

## THE CONDITION OF THE BIOTA OF LICHENS IN ŚWIDNIK

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**Summary.** The present paper contains an analysis of the lichen biota in Świdnik town. A total of 47 species of lichens were found – growing on tree bark (33 species), on wood (14), on rock (17) and on mosses (1). There were no species growing on the ground, even in stands located in the forest. Numerous species were observed in two or several more habitats. Four species were found on tree bark, wood and concrete, nine grew on tree bark and wood, seven were found on tree bark and concrete, and one species occurred on concrete and wood. Świdnik is a young, only 54-year-old, industrial town neighbouring the big Lublin city agglomeration. The results obtained in the study will serve as a basis for comparative and monitoring study.

**Key words:** biota of lichens, Świdnik

### INTRODUCTION

Lichens are regarded as the most sensitive bioindicators in biological monitoring. They indicate pollution of the atmosphere with sulphur dioxide, heavy metals, dusts and radioactive isotopes [Bystrek and Karczmarz 1988, Bystrek 1997, Fałtynowicz 2003].

Knowledge of the lichen biota condition is crucial in estimation of the effect on the environment of local contamination sources or of factors affecting the physicochemical condition of the environment, for instance changes in water relations. Numerous complex factors influence the level of lichens' response to toxic substances. Among them there are the following: the morphology of the thallus, biological properties, and physiological condition of the thallus, the lay of the land, substratum properties, climatic conditions, the kind and concentration of the toxic substance or element, distance from the emission source, the structure of built-up areas, neighbourhood of high green areas and presence of so called „ventilation channels” [Fałtynowicz 1995].

The aim of the present work was to catalogue and analyse the lichen habitat of Świdnik which appears to be a very interesting object of lichenological research as the development of the lichen biota can be traced back to the time of setting up the town. At the same time, the town is exposed to unfavourable influence of Lublin and developing industry.

Up to date, no lichenological research has been conducted on the territory of Świdnik. Very general information on this area can be found in papers on the local distribution of the genera *Parmelia* [Bystrek and Motyka-Zgłobicka 1972], *Peltigera* [Bystrek and Motyka-Zgłobicka 1974] and *Ramalina* [Bystrek 1966]. Only in the paper on the *Parmelia* genus were 3 species mentioned, however, with no data on their localisation. Also, the work on lichens of the Lublin Upland [Bystrek and Flisińska 1981] mentions several typical forest species.

#### STUDY AREA

Świdnik is a young, only 54-year-old town. In the first post-war decade, the decision was made to build a big plane factory here. Therefore, Świdnik was meant to become a typical factory housing estate of a similar role for Lublin as Nowa Huta plays for Kraków. Shortly before World War II, an airport for bomber planes, with huge hangars, was built in Świdnik. That investment facilitated the decision of the post-war Ministry of Industry and Trade to launch the construction of industrial factories and workers' housing estate. On January 1<sup>st</sup> 1951, the factory was set up under the name of Transportation Equipment Factory. The workers' barracks built in the neighbourhood of the factory gave rise to the town. Nowadays Świdnik has approximately 40500 inhabitants [www.swidnik.pl/liczby, www.swidnik.pl/historia].

Świdnik is situated 10 km east of Lublin and covers the area of 2035 ha. According to physical-geographical regionalisation, Świdnik belongs to the province of the Polish Upland, sub-province of Lubelsko-Lwowska Upland, macroregion of Lubelska Upland and mezoregion of Świdnik Plateau [Kondraci 2002]. In the physiogeographical classification of Lublin region elaborated by Chałubinska and Wilgat [1954], Świdnik is situated on Łuszczowska Plain which spreads north- and westwards of the town. There is no natural water watercourse on the territory of the town, which is a common phenomenon in upland areas built of permeable rock. There is no natural water outflow in the form of springs, either. The soil cover of Świdnik is relatively little differentiated, with brown soils dominating in the northern and western parts and fallow soils in the south and east of the town [Turski *et al.* 1993].

