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EPILITHIC LICHENS ON SERPENTINITE ROCKS IN POLAND

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Abstract: A list of 84 lichen species occurring on serpentinites in Lower Silesia (southwestern Poland) is presented. The studied lichen flora is relatively poor, due to the mineralogical and chemical properties of the serpentinic substrate, together with the artificial character of most of the exposures (quarries). No exclusive serpentinophytes were found. The lichen flora is composed mainly of species characteristic for neutral or slightly alkaline siliceous rocks, together with basi- and calciphilous taxa and some species typical for mineral- and metal-enriched substrates. One of them, *Catillaria atomarioides* (Müll. Arg.) Kilias, is recorded for the first time from Poland.

Key words: Lichens, serpentinites, Lower Silesia, distribution, Poland

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INTRODUCTION

Areas with serpentinite rocks are of special interest to botanists of various specializations around the world. Dozens of papers concerning serpentinicolous floras and related ecological problems have been published. Factors attracting the attention of scientists are the floristic and ecological distinctiveness of these areas, the effects of the specific mineral composition and the resulting physicochemical properties, and their relative rarity in the world.

In Europe, smaller or larger serpentinic areas occur in the Balkan Peninsula, the Alps, Scandinavia, Portugal, Great Britain, the Czech Republic, Poland and other places. Most of them have been the subject of various floristic studies, including lichenological ones (e.g., Suza 1927, 1928, 1931; Ritter-Studnicka & Klement 1968; Takala & Seaward 1978; Hafellner 1991) which produced descriptions of several new lichen species closely associated with serpentinite rocks: *Acarospora suzai* Magn., *Lecanactis serpentinicola* Räs., *Polyblastia suzae* Servit, *Rinodina serpentini* Mayrhofer & Poelt, *Squamarina serpentini* Poelt, *Verrucaria serpentinicola* Servit and others (Hafellner 1991).

There have been numerous floristic, phytosociological and ecological studies on serpentinic substrates in Poland, but they concern mostly vascular plants. Serpentinicolous lichen flora has not been studied in detail so far. Only a few localities of epilithic lichens growing on this substrate have been published (Stein 1879; Eitner 1895, 1900), with reports of species rare in Poland such as *Caloplaca atroflava* and *C. rubelliana*. The present study aims to help fill this gap in knowledge of the European serpentinicolous lichen flora. The paper presents the current distribution of epilithic lichens on serpentinites in our country and discusses the extent to which they are endangered.

STUDY AREA

In Poland, serpentinite rocks occur only in Lower Silesia (southwestern part of the country – Fig. 1). The most extensive areas of these rocks are situated in the Sudetic Foreland, where they form three large massifs: the Szklary and Grochów-Braszowice massif (also called the Grochowa massif) near Ząbkowice Śląskie, and the largest one – the Gogołów-Jordanów Śląski massif, which is the southern part of the Ślęża massif. The latter includes the Wzgórza Oleszeńskie hills, Wzgórza Kiełczyńskie hills, Radunia Mt. and a small ridge called Kamienny Grzbiet. Smaller lo-

calities of serpentinites also occur in the Sudety Mts – near Kamionka and Przygórze (Góry Sowie Mts) and near Janowice Wielkie (Góry Ołowiane Mts). In all these localities the serpentinite is generally covered by a soil layer, though in some places small rocks or boulders are exposed. More frequently the serpentinite has been artificially uncovered in quarries, mostly abandoned at present.

LIST OF LOCALITIES

The locality numbers given below match the numbers on the map (Fig. 1).

