Data in Brief 31 (2020) 105711

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data on epiphytic lichens and their host-trees in relation to non-forested area and natural deciduous lowland forest

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A R T I C L E   I N F O

Article history:
Received 24 April 2020
Accepted 8 May 2020
Available online 15 May 2020

Keywords:
Lichenized fungi
Lichen communities
Habitat factors
Ecology, Tree parameters
Lowland deciduous forest
Tree avenues
Rural landscape

A B S T R A C T

The article includes raw and analyzed data directly related to the research paper entitled “Non-forested vs forest environments: the effect of habitat conditions on host tree parameters and the occurrence of associated epiphytic lichens” [1]. These data concern the relationships between the composition of lichen communities and host-tree parameters in non-forested area and a natural lowland deciduous forest in northern Poland. Lichen species confined to non-forested area, associated with forest habitat, and non-specific mutual species occurring in both habitat types are listed together with their host-tree preferences. Data on the phenotypic variability of five common and native to Central Europe tree species in relation to the habitat type are provided. Data that concerns tree parameters are analyzed by the mixed model ANOVA and Principal Component Analysis. Additionally, sample rarefactions and indices of potential lichen species richness for both habitat types are included. Presented data could be used in further studies to compare

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https://doi.org/10.1016/j.dib.2020.105711

epiphytic community structure and may be support for campaigns aimed at lichen conservation and at shaping the environment with concern for biodiversity.

Specifications table

Subject	Environmental Science
Specific subject area	Lichen communities, impact of host-tree parameters and microhabitat factors on epiphytic lichen biota composition, phenotypic plasticity of deciduous trees
Type of data	Tables, graphs and figures
How data were acquired	Filed study, taxonomic identification of lichen specimens, microhabitat properties determination (field measurements and chemical analyzes of tree bark properties)
Data format	Raw, analyzed and filtered
Parameters for data collection	List of lichen taxa (presence/absence) with the characteristics; descriptive statistics for host-tree parameters: diameter (cm) at breast height (DBH), conductivity (µS/cm) of bark solution, bark pH, water-holding capacity (%) of bark (WHC), depth (mm) of periderm cracks (DPC); light intensity (µmol m^{-2} s^{-1}) at tree trunks
Description of data collection	The study was carried out in two different habitat types: non-forested area (tree avenues) and forest (mixed natural deciduous lowland forest) and included five deciduous tree species: *Acer platanoides, Fraxinus excelsior, Tilia cordata, Quercus robur, Ulmus laevis*. 100 tree individuals (20 per species) for both habitat types were examined in terms of their properties and lichen species diversity.
Data source location	well-preserved stretches of tree avenues (ca 200 m in length) and best-preserved parts of natural forest (largely protected within the NATURA 2000 network) in Olsztyn Lakeland mesoregion, northern Poland
Data accessibility	Data are included in this article
Related research article	Kubiak, D., and Osyczka, P. Non-forested vs forest environments: the effect of habitat conditions on host tree parameters and the occurrence of associated epiphytic lichens. Fungal Ecol.

Value of the data

- The data provide insight into the association of lichens and host-trees in relation to two different ecological systems. They can be used for comparative environmental studies in the future.
- Due to cultivation and breeding, old deciduous forests of Europe have been greatly affected and a decline in biodiversity in forests is still being observed [2–4]. The distribution of epiphytic lichens may be an indicator of environment condition and anthropogenic transformation therein [5,6]. Data can be used in further studies to estimate the direction and strength of changes in habitat quality of forest complexes over a longer period of time.
- Tree avenues in deforested area constitute reservoir for lichen biodiversity and can serve as ecological corridors for some of species [7]. The data may be useful in developing environmental strategies in the management of forest resources as well as landscaping of rural areas with concern for biodiversity.

1. Data Description

Data on the specific composition of epiphytic lichen communities and host-tree parameters for non-forested and forest habitats in relation to the same deciduous tree species are presented.

