Contribution of regeneration on dead wood to the spontaneous regeneration of a mountain forest

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ABSTRACT: In the Moravian-Silesian Beskids in the beech/spruce forest vegetation zone, the amount of dead wood was determined (pieces of wood and stumps) in five sample plots in a managed forest and in three plots in the National Nature Reserve (NNR) Kněhyně-Čertův Mlýn. In plots situated in the managed forest, 22 to 50 m^3/ha of lying wood was found. In the reserve, the volume of fallen wood ranged from 29 to 144 m^3/ha. The number of stumps in sample plots in the managed forest ranged from 530 to 980 per ha. In the reserve, the number of new stumps did not increase any more and only stumps from the period before the NNR declaration occurred. On the dead wood, spruce is regenerated nearly exclusively. In the managed forest and in the NNR, the number of regenerated spruce plants ranged from 5,000 to 16,000 and from 600 to 4,500 per ha, respectively. In plots where the sufficient amount of dead lying wood and stumps occurred, the proportion of spruce plants regenerated on the substrates amounted to even 75%. Other species (beech and silver fir) regenerated only on the soil surface. A sufficient amount of dead wood for the germination of seedlings can significantly ensure the natural regeneration of spruce in mountain forests.

Keywords: mountain forest; forest restoration; dead wood; natural regeneration; Norway spruce

Natural development of the mountain forest ecosystem occurs with different dynamics than in the forest of lower locations. All is dependent on more extreme climatic conditions which, together with parent rock, determine soil conditions and subsequently the composition and developmental dynamics of vegetation.

The management of mountain forests is worsened by specific climatic conditions and topography.

To decrease costs of mountain forest management appears to be a possible solution. It can be achieved by approaching the mountain forest to its natural condition. Then, it will be possible to fully use natural processes occurring spontaneously in the forest. However, it is necessary to recognize these natural processes and to start them even in a commercial forest. A basic condition for the development of a forest is sufficient and successful growth of natural regeneration which can be supported by well-considered steps and thus the successful forest regeneration can be ensured.

Due to limiting factors of climate and the soil surface conditions, the natural regeneration of a mountain forest at higher altitudes is related only to convenient places and generally, it takes a long time. Timely and systematic silvicultural preparation of a parent stand is necessary for the successful regeneration of a mountain forest. The natural regeneration does not occur only on the soil surface but also on rotting pieces of wood and stumps. In a natural forest, large-diameter dead wood preserving balanced ecological conditions, particularly stable temperature, even moisture and marked control of forest weed effects, is most important (MÍCHAL 1999). An analysis of the ecosystem dynamics from autochthonous spruce populations at the Strmá stráň locality in the Krkonoše Mts. (VACEK 1999) has shown that spruce regenerated best in the initial stage of forest disintegration on windthrows, dead stems and their rotting remainders. Decomposition of large-diameter stems occurs with various dynamics and can exceed even 100 years. Regeneration of spruce occurs only when the host stem is sufficiently decomposed, i.e. at least after 20–30 years from the time when the tree fell (VACEK 1990). In commercial forests, the stage of forest disintegration is replaced by intentional principal felling. Thus, the natural developmental cycle of a forest is interrupted and substantially shortened. In the mountain forest ecosystem with a fragile balance, it is necessary to reduce impacts of omission of the stage of disintegration from the developmental cycle and of the removal of stem wood, e.g. by keeping a certain proportion of dead wood for natural decomposition. Then, forest regeneration is possible on dead wood which is an indispensable component of the natural development of a forest in mountain locations. Unfortunately, an opinion always remains that dead wood does not belong to a managed forest remaining there due to a failure of the forest manager only. In our commercial forests, therefore, the only sources of wood kept for decomposition are logging residues and stumps the volume of which amounts to about 50 m^3/ha in beech young-growth stands and 90 m^3/ha in spruce thickets (MÍCHAL 1999). Investigations carried out by Forest Management Institute in 1987 and 1991 showed that the volume of lying wood amounted to 6.1 m^3/ha of timber to the top of 7 cm d.o.b (all-state average) or 5.7 m^3/ha of smallwood (below 7 cm d.o.b.) (KRAUS 1999). In Central-European natural forests in the stage of disintegration, the volume of dead wood ranges between 50 and 200 m^3/ha and in the following stages, the volume decreases according to the rate of disintegration (ALBRECHT 1991). In commercial forests, the amount of lying wood ranges between 15 and 30 m^3/ha (AMMER 1991).

In mountains, the natural regeneration on the soil surface is related to terrain elevations with shallow dry soil which are not weed-infested or are overgrown only with mosses and blueberry. At the same time, the regeneration is related to rich seed years which occurred in forests of the Krkonoše Mts. once in the period of 8–14 years. For the successful development of seedlings, however, two warm and long summers have to follow with generally favourable climatic conditions (VACEK 1990). Studies in the Šumava National Park show that natural regeneration is more limited by local ecological conditions than by the growth of plants from artificial regeneration. Even in stands underplanted by hundreds of plants, subsequent natural regeneration occurred amounting to thousands of seedlings. This natural regeneration originates a new stand. In the spruce vegetation zone, the deficiency of temperature and of the dead wood of suitable dimensions is considered to be limiting factors of regeneration. It has been found that even in stands disintegrating due to a bark beetle outbreak there is a sufficient amount of viable spruce natural seeding (in a half of the cases, it is more than 10,000 seedlings/ha). Other interspersed species also regenerate naturally (KUPKA 2000).

The aim of the paper is to assess the role of dead wood in the regeneration of a particular mountain forest and to evaluate its proportion in the successful regeneration of the mountain forest. Results will serve for the formulation of measures supporting natural regeneration in a mountain forest.

