The epiphytic lichen flora of the forest monitoring plot "Großer Zirmboden", Latemar, South Tyrol

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Abstract

This study summarizes the results of a lichen floristic survey carried out in a 4 ha coniferous forest plot located on the Western side of the Latemar massif (Dolomites, South Tyrol) as a preliminary phase of a research on the small scale distribution patterns of some selected lichen species. This survey was mainly focused on epiphytic lichens, but some collections were carried out also on dead wood. Eighty-four species, including two non lichenized fungi, were found. The ecology of the species reflects the features of the forest habitat, most of them being linked to acidic substrates, preferring intermediate and well-lit conditions, intermediate moisture conditions, and avoiding eutrophication.

Keywords: coniferous forests, dead wood-dwelling lichens, epiphytic lichens, forest management

1 Introduction

Lichens are a symbiotic association of a fungus with a photosynthetic partner, which is either a green alga or cyanobacterium. They are a species rich component of the forest biota, occurring on many substrates including trees, bare rocks and exposed soil surfaces. Epiphytic lichens growing on tree trunks and branches play an important role in the forest ecosystem functioning. They affect water-cycling by retaining precipitation in the canopy, and cyanobacterial lichens influence nutrient cycling by fixing atmospheric nitrogen. They are a crucial component in forest food-webs, increasing microhabitat complexity and diversity of forest invertebrate fauna, which in turn serves as food for a variety of passerine bird species. Along with climate and air pollution, forest management is a key direct control of epiphytic lichen diversity in forest ecosystems (Johansson 2008, Ellis 2012, Nascimbene et al. 2013). Diversity of epiphytes is related with forest structure and dynamics, and several environmental factors relevant to their dispersal, establishment, and maintenance are affected by forest management. The studies on lichen diversity clearly demonstrate dramatic losses of species caused by forest management in European temperate and boreal forests. The main negative effects of forestry are related with lack of old trees, short rotation cycles, excessive canopy cover, or excessive exposure to direct light in the final part of the rotation cycle, lack of substrate particularly for dead-wood dwelling species, decrease of structural diversity, lack of forest continuity, and forest fragmentation.

In this framework, a research project started in 2011 in South Tyrol to investigate the effect of climatic and management-related factors on the distribution of epiphytic lichens in mountain forests (Nascimbene et al. 2012). In particular, this study summarizes the results of a lichen floristic survey carried out in a 4 ha forest plot as a preliminary phase of a research on the small scale distribution patterns of some selected species. This floristic information was used to select appropriate species with contrasting dispersal strategies, growth forms and ecological requirements (Ackermann 2012) to retrieve information on the relative importance of habitat features and dispersal dynamics in determining the distribution of epiphytic lichens within forests.

2 Materials and methods

2.1 Study area

The study site is a 4-ha permanent plot located on the Western side of the Latemar massif in the Western Dolomites, in the South-Eastern part of South Tyrol, on the territory of Nova Ponente – Deutschnofen, at an elevation between 1896 and 1926 m a.s.l. (coordinates U.T.M. 5139850 N; 695650 E).
The study area has temperate-cold, continental climate conditions, characterized by strong daily and annual temperature fluctuations. Mean annual temperature is 4.6°C, while mean annual precipitation is c. 950 mm, with a peak during summer and a dip between December and February. On average, a solid precipitation of 260 cm per winter period has been recorded at the nearest nivological station of Obereggen (1872 m a.s.l.), forming a permanent snow cover during 110-131 days per year.
Vegetation belongs to Vaccinio-Piceetea, with forest species represented by *Picea abies*, *Pinus cembra* and *Larix decidua* (Larici-Cembretum with *Picea abies*; Natura 2000 habitat type 9420). The shrub layer is mainly composed of *Daphne striata*, *Juniperus communis* subsp. *alpina*, *Rhododendron hirsutum* and *R. ferrugineum*, *Ribes alpinum, Vaccinium myrtillus* and *V. vitis-idaea* and the herbal layer of *Adenostyles alliariae*, *Calamagrostis villosa*, *Luzula sylvatica*, *Maianthemum bifolium*, *Melampyrum sylvaticum*, *Petasites albus*, *Saxifraga* sp.
The area has been subject to a process of tree re-colonization after the abandonment of mountain pastures and decreasing intensity of silvicultural practices during the last centuries. This caused a typical tree species successional pattern also observed in other parts of the Alps: a colonization stage by *Larix decidua* is followed by an increasing presence of *Pinus cembra* and *Picea abies* (Carrer & Urbinati 2001, Markart 2007). Currently, management activities are abandoned and the forest is completely left to natural succession and used for long-term ecological studies.

