska Plain, Spalski Landscape Park, Spała nature reserve, the edge of forest section No. 285, on *Carpinus betulus* and *Quercus* sp., 1970 & 1993, K. Czyżewska (LOD-L 605 & 9053). **Ee-09** – Puszcza Kozienicka Forest, Załamanek nature reserve, 51°29′44″N, 21°24′54″E, on *Carpinus betulus*, 2004, S. Cieśliński (KTC). **Ee-19** – Puszcza Kozienicka Forest, Jedlnia nature reserve, 51°26′02″N, 21°21′02″E, on *Quercus* sp., 2003, S. Cieśliński (KTC). **Ee-60** – Wyżyna Przedborska Upland, Niecka Włoszczowska Basin, Oleszno nature reserve, on *Fraxinus excelsior*, 2008, A. Łubek (KTC). **Ee-86** – Wyżyna Kielecka Upland, Góry Świętokrzyskie Mts, Białe Ługi nature reserve, on *Alnus glutinosa*, 1997, S. Cieśliński (KTC). **Ef-59** – Wyniosłość Giełczewska Uplift, Chmiele village near Krzczonów village, ca. 51°00′25″N, 22°42′38″E, on *Quercus* sp., 1948, J. Motyka (LBL). **Ef-84** – Równina Biłgorajska Plain, Zaklików village, on *Carpinus betulus*, 1955, K. Tatarkiewicz (LBL). **Ef-87** – Wzniesienia Urzędowskie Heights, near Janów Lubelski town, Ruda forest district, forest section No. 61, on bark, 1951, J. Rydzak (LBL). **Eg-91** – Roztocze Środkowe, Kosobudy village, uroczysko Stoki range, on *Carpinus betulus*, 1964, B. Warmińska (LBL). **Fb-47** – Masyw Śnieżnika Massif, Dolina Wilczki valley, tourist path from Międzygórze village to Hala pod Śnieżnikiem alpine meadow, 50°13′06″N, 16°48′14.8″E, alt. ca. 750 m, on *Fagus sylvatica*, 2010.04.19, A. Szczepański 839 (herb. Szczepańska). **Fb-48** – Góry Złote Mts, Góry Bialskie Mts, Puszcza Śnieżnej Białki nature reserve, 50°14′32″N, 16°59′20″E, alt. ca. 1036 m, on *Acer pseudoplatanus*, 2010, A. Szczepański 840A (herb. Szczepańska). **Fe-52** – Kotlina Sandomierska Basin, Nizina Nadwiślańska Lowland, Puszcza Niepołomicka Forest, Brzesko administrative region, Groudy village, pine-oak forest, on *Quercus* sp., 1961, J. Kiszka (KRAP). **Fe-72** – Pogórze Bocheńskie Foothills, Puszcza Niepołomicka Forest, Stanisławice village, humid black alder-oak forest, on mosses over bark of *Quercus* sp., 1960, J. Kiszka (KRAP). **Ff-36** – Płaskowyż Kolbuszowski Plateau, Puszcza Sandomierska Forest, Brzóza forest district, forest section No. 220, on *Alnus glutinosa*, 1960, B. Ordyczyńska (LBL). **Ff-99** – Pogórze Przemyskie Foothills, Przemyśl town, 49°46′57″N, 22°46′46″E, on *Betula* sp., 19th century, s.coll. (KRAM-L 20190). **Fg-01** – Równina Biłgorajska Plain, Szum nature reserve near Józefów Biłgorajski town, on *Abies alba*, 1972, B. Żabińska (LBL). **Fg-25** – Roztocze Wschodnie, Hrebenica (Hrebenne), 50°17′46″N, 23°35′15″E, on *Alnus glutinosa*, 1956, K. Glanc (KRAM-L 38991). **Gd-01** – Beskid Śląski Mts, Czantoria Mt., alt. 790 m,

