GROWTH CHARACTERISTICS OF NORWAY SPRUCE IN THE POKLJUKA MIRES AND FORESTS

RASTNE ZNAČILNOSTI SMREKE NA POKLJUŠKIH BARJIH IN GOZDOVIH

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ABSTRACT UDC 674.032.475.5(497.452):591.134

Growth characteristics of norway spruce in the Pokljuka mires and forests

The spruce mires and forests on the Pokljuka plateau are characterised by very diverse ecological conditions, plant species diversity, and a high variability of spruce-tree growth. The ecological conditions are well indicated by the floristic composition and vegetation. Therefore, based on the similarity of the floristic composition, plant-species cover and vertical vegetation structure, the studied spruce mires and spruce forests were clustered into six eco-vegetation groups. The growth characteristics of the spruce trees were tested among different eco-vegetation groups. The differences in the mean age of the spruce trees among the eco-vegetation groups are not significant. However, significant differences in the spruce-tree growth regime between trees growing on the mires and in the forest have been confirmed. The significant differences in mean tree height, mean tree breast diameter and in mean tree-ring widths have been established. The slow growth of spruce trees on the mires can be explained by harsh ecological conditions, especially by high soil water content and high ground water level.

Key words: tree height, tree breast diameter, tree-ring, spruce mire, spruce forest, *Picea abies* (L.) Karst., Slovenia

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Rastne značilnosti smreke na poklјuških barjih in gozdovih

Za smrekova barja in gozdove na Poklјuški planoti so značilne zelo različne ekološke razmere, rastlinska raznovrstnost in velika variabilnost rasti smrekovih dreves. Floristična sestava in vegetacija dobro nakazujeta ekološke razmere, zato smo proučevana smrekova barja in smrekove gozdove razvrstili na podlagi floristične podobnosti, stopnje zastiranja rastlinskih vrst in vertikalne strukture vegetacije v šest eko-vegetacijskih skupin. Po eko-vegetacijskih skupinah smo primerjali rastne značilnosti smrekovih dreves. Ugotovili smo, da razlike v povprečni starosti smrekovih dreves med eko-vegetacijskimi skupinami niso statistično značilne. Vendar pa obstajajo značilne razlike v rastnemu režimu smrekovih dreves na barjih in v gozdu. Značilne razlike smo ugotovili v povprečni višini drevesa, povprečnem prsnem premeru dreves in povprečni širini drevesnih branik. Počasna rast smrekovih dreves na barjih je posledica neugodnih ekoloških razmer, predvsem visoke vsebnosti vode v tleh in visokega nivoja podtalnice.

Ključne besede: višina drevesa, prsni premer drevesa, drevesna branika, smrekovo barje, smrekov gozd, *Picea abies* (L.) Karst., Slovenija

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1 INTRODUCTION

In Slovenia, peat bogs are situated mostly on high Alpine plateaus. Among the peat bogs, in addition to true raised bogs, the so-called spruce mires can also be found; Norway spruce (*Picea abies*) plays an important role (Kutnar 2001, Kutnar & Martinčič 2001, 2003) in them. These mires derive their appearance and characteristics from the presence of Norway spruce trees (*Picea abies* (L.) Karst.). In comparison with true raised bogs, like those of Šijec and Veliko Blejsko Barje on the Pokljuka plateau (Martinčič & Piskernik 1985), spruce mires have been relatively poorly investigated in the past. However, some studies of vegetation and ecology of the spruce mires on the Pokljuka plateau have been undertaken in the previous decade (Kutnar 2001, Kutnar & Martinčič 2001, 2002, 2003, Kutnar & Urbančič 2001, Kutnar et al. 2001). Due to the different ecological influences, which are related to their transitional geographic position and diverse rock, these mires are highly mosaic-like ecosystems characterised by very specific ecological patterns and vegetation gradients.