The ranges of analysed parameters for each tree species in respect to habitat type are presented in Table 1. This table includes also the values of Pearson's coefficient if significant correlations ($p<0.05$) between bark parameters, tree diameters, and the intensity of light falling on tree trunks were found. The relationship between trees and their parameters is presented on the Principal Component Analysis (PCA) biplot (Fig. 1). To better illustrate the phenotypic variability for particular trees, convex hulls for tree individuals from the same species and habitat type were applied. The mixed model ANOVA with tree species and habitat treated as fixed factors and locality as a random factor nested within habitat was performed to recognize their effect on bark properties, tree diameter, and light intensity at tree trunks. The effect of factors on particular parameters are provided in Table 2. The sample rarefactions depicted by the species accumulation curves [8] together with Chao 2 indices [9] for non-forested and forest habitats are presented on Fig. 2; this illustrates relationship between number of lichen taxa and number of examined tree trunks and estimates the potential species richness in both habitat types. The lists of three identified sets of epiphytic lichens are provided: confined to non-forested areas – 40 species (Table 3), associated with lowland deciduous forests – 61 species (Table 4), and non-specific mutual species that occur in both habitat types – 53 species (Table 5). Host tree affinity and threat category are specified for particular lichen species. The nomenclature follows Index Fungorum [10], the collected lichen material is deposited in the OLTC herbarium.

2. Experimental Design, Materials, and Methods

2.1. Field study and sampling

The study was conducted in northern Poland within the Olsztyn Lakeland mesoregion. The composition of epiphytic lichen communities were examined in two different ecological systems, non-forested landscape area in the form of tree avenue and mixed deciduous lowland forest (the *Tilio cordatae-Carpinetum betuli* association) corresponding to the potential natural vegetation of Central Europe. Five deciduous tree species with high value for biodiversity conservation were examined: *Acer platanoides* (Norway maple), *Fraxinus excelsior* (ash), *Tilia cordata* (lime), *Quercus robur* (pedunculate oak), *Ulmus laevis* (European white elm). These trees constitute an important component of the eutrophic and mesoeutrophic forests and have frequently been planted along roads. The data were obtained from 100 trees (20 per species) for each habitat type. Mature tree individuals with a minimum diameter of 40 cm, in good condition, characterized by a single straight trunk and topped with a typical crown, were included in the examination. To meet these criteria and collect data, 30 relevant localities were designated for each habitat type. Lichens were identified over the entire surface of tree trunks at a height of 0–2 m from the ground. Most individuals were collected for detailed morphological and chemical examinations [11]. The diameter at breast height, i.e. 1.3 m from the ground, of each tree were measured. At this height, the depth of periderm cracks was determined using callipers at four points of trunks according to major geographical coordinates; the average value for individual tree specimen was treated as a single observation. Three bark pieces were cut off from the trunks at three different points at height of 1.5 m from the ground for chemical analyses. Light intensity was recorded at breast height close to the tree trunks using Kipp & Zonen PAR Quantum Sensor. Measurements were performed in four directions in the middle of the day towards the end of May; the average value for tree individual was treated as a single observation. In addition, to supplement the microhabitat data, relative humidity was recorded close to tree trunks using Testo, Inc. hygrometer.

2.2. Analysis of tree bark properties

Bark samples were cleaned of organic debris prior to analyses. Bark pH was measured using an Extech PH100 pH meter with a flat-surface electrode; 0.5 ml of 0.1 M KCl was placed on

Table 1
Diameter at breast height (DBH), properties of bark for particular host-trees (pH, conductivity of bark solution, water holding capacity – WHC, depth of periderm cracks – DPC) and additional microhabitat parameters (light intensity at tree trunks, average relative humidity for habitat type); mean, standard deviations (SD, n=20) and minimum–maximum values are provided. Pearson's coefficient are included for statistically significant correlations (p<0.05) between tree diameter and bark parameter (the correlated feature is given in parenthesis).

