

Bibliography, SLOVAKIAN REPUBLIC Milan Saniga

Korpel' Š. (1990): The structure, development and dynamics of the changes of the nature stands on the sustained research areas of the Tatra National Park (Štruktúra, vývin a dynamika zmien prírodných porastov trvalých výskumných plôch v Tanap-e)

Zborník prác TANAP 30, 43-86

Abstract: On purpose to investigate the developmental processes, dynamic changes of the stand structure and the production abilities, the series of the sustained research areas has been established in the year 1959 in the most wide-spread typological units of the Tatra National Park (*Sorbi aucupariae-piceeta*, *Aceri-fageta piceae*) in the selected stands with the character of the nature forest. After 25 years we have repeated in detail the dendrometric and biometric measurements using the same methodics on 3 investigated areas (the valey Čierna Javorová, Medzisteny II, Tisovky).

The results have confirmed the striking changes in the stand structure, basal dendrometric quantities, regeneration processes. On all research areas the decreased number of the "derbholz" has been recorded in 25 years. In the year 1959 it has differentiated form 228 up to 986 pieces per 1 ha, in the year 1984 from 186 up to 880 per 1 ha. The greatest number has been on the area in the ingrowth stage (Čierna Javorová), the fewest one on the area in the disintegration stage (Tisovky), while the number on the area in the optimum stage represented an average from the whole developmental cycle (332 up to 565 per 1 ha). The greatest decline by autoreduction (natural mortality) i.e. 42% from the total number, has been at the transition from the progressive phase of the ingrowth stage into the initial phase of the optimum stage. In the 7th spruce layer including the whole developmental cycle we suppose the differentiation rate ranging from 350 up to 1000 per 1ha, in the 6th vegetation layer from 150 up to 700 per 1 ha.

The growing stock has differentiated according to the site conditions and developmental phase from 310 up to 683 m³.ha⁻¹ in the year 1959, from 410 m³ up to 654 m³.ha⁻¹ in the year 1984. The average periodical volume increment has ranged from 3,5 m³ to 5,3 m³.ha⁻¹, whence the greatest one has been in the progressive phase of the ingrowth stage. The volume of the dying-off trees standing or lying has fluctuated from 34 m³ to 117 m³.ha⁻¹ according to the stage of progressiveness, but we can suppose its increase up to 150-160 m³.ha⁻¹ in the progressive disintegration.

The number of the seedlings and the individuals of the undergrowth varies considerably according to fructification, and how the disintegration synchronized to the rich seed crop and to favourable course of the weather. The number of the regenerated individuals (including seedlings) in the year 1959 fluctuated from 923 up to 20 785 and in the year 1984 from 1486 up to 4309, the number of the biologically secured individuals, however, in the year 1959 from 722 up to 13 374 and in the year 1984 to 2354.ha⁻¹. Originally the sporadic (Weak) fir regeneration has completely stagnated in the year 1984 already, so at present it doesn't occur in natural seeding and undergrowth at all. The maple is being the best regenerated, which is manifold substituted in the regeneration (40-60%) than in the "derbholz" of the parent stand (11-37%).

Key-words: Natural forest, spruce, structure, natural regeneration

Korpel' Š. (1993): The structure, development and dynamics of the changes of the nature stands on the sustained research areas of the Tatra National Park (Dynamika prírodného smrekového lesa v Západných Tatrách na príklade ŠPR Kotlov Ľab)

Zborník prác TANAP 33, 193-225

Abstract: On purpose to investigate the developmental processes, dynamic changes of the stand structure and the production abilities, the series of the sustained research areas has been established in the year 1959 in the most wide-spread typological units of the Tatra National Park

(*Sorbi aucupariae-piceeta*, *Aceri-fageta piceae*) in the selected stands with the character of the nature forest. After 25 years we have repeated in detail the dendrometric and biometric measurements using the same methodics on 3 investigated areas (the valey Čierna Javorová, Medzisteny II, Tisovsky).