Based on gradient studies on many Scandinavian mires, Økland et al. (2001) reported considerable shifts in species compositions from the (mostly open) mire expanse to the mire margin (mostly with trees). This 'direction of variation in vegetation' or vegetation gradient is caused by a specific set of environmental factors. The vegetation gradient can coincide with some important ecological gradients. A close link between plant communities and pH/alkalinity/cation concentrations has been observed in some northern mires (e.g. Wassen et al. 1989, Vitt & Chee 1990, Gorham & Janssens 1992). Often, Ca^{2+} concentrations and the pH of surface water are used to define the boundaries between different types of peat-land (Malmer 1986).

The ecological and vegetation gradient in mires can also coincide with the growth conditions of trees. On the Šijec bog and its edge, the influences of different site conditions on spruce growth characteristics were studied (Božič & Levanič 1998, Božič & Urbančič 2001, 2003). In these studies, significant differences in spruce tree growth on bogs and their edges have been shown.

Accordingly, the aim of this study was to test the coincidence of the ecological and vegetation gradients with the spruce tree growth regime on different spruce mires and spruce forests on the Pokljuka plateau.

2 STUDY AREA AND METHODS

This study was performed on the spruce mires and surrounding spruce forests on the Pokljuka high plateau on the eastern side of the Julian Alps in Slovenia. The study was carried out at six sites located near Mrzli Studenec and the Šijec bog (Martinčič & Piskernik 1985) on the Pokljuka plateau. Small spruce mires of area of less than 0.05 square kilometres were studied from different aspects. Six transects with seven homogenous plots, each with dimensions of 2 metres × 4 metres were placed systematically to determine ecological condition and vegetation diversity (Kutnar 2001, Kutnar & Martinčič 2001, 2002, 2003, Kutnar & Urbančič 2001, Kutnar et al. 2001), and spruce growth characteristics along the mire-forest gradient. Each transect includes several plots situated on mires with the peat soils, and at least one plot (or more) on the forest mineral soils. The distance between plots in each set (transect) is constant, but according to dimension of mires, it varies from 19 to 31 metres per transect.

If we assume that the ecological gradient and growth conditions are explained by the vegetation gradient, the spruce tree growth could be tested among different eco-vegetation groups. On the basis of vegetation vertical structure, plant cover and floristic composition assessed by the standard Central European method (Braun-Blanquet 1964) the following eco-vegetation groups were described in the previous studies (Kutnar & Martinčič 2001, 2003):

A) ombro-oligotrophic dwarf-pine bogs (*Pino mugi-Sphagnetum* s. lat. associations);

B) ombro-oligotrophic spruce mires (*Sphagno girgensohnii-Piceetum* W. Kuoch 1954 corr. Zupančič 1982 var. geogr. *Carex brizoides* Zupančič 1982 corr.);

C) oligotrophic spruce forests (*Rhytidiadelpho lorei-Piceetum* (M. Wraber 1953 n. nud.) Zupančič (1976) 1981 emend. *typicum* and *sphagnetosum*);

D) meso-oligotrophic spruce forests: transition to sedge fens (*Rhytidiadelpho lorei-Piceetum* (M. Wraber 1953 n. nud.) Zupančič (1976) 1981 emend. *cardaminetosum*);

E) meso-oligotrophic sedge fens (*Carici rostratae-Sphagnetum* Martinčič & Piskernik 1985 ex Martinčič & Seliškar 2004 and plant communities with dominated *Carex davalliana* or *Trichophorum alpinum*);

F) meso-oligotrophic transitions of sedge fens to spruce forests.

On each of the 42 plots, the closest two spruce trees were selected systematically. The height of selected spruces was at least half of dominant tree height in the surroundings of the particular plot. In a total of 84 trees, the tree height and tree diameter at a breast-height of 1.3 metres were measured. At a height of 0.4 m of the tree, the cores from above the root collar were taken in order to determine the age of the trees and average width of the tree-ring.

The Tukey HSD (Honestly Significant Difference) was use to test the differences between mean tree values of the eco-vegetation groups.

3 RESULTS

A similar pattern in the spruce-tree growth characteristics were shown on plots belonging to the same eco-vegetation group. It can be assumed that tree growth characteristics coincide well with ecological conditions indicated by the vegetation types and described by the eco-vegetation groups.