MATERIAL AND METHODS

The research area is situated on mountain slopes of Kněhyně (1,257 m altitude) and Čertův Mlýn (1,206 m altitude) in the western part of the Moravian-Silesian Beskids. From the viewpoint of the problem under study, climatic conditions appear to be fundamental. By the method of vertical and horizontal orographic interpolation of values measured at meteorological stations Lysá Hora (1,324 m altitude) and Mošnov (256 m altitude), mean annual temperature and total precipitation values of 4.0–4.5°C and 1,250–1,300 mm, respectively, were determined for the locality (HADAŠ 2000). In the period 1988–1998, the extrapolated mean annual SO_2 concentration for Kněhyně exceeded a limit of 20 μg/m^3 SO_2 only in 1992. Since 1992, a decrease in mean annual SO_2 concentrations down to 7 μg/m^3 is recorded (HADAŠ 2000).

The research area consists of five sample plots (SP) of circular form which were laid out in the managed forest after assessing the stand developmental stage (P2, P3, P4, P5 and P6) and other three plots laid out in the nature reserve (P10R, P11R, P12R) (Table 1). In the managed forest, SP were placed subjectively into parts of the stand differing in the developmental condition. In one stand, two pairs of SP were laid out, one of them with different stocking (P2, P3), the other with different species composition (P4, P5). Sample plot P6 represents the initial stage of the stand regeneration. Three SP in the reserve (Table 2) represent various developmental stages of a forest which was entirely left to its spontaneous development only 14 years ago when the national nature reserve was declared. However, a long time before the moment, no systematic silvicultural measures were carried out there. Thus, the forest approached to its natural condition.

The used Field – Map device developed by IFER Ltd. consists of a laser rangefinder and a clinometer IMPULS, an electronic compass MAPSTAR and a portable PC. The basic software (Project Manager) developed for research into forest ecosystems makes it possible to prepare a particular project according to requirements for outputs of measurements. The proper measurement is carried out through the Data Collector software. The scheme of measurements was compiled to record natural regeneration on all substrates and to record the structure of a parent stand.

Table 1. Overview of sample plots

Sample plot	Stand	Age	FT	Altitude (m)	Area (ha)
P2	562A5	87	6S1	1,095	0.10
P3	562A5	87	6S1	1,100	0.10
P4	563A5	61	5S1	965	0.06
P5	563A5	61	5S1	975	0.06
P6	437B10	99	6S1	1,045	0.10
P10R	551B4/3/2/1/0	0–167	6F1	1,180	0.06
P11R	551B4/3/2/1/0	0–167	6F1	1,180	0.03
P12R	432B17/2	18–162	6F1	1,175	0.06

Table 2. Characteristics of the stands on sample plots (per ha)

Sample plot	Species	N	(%)	*max*	$d_{1.3}$ (cm)	*min*	G (m^2)	*max*	h (m)	*min*	lk (m)	kn (m)	Pc (m^2)	Pc (%)
P2	SP	400	93	*49*	36.0	*24*	40.90	*26.6*	20.4	*13.8*	9.7	10.7	8,298	95
	BE	30	7	*20*	16.0	*10*	0.62	*16.9*	12.4	*6.9*	7.5	4.9	477	5
	All	430					41.52						8,776	
P3	SP	300	97	*66*	35.0	*25*	31.30	*26.1*	19.5	*14.7*	10.5	9.0	4,540	96
	BE	10	3	*26*	26.0	*26*	0.55		19.1		11.0	8.1	201	4
	All	310					31.85						4,741	
P4	SP	417	86	*42*	30.0	*22*	31.15	*25.8*	21.1	*16.8*	9.9	11.2	4,770	86
	BE	67	14	*16*	15.0	*12*	1.16	*20.4*	17.4	*14.3*	10.1	7.3	808	14
	Total	484					32.31						5,577	
P5	SP	383	72	*47*	35.0	*27*	37.54	*28.2*	24.2	*17.4*	11.4	12.8	4,701	81
	BE	150	28	*20*	7.0	*2*	0.99	*21.4*	6.7	*2.5*	5.0	1.7	1,119	19
	All	533					38.53						5,820	
P6	SP	240	89	*50*	37.0	*30*	27.62	*27.0*	21.5	*19.6*	9.6	11.9	4,449	93
	BE	30	11	*18*	13.0	*6*	0.45	*17.8*	10.9	*4.5*	6.3	4.6	353	7
	All	270					28.07						4,802	
P10R	SP	383	100	*46*	28.0	*1*	29.69	*20.8*	13.0	*1.6*	7.6	5.4	6,281	100
P11R	SP	600	43	*48*	8.7	*1*	10.30	*19.6*	4.5	*1.6*	3.5	1.0	2,429	39
	BE	267	19	*5*	4.2	*3*	0.38	*5.8*	3.8	*2.4*	3.6	0.2	1,470	23
	RO	533	38	*11*	7.0	*4*	2.30	*10.3*	6.0	*2.7*	3.9	2.1	2,390	38
	All	1,400					12.98						6,290	
P12R	SP	433	49	*57*	22.2	*1*	27.51	*21.1*	9.4	*1.5*	7.1	2.3	5,857	65
	BE	267	30	*21*	8.5	*2*	2.08	*10.9*	5.9	*2.2*	5.5	0.4	2,510	28
	RO	33	4	*6*	5.0	*4*	0.07	*6.8*	6.2	*5.5*	4.2	2.0	7	0.1
	FI	150	17	*16*	7.0	*1*	0.96	*8.5*	4.1	*1.1*	3.8	0.3	654	7
	All	883					30.62						9,027	

N – number per ha, $d_{1.3}$ – diameter at basal area, h – tree height, lk – crown length, kn – crown origin, G – stand basal area, Pc – crown projection area

In general, regeneration was considered starting the height of 10 cm when it is already viable. It was necessary to differentiate regeneration on the soil surface and on the wood substrate, i.e. on fallen wood and stumps (JEŽEK 2002).