A. Gogołów-Jordanów Śląski massif (S part of Ślęża massif)

1. Jordanów Śląski – abandoned serpentinite and nephrite quarry on SE edge of Kamienny Grzbiet ridge, *ca* 2 km NW of village;

2. Nasławice – grassland on Kamienny Grzbiet, near an active quarry;

3. Świątniki – inactive quarry surrounded by fields, *ca* 1.5 km E of village;

4. Przemiłów I – small serpentinite quarry in center of village;

5. Przemiłów II – small, very overgrown quarry in forest near village;

6. Sulistrowickie Skały – natural rock outcrop in forest at highest part of Wzgórza Oleszeńskie hills;

7. Ridge of Wzgórza Oleszeńskie hills – old working in forest;

8. Ridge of Wzgórza Oleszeńskie hills – small, very shaded quarry on one of the tops;

9. Radunia Mt. – rock outcrop at top;

10. Radunia Mt. – serpentinite exposure in cutting of road surrounding upper part;

11. Przełęcz Tąpadła pass – boulders of weakly serpentinized ultramafic rocks at foot of Radunia Mt., near hiking trail;

12. Świerczyna Mt. – abandoned quarry on SE slope near hiking trail;

13. Kiełczyn – large, densely overgrown quarry in village;

14. Szczytna Mt. – little rocks at highest peak of the Wzgórza Kiełczyńskie hills.

B. Szklary massif

15. Szklary – large quarry *ca* 1 km W of village of Tomice near Wrocław–Kłodzko road;

16. Szklary – serpentinite exposure in railway cutting facing Tomice;

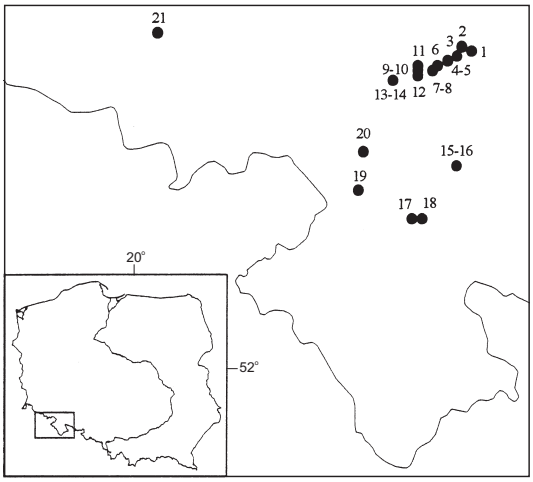

Fig. 1. Distribution of analyzed localities in Lower Silesia.

C. Grochów-Braszowice massif (Grochowa massif).

17. Budzów-Kolonia – small, very overgrown quarry at base of E slope of Mt. Brzeźnica;

18. Brzeźnica Mt. (Kozie Krzepty) – small rock crest at top of mountain.

D. Sudety Mts

19. Przygórze – scattered rock outcrops on steep afforested slope;

20. Kamionki – small shaded outcrops on steep slope of small serpentinite ridge E of village;

21. Janowice Stare – abandoned serpentinite quarry (at present made into a sports field) above village on S slope of Góry Ołowiane Mts.

CHARACTERISTICS OF SERPENTINIC SUBSTRATES

Serpentinites are metamorphic rocks developed as a result of hydrothermal alteration of ultramafic rocks – perodotites, dunites and pyroxenites. They are composed primarily of minerals of the serpentine group – hydrated magnesium silicates (antigorite, chrysolite and lizardite), which give the fresh rock a characteristic dark green color. Other common components are magnesite and compounds of iron, nickel and chromium. The specific mineral composition affects the physicochemical properties of these rocks and of the serpentine soil

developing as a result of their weathering process. Among them the most important for vegetation development are alkaline character, high heat capacity, low nutrient availability, high Mg/Ca ratio of the minerals, and the presence of potentially toxic compounds of chromium, nickel and cobalt (Purvis & Halls 1996).

Within Silesian altered ultramafic rocks, generally referred to as serpentinites, different types can be distinguished on the basis of the degree of serpentinization. Apart from true serpentinites, olivine serpentinites, serpentinized perodotites, perodotites and dunites have been recognized (Maciejewski & Niśkiewicz 1979). They differ in their chemical and mineral composition (especially in the proportion of serpentinite minerals to olivine). At a single site one usually can find several types as well as transitions between them.

List of found taxa

A total of 84 lichen species associated with serpentine rocks have been found, including 75 growing directly on rocks, and 9 over epilithic mosses or on bare soil close to an outcrop. A detailed list of taxa, together with a list of localities for each species, are presented in Table 1. The lichen nomenclature follows Santesson (1993).