Based on the spruce-tree growth characteristics, all eco-vegetation groups can be assembled into three aggregates with similar patterns. The first aggregate consists of Groups A and B, of which the first group represents the *Sphagnum* bogs overgrown by the dwarf pine shrubs (*Pinus mugo*), and the plots of second group are also dominated by the dwarf spruce trees on the acid peat soil.

The second aggregate is formed of plots belonging to the spruce forest community on acid mineral soil with the low species diversity (Group C). The second group of this aggregate (Group D) is represented by the spruce community with a richer species composition and characterised by species of less acidic mineral soil.

The third aggregate includes Groups E and F with plots overgrown by the different types of sedge fen vegetation with prevailing *Carex* species. The plots of Group F are located at the transition of the sedge fen vegetation to the spruce community on the mineral soil. The aggregate has a very alkaline character and a high level of soil humidity (Kutnar & Martinčič 2001, 2003, Kutnar & Urbančič 2001, Kutnar et al. 2001).

The age of spruce trees determined at 0.4 metres above ground ranges between 14 and 193 years. The mean spruce tree age of eco-vegetation groups is between 83 years (Group A) and 124 years (Group C) (Table 1). In spite of slightly lower mean spruce tree ages on the mires (Figure 1, Table 1), the differences in mean tree age among the eco-vegetation groups are not significant (Table 1).

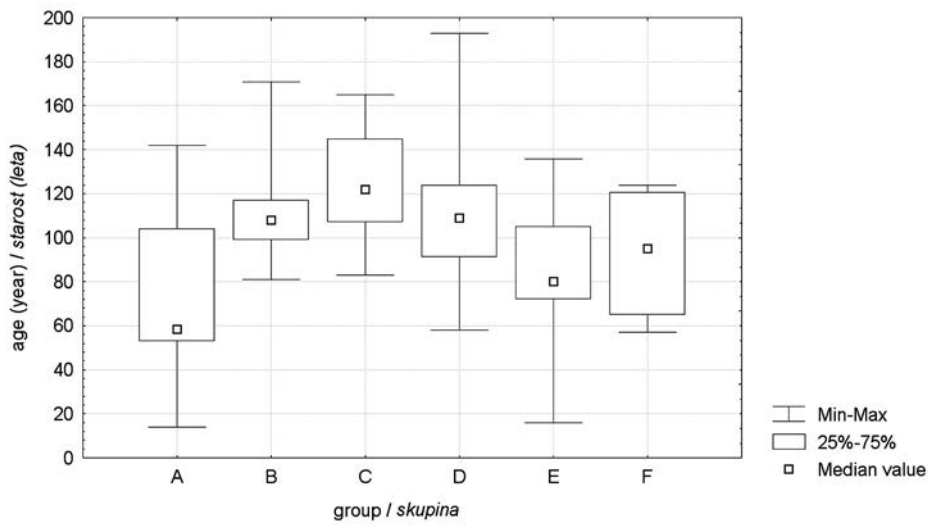

Figure 1: Age of spruce trees according to the eco-vegetation groups
Slika 1: Starost smrekovih dreves po eko-vegetacijskih skupinah

Table 1: Test of differences in the mean tree age among the eco-vegetation groups
Preglednica 1: Test razlik povprečne starosti dreves med eko-vegetacijskimi skupinami

Level of significance - (p)	A	B	C	D	E	F
mean (years)	83.2	116.3	124.2	114.0	98.3	92.8
N of plots	7	9	9	6	7	4
A	/	0.6467	0.4225	0.7122	0.9885	0.9987
B	/	/	0.9962	0.9999	0.9740	0.9222
C	/	/	/	0.9951	0.8877	0.7816
D	/	/	/	/	0.9859	0.9487
E	/	/	/	/	/	0.9999
F	/	/	/	/	/	/

In contrast, among the eco-vegetation groups we have found the statistical differences in tree heights and the diameters of the trees (Tables 2 and 3). The heights of trees in the forest Groups C and D are significantly higher than in the mire groups (Table 2). The height of all measured spruce trees ranges between 2 metres and 36 metres. On average, the height of trees on the mineral soils is 26 metres (Group D) and 28 metres (Group C), while the mean heights of the spruce trees on the mires range between 6 metres (Group A) and 13 metres (Group B) (Table 2).