	Tree:	*Acer*	*Fraxinus*	*Quercus*	*Tilia*	*Ulmus*	*Acer*	*Fraxinus*	*Quercus*	*Tilia*	*Ulmus*
Habitat type:		Non-forested (open area, tree avenue)					Natural deciduous lowland forest				
DBH (cm)	mean±SD	74±12	78±9	94±14	79±15	86±14	64±10	64±13	71±12	66±8	58±13
	min–max	53–101	64–98	65–122	56–105	60–108	50–90	50–91	56–96	56–83	44–99
				0.62 (WHC)			**0.58** (DPC)		**0.53** (DPC)		**-0.47** (pH)
pH	mean±SD	5.6±0.4	6.0±0.3	4.6±0.3	5.1±0.4	5.9±0.4	5.9±0.6	5.7±0.5	4.4±0.6	4.4±0.5	5.9±0.5
	min–max	5.0–6.4	5.3–6.7	3.7–5.3	4.2–5.9	5.1–6.5	4.8–6.8	4.7–6.7	3.7–5.8	3.8–5.3	5.2–6.9
Conductivity (µS/cm)	mean±SD	551±305	741±215	182±82	314±176	711±419	646±250	507±167	647±315	372±339	365±204
	min–max	248–1130	502–1147	103–347	176–634	291–1490	476–1190	228–750	370–1058	161–1045	170–754
WHC (%)	mean±SD	159±9	174±14	166±12	201±18	205±17	182±27	191±21	167±14	205±23	241±40
	min–max	142–176	151–197	144–194	161–236	171–231	155–232	158–235	142–191	168–272	192–338
DPC (mm)	mean±SD	15±2	11±3	19±3	13±3	13±2	11±2	11±1	25±7	9±2	11±3
	min–max	12–19	7–18	15–28	5–17	10–15	8–13	7–14	13–39	7–13	6–19
Light intensity (µmol m^{-2} s^{-1})	mean±SD	191±32	199±32	191±34	174±23	190±29	82±7	91±4	90±14	78±9	81±7
	min–max	150–260	150–255	140–265	145–245	145–250	72–96	85–98	75–116	68–102	72–98
Avg. relative humidity (%)				25±2 (21–31)					35±3 (30–41)		

