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Spruce Mire Types on the Pokljuka Plateau, Slovenia

By

L. KUTNAR ¹⁾

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S u m m a r y

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In addition to some of the most southerly peat bogs in Europe, Slovenia also has some spruce mires. In general, these are transitional bogs with a mixture of ombrotrophic and minerotrophic elements. The vegetation of the spruce mires and the surrounding ecosystems was examined on the Pokljuka plateau in the north-western part of Slovenia.

In accordance with the heterogeneous site conditions we found different types of vegetation. We found some spruce forests with *Sphagnum* mosses (*Sphagno girgensohnii-Piceetum* var. geogr. *Carex brizoides*) on supposedly autochthonous sites. The edges of the mires melded into the serried spruce forest (*Rhytidiadelpho lorei-Piceetum*). In the centre of the mires we found *Sphagno-Pinetum mugo* or other vegetation: *Sphagno-Caricetum rostratae* s. lat. and the plant communities where *Carex davalliana* Sm. or *Trichophorum alpinum* (L.) Pers. dominated. We also found some transitional types.

Because of the harsh conditions both the height and radial growth of the spruce trees on mire sites are very slow and variable. Differences between the group means of spruce height and diameter were significant.

I n t r o d u c t i o n

The peat bogs on Pokljuka, Slovenia (MARTINČIČ & PISKERNIK 1985, TOMAN 1995) are among the most southerly bogs in Europe (BRAGAZZA 1994, 1996, 1997, GERDOL & al. 1994, ALBER & al. 1996, BRAGAZZA & al. 1998).

Among the peat bogs, in addition to true raised bogs, we also have spruce mires, which in Slovenia have been insufficiently investigated (ZUPANČIČ 1982,

¹⁾ Forest Ecology Dept., Slovenian Forestry Institute, Večna pot 2, 1000 Ljubljana, Slovenia, Tel.: +386 61 123 13 43, Fax.: +386 61 273 589, e-mail: lado.kutnar@gozdis.si

1994, 1999). These are transitional bogs with a mixture of ombrotrophic and minerotrophic elements. Their spatial and ecological determination are quite unclear. In the phytosociological sense the spruce mires also belong to different vegetation types, which might be at different stages of progression. Because of the very different conditions, spruce growth is very variable.

The spruce mires are also labile and sensitive ecosystems, and as with other types of mires (CASPARIE 1993, PRIEDITIS 1993a, ZUPANČIČ 1994, 1996, 1999, MARTINČIČ 1996, GROSSE-BRAUCKMANN 1996), threatened by man as well as by natural processes.

The purposes of this study were:

- to describe the characteristic features of the spruce mires on the Pokljuka plateau.
- to determine the biodiversity of spruce mire vegetations and their transitions into the neighbouring vegetation types.

The spruce mires on the Pokljuka plateau in the Julian Alps in Slovenia (altitude 1200 m) were researched. They are situated in the serried secondary spruce forest with more than 95 % of the growing stock being Norway spruce (*Picea abies* (L.) Karst.). On the Pokljuka plateau, the predominantly spruce forest is mainly a result of forest management. Until the beginning of intensive iron production at the end of the 17th century, this region was covered mainly with a beech forest (*Fagus sylvatica* L.) (BUDNAR-TREGUBOV 1958a, 1958b, ŠERCELJ 1962, CULIBERG & al. 1981), which was further reduced in the 19th century. As a result of its high usability, and for economic reasons, the spruce was favoured by the forest management. Because of frost holes and specific edaphic conditions the spruce share had already been relatively high before the intensive human intervention. The supposedly autochthonous spruce sites are also mire ecosystems.

Methods

The study was carried out on 6 different spruce mires on the Pokljuka plateau (bGP, b8, b11, b12, b24, b25). The six series of seven 2 x 4 m plots were set out to primarily determine the diversity of the transition of spruce mire forest to other types of vegetation. The vegetation of the 42 plots was surveyed according to the standard Central European method (BRAUN-BLANQUET 1964). In each plot, cover estimates were made for all plant species in 7 vertical layers: moss, lower and upper herb layers, lower and upper shrub layers, lower and upper tree layers. For the statistical analyses, cover degrees were used according to van der MAAREL'S modification (1979).

