ISSUES RELATED TO THE POSSIBILITIES OF SIMULATION AND MODELING OF THINNINGS IN PINE STANDS

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Abstract

Simulation and modeling of silvotechins interventions are a topical issue in the light of the peculiarities and complexities of the forest and the logistic possibilities of investigation.

Stands structure is the base element that provides a range of information on the composition and stability and productivity forestry ecosistem.

Currently there are definite possibilities of representation in space 1D, 2D and 3D of forestry phytocenosis, using specialized software and a properly working technology.

For analysis and diagnosis of relevant silvotechins for grounding scientific specificity in stand interventions are necessary in a series of data collected on the ground, showing appropriate biometry elements with in the trees and fitocenotic biogrup analysed the relationship between them.

The sample plots will be determined having regard to the homogeneity of the forestry phytocenosis and the samples studied must be representative.

Key words: simulation, modeling, thinnings, pine, forestry phytocenosis, silvo-system, forestry ecosistem, calculation programs.

INTRODUCTION

Thinnings are positive individual selection works to create an environment favorable to the development of the trees, through an optimal spacing correlated with environmental requirements of the existing species. Their application is centered on the phenotype selection of the most valuable trees with implications for composition, state of health, creating favorable conditions for fructification. Those are a key factor in the training and selection of types of crowns, with direct effects on productivity and stability of stands (Doniţă et. al., 2006).

The extraction of non-tree species, conformation, regeneration mode or status of health all lead to changes in the spatial structure, both vertically and horizontally. Stand structure, typically determined by distribution of tree species, age, size, and their mean sitting in space, strongly affects the shape and dimensions of the crowns. This layout can be highlighted by horizontal and vertical profiles of the stand (Ashes et. al., 2002) on the basis of which you can evaluate the consistency, thickness, density, stands profile, the trees grouping mode, trunk pruning and dimensions of crowns. But the structure can be characterized by certain indicators.

Stand structure is an important parameter in assessing the economic productivity, the health status of the forest and predictions on the evolution or accumulation of biomass in different parts of the trees (Buchanan, 1996).

Having regard to the definition given by C.D. Oliver and Larson (Oliver et al., 1990), according to which the structure of physical distribution and stands depend on the time of the trees in the stand, in the present study we are evaluating the spatial distribution of trees through the vertical and horizontal profiles in the stand.

MATERIAL AND METHODS

The research was conducted in 2011 in the Production Unit I Sâniob, in the Forest District Săcueni, Forest Regional Board Bihor. The logistics used had to comply with the corresponding part of the hard and soft, having regard to the proposed objectives.

Biometric elements and position will acquire the tools dedicated to caliper, hypsometer, laser rangefinder, measuring-tape, digital cameras.

Processing of data requires specialized software case for positioning of areas of the sample using the SVS.

The EXCEL program and FOND will be used for quantitative assessments.

EXCEL utility has been used for the graphical structure of the stands.

The trees bio-groups studied will be represented vertically, horizontally and three-dimensionally, depending on the inclination of the land, using for this purpose the geometric and stylized figures with a view to playing as faithfully as objective reality on the ground.

In view of peculiarities of pine stands studied, being characterized by a relatively high thicket, we have proposed simulating a thinning compound, setting based on the model of the extract obtained trees and even the direction of felling.

It is obvious that the generalization of these models is relatively cumbersome, but the solutions proposed on the basis of the analysis and diagnosis carried out is suggestive for practical application.

The case study was carried out in u.a. 58, in a European black pine stand, 40 years, site class III, maturity stage, young high forest – high forest stage. Inventory of the trees are presented in tables 1 and 2.

Table 1

The inventory of the trees analyzed with FOND program

No.	Number u.a.	Survey shape	Survey surface [m^2]	No. of inventoried trees / surveys
1	58A	circle	500	990

Table 2

The inventory of the trees analyzed whit spacial modeling with SVS program

No.	Number u.a.	Survey			
		Shape	Dimensions (m)	Surface (m^2)	No. of inventoried trees
1	58A	Rectangle	20 x 25	500	50
			20 x 25	500	46

RESULTS AND DISCUSSION

As a result of processing, the data acquired has been provided for a series of results which are tabular (tab. 3, 4) and presented graphically below.