on *Fagus sylvatica*, 1963, J. Kiszka (KRAP). **Gd-02** – Beskid Śląski Mts, S slope of Skrzyczne Mt., alt. 1070 m, on *Fagus sylvatica*, 1964, J. Kiszka (KRAP). **Gd-03** – Beskid Śląski Mts, Podmagurka Mt., by the road to Szczyrk town, alt. 610 m, on *Fagus sylvatica*, 1964, J. Kiszka (KRAP). **Gd-05** – Beskid Mały Mts, Kocierz Moszczanicki village, alt. ca. 800 m, 49°45′28″N, 19°18′09″E, on *Acer pseudoplatanus*, 1960, J. Nowak (KRAM-L 7763). **Gd-11** – Beskid Śląski Mts, Łabajów stream valley, alt. 650 m, forest road, on *Acer pseudoplatanus*, 1966, J. Kiszka (KRAP). **Gd-12** – Beskid Śląski Mts, Barania Góra Mt., Przysłop village, alt. 920 m, on *Fagus sylvatica*, 1955, K. Tatarkiewicz (LBL). **Gd-13** – Beskid Śląski Mts, Malinowa Mt., alt. 860 m, beech forest, on *Fagus sylvatica*, 1962, J. Kiszka (KRAP). **Gd-15** – Beskid Mały Mts, Przełęcz Kocierska pass, by the road to Żywiec town, alt. 700 m, on *Fraxinus excelsior*, 1961, J. Nowak (KRAM-L 7012). **Gd-16** – Beskid Żywiecki Mts, Pasmo Jałowieckie range, Hala Kamińskiego alpine meadow, alt. 1050 m, on *Fagus sylvatica*, 1965, J. Nowak (KRAM-L 15652). **Gd-17** – Beskid Żywiecki Mts, Hala Krupowa alpine meadow, alt. 1100 m, on *Fagus sylvatica*, 1974, U. Bielczyk (KRAM-L 42088). **Gd-18** – Beskid Żywiecki Mts, Okrąglica Mt., ca. 6 km S of Skawica village, alt. 1000 m, on *Fagus sylvatica*, 1965, J. Nowak (KRAM-L 16083). **Gd-24** – Beskid Żywiecki Mts, Rysianka nature reserve, alt. ca. 1100 m, on *Fagus sylvatica*, 1964, J. Nowak (KRAM-L 16399). **Gd-25** – Beskid Żywiecki Mts, Hala Jodłowcowa alpine meadow, alt. ca. 1200 m, on *Fagus sylvatica*, 1964, J. Nowak (KRAM-L 14918). **Gd-32** – Beskid Żywiecki Mts, Jaworzyna Mt., alt. ca. 1150 m, on *Fagus sylvatica*, 1964, J. Nowak (KRAM-L 14276). **Gd-33** – Beskid Żywiecki Mts, Będoszka Wielka Mt., alt. ca. 1120 m, on *Fagus sylvatica*, 1964, J. Nowak (KRAM-L 13957). **Gd-42** – Beskid Żywiecki Mts, N slope of Orzeł Mt., alt. ca. 1050 m, on *Fagus sylvatica*, 1964, J. Nowak (KRAM-L 14288). **Gd-59** – Tatry Zachodnie Mts, Dolina Białego valley, ca. 970 m, on *Acer pseudoplatanus*, 1955, Z. Tobolewski (POZ) and alt. 1150 m, 1999, U. Bielczyk (KRAM-L 44658); Kotlina Orawsko-Nowotarska Basin, Gubałówka range, by the Cichy stream, alt. 820 m, on *Acer pseudoplatanus*, 1964, J. Kiszka (KRAP). **Ge-11** – Gorce Mts, Gorce National Park, below Turbaczyk Mt., on *Acer pseudoplatanus*, 1964, K. Glanc (KRAM-L 37043). **Ge-20** – Gorce Mts, Gorce National Park, by the road to Turbacz Mt., on bark, 1962, T. Sulma (UGDA-L 4354). **Ge-21** – Gorce Mts, Gorce National Park, NE slope of Czoło Turbacza, alt. 1120-1140 m, on *Fagus sylvatica*, 1966 & 1968, K. Glanc (KRAM-L 37058 & 38990). **Ge-22** – Gorce Mts, Gorce National Park, NW slope of Gorc Mt., alt. 1120 m, on *Fagus sylvatica*, 1959, K. Glanc (KRAM-L 37042). **Ge-25** – Beskid Sądecki Mts, Wierch Nad Kamieniem Mt., alt. 1050 m, on *Fagus sylvatica*, 1989, L. Śliwa (KRA). **Ge-26** – Beskid Sądecki Mts, Kryśców stream valley, alt. 610 m, on *Abies alba*, 1967, M. Olech (KRA 3848). **Ge-34** – Beskid Sądecki Mts, 0.3 km N of Kamień św. Kingi rock, alt. ca. 1000 m, on *Acer pseudoplatanus*, 1960, J. Nowak (KRAM-L 9194). **Ge-35** – Beskid Sądecki Mts, by the tourist route from Rytro village to Pisana Hala alpine meadow, on *Fagus sylvatica*, 1966, M. Olech (KRA 3621). **Ge-36** – Beskid Sądecki Mts, Łabowska Hala alpine meadow, alt. 1050 m, on *Fagus sylvatica*, 1966, M. Olech (KRA 1926). **Ge-40** – Kotlina Orawsko-Nowotarska Basin, Bukowina Tatrzańska range, slope by Mur village, alt. 880 m, on *Betula pendula*, 1967, J. Kiszka (KRAP 10266). **Ge-50** – Tatry Wschodnie Mts, Kuźnice settlement, on *Fraxinus excelsior*, 1927 & 1947, J. Motyka (KRAM-L 816, LBL) and 1955, Z. Tobolewski (POZ). **Gf-09** – Pogórze Przemyskie Foothills, Kalwaryjski Potok stream between Makowa and Kalwaria Pacławska villages, on *Fraxinus excelsior*, 1994, U. Bielczyk (KRAM-L 39897). **Gf-27** – Rzeszów district, Lesko town, by San river, on *Alnus glutinosa*, 1938, J. Motyka (LBL). **Gf-29** – Góry Sanocko-Turzańskie Mts, NE slope of Oratyk Mt., alt. ca. 600 m, 49°27′06″N, 22°41′27″E, on *Acer pseudoplatanus*, 1991, R. Kościelniak (KRAP). **Gf-49** – Bieszczady Zachodnie Mts, Polana, alt. 500 m, 49°17.25′N, 22°37.14′E, on *Malus domestica*, 1993, R. Kościelniak (KRAP). **Gf-57** – Bieszczady Zachodnie Mts, NW slope of Falowa Mt., alt. 850 m, on *Fagus sylvatica*, 1958, K. Glanc (KRAM-L 37038). **Gf-58** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Połonina Wetlińska mountain pasture, Średni Wierch Mt., by Suche Rzeki village, on bark of log, 1995, J. Kiszka (KRAP). **Gf-59** – Bieszczady Zachodnie Mts, Pszczeliny Mt., alt. 700 m, on *Alnus glutinosa*, 1958, K. Glanc (KRAM-L 37040). **Gf-68** – Bieszczady Zachodnie Mts, Hrubki Mt., pass between Hrubki Mt. and Czerteż Mt., alt. 1110 m, 49°05′35″N, 22°31′34″E, on *Acer pseudoplatanus*, 2000, R. Kościelniak (KRAP). **Gf-69** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Kamienna Góra Mt., 49°05′15″N, 22°33′18″E, alt. 1140 m, on *Acer pseudoplatanus*, 2000, R. Kościelniak (KRAP). **Gf-79** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Wołosatka river valley, on *Alnus glutinosa*, 2000, J. Kiszka (KRAP). **Gg-60** – Bieszczady Zachodnie Mts, NW slope of Bukowe Berdo Mt., alt. 1020 m, on *Acer pseudoplatanus*, 1956, K. Glanc (KRAM-L 37046). **Gg-70** – Bieszczady Zachodnie Mts, N slope of Kińczyk Mt., alt. 1120 m, on *Fagus sylvatica*, 1957, K. Glanc (KRAM-L 37056). **Gg-71** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Sianki, on *Acer pseudoplatanus*, 1999, R. Kościelniak (KRAP).