Description of lichen flora

As in similar areas elsewhere (cf. Sirois *et al.* 1988; Hafellner 1991; Purvis & Halls 1996), the epilithic lichen flora of serpentinite rocks in Lower Silesia is relatively poor. Essentially it is composed of several ubiquitous species common on various rock substrates (*Acarospora fuscata*, *Buellia stigmatea*, *Candelariella vitellina*, *Lecanora muralis*, *Scoliciosporum umbrinum*). The remaining species were usually recorded in single localities and were not confined to serpentinite rocks in the study area. The only exception was *Caloplaca* cf. *atroflava* – a lichen reported in the 19th century as *Callopsima ferrugineum* (*var. obscurum*) from localities on Radunia Mt. and the Wzgórza Kiełczyńskie hills (Stein 1879; Etner 1900). I found characteristic lead-colored thalli of this lichen on most of the exposed (unshaded) outcrops. In some places (e.g., locality 18 on Brzeźnica Mt. in the Grochowa massif) this species constitutes the dominant component of the lichen vegetation. It has not been recorded in this region on other substrates, not even on the chemically similar amphibolite and gabbro, and it has not been reported from other parts of Poland either. Further rare lichen species for Poland include *Lecidella bullata*, *L. scabra* (category E according to the *Polish Red Book of Lichens* – Cieśliński *et al.* 1992), *Rhizocarpon grande* (category E), *Rinodina confragosa*, *R. oxydata* and *Staurothele ambrosiana*.

In locality 14, in the top part of Szczytna Mt. (Wzgórza Kiełczyńskie hills) a small thallus of *Catillaria atomarioides* was found. This is a species with a Subatlantic range (Wirth 1985), reported from Germany, Austria, France, Sweden, Great Britain and other places, and not recorded in Poland previously. It differs from the similar species *Catillaria chalybeia* by its smaller apothecia (with diameter up to 0.2 mm), lower hymenium (30–40 μm) and colorless hypothecium.

Several species reported from the study area in the 19th century (Table 2) were not found again. Some of them are considered endangered in Poland or are generally very rare (e.g., *Caloplaca rubelliana*, a southern species reported in Poland from only two sites in Lower Silesia, and also *Collema flaccidum*, *Pannaria leucophaea*, *Rhizocarpon similinum*). They probably went extinct in former localities due to environmental changes (e.g., shading of formerly exposed rock surfaces by trees). Two uncommon species, *Caloplaca* cf. *atroflava* and *Rinodina oxydata*, are still present at their sites after over a hundred years.

A characteristic trait of serpentinicolous lichen floras is their heterogeneity. They comprise species typical for siliceous rocks as well as basiphilous and even calciphilous ones. Species typical for neutral and slightly basic siliceous substrates are dominant on Silesian serpentinites. Lichens of acidic rocks (e.g., *Rhizocarpon geographicum*) are very rare and usually form small

Table 1. List of lichen species found on serpentinites in Lower Silesia. * – lichenicolous fungi.