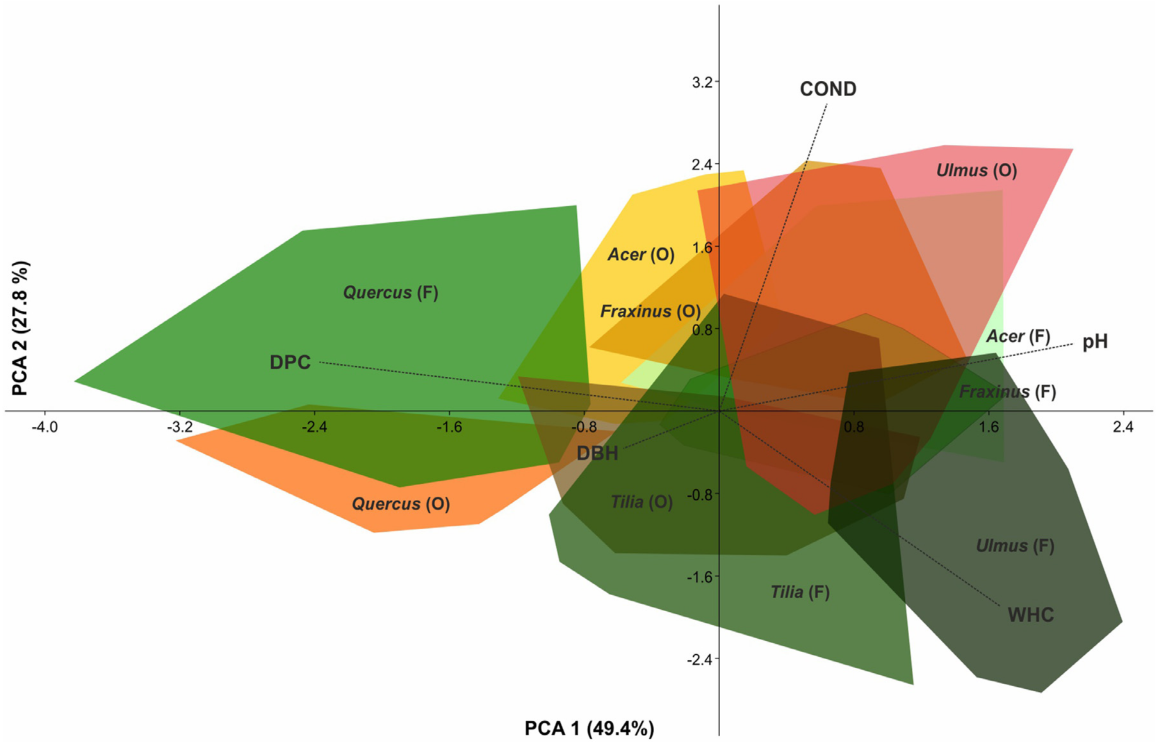

Fig. 1. Principal Component Analysis (PCA) graph illustrating the relationship between trees, diameter at breast height, and bark properties. Convex hulls encompass tree individuals (n=20) from the same species and habitat type, percentage of variance accounted by the axis 1 and axis 2 is provided. Habitat type: O – non-forested, F – deciduous forest; Variables: DBH – diameter at breast height, COND – conductivity of bark solution, WHC – water holding capacity, DPC – depth of periderm cracks.

Table 2
Mixed model ANOVA results for the effect of tree species (TREE), habitat (HAB), and locality (LOC{HAB}) on tree parameters and light intensity at tree trunks; significant values (p<0.05) are in bold.

Source of variation	Factors		*SS*	*MS*	*DF*	F	p
pH	TREE	Fixed	68.90	17.23	4	**73.99**	**<0.001**
	HAB	Fixed	1.77	1.77	1	**7.61**	**0.006**
	LOC{HAB}	Random (nested within HAB)	13.61	0.23	58	1.01	0.474
	Error		31.66	0.23	136		
Conductivity	TREE	Fixed	1,831,870	457,967	4	**4.88**	**0.001**
	HAB	Fixed	371	371	1	0.01	0.949
	LOC{HAB}	Random (nested within HAB)	4,546,767	78,393	58	0.84	0.778
	Error		1,275,2353	93,767	136		
WHC	TREE	Fixed	77,123	19,281	4	**37.13**	**<0.001**
	HAB	Fixed	12,577	12,577	1	**24.22**	**<0.001**
	LOC{HAB}	Random (nested within HAB)	23,280	401	58	0.77	0.866
	Error		70,625	519	136		
DPC	TREE	Fixed	2826	706	4	**47.10**	**<0.001**
	HAB	Fixed	65.24	65.24	1	**4.35**	**0.039**
	LOC{HAB}	Random (nested within HAB)	506	8.73	58	0.58	0.989
	Error		2040	15.00	136		
DBH	TREE	Fixed	4779	1195	4	**7.39**	**<0.001**
	HAB	Fixed	14,546	14,546	1	**91.65**	**<0.001**
	LOC{HAB}	Random (nested within HAB)	9202	159	58	0.98	0.521
	Error		21,977	162	136		
Light intensity	TREE	Fixed	5286	1322	4	**2.44**	**0.005**
	HAB	Fixed	524,218	524,218	1	**969.21**	**<0.001**
	LOC{HAB}	Random (nested within HAB)	22,061	380	58	0.70	0.935
	Error		73,559	541	136		