The surveying of regeneration on the soil surface was divided into two layers of measurement. In a layer "trees", scattered individual trees were surveyed giving species, height and possible browsing damage. In a "polygon" layer, the perimeter was surveyed of natural seeding and advance regeneration. In each of the polygons, tree species, average height, density per m^2 and possible degree of browsing were recorded. The total number of plants was obtained by the conversion to the actual polygon area.

Fallen wood was measured from 7 cm d.o.b. For each of the wood pieces, descriptive characteristics defined in advance were determined, viz. species, estimated time from the moment of fall or felling and the occurrence and species of a wood-destroying fungus. Further, the degree of decomposition and the percentage of bark were determined, both according to the method of Jankovský (LIČKA 2002). In the case of the occurrence of regeneration on the wood, tree species, average height, average number of seedlings per 1 m of the lying wood length and possible browsing damage were recorded. Data on the length and volume of particular pieces of dead wood were obtained from databases generated in the Field – Map program. The total length of lying wood is a sum of all lengths of wood pieces on the area. The total amount of natural seeding on particular pieces of dead wood was calculated on the basis of the piece length and the average number of plants per 1 m of the stem. Mean diameter was calculated on the basis of the piece length and volume. Further, the ground plan of each of the pieces was calculated based on the length and diameter of both ends.

At the same time, all stumps were surveyed and the species, stump diameter, bark percentage, degree of decomposition, the species of a wood-destroying fungus and the estimated stump age were recorded as well as the species and the amount of regeneration on the stump.

Also those plants that grow on the boundary line between soil substrate and root swellings, i.e. positively on an organic substrate, were included into the number of regenerated trees. Favourable effects of stumps for growing up the regeneration are evident in these places.

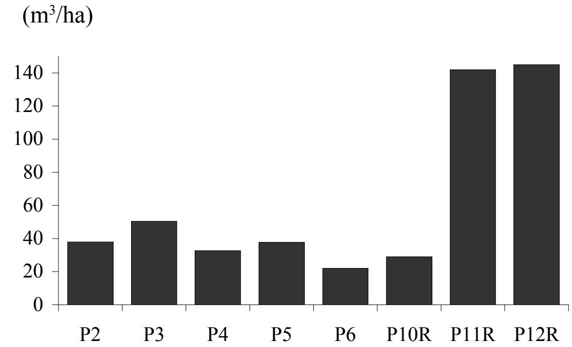

Fig. 1. Volume of dead wood

In SP, the location was surveyed of all trees that belonged (by the stem centre) into the area and their crown covers. Also those parts of border tree crowns overlapping the SP perimeter were included into the total of crown covers. Thus, non-included crown covers which overlap the area from trees standing out of the SP can be compensated. Sample plots were surveyed and inventoried in 2001 and 2002.

RESULTS AND DISCUSSION

Qualitative composition and the amount of decomposed wood and wood left for decomposition

Lying wood

The volume of dead wood in all SP in the managed forest is virtually the same ranging from 22 to 50 m^3/ha (Fig. 1). The lowest volume was recorded in P6. In the plot, regeneration has been already started using regeneration elements and the felled wood was removed, however, logging residues were left in the stand. In the reserve, the volume of dead wood ranges from 29 to 144 m^3/ha. Markedly lower volume in P10R is given by the stand condition when the majority of dead wood still occurs as standing volume and lying wood is represented mainly by top breakages or stems of small diameters. Dead standing spruce trees of small-diameter fall as late as in the advanced stage of wood decomposition. The number of fallen pieces of wood (Fig. 2) and their average length (Fig. 3) differ according to SP. In P2, P3, P4 and P5, some felled trees (both live and dead) were cut to pieces and piled either into piles or only stacked side by side in one or two layers. In the reserve (P11R a P12R), it refers to stems felled intentionally in the past but not cross-cut (management was stopped 14 years ago) or to wind breakages or windfalls. Therefore, the average length of one piece of wood is three-times higher in the plots. Differences in the average volume of one lying piece of wood are even more marked. In the managed forest, the volume does not exceed 0.08 m^3 whereas in the reserve, it reaches 0.58 m^3. P10R representing the stage of growing up is an exception. The area of fallen wood ranges from 140 to 370 m^2 in the managed forest and from 270 to 660 m^2 in the reserve (Fig. 4).

Stumps

The number of stumps in SP in the commercial forest ranges between 530 and 980 per ha. All stumps in