Species	Localities
DIRECTLY ON ROCK SURFACE	
Acarospora fuscata (Nyl.) Arnold	4, 6, 7, 9, 10, 11, 12, 14, 15, 16, 18, 19
Acarospora peliscypha Th. Fr.	18
Aspicilia caesiocinerea (Nyl.) Arnold	12, 14
Aspicilia cinerea (L.) Koerber	12
Aspicilia contorta (Hoffm.) Krempelh.	16
Aspicilia laevata (Ach.) Arnold	14, 18
Buellia aethalea (Ach.) Th. Fr.	4, 9, 15, 21
Buellia ambigua (Ach.) Malme	1, 3, 15
Buellia stigmatea Koerber	1, 3, 4, 9, 12, 14, 15, 17, 19, 21
Caloplaca cf. *atroflava* (Turner) Mong.	3, 9, 12, 14, 15, 18, 21
Caloplaca citrina (Hoffm.) Th. Fr.	3, 15, 17
Caloplaca holocarpa (Hoffm.) Nordin	3, 12, 15, 16, 17
Candelariella aurella (Hoffm.) A. Zahlbr.	12, 15, 16, 17
Candelariella vitellina (Hoffm.) Müll. Arg.	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 19, 21
**Carbonea vitellinaria* (Nyl.) Hertel (on *Candelariella vitellina*)	9
Catillaria atomarioides (Müll. Arg.) Kilias	14
Catillaria chalybeia (Borrer) Massal.	15, 16
Dimerella pineti (Ach.) Vězda	11
Lecanora campestris (Schaerer) Hue	14
Lecanora dispersa aggr.	3, 12, 15, 17
Lecanora intricata (Ach.) Ach.	6, 9, 11, 12
Lecanora muralis (Schreber) Rabenh.	1, 3, 4, 6, 9, 12, 14, 15, 16, 18
Lecanora polytropa (Ehrh.) Rabenh.	1, 4, 9, 12, 14, 18, 19, 21
Lecanora umbrina auct.	15, 16
Lecidea fuscoatra (L.) Ach.	4, 9, 10, 21
Lecidea tesselata Flk.	9
Lecidella anomaloides (Massal.) Hertel & Kilias	5, 19, 21
Lecidella asema (Nyl.) Knoph & Hertel	1
Lecidella bullata Koerber	18
Lecidella carpathica Koerber	1, 3, 4, 9, 12, 14, 15, 16
Lecidella scabra (Taylor) Hertel & Leuckert	15, 16, 19, 21
Lecidella stigmatea (Ach.) Hertel & Leuckert	3, 4, 12, 15, 16, 17
Lecidella viridans (Flotow) Koerber	21
Lepraria cf. *eburnea* Laundon	20
Lepraria incana (L.) Ach.	5, 7, 14, 18, 19
Lepraria lobificans Nyl.	13, 20, 21
Lepraria rigidula (de Lesd.) Tønsberg	7
Leproloma vouauxii (Hue) Laundon	3, 15
Melanelia fuliginosa (Fr.) Essl.	3, 6, 8, 9, 10, 14, 18, 21
Neofuscelia cf. *loxodes* (Nyl.) Essl.	3, 9, 12, 18
Parmelia saxatilis (L.) Ach.	3, 6, 9
Parmelia sulcata Taylor	3
Phaeophyscia nigricans (Flk.) Moberg	15
Phaeophyscia orbicularis (Necker) Moberg	4, 12, 17