Exsiccates examined: Krawiec, Lichenoth. Polon. 88 (LBL, LOD-L, sub *Parmelia cetrarioides*); Obermayer, Lich. Graec. 268 (B).

Cetrelia olivetorum (Nyl.) W. L. Culb. & C. F. Culb.

Contrib. U. S. Natl. Herb. 34: 515. 1968. ≡ *Parmelia olivetorum* Nyl., Not. Sällsk. Fauna Fl. Fenn. Forh.8: 180. 1866.

DIAGNOSTIC CHARACTERS. *Cetrelia olivetorum* is characterized by its small, not raised pseudocyphellae on upper cortex, rare occurrence of pseudocyphellae on lower cortex, often smooth and convex soralia with farinose to coarse soredia (25-55 μm in diam.), and the production of olivetoric acid as the major secondary compound in medulla. Additionally atranorin and a trace of anziac and 4-O-demethylmicrophyllinic (not detected in Polish material, as extracts were not studied in solvent B) acids are present [3]. Fatty acid was detected in two Polish specimens, as in the case of some specimens cited by Obermayer and Mayrhofer [3].

NOTES. *Cetrelia olivetorum* is very easily distinguished from all other members of the genus by its very distinctly red reaction with C and the production of olivetoric acid [3]. In the studied material, it has sometimes been confused with *Punctelia jeckeri* (Roum.) Kalb [syn. *P. ulophylla* (Ach.) van Herk & Aptroot], and it can also be mistaken for *P. subrudecta* (Nyl.) Krog. All those taxa have punctiform pseudocyphellae and their medullas react red with C, but *Punctelia* species differ in the abundantly rhizinate lower surface of thallus, narrower lobes and the production of lecanoric acid instead of olivetoric acid [51,52].

A similar spot test reaction is known in *Hypotrachyna afrorevoluta* (Krog & Swinscow) Krog & Swinscow and *H. revoluta* (Flörke) Hale, but those species contain gyrophoric acid as major medullary metabolite and they lack pseudocyphellae ([53] and literature cited therein).

As in the case of *C. monachorum*, the majority of *C. olivetorum* collections from Poland were made before 1970. In last two decades, *C. olivetorum* has been collected only 27 times, and, in our opinion, deserves the category critically endangered (CR) in Poland.

HABITAT REQUIREMENTS. The species is a typical epiphyte usually growing in deciduous forests, in humid places (e.g. stream valley). Substrates supporting this lichen include: *Quercus* spp. (27 specimens), *Fagus sylvatica* (26), *Carpinus betulus* (25), *Fraxinus excelsior* (10), *Salix* sp. (6), *Alnus glutinosa* (5), *Abies alba* (3), *Acer pseudoplatanus* (3), bark of unspecified trees (3), *Acer platanoides* (2), fallen trunk (2), *Tilia cordata* (2), *Malus domestica* (1), *Populus tremula* (1), *Sorbus aucuparia* (1) and epixylic bryophytes (1). According to Obermayer and Mayrhofer [3], it prefers mostly *Acer pseudoplatanus*, *Alnus* spp., *Fagus sylvatica*, *Fraxinus excelsior* and *Quercus* spp. The dissimilarities in substrate preference presented here and reported by the latter authors can be caused by various frequency of tree species due to phytogeographical differences.

DISTRIBUTION IN POLAND. *Cetrelia olivetorum* is similarly distributed in Poland as *C. monachorum*, but the latter species seems to be more frequent in central and north-eastern regions rather than in the mountains (Fig. 4).

