WILL THE REMOVAL OF THE RECREATIONAL SYMBOL OF JESENIKY MOUNTAIN SUMMIT PARTS, THE DWARF PINE FORESTS, AFFECT THE ECOSYSTEM FUNCTIONS OF THE HILLS?

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Abstract
The study evaluates how the removal of the dwarf pine from the forest stands of the summit parts of the Jeseníky Mountains will affect the performance of their ecosystem functions. The primary interest of the study is the assessment of the effect of the removal of the dwarf pine on the runoff conditions of the investigated locations, however, their recreational function is also considered. It is obvious that the dwarf pine has historically become one of the symbols of the local landscape in the summit parts of the Jeseníky Mountains. The results achieved by the author's team indicate that the removal of the dwarf pine will not significantly affect the functions of the forests in the monitored area compared to their current functionality. However, the social perception of this intervention will probably be very significant, both in the professional sphere (foresters) and in the sphere of the public (recreationists). It turns out that currently, the social significance of interventions implemented in socially exposed localities is as serious as its ecological and technical significance.

Key words: Dwarf pine reduction, surface runoff, Jeseníky Mountains

Introduction

The influence of tree vegetation on runoff from forested catchments has been confirmed by the results of many studies (Bosch and Hewlett 1982; Hrachowitz et al. 2013, Eisenbies et al. 2007, Bíba et al. 2010, Deutscher et al. 2016; Švihla et al. 2016, Černohous et al. 2017, Kupec et al. 2018, Kupec et al. 2019). Generally, reducing the forest cover causes an increment in the runoff, and oppositely causes the runoff reduction whereas the runoff quantity response to changes in forest cover is difficult to be predicted (Ganatsios et al. 2010).
The main objectives of the study, the results of which are presented in this article, were as follows:

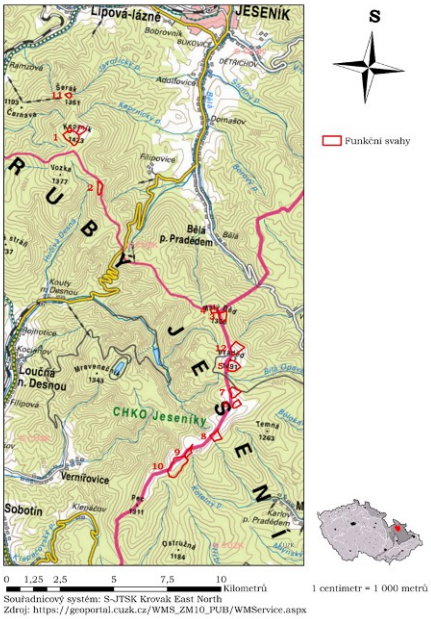
- Whether there will be changes in the parameters of the runoff process, or surface runoff from part of the top parts of the Jeseníky Mountains after mining in dwarf pine stands under normal hydrological (climatic) conditions?
- If there are any changes, what their extent will be?

Material and methods

The locality of the study has been the summit parts of the Jeseníky in general, or specific top hills identified by the study contractor (Jeseníky Protected Landscape Area Authority) respectively (see figure 1). These “Intervention localities” (24 localities) were reworked to “Functional slopes” (13 FS) in accordance with the used method of the study conducting (figure 1).
Methodologically, the method of runoff coefficients (rational method) has been used to determine potential changes in the runoff conditions of localities after the implementation of the intervention. Specific coefficients were taken from the Czech Standard ČSN 75 9010 and adjusted reflecting on the outputs of field verification and specific conditions of mountain slopes inclination (see tables 1 and 2).
For the final quantification of the influence of planned interventions (recalculations of the proportion of runoff from the annual precipitation values), the real precipitation data had to be used. Table 3 presents the annual precipitation data from the closest climatological stations (Dlouhé stráně and Šerák).

Results

Table 4 shows the overall results of the runoff changes on specific functional slopes. The results interpretation is given in next chapter.