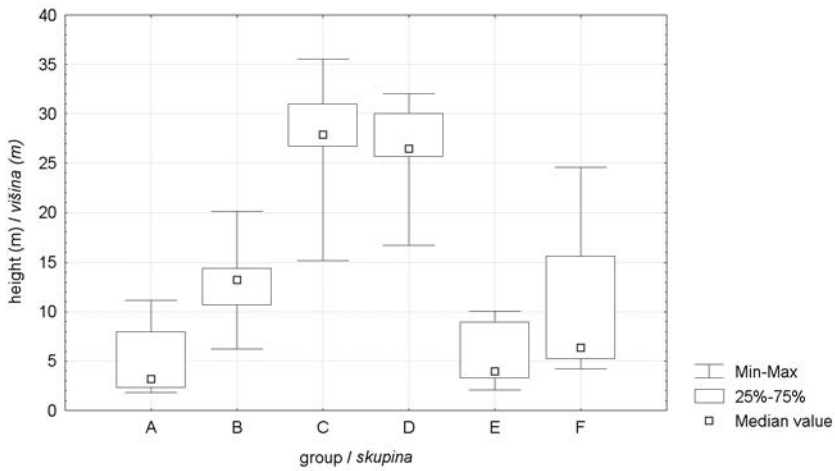

Figure 2: Spruce-tree heights according to the eco-vegetation groups
Slika 2: Višina smrekovih dreves po eko-vegetacijskih skupinah

Table 2: Test of differences in the mean spruce-tree height among the eco-vegetation
(Marked differences are significant at level p < .05)*
Preglednica 2: Test razlik povprečne višine smrekovih dreves med eko-vegetacijskimi skupinami
(Označene razlike so značilne na nivoju p < .05)*

Level of significance - (p)	A	B	C	D	E	F
mean (meter)	6.2	13.1	27.9	26.2	6.7	10.4
N of plots	7	9	9	6	7	4
A	/	0.3422	0.0001*	0.0002*	0.9999	0.8724
B	/	/	0.0001*	0.0026*	0.5475	0.9787
C	/	/	/	0.9934	0.0002*	0.0010*
D	/	/	/	/	0.0003*	0.0030*
E	/	/	/	/	/	0.9220
F	/	/	/	/	/	/

The breast height diameter of trees varies between 3 centimetres and 61 centimetres. The mean breast height diameters in spruce forests plots are significantly larger than in mire groups (Figure 3, Table 3). The thickest mean spruce tree is on the plots of Group D with the breast height diameter of 42 cm (Table 3). On plots of Group A, the spruce trees have the smallest mean breast height diameter. In most cases, their breast height diameter is no more than 10 cm.

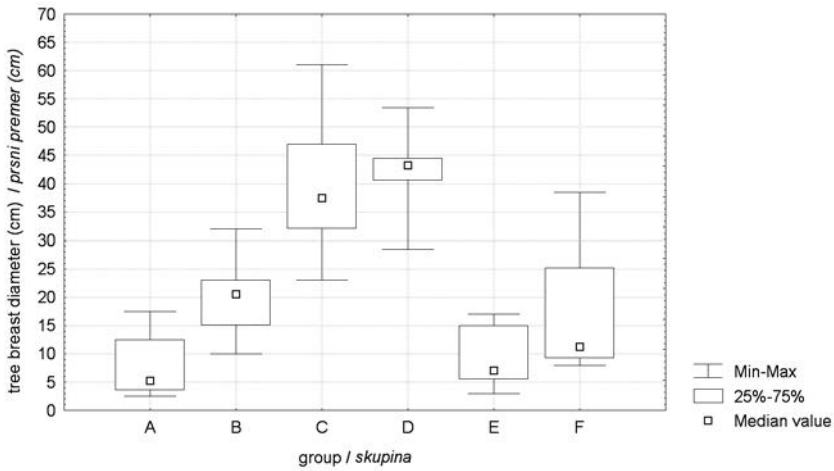

Figure 3: Tree breast diameter of spruce-trees according to the eco-vegetation groups
Slika 3: Prsni premer smrekovih dreves po eko-vegetacijskih skupinah