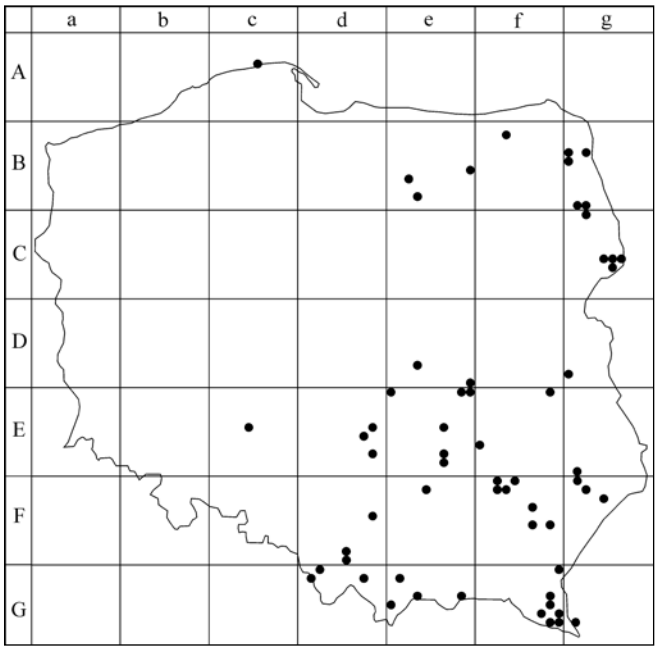

Fig. 4 Distribution of *Cetrelia olivetorum* in Poland.

GENERAL DISTRIBUTION. The species has been reported in Europe from Austria, the Czech Republic, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Lithuania, Montenegro, Norway, Portugal (Azores), Romania, Russia, Slovenia, Spain, Sweden, Switzerland and Ukraine [1-3,7,10, 12,14,15,36-39,54-56]. It has also been reported from Belgium and Luxembourg by Diederich & Sérusiaux [43] and Diederich et al. [44] as *C. olivetorum* s.l. with two chemotypes, one with imbricaric acid (which corresponds to *C. monachorum*) and the other one with olivetoric acid (which corresponds to *C. olivetorum* s.str.); however, it is not certain in which country the species occurs as the distribution of both strains was not specified by those authors.

Outside Europe, *C. olivetorum* has been recorded in Armenia, Azerbaijan, Bhutan, Canada, Canary Islands, China, Georgia, Hawaiian Islands, Iran, Japan, Madeira, Mongolia, Nepal, New Caledonia, Papua New Guinea, Asiatic part of Russia, Taiwan, Thailand, Turkey and USA [1,3,17,21,35,41, 42,50,54,57,58].

NUMBER OF SPECIMENS EXAMINED – 118.

Specimens examined (selected): **Ac-35** – Wybrzeże Słowińskie Coast, Szklana Huta village near Choczewo, on *Fagus sylvatica*, 1958, T. Sulma (UGDA-L 2450). **Be-59** – Kraina Wielkich Jezior Mazurskich Land, Krutynia nature reserve, near Krutynia river, oak-linden-hornbeam forest, on *Carpinus betulus*, 2006, R. Szymczyk (OLS-L 362) and 2008, D. Kubiak (OLTC-L). **Be-62** – Pojezierze Olsztyńskie Lakeland, Las Warmiński nature reserve, forest section No. 705a, on *Carpinus betulus*, 2008, D. Kubiak (OLTC-L). **Be-83** – Pojezierze Olsztyńskie Lakeland, Koniuszanka II nature reserve, by Koniuszanka river, oak-linden-hornbeam forest, on *Carpinus betulus*, 2008, D. Kubiak (OLTC-L). **Bf-13** – Pojezierze Ełckie Lakeland, Puszcza Borecka Forest, Borki nature reserve, forest section No. 18, on *Fraxinus excelsior*, 2004, A. Zalewska (OLS-L 550). **Bg-30** – Równina Augustowska Plain, Puszcza Augustowska Forest, Płaska forest district, forest seection No. 23, on *Fraxinus excelsior*, 1958, K. Glanc (KRAM-L 37036). **Bg-32** – Równina Augustowska Plain, Puszcza Augustowska Forest, forest section No. 128, by the road between Rubcowo and Gruszki villages, on *Salix* sp., 1986, S. Cieśliński (KTC). **Bg-40** – Kotlina Biebrzańska Basin, 1 km NE of Balinka village, 53°46′48″N, 23°10′32″E, on *Fraxinus excelsior*, 1986, S. Cieśliński (KTC). **Bg-91** – Wysoczyzna Białostocka High plain, Puszcza Knyszyńska Forest, 2.5 km E of Buksztel village, 53°19′N, 23°19′E, on *Quercus* sp., 1987, W. Fałtynowicz (KTC). **Bg-92** – Wysoczyzna Białostocka High plain, Puszcza Knyszyńska Forest, Budzisk nature reserve, on epixylic bryophytes, 1994, S. Cieśliński (KTC). **Cg-54** – Równina Bielska Plain, Puszcza Białowieska Forest, Hajnówka forest district, forest section No. 386B, on *Quercus* sp., 1983, Z. Tobolewski & S. Cieśliński (KTC). **Cg-55** – Równina Bielska Plain, Białowieża National Park, forest section No. 256, on *Carpinus betulus*, 1998, S. Cieśliński (KTC). **Cg-56** – Równina Bielska Plain, Białowieża National Park, forest section No. 402A, oak-linden-hornbeam forest, on *Carpinus betulus*, 2001, M. Kukwa 329 (UGDA-L). **Cg-65** – Równina Bielska Plain, Puszcza Białowieska Forest, Białowieża forest inspectorate, Zwierzyniec forest district, forest section No. 449A, on *Carpinus betulus*, 1982, S. Cieśliński & Z. Tobolewski (KTC); Białowieża village, Palace Park, on *Carpinus betulus*, 1951, J. Rydzak (LBL). **De-73** – Wysoczyzna Rawska High plain, Trębaczew nature reserve, on *Quercus* sp., 1969, K. Czyżewska (LOD-L 138). **De-99** – Puszcza Kozienicka Forest, Zagożdżon nature reserve, on *Quercus* sp., 1971, S. Cieśliński (KTC). **Dg-80** – Zaklęsłość Sosnowicka Depression, near Parczew village, Królowa Droga nature reserve, on *Carpinus betulus*, 1972, B. Ordyczyńska (LBL). **Ed-48** – Wzgórza Radomszczańskie Hills, uroczysko Bąkowa Góra range, Kobiele Wielkie forest inspectorate, on *Quercus* sp., 1972 & 1973, K. Czyżewska (LOD-L 4526 & 1127). **Ed-57** – Wzgórza Radomszczańskie Hills, Kobiele Wielkie nature reserve, on *Quercus* sp., 1969, K. Czyżewska (LOD-L 1125). **Ed-78** – Niecka Włoszczowska Basin, Silniczka forest inspectorate, uroczysko Dębowiec range, forest section No. 172, on *Fraxinus excelsior*, 1970, K. Czyżewska (LOD-L 895). **Ee-00** – Równina Piotrkowska Plain, Spalski Landscape Park, Spała nature reserve, on *Carpinus betulus*, 1969, 1983 & 1993 K. Czyżewska (LOD-L 137 & 7188, UGDA-L 4453). **Ee-08** – Puszcza