The vegetation of Świdnik is represented by roadside trees, woods, garden plants and various forms of urban green areas around detached houses and housing estates. The area described includes mainly mixed pine-oak (*Pino-Quercetum*) and linden-birch forests (*Tilio-Carpinetum*). Forests and tree-planted areas cover 326 ha

within the boundaries of Świdnik, which constitutes approximately 16% of the whole area of the town. The largest complex is the Rejkowizna Forest, with an area of 261 ha, which has production and recreational functions. The administration boundaries of the town include a small fragment of a forest traditionally called the Szpitalny (Hospital) Forest (21.9 ha). In the geobotanical classification of Fijałkowski [1972], Świdnik belongs to the following categories: State: Holarctica, Region: Eurosyberian, Province: Middle-Eurosyberian, Divide: Baltic, Subdivide: Middle Uplands, Country (Land, Landscape): Lubelska Upland, Region: Lubelski, Subregion: Świdnik Plateau.

### MATERIAL AND METHODS

The field study was carried out from October 2006 to March 2008 in 55 stands (Fig. 1). They were situated mainly in roadside and housing estate green areas. Data on lichens occurring on various substrata (trees and shrubs, wood, walls and soil) were collected. A great abundance of species was noted. With the aim of herbal identification and recording, small samples of thallus were taken. The nomenclature follows that of Fałtynowicz [2003a].

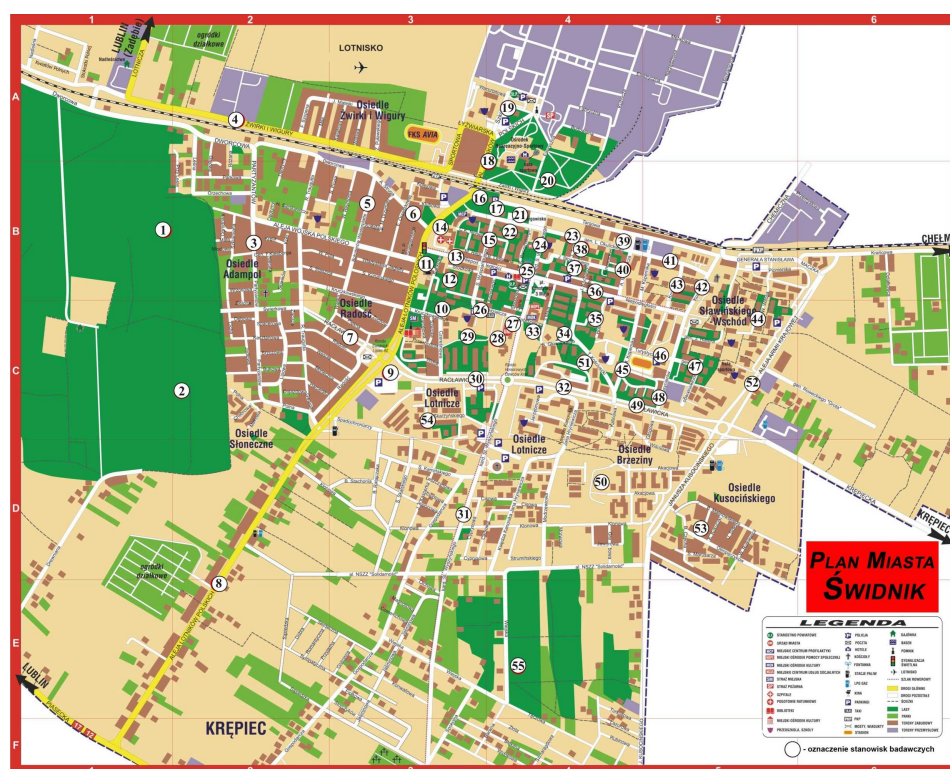


Fig. 1. The localization of research stands in the area of Świdnik

Table 1. The list of lichens; the number and numerical designation of the stands and the habitat's of their occurrence