Table 3: Test of differences in the mean spruce-tree breast diameter among the eco-vegetation
(Marked differences are significant at level p < .05)*
Preglednica 3: Test razlik povprečnega prsnega premera smrekovih dreves med eko-vegetacijskimi skupinami
(Označene razlike so značilne na nivoju p < .05)*

Level of significance - (p)	A	B	C	D	E	F
mean (centimetre)	9.8	19.9	39.6	42.3	11.4	17.3
N of plots	7	9	9	6	7	4
A	/	0.4879	0.0003*	0.0002*	0.9998	0.8416
B	/	/	0.0009*	0.0020*	0.7649	0.9983
C	/	/	/	0.9955	0.0015*	0.0154*
D	/	/	/	/	0.0005*	0.0053*
E	/	/	/	/	/	0.9393
F	/	/	/	/	/	/

The tree-ring width of the studied spruce trees varies between 0.2 and 2.2 millimetres. The mean tree-ring width in forest Groups C and D are significantly larger than in the mire groups (Figure 4, Table 4). The mean tree-ring width of groups is between 0.4 millimetres (Group A) and 1.5 millimetres (Group D).

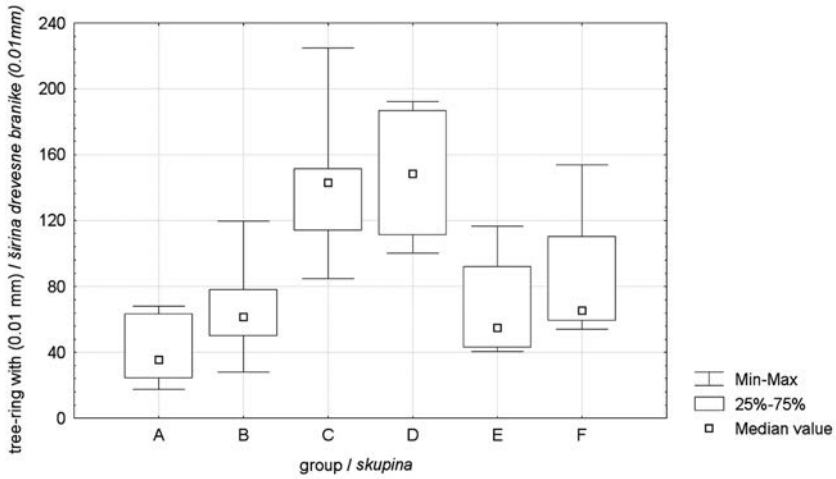

Figure 4: Average values of tree-ring widths of spruce trees according to the eco-vegetation groups
Slika 4: Povprečne širine branik smrekovih dreves po eko-vegetacijskih skupinah

Table 4: Tukey HSD test of the differences between average values of tree-ring widths according to the eco-vegetation groups (Marked differences are significant at level p < .05)*
Preglednica 4: Test razlik povprečne širine branik smrekovih dreves med eko-vegetacijskimi skupinami (Označene razlike so značilne na nivoju p < .05)*

Level of significance - (p)	A	B	C	D	E	F
mean (in 0.01 millimetre)	36.1	65.6	139.3	147.8	57.7	84.6
N of plots	7	9	9	6	7	4
A	/	0.7595	0.0008*	0.0003*	0.9492	0.3793
B	/	/	0.0012*	0.0035*	0.9995	0.9700
C	/	/	/	0.9982	0.0250*	0.2520
D	/	/	/	/	0.0107*	0.1336
E	/	/	/	/	/	0.8788
F	/	/	/	/	/	/

4. DISCUSSION

This study was focused to the spruce tree growth regime in different ecosystems (mires vs. forests) with significantly different ecological conditions (e.g. peat soil vs. mineral soil). On average, the growth of spruce trees is less intensive on mires than on their edges, and particularly out of them, in the forests. Similar growth patterns have been observed by Bubier (1991) reporting the decline of growth of black spruce-trees (*Picea mariana*) from edge to the centre of bogs.