Table 1. *Continued.*

Species	Localities
Phlyctis argena (Spreng.) Flotow	7, 12, 14, 21
Physcia adscendens (Fr.) Olivier	3, 12, 15, 16
Physcia caesia (Hoffm.) Fürnrohr	3, 4, 12, 15, 16, 17
Physcia dubia (Hoffm.) Lettau var. *dubia*	3, 4, 6, 12, 14, 15, 18, 19
Physcia dubia (Hoffm.) Lettau var. *teretiuscula* (Ach.) Clauz. & Roux	10, 12, 20
Physcia tenella (Scop.) DC.	17, 18
Physconia grisea (Lam.) Poelt	3
Placynthiella icmalea (Ach.) Coppins & P. James	11, 18
Polysporina lapponica (Ach.) Degel	1, 3, 4, 9, 10, 12, 15, 21
Polysporina simplex (Davies) Vězda	1, 3, 12, 15, 17
Porina chlorotica (Ach.) Müll. Arg.	10, 11, 20
Porpidia crustulata (Ach.) Hertel & Knoph	9, 10, 11, 21
Porpidia tuberculosa (Sm.) Hertel & Knoph	9
Rhizocarpon distinctum Th. Fr.	1, 3, 4, 5, 9, 10, 12, 14, 15
Rhizocarpon geographicum (L.) DC.	6, 9, 14, 15, 21
Rhizocarpon grande (Flk.) Arnold	14
Rhizocarpon obscuratum (Ach.) Massal.	5
Rinodina confragosa (Ach.) Koerber	9, 18
Rinodina gennari Bagl.	3, 4, 15
Rinodina oxydata (Massal.) Massal.	18
Scoliciosporum umbrinum (Ach.) Arnold	3, 4, 6, 7, 8, 10, 11, 12, 14, 16, 19, 21
Staurothele ambrosiana (Massal.) Zsch.	15
Tephromela atra (Huds.) Hafellner	14
Tephromela grumosa (Pers.) Hafellner & Roux	6
Thelocarpon laureri (Flotow) Nyl.	18
Trapelia coarctata (Sm.) Choisy	1
Trapelia involuta (Taylor) Hertel	9
Trapelia obtegens (Th. Fr.) Hertel	11, 21
Trapelia placodioides Coppins & P. James	6, 7, 8, 11, 18
Verrucaria dolosa Hepp	20
Verrucaria muralis Ach.	3
Xanthoparmelia conspersa (Ach.) Hale	9, 10, 12
Xanthoria parietina (L.) Th. Fr.	3
ONLY ON SOIL, WASTE OR OVER EPILITHIC MOSSES	
Catapyrenium squamulosum (Ach.) O. Breuss.	2
Cladonia chlorophaea (Flk.) Sprengel	3, 4
Cladonia coniocraea (Flk.) Sprengel	1
Cladonia fimbriata (L.) Fr.	1, 10, 17
Cladonia furcata (Huds.) Schrader	3, 4, 16
Collema limosum (Ach.) Ach.	16
Hypogymnia physodes (L.) Nyl.	3
Lempholemma cf. *chalazanum* (Ach.) B. de Lesd.	16
Leptogium tenuissimum (Dickson) Koerber	15
Peltigera didactyla (With.) Laundon	2, 15

Table 2. Historical lichen reports on serpentinic substrates in Lower Silesia.

Species	Locality	Source
Caloplaca atroflava	Radunia Mt., Wzgórza Kiełczyńskie hills	Stein 1879; Eitner 1900
Caloplaca rubelliana	Wzgórza Kiełczyńskie hills	Stein 1879
Collema flaccidum	Wzgórza Kiełczyńskie hills	Eitner 1895
Hymenelia ceracea	Grochowiec Mt. (Grochowa Massif)	Eitner 1900
Lecanora bicincta	Radunia Mt.	Eitner 1900
Lobothalia radiosa	Radunia Mt.	Eitner 1900
Pannaria leucophaea	Brzeźnica Mt.	Eitner 1895
Rhizocarpon polycarpum	Radunia Mt.	Eitner 1900
Rhizocarpon similinum	Radunia Mt.	Eitner 1900
Rinodina oxydata	Brzeźnica Mt.	Eitner 1900
Tephromela atra	Radunia Mt.	Stein 1879
Verrucaria dolosa	Grochowiec Mt.	Eitner 1900
Xanthoria elegans	Grochowiec Mt.	Eitner 1895

thalli with only a few or no apothecia. The group of basi- and calciphilous lichens is represented by *Aspicilla contorta*, *Caloplaca citrina*, *Candelariella aurella*, *Lecanora dispersa* aggr., and epigeous ones, especially abundant in Szklary (localities 15 and 16): *Catapyrenium squamulosum*, *Collema limosum*, *Lepholemma* cf. *chalazanum* and *Leptogium tenuissimum*. A characteristic feature of the studied lichen flora, resulting from the specific mineral composition of serpentine rocks, is the presence of species typical for mineral- and metal-enriched substrates. This group includes *Catillaria atomarioides*, *Lecidea fuscoatra*, *Rhizocarpon distinctum*, *Rinodina oxydata* and *Trapelia involuta* (Purvis *et al*. 1992; Wirth 1995). On the other hand, only a few nitrophilous species were found (mainly of the genera *Physcia*, *Physconia* and *Phaeophyscia*). They usually occur in abandoned quarries, eutrophicated by use as illegal refuse dumps. Some localities are also enriched in nitrogen compounds by birds; this is especially frequent at the top parts and crowns of the higher exposed quarries.

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