Clusters of similar plots were defined based on the floristic composition, cover degrees and vertical structure, by the PC-ORD computer package (McCUNE & MEFFORD 1995, 1997). In the analysis we used the complete linkage clustering method and the Sørensen distance measure. The main compositional gradients in the vegetation were extracted by detrended correspondence analysis (DCA). The DCA was carried out with the PC-ORD program.

On each plot, two spruce trees were chosen systematically: we measured their heights and diameters, and determined their ages.

Results and Discussion

In accordance with the heterogeneous site conditions (URBANČIČ & KUTNAR 1997) we found different types of vegetation (Fig. 1). We found some spruce forests with *Sphagnum* moss (*Sphagno girgensohnii-Piceetum* var. geogr. *Carex brizoides*) (KUOCH 1954, PRIEDITIS 1993b, ZUPANČIČ 1982, 1994, 1999) on supposedly autochthonous sites (group B).

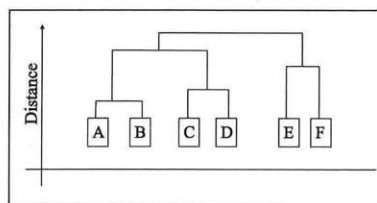


Fig. 1. Groups of similar plots based on the floristic composition and vertical vegetation structure. Legend: A - *Sphagno-Pinetum mugo*, B - *Sphagno-Piceetum* var. geogr. *Carex brizoides*, C - *Rhytidiadelpho lorei-Piceetum*, E - *Sphagno-Caricetum rostratae*, D and F - transitional types.

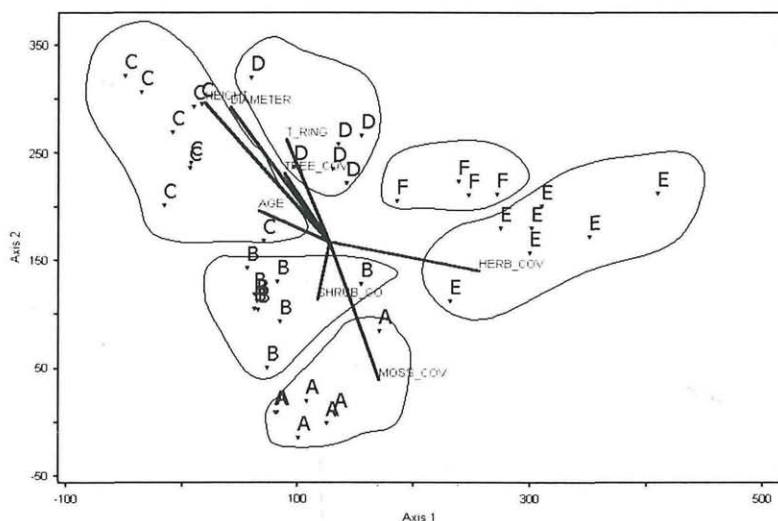


Fig. 2. DCA ordination of the plots for axes 1 and 2 with the tree height, diameter, age and ring vectors, and with the tree, shrub, herb and moss layer cover vectors. Legend: HEIGHT - tree height vector, DIAMETER - tree diameter vector, AGE - tree age vector, T_RING - mean tree ring vector, TREE_COV - tree layer cover vector, SHRUB_COV - shrub layer cover vector, HERB_COV - herb layer cover vector, MOSS_COV - moss layer cover vector. A - *Sphagno-Pinetum mugo*, B - *Sphagno-Piceetum* var. geogr. *Carex brizoides*, C - *Rhytidiadelpho lorei-Piceetum*, E - *Sphagno-Caricetum rostratae*, D and F - transitional types.

The edges of mires melded into the serried spruce forest (*Rhytidiadelpho lorei-Piceetum* (ZUPANČIČ 1999) and merged into spruce monocultures on the pre-

vious sites of *Homogyno sylvestris-Fagetum* (group C).

In the centre of the mires we found *Sphagno-Pinetum mugo* (group A) or other vegetation: *Sphagno-Caricetum rostratae* s. lat. and the plant communities where *Carex davalliana* Sm. or *Trichophorum alpinum* (L.) Pers. (group E) dominate.

We also found some transitional types between C and E (groups D and F) (Fig. 1, 2).