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Key words: Spruce, dynamic changes, natural forest

Korpeľ Š. (1993): The dynamism of the natural mixed forest in the nature reserve Sitno (Dynamika zmiešaného prírodného lesa v rezervácii Sitno)

Acta facultatis forestalis Zvolen, XXXV, 143-159

Abstract: The observations done during the past 10 years have shown that the mixed broadleaved natural forest (8 species) in the third oak and beech altitudinal zone is characterized by considerable steady structure, wood yield and characteristic small-scale texture of forest. The wide scale spectrum of species differing in ecology, growth and vitality aspects in the process of alternation of the development stages is relatively flexible in their mutual complementarity and substitutability. This caused the small variation of the growing stock (530-661 m³ per 1 ha) and the circular plot base (37-43 m² per 1 ha). The number of individuals of compact woods differs widely in accordance with the development stages, from 376 (initial stage of breaking down) to 1026 (ingrowth stage) per 1 ha. The mean annual increment, similarly locally varies from 3 to 9 m³ per ha). The initial phases of the forest regeneration are long-term favourable. The number of individuals of regeneration up to the height 50 cm varies from 1130 to 14042 per 1 ha but the growth to the higher categories is insufficient.

Key-words: Natural forest, development processes structure, mixed forest

Korpel' Š. (1995): The virgin forests of the Westkarpatian Mts. (Die Urwälder der Westkarpaten) Fischer, Stuttgart-Jena-New York, 310 p

Abstract: The book deals with the structure, growth and regeneration processes, as well as the life cycle of selected virgin forests in Slovakia, situated from the 1st up to the 7th altitudinal forest vegetation zones. The book evaluates the results of 20 to 40 years lasting investigations in virgin forests.

Key-words: Virgin forests, structure, life cycle, regeneration, development

Saniga M. (1995): Structure, development and the growth processes of natural forest Skalná Alpa (Štruktúra, vývoj a rastové procesy prírodného lesa Skalná Alpa)

Ochrana Prírody 13, 251-262

Abstract: This study is an evaluation of 10 years lasting examination in pine-beech forest Skalná Alpa, which was declared a State Protected Reserve. On the grounds of the tree research areas stabilised in the course of its maturing, the optimum and the decomposition assessment, the information on productivity relations and regeneration processes within the cycle of life of the primeval forest are presented here. It is supposed, that the total stock in decomposition phase will not fall under the limit of 300 m³ha⁻¹ and in the phase of optimum will exceed the limit of 700 m³ha⁻¹. Intensity of dendromas decrease is higher in case of beech than in case of pine relating to its lower physical age.

With regard to the regeneration processes it can be stated, that the beech has a suitable conditions for natural regeneration and it regenerates in form of flocks or groups. As far as mountainous maple is concerned, it regenerates in individual to flock mixture vegetation, while pine mostly regenerates on decaying wood of the fallen logs.

Key-words: Virgin forest, spruce, beech, growth

Réh J. (1996): The growth, evolution and production of mixed natural forest in Nature reserve Jedlinka (Rast, vývoj a zásoba zmiešaného prírodného lesa v prírodnej rezervácii Jedlinka)

Acta facultatis forestalis Zvolen-Slovakia, XXXVIII., 85-100

Abstract: The growth and production ratios of the Nature reservation Jedlinka are analyzed in this work. The Nature reservation Jedlinka is situated in Vihorlat mountains, in Forest enterprise Sobrance, Forest district Remetské Hámre, compartment 3193. The peculiarity of the Nature reservation is the fact that the original coniferous species fir and spruce are present here. The presence of them is denied by all the authors which realized the floral and phytogeographic research here. Réh (1958, 1981) confirmed the presence of the coniferous species in original forests of Vihorlat.