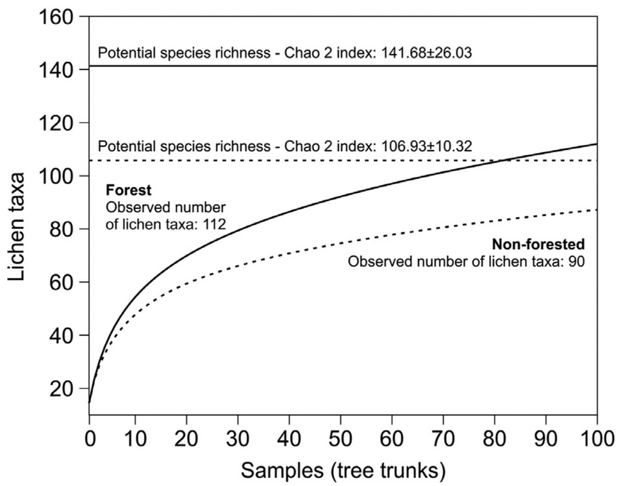

Fig. 2. Rarefaction curves (with potential species richness lines) for non-forested (dashed line) and forest (solid line) habitats.

the bark 1 min before measurements to enable the rapid solution of hydrogen ions [12]. Pieces of bark dried to a constant weight were milled to obtained composite samples. Portions 2 g weight were soaked in glass bottles with 20 ml of deionized water and shaken for 4 h using a vibration shaker. Following suspension filtration conductivity of solutions was measured using a conductivity meter SevenGo Duo SG23-FK5; Mettler Toledo. After two weeks air-drying, equal sized (ø 10 mm) and 2–3 mm thick discs were cut from the bark samples using a cork borer. The discs were weighed and subsequently submerged in deionised water and shaken in a vibration

Table 3
List of epiphytic lichen species confined to non-forested habitat.

Species	Host tree affinity	Threat category[1]
Anaptychia ciliaris	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	EN
Athallia pyracea	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	
Bryoria fuscescens	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	VU
Caloplaca monacensis	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Caloplaca obscurella	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	NT
Candelaria pacifica	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Candelariella reflexa	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	
Candelariella vitellina	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*●	
Gyalecta fagicola	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Lecania cyrtella	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Lecanora allophana	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	
Lecanora compallens	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	
Lecanora conizaeoides	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	
Lecanora dispersa	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*○	
Lecanora hagenii	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*●	
Lecanora persimilis	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	DD
Lecanora symmicta	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Melanohalea exasperatula	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	
Melanelixia subargentifera	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*●	VU
Micarea denigrata	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	
Parmelina tiliacea	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Phaeophyscia nigricans	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	
Physcia aipolia	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	NT
Physcia caesia	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	
Physcia dubia	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	
Physconia grisea	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Physconia perisidiosa	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	EN
Placynthiella dasaea	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	
Pleurosticta acetabulum	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	EN
Polycaulonia candelaria	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Polycaulonia polycarpa	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Polycaulonia ucrainica	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Ramalina fraxinea	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	EN
Rinodina exigua	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	VU
Rinodina gennari	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Scoliciosporum chlorococcum	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	
Scoliciosporum sarothamni	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Strangospora ochrophora	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Strangospora pinicola	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	LC
Tuckermanopsis chlorophylla	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	VU

Host trees: *Ac – Acer, Fr – Fraxinus, Qu – Quercus, Ti – Tilia, Ul – Ulmus;* ● – present; ○ – absent.
[1] acc. to [14]: EN – endangered, VU – vulnerable, NT – near threatened, LC – least concern, DD – data deficient.

shaker for 24 h. Then, the excess of water was remove and the discs were weighed again. Water-holding capacity was treated as the percent increase in weight. The mean value calculated from the measurements of three separate bark samples was considered one observation for each tree individual.

2.3. Data analyses

The mixed model ANOVA was performed using STATISTICA 12. PAST 3.25 [13] was applied for Principal Component Analysis, sample rarefaction, and Chao 2 index calculation.

Table 4
List of epiphytic lichen species associated with natural deciduous lowland forest.