Kozienicka Forest, Ciszek nature reserve, on *Carpinus betulus*, 2007, S. Cieśliński (KTC). **Ee-09** – Puszcza Kozienicka Forest, Ponty nature reserve, on *Quercus* sp., 2004, S. Cieśliński (KTC). **Ee-46** – Wyżyna Kielecka Upland, Płaskowyż Suchedniowski Plateau, vicinity of Skarżysko Kamienna, on *Fagus sylvatica*, 1928, J. Motyka (LBL). **Ee-76** – Góry Świętokrzyskie Mts, Dolina Wilkowska valley, forest section No. 43, on *Quercus* sp., 1982, S. Cieśliński (KTC); Świętokrzyski National Park, near the top of Łysica Mt., on *Fagus sylvatica*, 1928, J. Motyka (LBL). **Ee-86** – Góry Świętokrzyskie Mts, Wymysłów village, 1 km N of the road between Daleszyce and Cisów, on *Quercus* sp., 1980, S. Cieśliński (KTC). **Ef-08** – Wysoczyzna Lubartowska High plain, Lasy Kozłowieckie Forests, between Lublin town and Lubartów village, on *Quercus* sp., 1948, J. Motyka (LBL). **Ef-60** – Przedgórze Iłżeckie Foothills, Krzemionki Opatowskie nature reserve, on *Quercus* sp., 2004, S. Cieśliński (KTC). **Eg-91** – Roztocze Środkowe, Roztoczański National Park, Bukowa Góra nature reserve, near Zwieczyniec village, on *Abies alba* and *Fagus sylvatica*, 1950, J. Rydzak (LBL). **Fd-48** – Wyżyna Krakowsko-Częstochowska Upland, Wyżyna Olkuska Upland, Ojców National Park, Ojców, on bark, 1877, F. Berdau (KRAM-L 11023). **Fd-85** – Beskid Mały Mts, Kocierz Rychwaldzki, alt. ca. 500 m, by the road from Andrychów to Żywiec, on *Fraxinus excelsior*, 1960, J. Nowak (KRAM-L 7764). **Fd-95** – Beskid Mały Mts, Gładkie below Przełęcz Kocierska pass, alt. 650 m, by the road, on *Acer platanoides*, 1962, J. Nowak (KRAM-L 9456). **Fe-14** – Niecka Dolnej Nidy Basin, Marzęcin, oak forest, on *Quercus* sp., 1960, J. Nowak (KRAM-L 6078). **Ff-02** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Stale range near Jeziórko village, forest section No. 180, on *Quercus* sp., 1980, J. Kiszka (KRAP). **Ff-04** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Stalowa Wola town, forest section No. 158, on *Quercus* sp., 1982, J. Kiszka (KRAP); **Ff-12** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Alfredówka village, forest, on *Quercus* sp., 1962, J. Kiszka (KRAP). **Ff-13** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Krawce forest district, forest section No. 68, on *Quercus* sp., 1982, J. Kiszka (KRAP). **Ff-36** – Równina Tarnobrzeska Plain, Puszcza Sandomierska Forest, Jelna forest district, on *Quercus* sp., 1963, B. Ordyczyńska (LBL). **Ff-56** – Podgórze Rzeszowskie Foothills, Puszcza Sandomierska Forest, near Łańcut town, Julin forest district, forest section No. 234 (location not precise), on *Fagus sylvatica*, 1960, B. Ordyczyńska (LBL). **Ff-58** – Pradolina Podkarpacka Urstromtal, Białobrzeżki forest district, ca. 50°06′55″N, 22°32′00″N, on *Quercus* sp., 1963, B. Ordyczyńska (LBL). **Fg-01** – Roztocze Środkowe, forest inspectorate Kosobudy, Czerkies forest district, ca. 50°35′N, 23°01′E, on *Fagus sylvatica*, 1952, Z. Tobolewski (POZ). **Fg-12** – Roztocze Środkowe, Susiec village, forest section No. 202, on *Alnus glutinosa*, 1959, J. Bystrek (LBL). **Fg-24** – Roztocze Środkowe, Bełżec village, on *Fagus sylvatica*, 1960, J. Rydzak (LBL). **Gd-02** – Beskid Śląski Mts, W slope of Klimczok Mt., alt. 1060 m, on *Fagus sylvatica*, 1964, J. Kiszka (KRAP). **Gd-11** – Beskid Śląski Mts, W slope of Stożek Mt., alt. 960 m, on *Fagus sylvatica*, 1963, J. Kiszka (KRAP). **Gd-17** – Beskid Żywiecki Mts, Urwanica Mt., on *Fagus sylvatica*, 1965, J. Nowak (KRAM-L 16051, as admixture in specimen of *Cetrelia monachorum*). **Ge-11** – Gorce Mts, Gorce National Park, near the Orkan's nature reserve, alt. 1070 m, on *Fagus sylvatica*, 1959, K. Glanc (KRAM-L 37030). **Ge-33** – Beskid Sądecki Mts, Pasmo Jaworzyny range, NW slope of Dzwonkówka Mt., alt. 850 m, 49°27′54″N, 20°28′54″E, on *Fagus sylvatica*, 1965, M. Olech (KRA 2174). **Ge-38** – Beskid Niski Mts, Lackowa Mt., by the Biała Dunajcowa spring, 49°25′42″N, 21°05′46″E, on *Fagus sylvatica*, 1928, J. Motyka (LBL). **Ge-40** – Kotlina Orawsko-Nowotarska Basin, Bukowina Tatrzańska range, Białka stream, alt. 720 m, on *Alnus glutinosa*, 1967, J. Kiszka (KRAP). **Gf-09** – Pogórze Przemyskie Foothills, Kalwaryjski Potok stream between Makowa and Kalwaria Pacławska villages, on *Fraxinus excelsior*, 1994, U. Bielczyk (KRAM-L 11878). **Gf-38** – Góry Sanocko-Turczańskie Mts, Żuków range, Łobozew Dolny village, on *Salix* sp., 1999, R. Kościelniak (KRAP). **Gf-48** – Bieszczady Zachodnie Mts, Paniszczów village, alt. 460 m, 49°19′47″N, 22°33′03″E, on *Fraxinus excelsior*, 1996, R. Kościelniak (KRAP). **Gf-57** – Bieszczady Zachodnie Mts, NE slope of Falowa Mt., alt. 900 m, on *Abies alba*, 1958, K. Glanc (KRAM-L 37031). **Gf-59** – Bieszczady Zachodnie Mts, Czereszenka settlement near Stuposiany village, on *Fagus sylvatica*, 1958, Z. Tobolewski (POZ). **Gf-68** – Bieszczady Zachodnie Mts, Puszcza Bukowa Forest, by Beskidnik stream, alt. 740 m, on *Acer pseudoplatanus* and *Fagus sylvatica*, 1957, K. Glanc (KRAM-L 37033 & 37037). **Gf-69** – Bieszczady Zachodnie Mts, Dział Mts, slope below Berechy Mt., 49°07′10″N, 22°33′40″E, alt. 1130 m, beech forest, on *Acer pseudoplatanus*, 2000, R. Kościelniak (KRAP). **Gg-61** – Bieszczady Zachodnie Mts, Bieszczadzki National Park, by San river, on *Salix* sp., 2001, J. Kiszka (KRAP). Additionally 16 very poorly localized specimens examined, mostly collected in Puszcza Białowieska Forest.