First detailed biometric measurements were realized in 1975 and repeated measurements were realized in 1995. We derived the following facts from them:

- the average tree height in Nature reservation Jedlinka is lower than in surrounding bee deteriorated climatic (frost hollow) and soil (rockiness) conditions,
- the decreased tree height is projected to lower growing stock and lower basal area. The growing stock for 1 ha do not achieve the lowest level of growing stock in our mixed selection forests,
- nature reservation Jedlinka is in the state of disintegration what is documented by the tree representation at diameter classes of the forest and by the polygon of diameter abundances,
- from the course of polygons of diameter abundances in which the average thicknesses are still quite good present, it is possible to recognize that the forest has selected structure with the typical sinking curves of diameter abundances of trees,
- ascendant trend of height growth is observed for every species,
- the growing stock of the forest in the consequence of disintegration of the community decreased by 21 %
- the similar decrease is typical for the basal area

- the regenerative processes dependent on seed years and atmospheric conditions are small-area shelterwooded, the process of the regeneration is not interrupted for a long time and the abundance of the individuals provides nature, permanent existence of the community,
- during the evolution the interchange of the species regeneration occurs, coniferous species are more regenerated under broadleaved species and broadleaved species are more regenerated under coniferous species.

The area of the nature reservation Jedlinka (10,30 ha) does not enable to follow the course of the development of the forest in the developmental phases with the exactness and therefore the proposal for the extension of the reservation with regard to its conservation for the future is necessary.

Key-words: Growth, development, growing stock, reserve

Saniga M., Veselý L. (1998): Dynamics of changes of structure, yield and regeneration of a beech natural beech forest in the state nature reserve Raštún (Dynamika zmeny štruktúry, produkcie a regenerácie bukového prírodného lesa v štátnej prírodnej rezervácii Raštún)
Forestry 44, 116-125

Abstract: The results of the investigations in the natural forest Raštún can be summarized as follows: The number of trees ranges from 196 to 226 individuals per hectare depending on the development phase and/or stage. The distribution over diameter classes on both experimental plots approximates a typical distribution in older even-aged managed forests.

The standing stock volume on permanent experimental plot (TVP-1) which is situated in the area with a progressed optimum stage and/or beginning destruction stage, decreased from 552.88 m^3ha^{-1} in 1973 to 521.48 m^3ha^{-1} in 1993 which represents a relative reduction by 5,7% within 20 years. On the TVP 2 situated in the beginning phase of the destruction stage, the standing stock in 1983 was 478,39 m^3ha^{-1} and in 1993 it increased moderately by 9,1% i.e., it reached 531,01 m^3ha^{-1}

The basal area on TV-1 is 36,344 m^2ha^{-1} at present, it decreased by 9,5% within 20 years. On TVP-2, it is unexpectedly equal and reaches 37,434 m^2ha^{-1} at present, which represent, an increase of 0,1 % as compared with 1983.

The findings indicate a high mortality of the natural regeneration, where by also those species aborted that reached the height of the growth phase of advanced growth or sapling in 1973 on TVP-1 or in 1983 on TVP-2, and which are absent on both TVPs due to adverse climatic conditions (climate change) as well as the attack by deer, which are overpopulated here.

It is interesting that from the total number of individuals of the natural regeneration on TVP-1 (36,338 individuals per hectare) beech as the main and most represented tree species of the old generation of the natural forest (90%) shares only 11,1% and on TVP-2 this share is only 16,4% (considering the already mentioned representation of beech in the 1-st height class).

Key-words: Beech, natural forest, regeneration processes.

Saniga M. (1998): Regeneration processes of a Norway spruce virgin forest of the State Nature Reserve Pilsko in the Oravské Beskydy Mts. (Regeneračné procesy smrekového pralesa ŠPR Pilsko v Oravských Beskydách)
Zpravodaj Beskydy 11, 125-130

Abstract: On the basis of the analysis of structure and regeneration processes, we can state that in this virgin forest, whose site conditions are strongly differentiated, the course and the state of the dynamics on natural regeneration differ considerably. Natural regeneration of spruce is very slow and it is determined first of all by a low germination capacity of seeds and small seed crops, which, in addition to altitude, are considerably affected by industrial pollution. At the altitude over 1300 m a.s.l. an additional adverse effect of a high abundance of tall herbs (*Dryopteris spinulosa*, *Athyrium alpestre*) is exhibited.

Spruce seedlings survive and grow best in case of a gradual begin of the state of destruction in the patches of the size of small groups up to 0,1 ha.