Species	Host tree affinity	Threat category[1] and indicative value[2]
Agonimia repleta	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Arthonia arthonioides	*Ac*● *Fr*○ *Qu*● *Ti*○ *Ul*○	CR (Ind)
Arthonia byssacea	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	EN (Ind)
Arthonia didyma	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	EN (Ind)
Arthonia muscigena	*Ac*● *Fr*○ *Qu*● *Ti*○ *Ul*●	
Arthonia radiata	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	
Arthonia ruana	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	NT
Arthonia spadicea	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*●	
Arthonia vinosa	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*●	NT (Ind)
Bacidia laurocerasi	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	CR (Ind)
Bacidina sulphurella	*Ac*○ *Fr*● *Qu*○ *Ti*● *Ul*●	
Biatora efflorescens	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	VU
Biatoridium monasteriense	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	NT
Biatora hemipolia f. *pallida*	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Calicium adspersum	*Ac*● *Fr*○ *Qu*● *Ti*● *Ul*○	EN (Ind)
Calicium salicinum	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU
Calicium viride	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU (Ind)
Caliplaca lucifuga	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	
Catinaria atropurpurea	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	EN
Catillaria croatica	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Chaenotheca furfuracea	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	NT
Chaenotheca gracilenta	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	CR (Ind)
Chaenotheca stemonea	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*●	EN
Chrysothrix candelaris	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	CR (Ind)
Cladonia coniocraea	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Fellhanera gyrophorica	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*●	LC (Ind)
Fuscidea arboricola	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Fuscidea pusilla	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Graphis scripta	*Ac*○ *Fr*● *Qu*○ *Ti*● *Ul*○	NT
Gyalecta truncigena	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	EN
Hypotrachyna revoluta	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	EN (Ind)
Lecanora albella	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	EN (Ind)
Lecanora stansilai	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*○	
Lecanora thysanophora	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Lepraria elobata	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Lepraria rigidula	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*○	
Lepraria vouauxii	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	
Lobaria pulmonaria	*Ac*● *Fr*○ *Qu*● *Ti*○ *Ul*○	EN (Ind)
Micarea hedlundii	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	VU (Ind)
Micaerea prasina agg	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Ochrolechia bahusiensis	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*○	VU
Ochrolechia turneri	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*○	
Opegrapha vermicellifera	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	EN (Ind)
Opegrapha vulgata	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	VU
Opegrapha niveoatra	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU
Parmeliopsis ambigua	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*○	
Peltigera praetextata	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	VU
Pertusaria coronata	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	VU (Ind)
Pertusaria flavida	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*○	EN (Ind)
Pertusaria leioplaca	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	NT
Phaeophyscia endophoenicea	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	EN
Platismatia glauca	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	
Pyrenula nitida	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Ramalina obtusata	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	EN
Reichlingia leopoldii	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	
Rinodina degeliana	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	
Ropalospora viridis	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Strigula jamesii	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Varicellaria hemisphaerica	*Ac*● *Fr*○ *Qu*● *Ti*○ *Ul*○	VU (Ind)
Vezdaea aestivalis	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	DD
Zwackhia viridis	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU (Ind)

Host trees: *Ac* – *Acer, Fr* – *Fraxinus, Qu* – *Quercus, Ti* – *Tilia, Ul* – *Ulmus;* ● – present; ○ – absent.

[1] acc. to [14]: CR – critically endangered, EN – endangered, VU – vulnerable, NT – near threatened, LC – least concern, DD – data deficient

[2] acc. to [15]: Ind – lowland old-growth forests indicator (bolded).

Table 5
List of non-specific epiphytic lichen species occur both in non- forested and forest habitats.