2.2 Data collection, species traits and nomenclature

This floristic survey was mainly focused on epiphytic lichens. However, some collections were carried out also on dead wood (mainly stumps). Lichen specimens were collected for identification (morphology, Thin Layer Chromatography – TLC analyses) and stored

in both the personal herbarium of JN and in the herbarium of the Natural Sciences Museum of South Tyrol (Bolzano).
The species ecological traits were evaluated using the ecological indicator values retrieved from Nimis & Martellos (2008). These values indicate, on a 5-class ordinal scale, the ecological requirements of each species for (a) pH of the substrate (1 = on very acid substrata; 2 = on acid substrata; 3 = on subacid to subneutral substrata; 4 = on slightly basic substrata; 5 = on basic substrata); (b) light (1 = in very shaded situations; 2 = in shaded situations; 3 = in sites with plenty of diffuse light but scarce direct solar irradiation; 4 = in sun-exposed sites, but avoiding extreme solar irradiation; 5 = in sites with very high direct solar irradiation); (c) moisture (1 = hygrophytic species; 2 = rather hygrophytic species; 3 = mesophytic species; 4 = xerophytic species living in dry situations, but absent from extremely arid stands; 5 = very xerophytic species); (d) eutrophication (1 = no eutrophication; 2 = very weak eutrophication; 3 = weak eutrophication; 4 = rather high eutrophication; 5 = very high eutrophication).
Also species traits (growth forms and reproductive strategies) were retrieved from Nimis & Martellos (2008). Foliose lichens include both those with narrow (*Physcia*-like) and large (*Parmelia*-like) lobes; fruticose lichens include both those with filamentous and non-filamentous thalli; crustose lichens include true crustose, leprose and squamulose species. Reproductive strategies are classified as: (a) mainly sexual reproduction by ascospores, mainly asexual reproduction by (b) isidia, (c) soralia, and (d) thallus fragmentation.
The conservation importance of the species is based on their inclusion in the IUCN threat categories in the red list of the Italian epiphytic lichens (Nascimbene et al. *in press*).
Nomenclature follows Nimis & Martellos (2008) except for *Lecanora symmictiza* (Nyl.) Hedl. and *Usnea barbata* (L.) Weber ex F.H. Wigg.

3 Results and discussion

Eighty-four species, including two non lichenized fungi (*Chaenothecopsis pusilla*, *Microcalicium disseminatum*) were found (Table 1). Thirty-seven are crustose, 20 are foliose, and 27 are fruticose. The two main reproduction strategies are by ascospores (sexual reproduction, 37 species) and asexually by soredia (34 species) and the photobiont is mainly a coccoid green alga (76 species), while species with cyanobacteria or *Trentepholia* are rare. Five species are included in the red list of the epiphytic lichens of Italy (Nascimbene et al. *in press*) and are therefore of conservation concern. Two of them, *Ramalina obtusata* and *Tuckneraria laureri*, are also included in the European red list of macrolichens (Sérusiaux 1989). The former is mainly related with old spruce trees, while the latter is mainly related with old larch trees.
Twelve are Calicioid species that are considered reliable indicators of forest continuity and conservation importance to be used in monitoring programs (Selva 2002, Tibell 1992). Since they are mostly related to old trees and to CWD, their presence in the study area is expected to increase in the future, due to the absence of forest management and the increasingly aging of forests toward old growth conditions.

