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Review

Ecological indicator values and life history traits of terricolous lichens of the Western Carpathians

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ABSTRACT

Plant indicator values are widely used in ecological studies, but they are not well developed for cryptogams, what prevents their application in some environments such as lichen-rich habitats. The aim of this study was to determine the ecological indicator values of terricolous lichens occurring in the Western Carpathians. A total of 271 lichen taxa from the eastern part of Central Europe in Czech Republic, Slovakia, Hungary and Austria are listed and evaluated. Their known indicator values for light conditions, climate (temperature, continentality), substratum (humidity, soil reaction-pH, nutrients, eutrophication) were reviewed or modified, and original values were established for taxa with missing information. Besides the traditional ordinal scale, the index of variability was established to distinguish between generalists and specialists in particular applications. Our list further contains important species traits such as ecological strategies (growth and life forms, photobiont type, substrate, reproduction) and geographic values (geographical elements, threat, frequency) allowing applications in functional ecology and macroecology. Our database can be easily associated with widely used software for the analysis of vegetation data allowing the indication of ecological conditions in lichen-rich vegetation types in currently developed large-scale vegetation surveys.

Contents

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1. Introduction

The system of plant indicator values became widely used in ecological studies, because it allows scientists to estimate environmental conditions based upon species composition of plants. This approach has a great advantage in the analyses of recently developed large vegetation-plot databases (Dengler et al., 2011). The most commonly used system is that of expert-based Ellenberg's indicator values for vascular plants (Ellenberg, 1965; Ellenberg et al., 1992) which was established for Central European plants, with some later modifications for either western (Hill et al., 2000) or eastern (Borhidi, 1993; Jurko, 1990) areas of Central Europe. Their extremely wide application has stimulated long-lasting discussion (Jurko, 1986; Klimeš, 1987; Mucina, 1985; ter Braak and Looman, 1986; ter Braak and Gremmen, 1987) which has continued to the present (Käfer and Witte, 2004; Pröll et al., 2011; Seidling and Fischer, 2008; Smart et al., 2010; Tichý et al., 2010; Urban et al., 2012; Zelený et al., 2010). A series of papers directly tests the validity of Ellenberg's indicator values by their comparison with direct field measurement of environmental characteristics (e.g., Balkovič et al., 2012; Huisman et al., 1993; Klaus et al., 2012; Lawesson and Oksanen, 2002; Pakeman et al., 2008; Peppler-Lisbach, 2008; Wamelink et al., 2005).

Apart from methodological problems associated either with the validity of the values (Ersten et al., 1998; Smart and Scott, 2004; Wamelink et al., 2002, 2003; Witte and Von Asmuth, 2003) or with statistical analyses (Zelený and Schaffers, 2011), indicator values for vascular plants became an essential tool in European vegetation science and large-scale ecology. However, the system is more poorly developed for cryptogams, especially terricolous lichens. This shortcoming largely prevents applications of the plant indicator values in some lichen-rich habitats such as alpine and boreal heaths, sandy habitats, pine forests, rocks or screes. The previous works dealing with the ecological values of lichens used various ordinal scales.

Wirth (1992, 2010) and Bültman (2006) used a 9-number scale, while Nimis and Martellos (2008), Landolt et al. (2010) and Fabiszewski and Szczepańska (2010) modified the scale to 5 numbers. Landolt et al. (2010) used the index of variability which showed the niche breadth of species with respect to the target ecological factor. Because these studies did not present complete lists of the eastern part of Central-European lichen flora and have listed factors using different scales, we aim to review and complement accumulated data and create a consensus list for the West Carpathians, the region that contain most of the eastern part of Central-European lichen flora. The basis for our list is the similar studies for Germany by Wirth (1992, 2010), using a rather wide ordinal scale from 1 to 9. The same scale was used by Bültman (2006) for lichens occurring in grassland vegetation. The uncritical application of these values outside of Germany may lead to incorrect results, because of possible niche shifts between the distant regions as well as missing data for the taxa that do not occur in Germany. Other recent studies were performed by Nimis and Martellos (2008) for Italy, Fabiszewski and Szczepańska (2010) for Poland and Landolt et al. (2010) and Clerc and Truong (2010) for Switzerland. We reviewed these indicator systems using knowledge gathered by the leading Slovakian expert in terricolous lichens, Ivan Pišút, who co-operated with us in creating the list.

Our objective was to review and complement the accumulated data and create a consensus list of terricolous lichens for the Western Carpathians with the specific conditions of its sub-continental region.

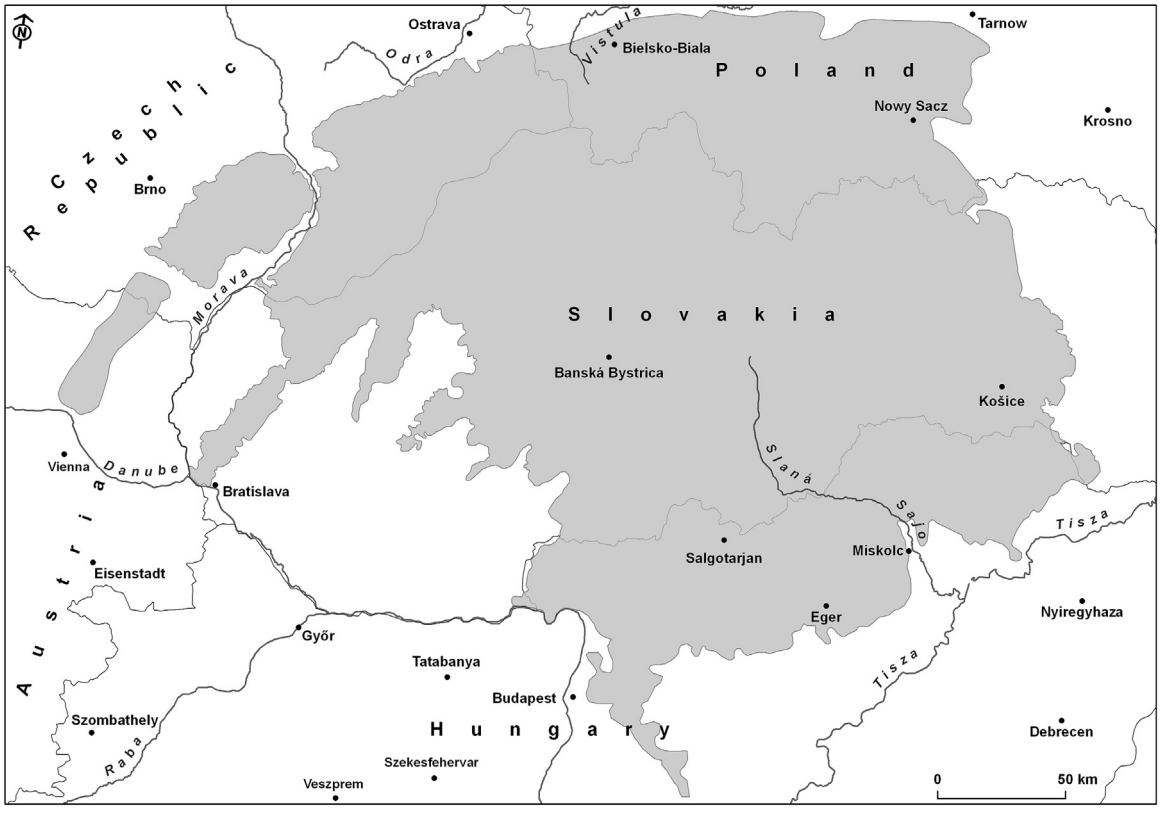

Fig. 1. Range of the Western Carpathians.