Šerák	FS 11	IL 0
Keprník	FS 0,1	IL 1, 2,19
Červená hora	FS 2	IL 20, 21
Malý děd	FS 3, 4	IL 3, 4
Praděd	FS 5, 12	IL 5, 6, 7, 8, 9
Petrovy kameny	FS 7	IL 10, 11, 12
pod Vysokou holí	FS 6	IL 13, 14, 15
Kamzičník	FS 8	IL 22, 23
Velký máj	FS 9	IL 16
Jelení hřbet	FS 10	IL 16, 17, 18

Fig. 1: Location of the study sites

Tab. 1: Transfer of the categories of ČSN 75 9010 to the real vegetation types in the locality

Vegetation types in the locality	**Categories of ČSN 75 9010**
Trees – full canopy	Forests
Trees canopy > 60 %	Forests
Trees canopy 40-60 %	*Forests with canopy 40-60*
Trees canopy <40 %	*Forests with a canopy of less than 40*
Dwarf pine – full canopy	Forests
Dwarf pine > 60 %	Forests
Norway spruce – full canopy	Forests
Norway spruce 40-60 %	*Forests with canopy 40-60*
Norway spruce <40 %	*Forests with a canopy of less than 40*
Meadows	Green belts, fields, meadows
Rocks/Roads/Roofs	Built-up areas

Tab. 2: Adjusted runoff coefficients

Category of slope inclination (%)	**Built-up areas**	**Green belts, fields, meadows**	**Forests with a canopy of less than 40**	**Forests with canopy 40-60**	**Forests**
1	0.9	0.05	0.04	0.03	0
5	0.9	0.1	0.09	0.08	0.05
10	0.9	0.15	0.14	0.13	0.1
15	0.9	0.2	0.19	0.18	0.15
20	0.9	0.25	0.24	0.23	0.2
25	0.9	0.3	0.29	0.28	0.25
30	0.9	0.35	0.34	0.33	0.3
35	0.9	0.4	0.39	0.38	0.35
40	0.9	0.45	0.44	0.43	0.4

Tab. 3: Annual precipitation data from the closest climatological stations (Dlouhé stráně and Šerák) 2004 - 2021

Year	Dlouhé stráně (mm)	Šerák (mm)	Year	Dlouhé Stráně (mm)	Šerák (mm)
2004	1178.6	1018.2	2014	1025.6	1114.3
2005	1189.5	1120.9	2015	937.2	842.8
2006	1296.0	1139.9	2016	1070.6	1222.3
2007	1327.2	1270.3	2017	1140.3	1302.1
2008	1179.6	1148.8	2018	889.7	1145.8
2009	1299.3	1235.7	2019	1140.8	1230.8
2010	1600.1	1563.2	2020	1497.8	1449.8
2011	1041.7	954.7	2021	1165.0	1138.4
2012	1108.9	975.4	**Average**	**1178.9**	**1168.1**
2013	1132.8	1151.9	**Average last 10 years**	**1110.9**	**1157.4**

Tab. 4: Overall results of the runoff changes on specific functional slopes

Functional slope	Locality		Rational method						
	Area (ha)	Ø Inclin. (%)	Ø Runoff coef. before interv.	ø Runoff coef. after interv.	Runoff coef. increment øΨ (%)	Average runoff 18 years (mm)	Average runoff 10 years (mm)	Runoff increment 18 years (mm)	Runoff increment 10 years (mm)
0 – Keprník sever	10.02	13	0.2217	0.2346	5.5	259	272	15.05	14.91
1 – Keprník jih	32.15	14	0.2110	0.2161	2.4	246	250	6.01	5.95
2 – Panna Maria	9.77	16	0.3654	0.3834	4.7	427	444	20.96	20.76
3 – Malý děd	13.87	6	0.2127	0.2276	6.6	251	253	17.62	16.60
4 – Švýcárna	7.05	3	0.1792	0.1981	9.5	211	220	22.23	20.95
5 – Praděd	21.08	21	0.2786	0.2803	0.6	328	311	1.97	1.86
6 – Vysoká hole	8.86	4	0.2412	0.2500	3.5	284	278	10.38	9.78
7 – Petrovy kameny	15.34	49	0.3958	0.4008	1.2	467	445	5.90	5.56
8 – Kamzičník	15.03	23	0.3332	0.3381	1.4	393	376	5.73	5.40
9 – Velký máj	7,51	7	0.1874	0.1996	6.1	221	222	14.37	13.54
10 – Jelení hřbet	51,36	7	0.2744	0.2797	1.9	323	311	6.28	5.91
11 – Šerák	4,32	12	0.3516	0.3549	0.9	411	411	3.94	3.90
12 – Tabulové skály	22,68	13	0.3088	0.3195	3.3	364	355	12.57	11.84

Discussion and conclusion

The interpretation of the results given above could be as follows:

The average runoff coefficient before the intervention reaches a value of 0.274 (27.4%).