The ecology of the species reflects the features of the forest habitat (Figure 1), most of them being linked to acidic substrates (bark of conifers and dead wood), preferring intermediate and well-lit conditions, intermediate moisture conditions. Interestingly, the lichen biota of the study area is almost completely composed of species avoiding eutrophication. According to the dynamics of the forest habitat, that is evolving toward more canopy closed conditions due to the establishment of spruce, it may be expected a shift of the lichen biota that in the future could be composed of more shade-tolerant and hygrophytic species. This situation could be represented by the contrasting pattern of the light-demanding species *Letharia vulpina* (mainly associated with larch trees) and that of more shade-tolerant species such as *Schismatomma pericleum* or *Dimerella pineti* mainly associated with spruce. The former is expected to decline along with canopy closure, while the latter are expected to become more frequent and abundant. The absence of pasture should prevent this forest from eutrophication and therefore the nitrophitic component should remain scarcely represented also in the future.

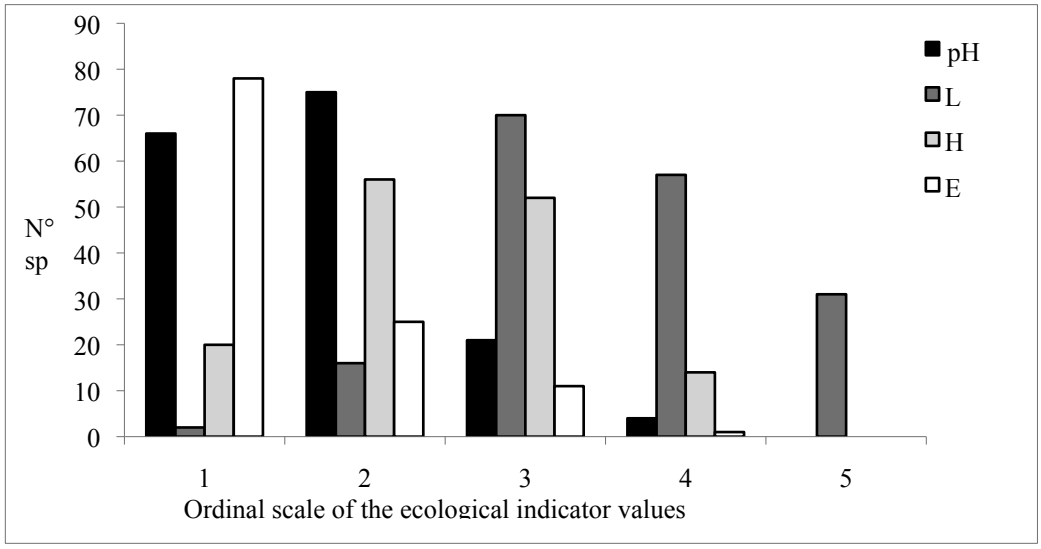

Figure 1: Ecological requirements of the species represented by 4 indicator values ranging on a five-level ordinal scale (pH = substrate pH; L = light; H = moisture; E = eutrophication).
For more details see M & M section.

Riassunto

Questo lavoro sintetizza i risultati di un'indagine floristica sui licheni epifiti e lignicoli all'interno di un plot forestale (larici-cembreto con abete rosso) di 4 ettari situato nella zona occidentale del massiccio del Latemar (Dolomiti, Sud Tirolo). Questa indagine ha costituito la fase preliminare di una ricerca finalizzata ad analizzare i pattern di distribuzione a piccola scala di alcuni licheni con caratteristiche bio-ecologiche contrastanti. In totale sono state rinvenute 84 specie, compresi due funghi non lichenizzati. L'ecologia delle specie riflette le caratteristiche dell'habitat forestale e in particolare la maggior parte di esse sono legate a substrati acidi, a condizioni intermedie di illuminazione e umidità e assenza di eutrofizzazione.