Exsiccates examined: Czarnota & Kukwa, Lich. Pol. Exs. 51 (UGDA, sub *C. olivetorum* s.l.); Krawiec, Lichenoth. Polon. 88 (KRAM, sub *Parmelia cetrarioides* (locality in ATPOL grid square **Ec-44**); Pišút, Lich. Slovak. Exs. 218 (KRAM, sub *C. cetrarioides*); Wetmore, Lich. Exs. Min. 138 (KRAM); Wetmore, Lich. Exs. Min. 35 (KRAM).

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References

1. Culberson WL, Culberson CF. The lichen genera *Cetrelia* and *Platismatia* (Parmeliaceae). Washington: Smithsonian Institution Press; 1968. (Contributions from the United States National Herbarium; vol 34 pt 7).
2. Randlane T, Saag A. Chemical and Morphological Variation in the genus *Cetrelia* in the Soviet Union. Lichenologist. 1991;23(02):113-126. http://dx.doi.org/10.1017/S0024282991000282
3. Obermayer W, Mayrhofer H. Hunting for *Cetrelia chicitae* (lichenized Ascomycetes) in the eastern European Alps (including an attempt for a morphological characterization of all taxa of the genus *Cetrelia* in Central Europe). Phyton. 2007;47:231-290.
4. Culberson CF, Culberson WL. Chemosyndromic variation in lichens. Syst Botany. 1976;1(4):325-339. http://dx.doi.org/10.2307/2418700
5. Otnyukova TN, Stepanov NV, Elix JA. Three new species of Parmeliaceae (Ascomycota) from Siberia. Mycotaxon.