The estimated growth ratio between mires and forests in our study is comparable to previous studies of growth characteristics of spruce on the Šijec bog (Božič & Levanič 1998, Božič & Urbančič 2001, 2003). Based on our measurements, on average, the spruce trees in the forest groups are from 2.0 to 4.5-times higher than those growing in mires. The spruce trees in the forests are also 2.3 to 4.3-times thicker than the spruce trees on mires.

In the harsh ecological conditions of some spruce mires, where the spruce trees grow extremely slowly, the specific plant community of dwarf spruce trees has been described as the initial form of spruce mire vegetation development (Kutnar & Martinčič 2002).

Furthermore, in this study, it has been established that the floristic composition and vegetation are good indicators of the ecological conditions. Moreover, the significant differences in the tree growth regime among studied eco-vegetation are well supported by previous studies of mire and forest ecology (Kutnar et al. 2001, Kutnar & Urbančič 2001, Kutnar & Martinčič

2003). In these studies, the differences in soil and water properties between the spruce mires and surrounding spruce forests have been observed. Although the differences in the spruce tree growth regime among different types of mires, like dwarf pine bog, spruce mire and sedge fen are not significant, the chemical soil and water properties differ significantly among the studied groups (Kutnar et al. 2001, Kutnar & Urbančič 2001, Kutnar & Martinčič 2003). Comparing the mire aggregate, including Groups A and B to the third aggregate consist of fen Groups E and F, the differences in pH, C/N, base saturation, content of the exchangeable Ca, Al and Fe were confirmed, while no significant differences in the soil water content between two mire aggregates have been shown (Kutnar & Martinčič 2003).

Based on previous studies and the present study of the spruce tree growth regime, it can be assumed that the water is the main driving factor constraining the growth of spruce trees on the mires with different ecological backgrounds. The slow spruce tree growth rate on the mires could be explained by the set of ecological factors, among them the high soil water and high ground water level are significant.

The differences in age of spruce-trees between the mire and surrounding forests on the Pokljuka plateau are small, but not significant. Assuming the spruce trees on mires grow more slowly and therefore need more years to reach the measuring height of 0.4 metres than those in the forests, the actual differences in spruce-tree age between these two main ecosystems might be even smaller.

POVZETEK

Uvod

V Sloveniji se barja pojavljajo predvsem na visokih alpskih planotah. Med šotnimi barji so poleg visokih barij tudi t.i. smrekova barja, na katerih ima smreka (*Picea abies* (L.) Karst.) pomembno funkcionalno vlogo (Kutnar 2001, Kutnar & Martinčič 2001, 2003).

V primerjavi s pravimi visokimi barji, kot sta npr. Šijec in Veliko Blejsko barje na Pokljuki (Martinčič & Piskernik 1985), so bila smrekova barja v preteklosti relativno slabo raziskana. Intenzivnejše raziskave vegetacije in ekologije smrekovih barij na Pokljuki so bile opravljene v zadnjem obdobju (Kutnar 2001, Kutnar & Martinčič 2001, 2002, 2003, Kutnar & Urbančič 2001, Kutnar et al. 2001). V različnih raziskavah ugotavljajo, da lahko vegetacijski gradienti na barjih sovpadajo z nekaterimi gradienti ekoloških parametrov, kot so npr. pH, bazičnost, koncentracija kationov (e.g. Wassen et al. 1989, Vitt & Chee 1990, Gorham & Janssens 1992, Kutnar & Martinčič 2003). Predpostavljamo, da na barjih obstajajo tudi razmeroma jasne korelacije med rastnimi značilnostmi dreves in ekološkimi ter vegetacijskimi gradienti. Že predhodne raziskave so potrdile značilne razlike med rastnimi značilnostmi dreves na barju Šijec in njegovem robu (Božič & Levanič 1998, Božič & Urbančič 2001, 2003).

Cilj te študije je bil preveriti, ali obstaja povezava med rastnim režimom smrekovih dreves in ekološkimi ter vegetacijskimi gradienti na različnih smrekovih barjih in v smrekovih gozdovih na Pokljuki.