Name of lichen	Number and numerical designation of the stands	Habitat
<i>Amandinea punctata</i> (Hoffm.) Coppins et Scheid.	18 (1, 3, 8, 9, 10, 11, 12, 16, 18, 22, 25, 29, 30, 32, 34, 41, 45, 55)	d, Asp, Bp, Fe, Psp, Qr, Tc
<i>Bacidia bagliettoana</i> (Massal. & de Not. in Massal.) Jatta	1 (34)	m
<i>Buellia aethalea</i> (Ach.) Th. Fr.	1 (9)	b
<i>Caloplaca citrina</i> (Hoffm.) Th. Fr.	13 (4, 8, 10, 16, 17, 18, 22, 29, 36, 41, 48, 49, 51)	b
<i>Caloplaca decipiens</i> (Arnold) Blomb & Forss.	12 (4, 5, 7–9, 19, 29, 32, 45, 47, 48, 51)	b, c
<i>Caloplaca holocarpa</i> (Hoffm.) Waede	22 (4, 5, 7–10, 13, 22, 23, 32, 33, 36, 37, 40, 41, 45, 47–52, 55)	b, Msp
<i>Caloplaca saxicola</i> (Hoffm.) Nordin	10 (4, 5, 8, 9, 17, 19, 32, 37, 48, 51)	b
<i>Candelaria concolor</i> (Dickson) B. Stein	4 (20, 21, 25, 39)	Asp, Fe, Qr, Usp
<i>Candelariella aurella</i> (Hoffm.) A. Zahlbr.	18 (3–5, 7, 8, 10, 13, 17, 19, 22, 33, 37, 41, 45, 48, 49, 51, 52)	b, d, Asp
<i>Candelariella reflexa</i> (Nyl.) Lettau	2 (34, 41)	Psp
<i>Candelariella vitellina</i> (Hoffm.) Müll. Arg.	11 (3, 6, 9, 10, 17, 23, 27, 29, 32, 48, 51)	b, d, Fe, Pa, Psp, Qr, Tc
<i>Candelariella xanthostigma</i> (Ach.) Lettau	4 (3, 29, 31, 37)	d, Ah, Fe, Rp
<i>Cladonia coniocraea</i> (Flk.) Vainio	1 (2)	Bp, Qr
<i>Evernia prunastri</i> (L.) Ach.	6 (23, 28, 34, 42, 45, 55)	Asp, Fe, Psp, Qr, Tc
<i>Hypocnomysce scalaris</i> (Ach.) Choisy	13 (1–4, 6, 16, 18–21, 28, 29, 55)	d, Asp, Bp, Fe, Ps, Psp, Qr
<i>Hypogymnia farinacea</i> Zopf	1 (42)	Asp
<i>Hypogymnia physodes</i> (L.) Nyl.	33 (2, 4, 6, 8, 10–14, 16–18, 20–23, 25–29, 31–36, 39, 41, 42, 45, 47, 55)	Ah, Asp, Bp, Csp, Fe, Msp, Pa, Psp, Qr, Rp, Tc, Usp
<i>Lecania naegelli</i> (Hepp) Diederich & P. Boom	1 (3)	d
<i>Lecanora albescens</i> (Hoffm.) Flk.	17 (4, 5, 8–10, 17, 19, 23, 29, 36, 37, 41, 45, 48, 50–52)	b, Msp
<i>Lecanora carpinea</i> (L.) Vainio	1 (3)	d
<i>Lecanora conizaeoides</i> Nyl. in Crombie	13 (2, 7, 14, 16–18, 20, 21, 29, 34, 41, 47, 55)	Bp, Fe, Ps, Psp, Qr, Tc, Usp
<i>Lecanora crenulata</i> Hook	14 (4, 5, 7, 9, 10, 19, 32, 33, 36, 41, 47–49, 51)	b
<i>Lecanora dispersa</i> (Pers.) Sommerf.	19 (4, 7–9, 19, 22, 23, 29, 32, 33, 36, 37, 41, 45, 47–49, 51, 52)	b
<i>Lecanora saligna</i> (Schrader) A. Zahlbr.	1 (3)	d
<i>Lecanora subintricata</i> (Nyl.) Th. Fr.	1 (34)	Aps
<i>Lecanora umbrina</i> (Ehrh.) Massal.	1 (3)	d