2009;108(1):249-256. http://dx.doi.org/10.5248/108.249
6. Feuerer T. Checklists of lichens and lichenicolous fungi [Internet]. 2010 [cited 2010 Aug 18]; Available from: http://www.checklists.de
7. Bjelland T, Halleraker G, Reeb V, Tønsberg T. The chemotypes of *Cetrelia olivetorum* in Norway. Graphis Scripta. 1997;8:5-7.
8. Vězda A, Liška J. A catalogue of lichens of the Czech Republic. Průhonice: Institute of Botany – Academy of Sciences of the Czech Republic; 1999.
9. Fałtynowicz W. The lichens, lichenicolous and allied fungi of Poland – an annotated checklist. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences; 2003. (Biodiversity of Poland; vol 6).
10. Santesson R, Moberg R, Nordin A, Tønsberg T, Vitikainen O. Lichen-forming and lichenicolous fungi of Fennoscandia. Uppsala: Uppsala University; 2004.
11. Sérusiaux E, Diederich P, Lambinon J. Les macrolichens de Belgique, du Luxembourg et du nord de la France. Ferrantia. 2004;40:1-188.
12. Gilbert OL, Purvis OW. *Cetrelia* W. L. Culb. & C. F. Culb. (1968). In: Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW, et al., editors. The Lichens of Great Britain and Ireland. London: British Lichen Society; 2009. p. 296-297.
13. Harrold P, Grundy K, Coppins BJ, Ellis C. Distribution of chemotypes of *Cetrelia olivetorum* in England, Scotland and Wales. Brit Lich Soc Bull. 2009;105:3-9.
14. Barbero M, Etayo J, Gómez-Bolea A. Chemotypes of *Cetrelia cetrarioides* s.l. (Lichenes) in the Iberian Peninsula. Cryptogam Bot. 1995;5(1):28-30.
15. Wirth V. Die Flechten Baden-Württembergs. Parts 1 & 2. Stuttgart: Ulmer; 1995.
16. Mrak T, Mayrhofer H, Batič F. Contributions to the lichen flora of Slovenia XI: lichens from the vicinity of Lake Bohinj (Julian Alps). Herzogia. 2004;17:107-127.
17. Randlane T, Saag A. Distribution patterns of some primary and secondary cetrarioid species. Symb Bot Ups. 2004;34(1):359-376.
18. Randlane T, Saag A. Cetrarioid lichens in Europe – an identification key for the species. In: Lackovičová A, Guttová A, Lisická E, Lizoň P, editors. Central European lichens – diversity and threat. Ithaca NY: Mycotaxon Ltd; 2006. p. 75-84.
19. Hafellner J, Obermayer S, Obermayer W. Zur Diversität der Flechten und lichenicolen Pilze im Hochschwab-Massiv (Nordalpen, Steiermark). Mitt Naturwiss Vereins Steiermark. 2005;134:57-103.
20. Obermayer W. Lichenotheca Graecensis, Fasc. 16 (Nos 281-300). Fritschiana. 2007;60:1-6.
21. Sohrabi M, Ahti T, Urbanavichus G. Parmelioid lichens of Iran and the Caucasus region. Mycol Balcanica. 2007;4:21-30.
22. Luo H, Wei XL, Han KS, Koh YJ, Hur JS. Taxonomic study on the lichen genus *Cetrelia* (Lecanorales, Ascomycota) in South Korea. Mycobiology. 2007;35(3):117-123.
23. Crespo A, Kauff F, Divakar PK, del Prado R, Pérez-Ortega S, de Paz GA, et al. Phylogenetic generic classification of parmelioid lichens (Parmeliaceae, Ascomycota) based on molecular, morphological and chemical evidence. Taxon. 2010;59(6):1735-1753.
24. Kiszka J, Piórecki J. Porosty (Lichenes) Pogórza Przemyskiego. Warszawa: Uniwa; 1991.
25. Fałtynowicz W. A checklist of Polish lichen forming and lichenicolous fungi including parasitic and saprophytic fungi occurring on lichens. Polish Bot Stud. 1993;6:1-65.
26. Bielczyk U. The lichens and allied fungi of the Polish Western Carpathians. In: Bielczyk U, editor. The lichens and allied fungi of the Polish Carpathians: an annotated checklist. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences; 2003. p. 23-232. (Biodiversity of the Polish Carpathians; vol 1).
27. Kościelniak R. Porosty (Lichenes) Bieszczadów Niskich. Fragm Flor Geobot. 2004;5 suppl:1-164.
28. Cieśliński S, Czyżewska K, Fabiszewski J. Red list of the lichens in Poland. In: Mirek Z, Zarzycki K, Wojewoda W, Szeląg Z, editors. Red list of plants and fungi in Poland. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences; 2006. p. 71-89.
29. Jabłońska A, Oset M, Kukwa M. The lichen family Parmeliaceae in Poland I. The genus *Parmotrema*. Acta Mycol. 2009;44(2):211-222.
30. Culberson CF, Kristinsson HD. A standardized method for the identification of lichen products. J Chromat A. 1970;46:85-93. http://dx.doi.org/10.1016/S0021-9673(00)83967-9
31. Orange A, James PW, White FJ. Microchemical methods for the identification of lichens. London: British Lichen Society; 2001.
32. Zając A. Atlas of distribution of vascular plants in Poland (ATPOL). Taxon. 1978;27(5-6):481-484. http://dx.doi.org/10.2307/1219899
33. Cieśliński S, Fałtynowicz W, editors. Note from editors. In: Atlas of the geographical distribution of lichens in Poland. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences; 1993. p. 7-8.
34. Kukwa M, Motiejūnaitė J, Rutkowski P, Zalewska A. New or interesting records of lichenicolous fungi from Poland. Part I. Herzogia. 2002;15:129-139.
35. Elix JA, McCarthy PM. Catalogue of the lichens of the smaller Pacific islands. Bibl Lichenol. 1998;70:1-361.
36. Scheidegger C, Clerc P, Dietrich M, Frei M, Groner U, Keller C, et al. Rote Liste der gefährdeten Arten der Schweiz: baum- und erdbewohnende Flechten. Bern: BUWAL; 2002.
37. Kondratyuk SY, Popova LP, Lackovičová A, Pišút I. A catalogue of Eastern Carpathian lichens. Kostrino: M.H. Kholodny Institute of Botany; 2003.
38. Randlane T, Saag A, Suija A. Lichenized, lichenicolous and allied fungi of Estonia [Internet]. 2006 [cited 2010 Aug 18]; Available from: http://www.ut.ee/lichens/fce.html
39. Knežević B, Mayrhofer H. Catalogue of the lichenized and lichenicolous fungi of Montenegro. Phyton. 2009;48(2):283-328.
40. Culberson WL, Culberson CF. *Cetrelia cetrarioides* and *C. monachorum* (Parmeliaceae) in the New World. Bryologist. 1978;81(4):517-523. http://dx.doi.org/10.2307/3242338
41. Aptroot A, Feijen FJ. Annotated checklist of the lichens and lichenicolous fungi of bhutan. Fungal Divers. 2002;11:21-48.
42. Kurokawa S, editor. Checklist of Japanese Lichens. Tokyo: National Science Museum; 2003.
43. Diederich P, Sérusiaux E. The lichens and lichenicolous fungi of Belgium and Luxembourg: an annotated checklist. Luxembourg: Musee national d'histoire naturelle; 2000.
44. Diederich P, Ertz D, Stapper N, Sérusiaux E, van den