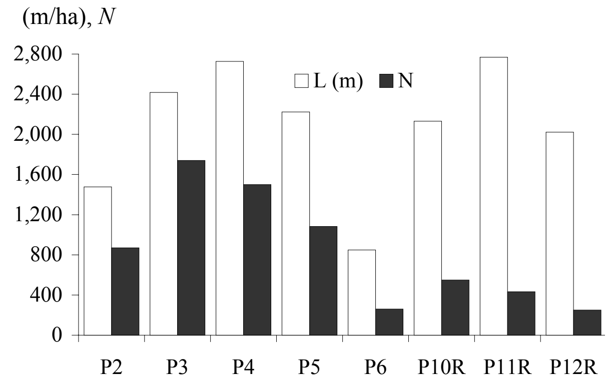

Fig. 2. Length and number of dead wood

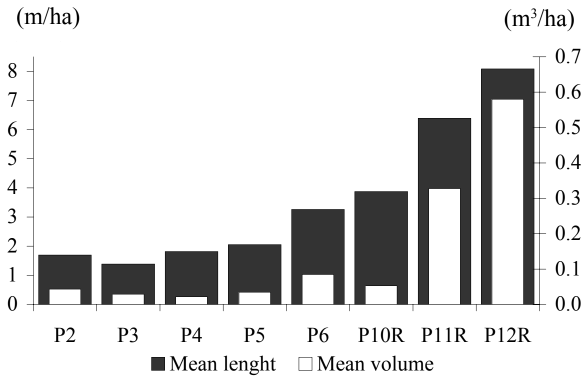

Fig. 3. Mean length and volume of dead wood

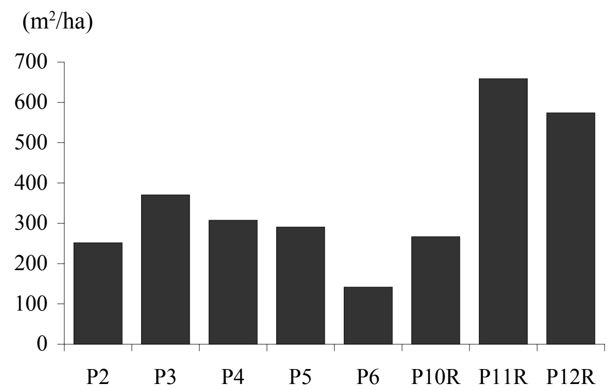

Fig. 4. Area of lying wood

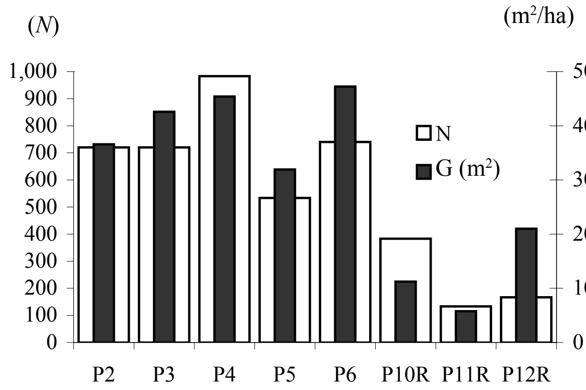

Fig. 5. Number and basal area of stumps

the reserve are aged over 14 years. As compared with SP in the managed forest, the number is one third only (130–380 stumps/ha). The total of basal areas of stumps in the managed forest and in the reserve ranges from 32 to 47 m²/ha and from 6 to 21°m²/ha, respectively. The basal area of stumps is one order lower than the area of lying wood (Fig. 5). In SP, stumps are distributed into decomposition degrees unevenly (Fig. 9). Only in plots P4 and P5 which are situated in the same stand and where felling was carried out simultaneously, the proportion of stumps according to decomposition degrees is similar. In the reserve, there are only stumps in the highest degree of decomposition.

The amount of regenerated seedlings occurring on dead wood

Regeneration on lying wood

The mathematical-statistical dependence of the number of regenerated trees on the surface of fallen wood or on its total volume has not been proved. The results, however, show that rooting the natural seeding is possible only on heavily decomposed lying wood (decomposition degree 4) and mainly on completely decomposed wood (decomposition degree 5) (Fig. 6). This trend of the increasing number of regenerated trees with the increasing degree of wood disintegration is evident in all sample plots. It is also possible to observe positive effects of the stem diameter on the number of rooted seedlings (Fig. 7). On lying dead wood, it is almost exclusively spruce which regenerates. In SP P2 only, a sporadic case was noted of regenerated beech on totally decomposed wood and similarly in SP P11R, several young plants of rowan regenerated on totally decomposed wood.

Sample plots P2 and P3 deserve special attention. We can find there natural seeding of spruce already on medium-decomposed wood (decomposition degree 3) and in some cases even on wood occurring in the initial stage of decomposition (decomposition degree 2) (Fig. 6) namely even on wood of smaller diameters (Fig. 7).

However, it is necessary to emphasize that this wood is not an actual substrate. Litterfall depositing on pieces of wood which is cut and arranged closely side-by-side appears to be the substrate. The litterfall decomposes much faster than the proper fallen wood. It preserves the steady moisture of lying stems accelerating wood decomposition. Water from round faces of wood also flows into litterfall and thus supports the moisture supply to rooted natural seeding even during dry periods.

In the reserve, spruce regenerated only on stems or their parts over 30 cm in diameter. It can be explained by the fact that the surface of such stems is already out of reach of the ground vegetation which makes the rooting of natural seeding impossible similarly like right on the soil surface. In SP P12R, both natural seeding and advance regeneration occur on all large-diameter stems.