<i>Lecidella elaeochroma</i> (Ach.) Choisy	2 (3, 50)	d, Msp
<i>Lepraria incana</i> (L.) Ach.	7 (1, 8, 18, 20, 29, 31, 55)	Bp, Fe, Pa, Qr, Rp, Tc
<i>Melanelia exasperatula</i> (Nyl.) Essl.	4 (11, 13, 17, 18)	Fe, Psp, Qr, Sa
<i>Melanelia fuliginosa</i> (Fr. ex Duby)	6 (9, 16, 26, 34, 42, 55)	Asp, Bv, Tc
<i>Phaeophyscia nigricans</i> (Flk.) Moberg	16 (4, 5, 7, 8, 14, 21, 22, 32, 33, 36, 37, 41, 45, 48, 49, 51)	b, Asp, Fe, Qr, Tc
<i>Phaeophyscia orbicularis</i> (Necker) Moberg	52 (3, 4, 6–55)	b, d, Asp, Csp, Fe, Jr, Pa, Ps, Psp, Qr, Sa, Sac, Rp, Tc
<i>Phlyctis argena</i> (Ach.) Flotow	1 (1)	Qr
<i>Physcia adscendens</i> (Fr.) Oliver	38 (3, 4, 8, 10–14, 16–19, 21–26, 28–39, 41, 43, 44, 46–49, 51)	b, Asp, Csp, Fe, Pa, Psp, Qr, Rp, Sa, Sac, Tc
<i>Physcia aipolia</i> (Ehrh.) Hampe	1 (41)	Fe
<i>Physcia dubia</i> (Hoffm.) Lettau	51 (2–4, 6, 8–19, 21–55)	d, Asp, Csp, Fe, Jr, Pa, Psp, Qr, Rp, Sa, Tc
<i>Physcia stellaris</i> (L.) Nyl.	19 (3, 4, 7, 8, 11, 17, 26, 28, 32, 34, 37, 39, 41, 42, 45–47, 49, 55)	Asp, Csp, Fe, Pa, Psp, Qr, Sa, Sac, Tc
<i>Physcia tenella</i> (Scop.) DC. in Lam. & DC.	16 (4, 12, 18–21, 26, 29–30, 33, 34, 36, 37, 47, 55)	Asp, Csp, Fe, Pa, Psp, Qr, Rp, Tc
<i>Physconia grisea</i> (Lam.) Poelt	1 (14)	Qr
<i>Placynthiella uliginosa</i> (Schrader) Coppin & P. James	1 (51)	d
<i>Pramelia sulcata</i> Taylor	37 (1, 2, 4, 6–8, 10–14, 16–18, 20–23, 25–29, 31–34, 39–42, 45, 47–49, 51, 55)	Ah, Asp, Bp, Csp, Fe, Msp, Pa, Psp, Qr, Tc
<i>Protoparmeliopsis muralis</i> (Schreb.) Choisy	1 (10)	b, d
<i>Pseudevernia furfuracea</i> (L.) Zopf	3 (13, 28, 55)	Fe, Tc
<i>Xanthoria candelaria</i> (L.) Th. Fr.	5 (9, 12, 27, 33, 50)	Ah, Asp, Fe, Usp
<i>Xanthoria elegans</i> (Link.) Th. Fr.	3 (4, 7, 29)	b
<i>Xanthoria parietina</i> (L.) Th. Fr.	48 (1, 3, 4, 6–19, 21–24, 26–37, 40, 41, 43–55)	b, d, Ah, Asp, Bp, Csp, Fe, Jr, Msp, Pa, Psp, Qr, Rp, Sa, Sac, Tc, Usp
<i>Xanthoria polycarpa</i> (Hoffm.) Rieber	34 (3, 4, 7–12, 14, 18, 19, 21–23, 26, 28, 31–36, 38, 41–47, 49, 50, 53–55)	Asp, Bv, Csp, Msp, Psp, Qr, Sa, Tc, Usp

Legend of abbreviations: b – concrete, c – brick, d – wood, m – mosses, Ah – *Aesculus hippocastanum*, Asp – *Acer sp.*, Aps – *Acer pseudoplatanus*, Bp – *Betula pendula*, Csp – *Crataegus sp.*, Fe – *Fraxinus excelsior*, Jr – *Juglans regia*, Msp – *Malus sp.*, Pa – *Prunus avium*, Ps – *Pinus sylvestris*, Psp – *Populus sp.*, Qr – *Quercus robur*, Rp – *Robinia pseudoacacia*, Sa – *Salix alba*, Sac – *Sorbus aucuparia*, Tc – *Tilia cordata*, Usp – *Ulmus sp.*

## RESULTS

The study conducted in the town of Świdnik revealed the occurrence of 47 lichen species. Table 1 contains an alphabetical index of the species observed and the number of stands in which they were present (stand numbers in brackets) as well as the substrata on which they grew.