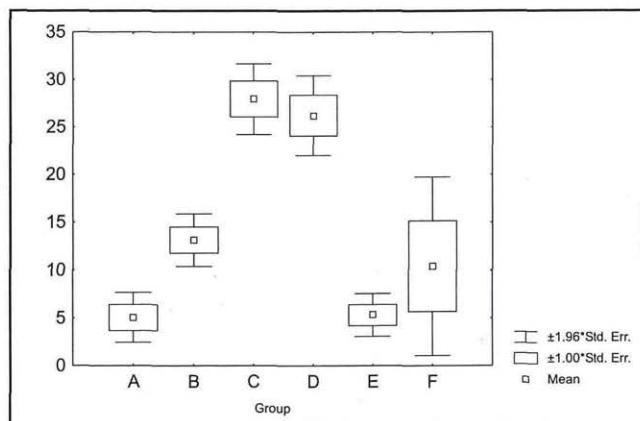


Fig. 3. Spruce tree heights according to the groups. Legend: A - *Sphagno-Pinetum mugo*, B - *Sphagno-Piceetum* var. geogr. *Carex brizoides*, C - *Rhytidiadelpho lorei-Piceetum*, E - *Sphagno-Caricetum rostratae*, D and F - transitional types.

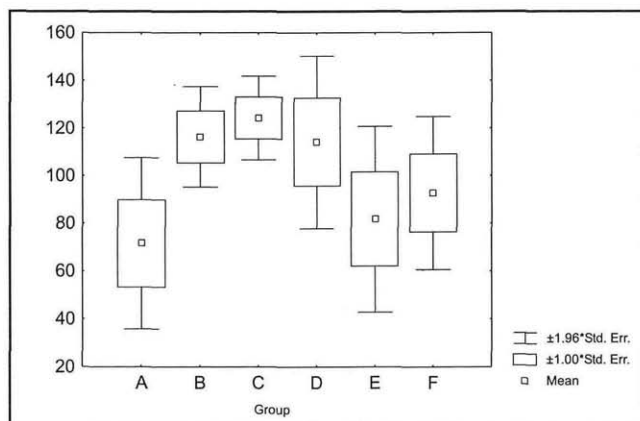


Fig. 4. Spruce trees ages according to the groups. Legend: A - *Sphagno-Pinetum mugo*, B - *Sphagno-Piceetum* var. geogr. *Carex brizoides*, C - *Rhytidiadelpho lorei-Piceetum*, E - *Sphagno-Caricetum rostratae*, D and F - transitional types.

Significant species of the groups are:

group A: *Pinus mugo* Turra, *Carex pauciflora* Lightf., *Oxycoccus palustris* Pers.;

group B: *Sphagnum girgensohnii* Russ., *Polytrichum commune* L.;
 group C: *Lycopodium annotinum* L., *Polytrichum formosum* Hedw., *Rhytidiadelphus loreus* (L.) Warnst.;
 group D: *Dicranum scoparium* (L.) Hedw., *Poa alpina* L.;
 group E: *Carex rostrata* Stokes ex With., *Bryum pseudotriquetrum* (Hedw.) Schwaegr., *Aulacomnium palustre* (L.) Schwaeg.;
 group F: *Caltha palustris* L., *Calliergon cuspidatum* (Hedw.) Kindb.

Because of the harsh conditions, the height and radial growth of spruce trees on mire sites are very slow and variable. Differences between the group means of spruce height (Fig. 3) and diameter are significant. In contrast, differences between the mean ages of the spruce trees are not significant (Fig. 4). The mean tree spruce height and the breast diameter are the highest in groups C and D (Fig. 2, 3). In these two groups, the mean tree ring is also the highest (Fig. 2).

The mean cover of tree layer is increasing towards groups C and D, the mean cover of shrub layer towards groups B and A, of herb layer towards group E, and moss layer towards group A (Fig. 2).

Conclusion

The spruce mires on Pokljuka are very mosaic ecosystems. In the vegetational and ecological sense, they are not unified. There are very different types of vegetation with sporadic appearance. We also determined some of the transition types between the mires and the spruce forest in the surroundings.

The spruce growth is very slow in the centres of the mires. The difference between the height of spruce trees on the mires and outside of them is obvious.

Thus, because of the very specific floristic, vegetational, and heterogeneous site conditions, the spruce mires on the Pokljuka plateau contribute greatly to the biodiversity of largely monoculture forests.

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