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Reasons for moss rarity: Study in three neighbouring countries

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ABSTRACT

The causes of moss rarity were analysed in three neighbouring countries. Estonia, Latvia and Lithuania, situated along the coast of the Baltic Sea, cover together 175,000 km^2. They belong to the same vegetation zone, and have similar economic and natural history, but there are still certain differences in climate, bedrock, soil and land use.

Three frequency groups of mosses, altogether 184 species, were compared in this study: (1) mosses present in all three countries and frequent in every country, (2) mosses present in all three countries, but rare in every country and (3) mosses present in only one country and rare in this country, i.e. very rare mosses. The distribution of moss species according to families, life history characters (sexuality, spore size and life span) and ecological characters (substrate and community type preferences) were compared among these three groups.

There were differences in the distribution of species according to families between the three frequency groups. Frequent and rare moss species groups were also characterised by different life historical (life span) and ecological characteristics (substrate pH and community type). Comparison of ecological indexes in the group of country specific mosses revealed that species preferences regarding soil alkalinity follow the pattern of the distribution of alkaline soils in the three countries. Species occurring in the most southern country – Lithuania – are characterised by highest temperature indexes.

On the basis of the studied species we can conclude that taxonomical and life historical trends explain one part of rarity in the studied region, while local ecological conditions in connection with land use are responsible for the other part.

1. Introduction

Human activity has changed the environment enormously during the last centuries. A growing number of species is not able to adapt themselves to it. The distribution area of numerous species has reduced, and some species have even disappeared forever due to community degradation and the spread of invasive species (Luga, 1994; McNeely, 2001). Rare species are often at risk of becoming extinct, either because of human activity or occasionally through local ecological or climatical fluctuations that could cause a loss of suitable habitats. This has prompted the need to understand the essence of rarity – when can a species be labelled as rare and what are the reasons for rarity. Many studies have attempted to solve this problem, and several of them are dedicated to bryophytes (Laaka-Lindberg et al., 2000; Longton and Hedderson, 2000; Heinlen and Vitt, 2003). The dependence of rarity on scale is a well-known concept (e.g. Rabinowitz, 1981). Thus the regio-

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nal lists of rare species may include only few or no globally rare species, or species that are very common or even invasive in other regions. Here we might ask, why be concerned about those species? Until quite recently it was thought that preserving a small number of abundant species is sufficient to maintain ecosystem functioning. The importance of rare species in these processes has become evident only more recently (Chapin et al., 2000; Lyons et al., 2005). Thus the maintenance of all local biodiversity is not only a matter of national pride, but also serves the purpose of stabilizing ecosystems.

Reasons for rarity can be divided into general reasons that have an evolutional background, and regional reasons caused by local geographical specificities.

The evolutional nature of rarity may become evident if we evaluate the proportion of rare species in different taxonomical units. Although species rich vascular plant families tend to contain also more rare species in general (Lozano and Schwartz, 2005), on the basis of British vascular plant flora it has been shown that some families include more rare species than others that are of almost the same size (Pilgrim et al., 2004). Similar results were gained by analysing bryophyte flora in Alberta, Canada, where more rare species were found in genus *Bryum* than in genus *Sphagnum* (Vitt and Belland, 1997).

Also differences in sexuality may lead to rarity (Söderström and During, 2005). Two sexes of dioecious species may fail to get established near to each other, while monoecy may lead to rarity through inbreeding effects (Longton, 1994). Analysing British bryophyte flora it has become evident that more species are dioecious, and they sporulate more rarely than monoecious species (Longton, 1997; Laaka-Lindberg et al., 2000).

Regional reasons for rarity can be caused by local climate in the present and past, geographical and ecological conditions, as well as historical and present land use. Rare species can be local relicts from warmer climate periods, such as several neotropical species found in western Europe (Frahm, 2003).

Habitat shortage can cause rarity in many species (Wiklund, 2002; Vanderpoorten and Engels, 2003; Pilgrim et al., 2004). Rare species are usually also more specialized to one type of habitat (Birks et al., 1998; Heinlen and Vitt, 2003) and one type of substrate (Ingerpuu and Vellak, 1995). Neglecting or changing traditional management to more intensive logging or agricultural use can make species rare locally (Mägipää and Heikkinen, 2003; Zechmeister et al., 2003) or can cause their replacement with expansive species (Söderström, 1992).

The present study aims to explain the reasons for moss rarity in the region of the eastern coast of the Baltic Sea. The history of bryological investigations in three neighbouring Baltic States dates back to the 18th century, when the first data about moss flora (Fischer, 1778) were published for Livland, that includes territories of today's republics of Estonia and Latvia. At the end of the 19th century and at the beginning of the 20th century several new species were described (Russow, 1865, 1890; Mikutowicz, 1908–1913), and taxonomical as well as ecological works including material from the whole region, were published (Malta, 1926; Apinis and Lacis, 1936). Starting from the middle of the 20th century bryological studies continued separately in each country, and floristical research became prevailing. First native language key-books and supplemented floras appeared (Laasimer et al., 1954; Minkevičius, 1955; Ābolina, 1968, 1985; Kannukene, 1986; Strazdaite and Liepinaityte, 1986).

This study focuses on mosses, since the history and state of their investigation is similar in all Baltic States. Liverworts are excluded from the study due to their evolutional as well as ecological specification and several gaps in the available data. We searched for answers to the following questions:

(1) Are there differences in the taxonomy and life history of frequent and rare moss species of the region?
(2) Do rare mosses inhabit other types of habitats and substrates than frequent mosses?
(3) Are the demands for temperature, light, substrate pH and moisture different in rare and frequent mosses groups?
(4) Do regionally very rare mosses, present in only one country, differ according to taxonomy, or their life historical, or ecological demands?

2. Material and methods

2.1. *Study area*

The study area covers the territory of three Baltic countries on the eastern coast of the Baltic Sea (59°41′–53°53′ N; 20°58′–28°14′ E). The Baltic States together cover almost 175,000 km^2 stretching approximately 700 km from north to south and 400 km from west to east. The coastline of the three Baltic States is altogether 4424 km, including islands (http://www.cia.gov/cia/publications/factbook/; Fig. 1).

Specific features of these territories compared with other countries at the same latitudes appear mainly in climate and in bedrock (Table 1). Estonia and Latvia have a considerable coastline length, which results in a maritime climate with wet, moderate winters and cool summers in coastal

Fig. 1 – Location of the study region.