### Stand analysis

Lichens occur on diverse substrata: on the bark of trees and bushes, on concrete, brick and also on wooden fences. Among the specimens found there were 33 epiphytic, 14 epixylic, 17 epilithic and 1 epibryophytic species (Tab. 1).

#### **Epiphytic species**

The lichens grew on 17 tree species, most prevalently on oaks (*Quercus sp.*) – 22 species, ashes (*Fraxinus sp.*) – 21, maples (*Acer sp.*) – 19, lindens (*Tilia sp.*) – 17 and poplars (*Populus sp.*) – 17. The least numerous species grew on pines (*Pinus sp.*) and walnuts (*Juglans regia*) – 3 species on each.

Most frequently and most abundantly occurring was *Phaeophyscia orbicularis*, found on each tree species. Similar occurrence was observed in the case of *Physcia dubia* (on 16 tree species), *Xanthoria parietina* (15) and *Physcia adscendens* (14). These lichens were found in the biggest number of stands (Table 1). The species which grew in one stand only were *Hypogymnia farinacea*, *Lecanora subintricata*, *Physconia grisea* and *Cladonia coniocraea*.

#### **Epixylic species**

The following species were observed on rotting wood: *Amandinea punctata*, *Candelariella vitellina*, *Lecanora carpinea*, *Lecanora saligna*, *Lecanora umbriana* and *Lecania naegelli*. They were mainly found on wooden fences.

#### **Epilithic species**

The most prevalent species found on concrete walls under fences and on bricks was *Caloplaca citrina*, whereas *Caloplaca holocarpa*, *Caloplaca decipiens*, *Caloplaca saxicola*, *Candelariella aurella*, *Lecanora albescens*, *Lecanora crenulata* and *Lecanora dispersa* were frequently found on concrete lamp posts. *Phaeophyscia nigricans*, *Phaeophyscia orbicularis* and *Xanthoria parietina* were equally often observed on anthropomorphic bedrock.

Only one epibryophytic species – *Bacidia bagliettoana* – was found on dead mosses.

#### **Analysis of lichen distribution in particular stands**

Świdnik is a young town and the stands within its boundaries differ from each other with regard to the area they cover, date of origin (housing estates) and habitat conditions. Hence, there are differences in the species count. The biggest number of lichen species were noted in stand 4, i.e., in Żwirki i Wigury Street, Adampol District – 20 species, and the smallest number was observed in stand 15 (a fragment of S. Wyspiańskiego Street) with only 3 species. 4 species grew in each of the stands: 24, 38, 53 and 54; 5 in each of the stands: 40, 43 and 44; 6 in each of stands: 1, 2, 30, 35 and 46; 7 species in stands 5, 6, 25, 27, 39 and 52; 8 species in stand 20; 9 species in each of the following stands: 31, 42 and 51; there were 10 species in stands 11, 12, 13, 14 and 26 each; 11 species in stand 16; 12 species in stands 21, 23 and 49; 13 species in each of the following stands: 7, 18, 19,

22, 36 and 37; 14 species in stands 17, 33 and 47; 15 in stands 9, 10, 45 and 48; there were 16 species in each of the following stands: 3, 32, 34 and 51; 17 species in stand 55; 18 species in both stand 8 and 29; and 19 species in stand 41.

#### CONCLUSIONS

The lichen biota in Świdnik is characterised by a relatively low diversity of species, compared to other towns of similar size [Rydzak 1957]. This results from the young age of the town and its close location to Lublin, a big urban centre, and from the presence of a big industry centre (WSK PZL-Świdnik). Despite these conditions, we managed to note here as many as 47 species of lichens growing in various habitats.

With regard to the morphological forms, the most numerous were foliose (22 species) and crustose lichens (22 species), constituting 47% each; the fruticose forms were less numerous (3 species) – 6%.