The greatest amount of natural regeneration of spruce rooted on wood occurs in SP P2 and P3 (4,000 and 6,000 plants, respectively) where the largest amount of decom-

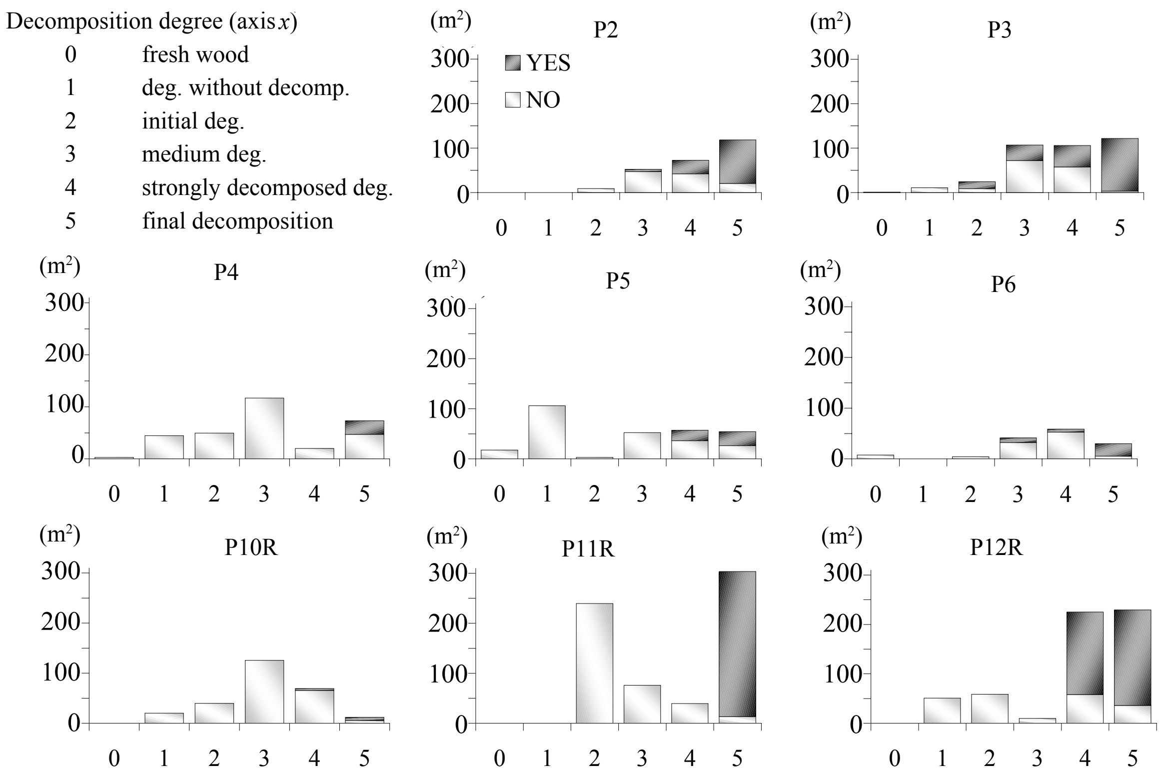

Fig. 6. The occurrence of natural seeding and advance growth on lying wood (total area) according to the degree of decomposition (per ha)

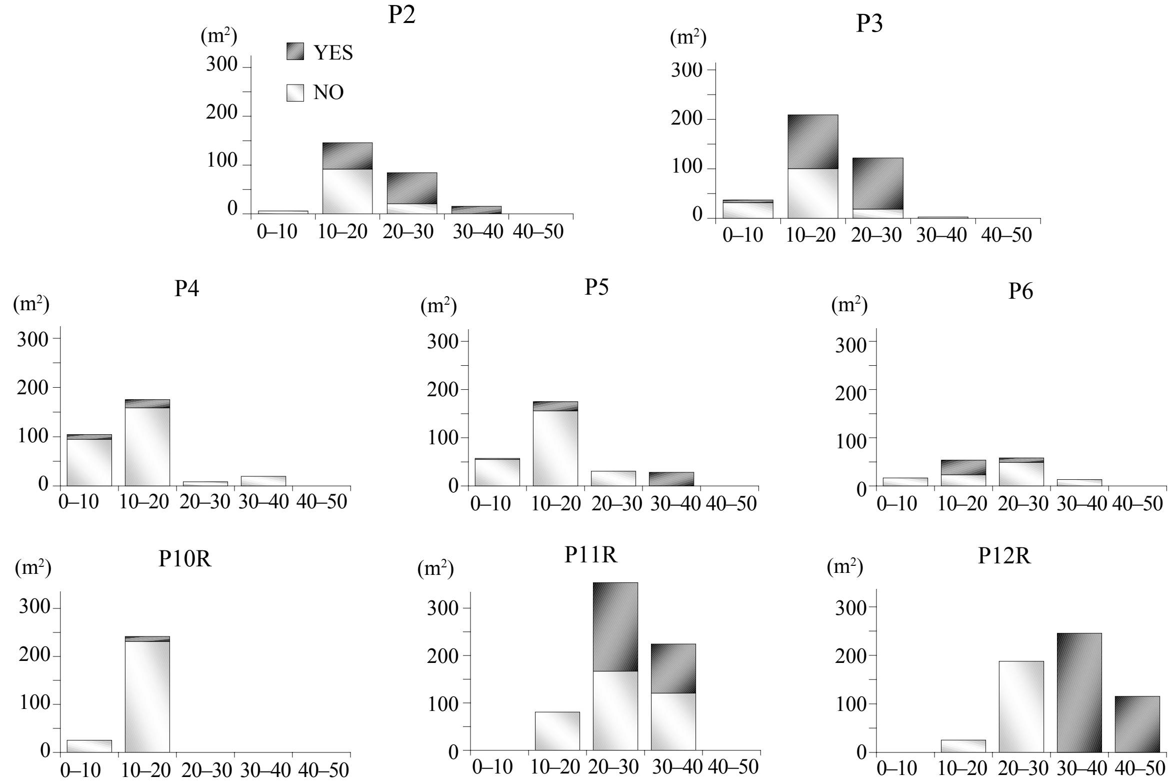

Fig. 7. The occurrence of natural seeding and advance growth on lying wood (total area) according to mean diameter (per ha, intervals in cm)

posed substrate suitable for regeneration occurred (lying wood with decomposing litterfall) (Fig. 8) and in the reserve (P11R – 2,400 plants and P12R – 4,400 plants). The smallest amount of natural seeding and advance regeneration occurred in SP P4 and P5 (600 and 750 plants, respectively), a 70-year-old stand with a very small amount of suitable decomposing wood.