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Table 1:
Checklist of the species recorded in the forest monitoring plot "Großer Zirmboden", Latemar, South Tyrol. Species are listed in alphabetical order.
Gr: growth form. Cr = crustose, Fol = foliose, Fr = fruticose.
Rep: Reproductive strategies. S = mainly sexual reproduction by ascospores;
A.s. = mainly asexual reproduction by soralia; A.i. = mainly asexual reproduction by isidia;
A.f. = mainly asexual reproduction by thallus fragmentation.
Photo: photobiont type. Ch = green algae other than Trentepohlia; Tr = Trentepohlia;
Cy = cyanobacteria.
Cal: calicioid species
Red: species included in the Italian red list of epiphytic lichens (Nascimbene et al. *in press*)

	Species traits				
Species	**Gr**	**Rep**	**Photo**	**Cal**	**Red**
Alectoria sarmentosa (Ach.) Ach.	Frut	Ch	A.f		
Aplotomma turgida (A.Massal.) A. Massal.	Cr	Ch	S		
Arthonia spadicea Leight.	Cr	Tr	S		
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw.	Frut	Ch	A.s		
Bryoria implexa (Hoffm.) Brodo & D.Hawksw.	Frut	Ch	A.s		
Bryoria nadvornikiana (Gyeln.) Brodo & D. Hawksw.	Frut	Ch	A.s		
Buellia schaereri De Not.	Cr	Ch	S		
Calicium glaucellum Ach.	Cr	Ch	S	+	
Calicium trabinellum (Ach.) Ach.	Cr	Ch	S	+	
Calicium viride Pers.	Cr	Ch	S	+	
Caloplaca herbidella (Hue) H. Magn.	Cr	Ch	A.i		
Cetraria islandica (L.) Ach.	Frut	Ch	A.f		
Chaenotheca chrysocephala (Ach.) Th. Fr.	Cr	Ch	S	+	
Chaenotheca ferruginea (Sm.) Mig.	Cr	Ch	S	+	
Chaenotheca furfuracea (L.) Tibell	Cr	Ch	S	+	
Chaenotheca phaeocephala (Turner) Th. Fr.	Cr	Ch	S	+	
Chaenotheca trichialis (Ach.) Th. Fr.	Cr	Ch	S	+	
Chaenotheca xyloxena Nádv.	Cr	Ch	S	+	
Chaenothecopsis pusilla (Ach.) A.F.W. Schmidt	Cr	-	S	+	
Chrysothrix candelaris (L.) J.R. Laundon	Cr	Ch	A.s		
Cladonia arbuscula (Wallr.) Flot. ssp. *arbuscula*	Frut	Ch	A.f		
Cladonia cenotea (Ach.) Schaer.	Frut	Ch	A.s		
Cladonia coniocraea (Flörke) Spreng.	Frut	Ch	A.s		
Cladonia digitata (L.) Hoffm.	Frut	Ch	A.s		
Cladonia fimbriata (L.) Fr.	Frut	Ch	A.s		
Cladonia furcata (Huds.) Schrad.	Frut	Ch	S		