Key-words: Virgin forest, Norway spruce, natural regeneration

Saniga M. (1999): Structure, yield conditions and regeneration processes of the Badín virgin forest (Štruktúra, produkčné pomery a regeneračné procesy Badínského pralesa)
Forestry 45 (3), 121-133

Abstract: This contribution deals with the problems of the stand structure, growth and regeneration processes in the Badín virgin forest within the period of last 10 years. The data have been obtained from the series of four permanent experimental plots (TVP) and by diameter measurement of the whole virgin forest. From the point of view of nutrient supplies, Badín virgin forest is situated on a more rich substrate than the Dobroë virgin forest. However, silver fir does not reach such dimensions and volume as in Dobroë, since in Badín, it reaches the lower limit of distribution. Last measurements confirm the results presented by Korpel (1989) concerning the dynamics of destruction. The destruction is very intensive and relatively rapid, because the virgin forest is exposed to severe wind blasts. The yield is balanced over the whole virgin forest area. The results of measurements confirmed and equalized mean standing stock, which fluctuates in a long term between $650 \text{ m}^3 \text{ha}^{-1}$ and $700 \text{ m}^3 \text{ha}^{-1}$. Depending from the development stage of the virgin forest, the stock oscillates between $500 \text{ m}^3 \text{ha}^{-1}$ and $900 \text{ m}^3 \text{ha}^{-1}$ at the beginning of the destruction stage. The optimum stage has not been found on any TVP. On places where this stage occurs, the standing stock ranges from $1120 \text{ m}^3 \text{ha}^{-1}$ to $1180 \text{ m}^3 \text{ha}^{-1}$.

The investigation of the natural regeneration confirmed an expansion of beech and the retreat of silver fir from the tree species composition of the virgin forest. Considering a radical decrease of the numbers of red deer, which was the main factor for preserving of fir in the original tree species composition, the representation of fir on the level of 15 to 30 % from the number of trees as well as from the standing stock of the Badín virgin forest can be supposed for the future. Beech is becoming the tree species determining the general life cycle of the virgin forest.

Key-words: Silver fir beech, natural regeneration, production, virgin forest

Gömöry D., Paule L. (1999): Spatial structure of a Norway spruce virgin forest in the Nature Reserve Pozdana (Central Slovakia).

In: Paule L., Skroppa T., Gömöry D. (eds.): Genetics and Breeding of Norway Spruce, Proceedings of the IUFRO WP 2.02.11 Symposium, Stará Lesná, September 1997 (in print).

Abstract: Spatial genetic structure and kinship relationships were investigated in a montane Norway spruce virgin forest in the Pozdana Nature Reserve, Central Slovakia. A transect of $40 \times 150 \text{ m}$ was established in the reserve, on which 200 trees were sampled and analysed for 23 isozyme loci. Twenty-one putatively clonal groups containing 2–6 individuals were identified on the transect, indicating an important role of the vegetative reproduction. Considerable discrepancies were found between the observed and expected genotype frequencies at several individuals, rare alleles seemed to be concentrated in a few individuals rather than dispersed randomly over the population. Eight independent alleles were used for the spatial autocorrelation analysis, which showed a weak patchy substructure, with a patch size of approx. 35 to 40 m in diameter. The analysis of kinship relationships proved that practically all individuals belong to half-sib or full-sib families, but there were no clear relationships between the kinship and the topographical distance of trees.

Keywords: Norway spruce, virgin forest, spatial genetic structure, kinship

Saniga M.(1999): Structure, production and regeneration processes of the Dobroč virgin forest (Štruktúra, produkcia a regeneračné procesy Dobročského pralesa)
Vedecké štúdie 2/1999.TS Technická universita Zvolen, 64 pp

The Dobroč virgin forest is situated in the western part of Slovak Ore Mountains at the altitude of 720 to 1000 m a.s.l. The area of original core of the reserve is 49.88 hectares. It is the oldest natural reserve, established in 1913. At the same time, it is among the reserves which have intensively been investigated from the point of view of the life cycle, and yield and regeneration processes. A systematic research started in 1958. The results of the investigations up to 1988 were published by Korpel' (1989, 1995). The observation from the last 10-year period (from 1988 to 1998) are evaluated in the presented study. To allow a generalization of the acquired knowledge, the recent results were compared with measurements from 1978 and 1988.