Regeneration on stumps

In all plots, it is possible to observe slight positive effects of the higher degree of decomposition on the amount of growing up seedlings on a stump and its close proximity (Fig. 9). On the other hand, the increasing diameter of stumps does not affect the amount of natural seeding with the exception of sample plots P3 and P6 where positive effects can be noticed. In all plots, spruce regenerates on stumps nearly exclusively. The greatest amount of regeneration occurs in plots P2

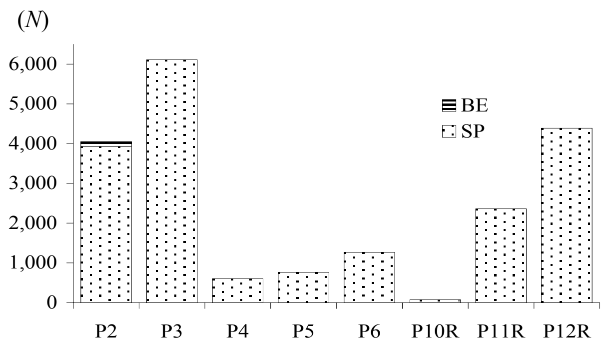

Fig. 8. The amount of regeneration on lying wood

and P3 (300 and 950 plants/ha, respectively). In plots P4, P5 and P6 in the close vicinity of stumps between root swellings, other tree species also take roots (silver fir and beech), however, only sporadically. The smallest amount of regeneration of this type occurs in the reserve. The number of stumps is, however, two thirds lower there (Fig. 10).

Regeneration on the soil surface

Regeneration on the soil surface deserves a separate analysis in relation to the stand condition (particularly shade conditions). In order to assess the actual contribution of regeneration on dead wood we give basic data. Also on this substrate, spruce regenerates most abundantly. The number of seedlings (N) ranges from 1,700 to 9,000 per ha in a managed forest, however, in the reserve, it amounts to several hundreds only (Fig. 11).

As for the regeneration of other species, beech regenerates sporadically its regeneration being markedly related to the vicinity of a seed-bearing tree. It is proved by values of N in SP P6 (2,300 seedlings/ha) where the highest amount of seed-bearing beech trees occurs. In other plots, full-grown trees occur only as subdominant trees and do not bear seed yet. The number of beech trees (50 to 400 trees/ha) which spontaneously regenerate in spruce stands indicates its natural position under given conditions of a mountain forest.

Regeneration of silver fir is absolutely sporadic. Significant amounts of natural regeneration occur only in SP P4 (300 seedlings/ha). There is no seed-bearing silver fir tree in the stand and the nearest fir (similarly like beech) is at

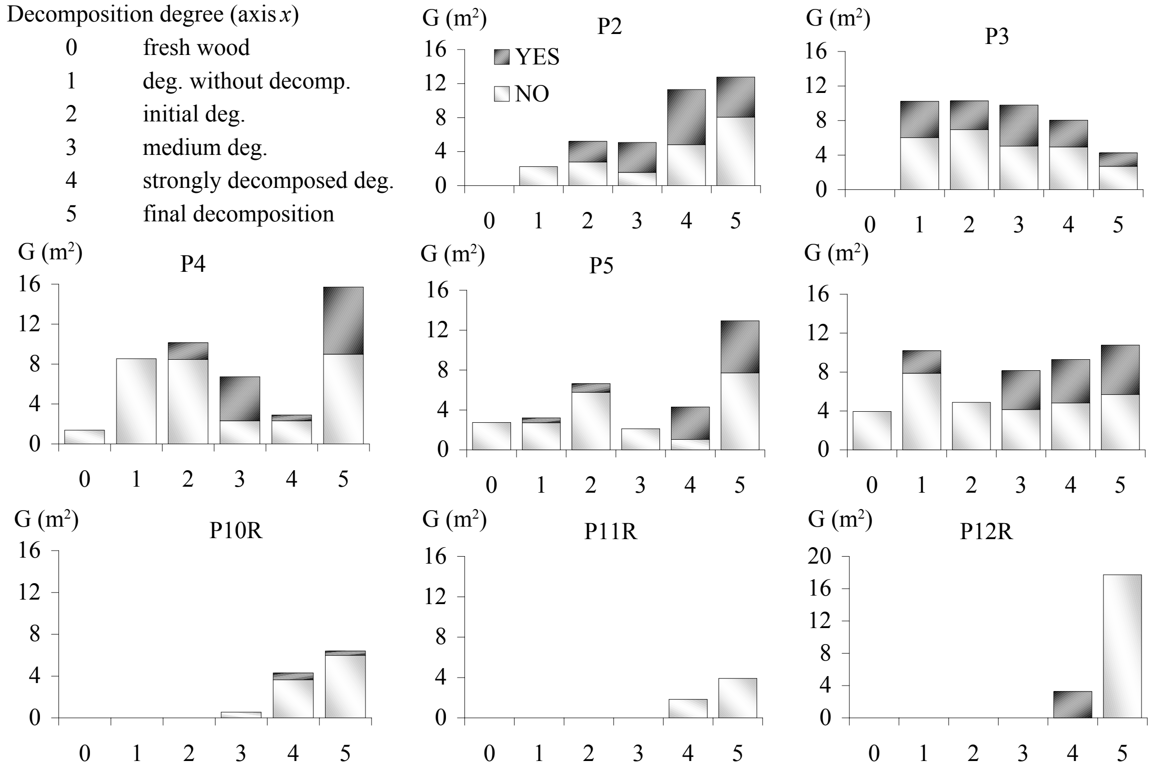

Fig. 9. The occurrence of natural seeding and advance growth on stumps (basal area) and in their nearest vicinity according to the degree of decomposition (per ha)