Raziskovalno območje in metode

Raziskava je potekala na izbranih smrekovih barjih in okoliških smrekovih gozdovih na Pokljuki. Na šestih manjših barjih v bližini Mrzlega Studenca in barja Šijec smo postavili šest transektov s po sedmimi sistematično razvrščenimi ploskvami (velikost 2 metra x 4 metre). Vsak transekt vključuje ploskve na barju s šotnimi tlemi in ploskve v gozdu z mineralnimi tlemi. Na ploskvah vzdolž gradientov barje-gozd smo poleg proučevanja ekoloških in vegetacijskih razmer (Kutnar & Martinčič 2001, 2003, Kutnar & Urbančič 2001, Kutnar et al. 2001) analizirali tudi rastne značilnosti smrekovih dreves.

Ob predpostavki, da vegetacijski gradient korelira z ekološkimi gradienti in rastnimi značilnostmi dreves, lahko primerjamo rast smrekovih dreves med različnimi eko-vegetacijskimi skupinami, ki so bile opisane v predhodnih raziskavah (Kutnar & Martinčič 2001, 2003):

A) ombro-oligotrofna barja z rušjem (*Pino mugi-Sphagnetum* s. lat.);

B) ombro-oligotrofna barja s smreko (*Sphagno girgensohnii-Piceetum* var. geogr. *Carex brizoides*);

C) oligotrofni smrekov gozd (*Rhytidiadelpho lorei-Piceetum typicum* and *sphagnetosum*);

D) mezo-oligotrofni smrekov gozd: prehod proti barjem s šaši (*Rhytidiadelpho lorei-Piceetum cardaminetosum*);

E) mezo-oligotrofna barja s šaši (*Carici rostratae-Sphagnetum* in združbe s prevladujočimi *Carex davalliana* in *Trichophorum alpinum*);

F) mezo-oligotrofni prehodi barij s šaši proti smrekovih gozdovom.

Na vsaki od 42 ploskev smo sistematično izbrali dve najbližji smrekovi drevesi, ki sta dosegali vsaj polovico višine dominantnih dreves v bližini posamezne ploskve. Izbranim drevesom smo izmerili drevesne višine in prsne premere na višini 1,3 metra od tal. Na višini 0,4 metra od tal smo odvzeli izvrtke debel, na osnovi katerih smo določili starost dreves in povprečne širine drevesnih branik.

Za analizo razlik med povprečnimi vrednostmi rastnih parametrov smrekovih dreves po eko-vegetacijskih skupinah smo uporabili Tukey HSD test.

Rezultati

Ugotovili smo, da imajo smrekova drevesa po posameznih eko-vegetacijskih skupinah podobne rastne značilnosti. Na osnovi tega lahko sklepamo, da rastne značilnosti smrekovih dreves dobro korelirajo z ekološkimi razmerami, ki jih nakazujejo različni tipi vegetacije in so bile opisane z eko-vegetacijskimi skupinami.

Na podlagi podobnih rastnih značilnosti smrekovih dreves lahko eko-vegetacijske skupine združimo v tri večje agregate. V prvem agregatu sta združeni skupini ombro-oligotrofnih barij (A in B). Drugi agregat sestavljata skupini, ki vključujeta ploskve v smrekovem gozdu (C in D). Tretjega pa sestavljajo ploskve na mezo-oligotrofnih barjih s šaši in prehodi proti gozdu (skupini E in F).

Ugotovljene starosti dreves iz izvrtkov na višini 0,4 metra nad tlemi so bile med 14 in 193 leti. Po eko-vegetacijskih skupinah je povprečna starost smrekovih dreves med 83 leti (skupina A) in 124 leti (skupina C) (preglednica 1). Kljub nekoliko nižji povprečni starosti smrekovih dreves na barjih, pa razlike v povprečni starosti dreves med skupinami niso statistično značilne (slika 1, preglednica 1).

Po drugi strani pa smo ugotovili značilne razlike med povprečnimi višinami in prsnimi premeri smrekovih dreves po eko-vegetacijskih skupinah (preglednici 2 in 3). Višine dreves v gozdu (skupini C in D) so značilno večje kot v barjanskih skupinah (preglednica 2). Na mineralnih tleh v gozdu so povprečne višine med 26 metri (skupina D) in 28 metri (skupina C), medtem ko je povprečna višina smrekovih dreves na šotnih barjanskih tleh med 6 metri (skupina A) in 13 metri (skupina B) (preglednica 2). Višine vseh izmerjenih smrekovih dreves so med 2 in 36 metri.