The analysis of dendrometric traits and characteristics of necromass decay dynamics and regeneration processes leads to the following conclusions.

From the point of view of structural changes and changes of dendrometric traits, at least two variants of height structure of trees can be distinguished. The first example is a horizontally and vertically uniform forest stand, formed of conifers (Norway spruce, silver fir) in the upper layer, with a clearly separated lower layer formed of common beech of the second generation. In the upper layer, only individual beeches can be found, or they are even missing.

The second type of structure is characterized by balanced representation of conifers (spruce and fir) and beech. The proportion of beech by volume varies from 20 to 40 %. This type of structure lasts a shorter time and the degeneration stage starts more early, since beech lives up to 220–250 years and therefore it dies substantially earlier than conifers, forming suitable conditions for its natural regeneration.

The analysis of the necromass of standing and lying trees indicates that silver fir is most represented in these categories. Silver fir is most represented also among standing dead trees, what confirms the fact that the majority of fir trees at the end of their physical age die standing, or they are broken in the crown part, and that they do not fall to the ground until the advanced stage of decay (in the advance phase of the stage "a", or even in the transition to the stage "b"). The volume of standing as well as lying trees is the lowest in case of beech, even if on some experimental plots, the volume of living beech trees is higher than that of conifers. The average volume of dead trees ranges between 25 % and 35 % of the standing stock of living trees, dep-forest life cycle.

The analysis of the structure of numbers and volumes of thick trees (BHD over 7 cm), measured in the whole core of the reserve in 1978, 1988, and 1998, suggests the following facts. The average standing stock of the reserve did not drop below $650 \text{ m}^3 \text{ha}^{-1}$ during the period from 1978 to 1998, and it did not exceed $730 \text{ m}^3 \text{ha}^{-1}$. The total standing stock of the virgin forest ranged from $32,331.5 \text{ m}^3 \text{ha}^{-1}$ to $36,362 \text{ m}^3 \text{ha}^{-1}$. The standing stock fluctuation is relatively small. The analysis of the spatial texture of individual stages and/or phases of the life cycle proved that the size of the plots belonging to a stage ranged from 500 to 1000 square metres.

From the point of view of the regeneration processes of individual tree species in the Dobroč virgin forest, the most favourable conditions for germination, survival and growth of seedlings and young trees are in the advanced phase of the optimum stage, turning into the initial phase of the degeneration stage, as can be concluded based on several characteristics (permanently and considerably decreasing standing stock, changes in canopy closure), as well as in the typical initial phase of the degeneration stage. In the tree species composition, sycamore is dominating, which cannot permanently keep a high share in higher height classes due to a strong browsing by red deer. On plots with a higher representation of beech in declining generation, beech also competes successfully in the tree species composition of natural regeneration. The number of surviving young beech individuals ranges from 2260 to 3089 individuals per hectare. In the advanced degeneration stage, the conditions for the survival and growth of seedlings are less favourable, since the lower layer, formed of older individuals and partially the herbaceous vegetation hinders the regeneration processes.

According to the measurements in 1998, the proportion of spruce and fir in the natural regeneration is relatively small. Fir reached the highest proportions of 25.4 % and 27.7 % on permanent experimental plots, which are in the initial phase and at the beginning of the advanced phase of the

stage of degeneration, respectively. Based on the ecological profile, which is characteristic for this phase, it can be concluded that the regeneration process of silver fir is very slow and long-lasting. It means that the best conditions are not established until the lower layer is formed, in which beech is most represented. It must be emphasized that beech does not form a compact lower layer. This layer is characterized by a cover with gaps, where there are very good conditions for the survival and growth of fir. A dense canopy closure of the intermediate and upper layers and a disconnected structure of the cover of the lower layer form better conditions for the height growth rhythm of fir as compared with beech.

The evaluation of the whole spatial structure of the reserve allows to conclude, that the fructification of the trees of the upper layer is regular despite their high physical age, whereby the tree species composition changes each 400 to 800 m². This change contributes to the formation of different ecological profiles for the survival and growth of seedlings of various tree species. This structure forms in this way favourable conditions for a local permanent regeneration.

Key-words: Virgin forest, Norway spruce, silver fir, beech, structure, regeneration