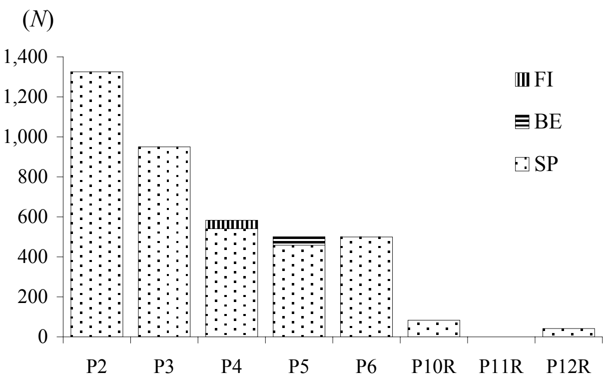

Fig. 10. The amount of regeneration on stumps

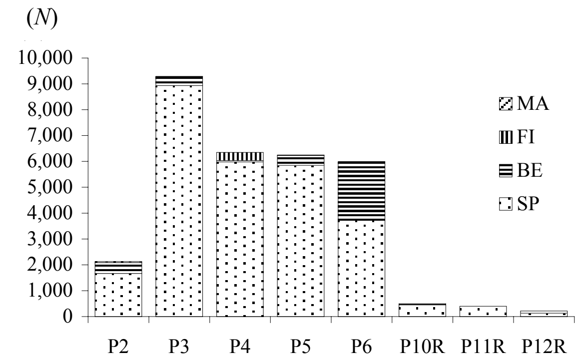

Fig. 11. The amount of regeneration on the soil surface

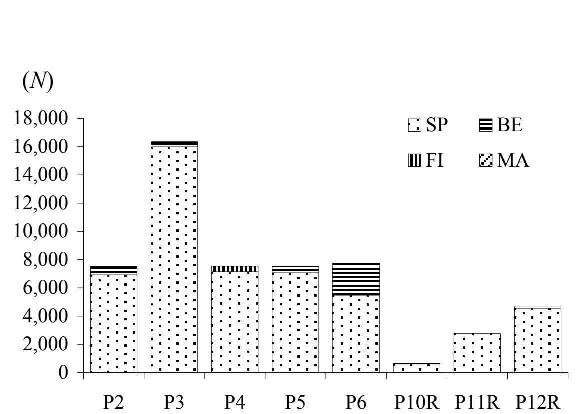

Fig. 12. Total regeneration on the sample plot

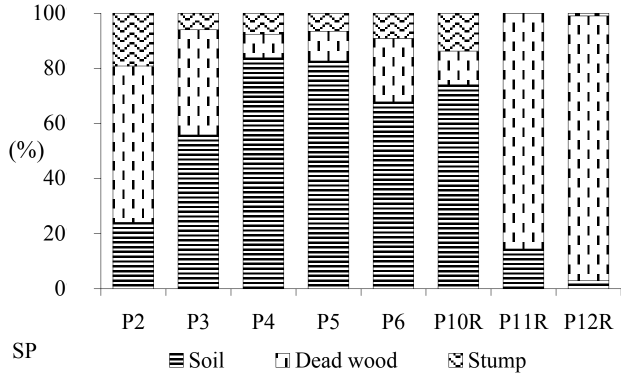

Fig. 13. Regeneration of spruce according to substrates

a distance of several hundred metres. Maturity approaching fir trees in SP P12R come from planting. In plots P2 and P10R, sycamore maple also occurs sporadically.

CONCLUSIONS

On dead wood, spruce regenerates exclusively. The amount of natural regeneration on dead wood is not dependent on its total volume. The amount of wood suitable for taking roots of seedlings is determining. In localities with a sufficient amount of decomposing lying wood and stumps, regeneration on the substrate accounts for more than 75% of the total spruce regeneration. Natural seeding and advance growth occur mainly on lying wood in the advance stage of decomposition, which was also found by MAUER (2000) based on experience obtained in planting Norway spruce into decomposing wood. Nevertheless, spruce regenerates also on stems occurring in lower stages of decomposition that are, however, cut and arranged closely side-by-side. Growth environment is not formed by the proper decomposing wood but mainly by quickly decomposing litterfall between stems. The litterfall between stems preserves constant moisture of lying stems accelerating their decomposition. Placing the stems closely side by side, it is possible to accelerate the formation of a suitable substrate for natural seeding for future 10 to 15 years. The period of decomposition of fallen stems until the formation of suitable conditions for regeneration is longer than 20 years depending on the condition of wood and its contact with soil (VACEK 1990). When using debarked stems, the period necessary for the formation of a substrate is almost the same. Debarked stems left in whole lengths without contact with soil are decomposed only very slowly due to the rapid decrease in the moisture content and subsequent insufficient wood moisture for the development of wood-destroying fungi (JANKOVSKÝ 1999). At the same time, effects of the herbaceous cover are markedly suppressed.

Natural regeneration of spruce on stumps is less significant. The area of stumps is one order lower than the area of lying wood. However, stumps create a more favourable microclimate for taking roots and growing up of seedlings in their vicinity.

The analysed cases show that favourable places for the natural regeneration of spruce can be created by the purpose-oriented use of unutilized wood. On sporadic piled up pieces of wood, regeneration of spruce begins to take roots after about 20 years depending on the stand climate. Therefore, such a measure should be realized in advance of the proper regeneration even during thinnings of maturity approaching stands.