- Significantly lower value - Švýcárna and Velký Máj,

- Higher runoff coefficient (exceeding 30%) Tabulové skály, Kamzičník, Šerák, Panna Maria, and Petrovy kameny (almost 40%)

The average runoff coefficient after the intervention reaches 0.283 (28%), the increase in the value of the runoff coefficient occurs on all investigated functional slopes.

- Below average - Švýcárna and Velký Máj,
- Above average - Tabulové skály, Kamzičník, Šerák, Panna Maria and Petrovy kameny

The average potential increase in the values of the runoff coefficient at all investigated sites after the interventions was 3.67%.

- The smallest potential change - Praděd, Šerák, Petrova kameny, and Kamzičník (below 2%)
- The highest change (above 5%) - Keprník sever, Velký máj, Malý děd, and Švýcárna (9.9%)

Average runoffs for all functional slopes:

- approx. 322 mm per year from an average annual rainfall of approx. 1176 mm (for the period 2004-2021)
- approx. 319 mm per year from an average rainfall of approx. 1125 mm (for the period 2012-2021)

At these values, there will be an average increase in annual runoff from the sites:

- approx. 11.0 mm (in the case of the period 2004–2021)
- approx. 10.5 in (for the period 2012-2021)
- the lowest increase values - Praděd, Šerák, Petrovy kameny, and Kamzičník (below 6 mm)
- the highest increase values - Keprník sever, Malý děd and Švýcárna (over 15 mm)

The results of the study have shown that the changes in runoff conditions that will potentially occur on the examined functional slopes after the removal of the dwarf pine in the defined range will be very low to negligible in the context of normal hydrological conditions, considering the specifics of individual functional slopes. It can be indirectly stated that not only the hydric but also the soil protection efficiency of the functional slopes will be affected by the mentioned interventions, in the context of normal hydrological conditions, negligibly or very little.

However, the opposite situation is likely to occur in the social-recreational function of localities, where stands of dwarf pine form a long-term perceived image of the landscape character of the top parts of the Jeseníky Mountains. In this case, the main tool for education is an extensive positive campaign, with the help of which it is necessary to explain to tourists not only the fact that the dwarf pine is not native to the Jeseníky Mountains, but especially that it is harmful as competition for the native mountain meadows. In this campaign, the results of the presented study give an argument to both experts and the lay public that after the removal of the dwarf pine there will be no significant reduction in the functional efficiency of the hydric function in the top parts of the Jeseníky Mountains.

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Souhrn
Článek se zabývá hodnocením změny plnění ekosystémových funkcí lesních porostů vrcholových partií Jeseníků po potenciálním odstranění borovice kleče. Primárním zájmem studie je posouzení vlivu odstranění borovice kleče na odtokové poměry zkoumaných lokalit, uvažována je však i její implicitní rekreační funkce.
Změny v odtokových poměrech, které potenciálně nastanou na šetřených funkčních svazích po odstranění kleče v rozsahu, který definoval zadavatel studie budou v kontextu normálních hydrologických podmínek velmi nízké až zanedbatelné, s přihlédnutím ke specifikům jednotlivých funkčních svahů. Lze zprostředkovaně konstatovat, že nejen hydrická, ale i půdoochranná účinnost funkčních svahů bude zmiňovanými zásahy ovlivněna v kontextu normálních hydrologických podmínek zanedbatelně či velmi málo.
Opačná situace však pravděpodobně nastane v sociálně-rekreační funkci lokalit, kde klečové porosty tvoří turisty dlouhodobě vnímaný obraz krajinného rázu vrcholových partií Jeseníků. V tomto případě je hlavním nástrojem osvěty rozsáhlá pozitivní kampaň, pomocí které je nutné turistům vysvětlit nejen fakt, že borovice kleč není v Jeseníkách původní, ale zejména to, že je škodlivá jako konkurence původních horských luk. Výsledky prezentované studie pak dávají v této kampani argument jak odborné, tak laické veřejnosti, že po odstranění trpasličí borovice nedojde ve vrcholových partiích Jeseníků k významnému snížení funkční účinnosti hydrické funkce.

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