Prsni premeri dreves so v razponu med 3 in 61 centimetri. Povprečni prsni premer dreves v gozdu je značilno večji kot na barju (slika 3, preglednica 3). Povprečno najdebelejše smrekovo drevo raste na ploskvah skupine D (42 cm), najtanjše pa v skupini A, kjer ne dosega 10 centimetrov v debelino (preglednica 3).

Povprečna širina branik smrekovih dreves je med 0,2 in 2,2 milimetri. Povprečna širina branik vseh dreves v skupini A je le 0,4 milimetre, medtem ko je povprečje najvišje v skupini D, kjer je 1,5 milimetra (slika 4, preglednica 4).

Razprava

Raziskava je obravnavala rastni režim smreke v različnih ekosistemih (barje, gozd) z različnimi ekološkimi razmerami (šotna tla, mineralna tla). V povprečju je rast smrekovih dreves precej bolj počasna na barjih kot na njihovih robovih in okoliškem gozdu. Ugotovili smo podoben vzorec upadanja rasti smrekovih dreves z roba barij proti središču, kot ga je opisal že Bubier (1991) za črno smreko (*Picea mariana*).

V povprečju so smrekova drevesa v gozdu 2,0 do 4,5-krat višja od tistih, ki rastejo na barjih. Smrekova drevesa v gozdu so v prsni višini 1,3 metra 2,3 do 4,3-krat debelejša kot smrekova dreves na barjih, kar se dobro ujema s primerljivimi študijami rasti smreke na barju Šijec (Božič & Levanič 1998, Božič & Urbančič 2001, 2003).

V zaostrenih ekoloških razmerah na nekaterih smrekovih barjih, kjer smrekova drevesa rastejo zelo počasi in so krnjave, pritlikave rasti, je bila opisana tudi posebna inicalna oblika barjanskega smrekovja (Kutnar & Martinčič 2002). Tudi v tej študiji smo ugotovili, da vegetacija dobro nakazuje ekološke razmere. Poleg tega pa so razlike v rastnem režimu smrekovih dreves dobro pojasnjena z ekološkimi lastnostmi tal in vode na barju in okoliškem gozdu (Kutnar et al. 2001, Kutnar & Urbančič 2001, Kutnar & Martinčič 2003). Čeprav nismo ugotovili značilnih razlik v rasti smreke na različnih barjih, kot so npr. barje z rušjem, s smreko in s šaši, pa se med njimi kažejo značilne razlike v kemizmu tal in talne vode (Kutnar et al. 2001, Kutnar & Urbančič 2001, Kutnar & Martinčič 2003).

Primerjava prvega agregata, ki vključuje skupini A in B, s tretjim agregatom s skupinama E in F, je pokazala značilne razlike v vrednostih pH, C/N, stopnji nasičenosti z bazami in vsebnosti izmenljivih Ca, Fe in Al. Hkrati pa med agregatoma nismo ugotovili večjih razlik v stopnji vsebnosti vode v tleh (Kutnar & Martinčič 2003). Na podlagi predhodnih vegetacijsko-ekoloških raziskav in študije rasti smrekovih dreves lahko sklepamo, da je voda eden od ključnih dejavnikov, ki omejujejo rast smrekovih drevesi na barjih z različnimi ekološkimi ozadji. Počasno rast smrekovih dreves na barjih je mogoče pojasniti s celotnim nizom ekoloških dejavnikov, med katerimi imata posebej odločilno vlogo visoka vsebnost vode v šotnih tleh in visok nivo podtalnice.

Razlike v starosti smrekovih dreves na barju in okoliškem gozdu na Pokljuki so razmeroma majhne. Smrekova drevesa na barju v povprečju rastejo počasneje in zato potrebujejo več let, da dosežejo merilno višino 0,4 metra, kot drevesa v gozdu. Na osnovi tega lahko sklepamo, da so razlike v starosti smrekovih dreves med tema dvema ekosistemoma dejansko še manjše od ugotovljenih.

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