	Species traits				
Species	**Gr**	**Rep**	**Photo**	**Cal**	**Red**
Cladonia macroceras (Delise) Hav.	Frut	Ch	S		
Cladonia pyxidata (L.) Hoffm.	Frut	Ch	S		
Cladonia rangiferina (L.) F.H. Wigg.	Frut	Ch	A.f		
Cladonia sulphurina (Michx.) Fr.	Frut	Ch	A.s		
Cyphelium tigillare (Ach.) Ach.	Cr	Ch	S	+	
Dimerella pineti (Ach.) Vezda	Cr	Tr	S		
Evernia divaricata (L.) Ach.	Frut	Ch	A.f		
Evernia mesomorpha Nyl.	Frut	Ch	A.s		
Evernia prunastri (L.) Ach.	Frut	Ch	A.s		
Hypocenomyce caradocensis (Nyl.) P. James & Gotth. Schneid.	Cr	Ch	S		
Hypocenomyce scalaris (Ach.) M. Choisy	Cr	Ch	A.s		
Hypogymnia bitteri (Lynge) Ahti	Fol	Ch	A.s		
Hypogymnia farinacea Zopf	Fol	Ch	A.s		
Hypogymnia physodes (L.) Nyl.	Fol	Ch	A.s		
Hypogymnia tubulosa (Schaer.) Hav.	Fol	Ch	A.s		
Icmadophila ericetorum (L.) Zahlbr.	Cr	Ch	S		
Imshaugia aleurites (Ach.) S L.F. Meyer	Fol	Ch	A.i		
Lecanora cadubriae (A.Massal.) Hedl.	Cr	Ch	S		
Lecanora symmictiza (Nyl.) Hedl.	Cr	Ch	S		
Lecanora varia (Hoffm.) Ach.	Cr	Ch	S		
Lecidea turgidula Fr.	Cr	Ch	S		
Lepraria jackii Tønsberg	Cr	Ch	A.s		
Leptogium subtile (Schrad.) Torss.	Cr	Cy	S		
Letharia vulpina (L.) Hue	Frut	Ch	A.s		
Lichenomphalia velutina (Quélet) Redhead, Lutzoni, Moncalvo & Vilgalys	Cr	Ch	S		
Melanelixia fuliginosa (Duby) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch	Fol	Ch	A.i		
Melanohalea exasperatula (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch	Fol	Ch	A.i		
Micarea melaena (Nyl.) Hedl.	Cr	Ch	S		
Micarea prasina Fr.	Cr	Ch	S		
Microcalicium disseminatum (Ach.) Vain.	Cr	-	S	+	
Mycoblastus affinis (Schaer.) T. Schauer	Cr	Ch	S		En
Ochrolechia alboflavescens (Wulfen) Zahlbr.	Cr	Ch	A.s		
Ochrolechia microstictoides Räsänen	Cr	Ch	A.s		

	Species traits				
Species	**Gr**	**Rep**	**Photo**	**Cal**	**Red**
Parmelia saxatilis (L.) Ach.	Fol	Ch	A.i		
Parmelia sulcata Taylor	Fol	Ch	A.s		
Parmeliopsis ambigua (Wulfen) Nyl.	Fol	Ch	A.s		
Parmeliopsis hyperopta (Ach.) Arnold	Fol	Ch	A.s		
Peltigera canina (L.) Willd.	Fol	Cy	S		
Peltigera leucophlebia (Nyl.) Gyeln.	Fol	Ch-Cy	S		
Peltigera venosa (L.) Hoffm.	Fol	Ch	S		
Platismatia glauca (L.) W. L. Culb. & C. F. Culb.	Fol	Ch	A.i		
Pseudevernia furfuracea (L.) Zopf v. *furfuracea*	Fol	Ch	A.i		
Pseudevernia furfuracea v. *ceratea* (Ach.) D. Hawksw.	Fol	Ch	A.i		
Pycnora sorophora (Vain.) Hafellner	Cr	Ch	A.s		Vu
Ramalina farinacea (L.) Ach.	Frut	Ch	A.s		
Ramalina obtusata (Arnold) Bitter	Frut	Ch	A.s		Vu
Ramalina pollinaria (Westr.) Ach.	Frut	Ch	A.s		
Ramalina thrausta (Ach.) Nyl.	Frut	Ch	A.s		
Schismatomma pericleum (Ach.) Branth & Rostr.	Cr	Tr	S		
Trapeliopsis flexuosa (Fr.) Coppins & P. James	Cr	Ch	S		
Tuckermannopsis chlorophylla (Willd.) Hale	Fol	Ch	A.s		
Tuckneraria laureri (Kremp.) Randlane & Thell	Fol	Ch	A.s		Vu
Usnea barbata (L.) Weber ex F.H. Wigg.	Frut	Ch	A.s		
Usnea cavernosa Tuck.	Frut	Ch	S		
Usnea diplotypus Vain.	Frut	Ch	A.s		Cr
Usnea hirta (L.) F.H. Wigg.	Frut	Ch	A.s		
Vulpicida pinastri (Scop.) J.-E. Mattsson & M.J. Lai	Fol	Ch	A.s		
Xylographa parallela (Ach.: Fr.) Behlen & Desberger	Cr	Ch	S		