Broeck D, Ries C. The lichens and lichenicolous fungi of Belgium, Luxembourg and northern France [Internet]. 2010 [cited 2010 Aug 18]; Available from: http://www.lichenology.info
45. Culberson WL. *Cetraria chicitae*, a new and widely distributed lichen species. Bryologist. 1965;68(1):95-99. http://dx.doi.org/10.2307/3240991
46. Hale ME. A monograph of *Parmelia*, subgenus *Amphigymnia*. Washington: Smithsonian Institution; 1965. (Contributions from the United States National Herbarium; vol 36 pt 5).
47. Beguinot J. Le genre *Cetrelia* (lichens Parmeliacees) en autunois. Presence d'une espece nouelle, *Cetrelia chicitae*. Bull Soc Hist Nat Autun. 1982;104:9-12.
48. Randlane T, Saag A, Kondratyuk SY. Genus *Cetrelia* Culb. et Culb. in the Ukraine. Ukrainian Botanical Journal. 1991;48(1):41-44.
49. Wei J. An enumeration of lichens in China. Beijing: International Academic Publishers; 1991.
50. Aptroot A, Diederich P, Sérusiaux E, Sipman HJM. Lichens and lichenicolous fungi from New Guinea. Bibl Lichenol. 1997;64:1-220.
51. van Herk K, Aptroot A. The sorediate *Punctelia* species with lecanoric acid in Europe. Lichenologist. 2000;32(3):233-246. http://dx.doi.org/10.1006/lich.1999.0261
52. Kalb K. New or otherwise interesting lichens III. Bibl Lichenol. 2007;95:297-316.
53. Flakus A, Kukwa M. Additions to the biota of lichenized fungi of Poland. Acta Mycol. 2009;44(2):249-257.
54. Hafellner J. A new checklist of lichens and lichenicolous fungi of insular Laurimacaronesia including a lichenological bibliography for the area. Fritschiana. 1995;5:1-132.
55. Motiejūnaitė J, Alstrup V, Randlane T, Himelbrant D, Stončius D, Hermansson J, et al. New or noteworthy lichens, lichenicolous and allied fungi from Biržai district, Lithuania. Botanica Lithuanica. 2008;14(1):29-42.
56. Seaward MRD. Census catalogue of Irish lichens. 3rd ed. Belfast: National Museums Northern Ireland; 2010.
57. Wolseley PA, Aguirre-Hudson B, McCarthy PM. Catalogue of the lichens of Thailand. Bull Nat Hist Mus Bot Ser. 2002;32(1):13-59. http://dx.doi.org/10.1017/S0968044602000038
58. Yazýcý K, Aslan A. Additional lichen records from Rize Province. Turk J Bot. 2002;26:181-193.