SUMMARY

Dead wood as a substrate for mountain forest regeneration occurs in two forms, viz. lying wood (stems) and stumps. Based on our study, lying wood represents a ten-times larger area than stumps. On the substrates, spruce regenerates nearly exclusively. Sporadically, also other species can take roots on fallen wood occurring in the advanced stage of decomposition. As for stumps, seedlings can take roots in their close vicinity.

Fig. 14. Regeneration of spruce on stump

Fig. 15. Regeneration on litterfall decomposing among stems

The total amount of natural regeneration of commercial species ranged from 7,500 to 16,000 seedlings/ha in the managed forest and from 600 to 4,500 seedlings/ha in the reserve (Fig. 12). In all the plots, spruce regenerates predominantly. Only in SP P6, there is a significant proportion (30%) of beech regeneration. In other plots, the amount of beech natural seeding does not exceed 500 seedlings/ha. Silver fir regenerates only sporadically. Only SP P4 shows a higher number of seedlings, viz. 350/ha (5%).

On the dead wood of lying stems and stumps, only spruce regenerates abundantly. In the case of a sufficient amount of dead wood (P2 and P3, partly also P6), natural regeneration on the wood represents a significant proportion of the total regeneration of spruce. In SP P2 and P3, it is more than 75 and 44%, respectively (Fig. 13). In plots P4 and P5, there is not a sufficient amount of suitable decomposing wood and, therefore, the proportion of spruce regeneration is small. Regeneration on stumps and in their close vicinity is comparable in all plots of the managed forest not exceeding 10% (but some exceptions). In plots P11R and P12R in the reserve, natural regeneration occurs nearly exclusively on the dead wood (85 and 97%, respectively). In SP P10R, there is not a sufficient amount of fallen suitable wood and, therefore, regeneration predominates on the soil surface. Beech regenerates only sporadically on completely decomposed wood. Silver fir regenerates mainly on the soil surface.

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Přínos zmlazení na tlejícím dřevě pro samovolnou obnovu horského lesa

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ABSTRAKT: V Moravskoslezských Beskydech v bukosmrkovém lesním vegetačním stupni bylo na pěti zkusných plochách v obhospodařovaném lese a na třech v Národní přírodní rezervaci Kněhyně-Čertův Mlýn zjištěno množství tlejícího dřeva (ležící kusy dřeva a pařezy). Na plochách v hospodářském lese bylo zjištěno 22 až 50 m^3/ha ležícího dřeva. V rezervaci se pohybuje objem ležícího dřeva od 29 do 144 m^3/ha. Počet pařezů na ZP v hospodářském lese se pohybuje od 530 do 980 ks/ha. V rezervaci nové pařezy již nepřibývají, jsou zde jen pařezy z doby před vyhlášením NPR. Na tlejícím dřevě se zmlazuje téměř výlučně smrk. V obhospodařovaném lese se pohybovalo množství zmlazeného smrku od 5 000 do 16 000 stromů/ha, v rezervaci 600 až 4 500 stromů/ha. Na plochách s dostatkem zetlelého ležícího dřeva až 75 % semenáčků roste právě na něm. Zmlazení buku a jedle bylo zaznamenáno jen na půdním povrchu. Dostatečné množství příhodného tlejícího dřeva může významně pomoci zabezpečit přirozenou obnovu smrku v horských lesích.

Klíčová slova: horský les; obnova lesa; tlející dřevo; přirozená obnova; smrk

Tlející dřevo v horském lese zahrnuje dva podobné substráty, a to ležící dřevo (kmeny) a pařezy. Ležícího dřeva je podle zaujímané plochy ve zkoumaném případě desetkrát více než činí plocha pařezů. Na těchto substrátech se zmlazuje téměř výlučně smrk. Sporadicky se na ležícím dřevě v pokročilé fázi rozkladu uchytí i jiná dřevina, u pařezů dochází k uchycení semenáčku v těsné blízkosti pařezu.

Celkové množství přirozené obnovy hospodářských dřevin se pohybuje od 7 500 do 16 000 stromů/ha v obhospodařovaném lese, v rezervaci je ho celkově méně (600 až 4 500 stromů/ha – obr. 12). Na všech plochách se převážně zmlazuje smrk. Jen na ploše P6 je také významný podíl bukového zmlazení (30 %). Na ostatní plochách nepřesahuje počet bukového náletu 500 ks/ha. Jedle se zmlazuje jen ojediněle. Více jedlového zmlazení – 350 ks/ha – je pouze na ploše P4 (5 %).

Na tlejícím dřevě ležících kmenů a pařezů se v hojné míře zmlazuje jen smrk. Kde je ho dostatek (P2 a P3, částečně i P6), tvoří na něm přirozená obnova významný podíl z celkového zmlazení smrku. Na ploše P2 je to více než 75 %, na P3 to je 44 % (obr. 13). Na plochách P4 a P5 není dostatek příhodného tlejícího dřeva, proto je podíl smrkového zmlazení na něm malý. Zmlazení na pařezech a v jejich těsné blízkosti je na všech plochách v obhospodařovaném lese srovnatelné – nepřesahuje až na výjimky 10 %. Na plochách v rezervaci P11R a P12R dochází k přirozenému zmlazení téměř výhradně na tlejícím dřevě (z 85 na 97 %). Na ploše P10R není dostatek vhodného ležícího dřeva, proto převažuje zmlazení na půdě. Buk se jen ojediněle zmlazuje na plně rozloženém tlejícím dřevě. Jedle se zmlazuje v převážné míře na půdním povrchu.

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