Species	Species abbreviations	Host tree affinity		Threat category[1]
		Non-forested habitat	Forest habitat	
Acrocordia gemmata	Acro gem	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	VU
Alyxoria varia	Alyx var	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*●	*Ac*● *Fr*○ *Qu*● *Ti*○ *Ul*●	NT
Amandinea punctata	Aman pun	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Anisomeridium polypori	Anis pol	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Arthonia mediella	Arth med	*Ac*● *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	VU
Bacidia rubella	Baci rub	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU
Bacidia subincompta	Baci sub	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	EN
Bacidina adastra	Baci ada	*Ac*○ *Fr*● *Qu*○ *Ti*● *Ul*●	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Bacidina neosquamulosa agg.	Baci neo	*Ac*● *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Biatora globulosa	Biat glo	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	
Biatora vernalis	Biat ver	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Buellia griseovirens	Buel gri	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*● *Qu*○ *Ti*● *Ul*●	
Candelariella efflorescens	Cand eff	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*●	*Ac*○ *Fr*○ *Qu*● *Ti*○ *Ul*○	
Candelariella xanthostigma	Cand xan	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Chaenotheca chrysocephala	Chae chr	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Chaenotheca ferruginea	Chae fer	*Ac*● *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Chaenotheca phaeocephala	Chae pha	*Ac*● *Fr*○ *Qu*○ *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*○	EN
Chaenotheca trichialis	Chae tri	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	NT
Cladonia fimbriata	Clad fim	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*○	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*●	
Coenogonium pineti	Coen pin	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Evernia prunastri	Ever prun	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*○	NT
Hypogymnia physodes	Hypo phy	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*○	
Hypocenomyce scalaris	Hypo sca	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Lecania naegeli	Leca nae	*Ac*● *Fr*○ *Qu*○ *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Lecanora argentata	Leca arg	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*○	
Lecanora carpinea	Leca car	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*●	
Lecanora chlarotera	Leca chl	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*○	
Lecanora expallens	Leca exp	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Lecanora saligna	Leca sal	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Lecanora varia	Leca var	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	
Lecidella eleaochroma	Leci ele	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*●	
Lecidella flavosorediata	Leci flav	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*○	
Lepraria finkii	Lepr fin	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Lepraria incana	Lepr inc	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Macentina abscondita	Mace abs	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Melanelixia glabratula	Mela gla	*Ac*○ *Fr*● *Qu*○ *Ti*● *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Parmelia sulcata	Parm sul	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Pertusaria albescens	Pert alb	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Pertusaria amara	Pert ama	*Ac*○ *Fr*○ *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Pertusaria coccodes	Pert coc	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*○	NT
Phaeophyscia orbicularis	Phae orb	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Phlyctis argena	Phly arg	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	
Physcia adscendens	Phys ads	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Physconia enteroxantha	Phys ent	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*●	
Physcia tenella	Phys ten	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*○ *Ti*● *Ul*●	
Porina aenea	Pori aen	*Ac*○ *Fr*○ *Qu*○ *Ti*● *Ul*○	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Pseudevernia furfuracea	Pseu fur	*Ac*○ *Fr*● *Qu*● *Ti*○ *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	
Pseudoschismatomma rufescens	Pseu ruf	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*●	*Ac*● *Fr*● *Qu*○ *Ti*○ *Ul*○	VU
Ramalina farinacea	Rama far	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	VU
Ramalina fastigiata	Rama fas	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*● *Qu*○ *Ti*○ *Ul*○	EN
Ramalina pollinaria	Rama pol	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*○	*Ac*● *Fr*● *Qu*● *Ti*○ *Ul*○	VU
Rinodina efflorescens	Rino eff	*Ac*● *Fr*○ *Qu*○ *Ti*○ *Ul*○	*Ac*○ *Fr*● *Qu*● *Ti*● *Ul*○	
Xanthoria parietina	Xant par	*Ac*● *Fr*● *Qu*● *Ti*● *Ul*●	*Ac*○ *Fr*○ *Qu*○ *Ti*○ *Ul*●	

Host trees: *Ac* – *Acer*, *Fr* – *Fraxinus*, *Qu* – *Quercus*, *Ti* – *Tilia*, *Ul* – *Ulmus;* ● – present; ○ – absent.
[1] acc. to [14]: EN – endangered, VU – vulnerable, NT – near threatened.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relation-ships that could have appeared to influence the work reported in this paper.