14 species of lichens were found on more than one type of bedding. Four of them, namely *Candelariella aurella*, *Candelariella vitellina*, *Phaeophyscia orbicularis* and *Xanthoria parietina* grew on tree bark, wood and concrete. Research revealed that *Amandinea punctata*, *Candelariella aurella*, *Candelariella vitellina*, *Candelariella xanthostigma*, *Hypocenomyce scalaris*, *Lecidella elaeochroma*, *Phaeophyscia orbicularis*, *Physcia dubia* and *Xanthoria parietina* can be classified as epiphytic and epixylic lichens.

The following species were found on concrete and tree bark: *Caloplaca holocarpa*, *Candelariella reflexa*, *Lecanora albescens*, *Phaeophyscia nigricans*, *Phaeophyscia orbicularis*, *Physcia adscendens* and *Xanthoria parietina*.

*Protoparmeliopsis muralis* occurred on a concrete wall and, exceptionally, on a wooden fence. No lichen growing on the ground was found within the town boundaries.

The most abundant and most frequently occurring were *Phaeophyscia orbicularis* – in 52 stands and *Physcia dubia* – in 51. These two species grew on whole trunks of roadside trees. Tree bark was equally often overgrown by *Xanthoria parietina* (48 stands), *Physcia adscendens* (38), *Parmelia sulcata* (37), *Xanthoria polycarpa* (34) and *Hypogymnia physodes* (33). The richest lichen stand was No.4 (Żwirki i Wigury str.) with 20 species; stand 41 included 19 species and Nos. 8 and 29 contained 18 species each. The smallest number was noted in stand 15 where there were only 3 lichen species. 14 species grew in single stands only.

Among the species found within the boundaries of Świdnik, 5 are included in the lichen Red Data Book [Cieśliński *et al.* 2006]. These are: *Melanelia exasperatula* – CR (Critically Endangered), *Buellia aethalea* and *Hypogymnia farinacea* – VU (Vulnerable), *Evernia prunastri* and *Physcia aipolia* – NT (Near Threatened). 4 species are under strict protection: *Hypogymnia farinacea*, *Melanelia exasperatula*, *Melanelia fuliginosa* and *Pseudevernia furfuracea*, whereas one species – *Evernia prunastri* – is partially protected.

No species of the *Parmelia* Ach. genus (*Parmelia fuliginosa*, *Parmelia*

*subaurifera*, *Parmelia revoluta*) earlier reported by Bystrek and Motyka-Zglobicka [1972] were found in the area of our study. Neither were the following species found, described by Bystrek and Flisińska [1981]: *Coniocybe furfuracea*, *Cladonia botrytes*, *Cladonia coccifera*, *Cladonia floerkeana*, *Cladonia fimbriata*, *Cladonia tenuis*, *Cetraria crispa*, *Evernia mesomorpha* and *Ramalina farinacea*. The species mentioned in the present paper may have been observed in the area of Świdnik Forest Inspectorate, as these taxa are prevalent in big forest complexes rather than in urban areas.

It should be emphasized that the lichen biota of the forest within the administration boundaries of Świdnik is extremely poor.

The data obtained in preparation of the present paper may be a basis for a future comparative study and for monitoring of Świdnik's environmental condition, especially considering the prospective passenger airport.

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**Internet websites**

(www ... 1) <http://www.swidnik.pl/liczby.php>

(www ... 2) <http://www.swidnik.pl/historia.php>

**STAN BIOTY POROSTÓW ŚWIDNIKA**

**Streszczenie.** W pracy przedstawiono analizę bioty porostów Świdnika. Stwierdzono występowanie 47 gatunków porostów. Rosły na korze drzew (33 gatunki), drewnie (14), podłożu skalnym (17) i na mszakach (1). Nie stwierdzono gatunków naziemnych, nawet na stanowiskach zlokalizowanych w lesie. Duża grupa gatunków rosła na dwóch lub więcej siedliskach. Cztery gatunki rosły na korze drzew, drewnie i betonie, dziewięć na korze drzew i drewnie, siedem na korze drzew i betonie, jeden na betonie i drewnie. Świdnik jest bardzo młodym miastem przemysłowym, liczącym dopiero 54 lata, sąsiadującym z dużą aglomeracją miejską – Lublinem. Uzyskane wyniki dadzą podstawę badań porównawczych i monitoringowych.

**Słowa kluczowe:** biota porostów, Świdnik