References

[1] D. Kubiak, P. Osyczka, Non-forested vs forest environments: the effect of habitat conditions on host tree parameters and the occurrence of associated epiphytic lichens, Fungal Ecol.
[2] M. Löf, J. Brunet, A. Filyushkina, M. Lindbladh, J.P. Skovsgaard, A. Felton, Management of oak forests: striking a balance between timber production, biodiversity and cultural services, Int. J. Biodiv. Sci. Eco. Serv. Mgmt. 12 (2016) 59–73, doi:10.1080/21513732.2015.1120780.
[3] P. Balvanera, A.B. Pfisterer, N. Buchmann, J.-S. He, T. Nakashizuka, D. Raffaelli, B. Schmid, Quantifying the evidence for biodiversity effects on ecosystem functioning and services, Ecol. Lett. 9 (2006) 1146–1156, doi:10.1111/j.1461-0248.2006.00963.x.
[4] M. Scherer-Lorenzen, E.-D. Schulze, A. Don, J. Schumacher, E. Weller, Exploring the functional significance of forest diversity: A new long-term experiment with temperate tree species (BIOTREE), Perspect. Plant. Ecol. Syst. 9 (2007) 53–70, doi:10.1016/j.ppees.2007.08.002.
[5] M. Hauck, U. de Bruyn, C. Leuschner, Dramatic diversity losses in epiphytic lichens in temperate broad-leaved forests during the last 150 years, Biol. Conserv. 157 (2013) 136–145, doi:10.1016/j.biocon.2012.06.015.
[6] D. Kubiak, P. Osyczka, K. Rola, Spontaneous restoration of epiphytic lichen biota in managed forests planted on habitats typical for temperate deciduous forest, Biodivers. Conserv. 25 (2016) 1937–1954, doi:10.1007/s10531-016-1169-8.
[7] R.T.T. Forman, L.E. Alexander, Roads and their major ecological effects, Annu. Rev. Ecol. Evol. Syst. 29 (1998) 207–231, doi:10.1146/annurev.ecolsys.29.1.207.
[8] R.K. Colwell, C.X. Mao, J. Chang, Interpolating, extrapolating, and comparing incidence-based species accumulation curves, Ecology 85 (2004) 2717–2727, doi:10.1890/03-0557.
[9] A. Chao, Estimating the population size for capture-recapture data with unequal catchability, Biometrics 43 (1987) 783–791, doi:10.2307/2531532.
[10] Index Fungorum, Landcare Research and RBG Kew: Mycology (2016) http://www.indexfungorum.org
[11] A. Orange, P.W. James, F.J. White, Microchemical methods for the identification of lichens, British Lichen Society, London, 2001.
[12] L. Marmor, T. Tõrra, T. Randlane, The vertical gradient of bark pH and epiphytic macrolichen biota in relation to alkaline air pollution, Ecol. Indic. 6 (2010) 1137–1143, doi:10.1016/j.ecolind.2010.03.013.
[13] Ø. Hammer, D.A.T. Harper, P.D. Ryan, PAST: paleontological statistics software package for education and data analysis, Palaeontol. Electron. 4 (2001) 1–9.
[14] S. Cieśliński, K. Czyżewska, J. Fabiszewski, Red list of the lichens in Poland, in: Z. Mirek, K. Zarzycki, W. Wojewoda, Z. Szeląg (Eds.), Red list of plants and fungi in Poland, W. Szafer Institute of Botany, PASc, Kraków, pp. 71–89.
[15] J. Motiejūnaitė, K. Czyżewska, S. Cieśliński, Lichens – indicators of old-growth forests in biocentres of Lithuania and North-Eastern Poland, Bot. Lith. 10 (2004) 59–74.