Table 3

The track number of trees in the area and volume by category with diameter –class and species per hectare in the stand of the u.a. 58A

D cm	Pin trees/ha	Ca trees/ha	Prn trees/ha	G_{Pin} m^2/ha	G_{Ca} m^2/ha	G_{Prn} m^2/ha	V_{Pin} m^3/ha	V_{Ca} m^3/ha	V_{Prn} m^3/ha
10	30	10	0	0.24	0.08	0.00	1.440	0.540	0.000
12	10	0	0	0.11	0.00	0.00	0.750	0.000	0.000
14	70	0	0	1.08	0.00	0.00	7.700	0.000	0.000
16	80	0	0	1.61	0.00	0.00	12.240	0.000	0.000
18	150	0	0	3.82	0.00	0.00	30.600	0.000	0.000
20	210	0	0	6.59	0.00	0.00	55.230	0.000	0.000
22	150	0	0	5.70	0.00	0.00	53.700	0.000	0.000
24	80	0	0	3.62	0.00	0.00	31.920	0.000	0.000
26	70	10	10	3.71	0.53	0.53	33.390	4.560	4.190
28	30	0	10	1.85	0.00	0.62	16.830	0.000	0.000
30	30	0	0	2.12	0.00	0.00	19.530	0.000	5.880
32	10	0	20	0.80	0.00	1.61	7.470	0.000	13.580
34	0	0	0	0.00	0.00	0.00	0.000	0.000	0.000
36	0	10	0	0.00	1.02	0.00	0.000	9.860	0.000
Total	**920**	**30**	**40**	**31.24**	**1.63**	**2.75**	**270.800**	**14.960**	**23.650**

$$I_n = \frac{N_{land}}{N_{table}};\ I_n = \frac{990}{1379} = 0.7;$$

where N_{land} – the number of trees in the land; N_{table} - the number of trees in the yield table

$$I_g = \frac{G_{land}}{G_{table}};\ I_g = \frac{35.62}{26.47} = 1.3;$$

where G_{land} – basal area in the land; G_{table} - basal area in the in the yield table

$$I_v = \frac{V_{land}}{V_{table}};\ I_v = \frac{309.410}{187} = 1.6$$

where V_{land} – in land volume; V_{table} – yield table volume

Spaced index Hart- Beking - s%:

$$s_4 = \frac{a_4}{h_{dom}} \times 100;\ s_{4[\%]}=16\%;\ s_6 = \frac{a_6}{h_{dom}} \times 100;\ s_{6[\%]}=17\%;$$

$$h_{dom} = h + 0{,}15 \times h;\ h_{dom}=20{,}3;$$

where h_{dom} – dominant height; h - height

$$a_4 = \sqrt{\frac{10000}{N}};\ a_4=3{,}2;\ a_6 = \sqrt{\frac{10000}{N \times \frac{\sqrt{3}}{2}}};\ a_6=3{,}4$$

where a_4 şi a_6 – the distance between trees

N – trees number

N = 990; h = 17,66;

Stability index Z: $Z = \frac{h^-}{d^-}$; Z= 59%

where h^- - mean height; d^- - mean diameter

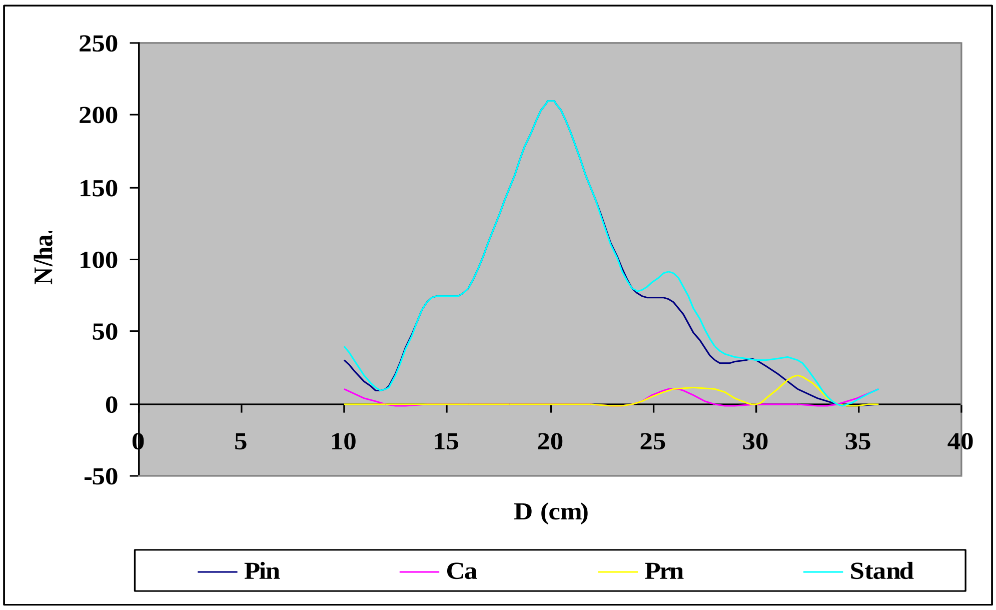
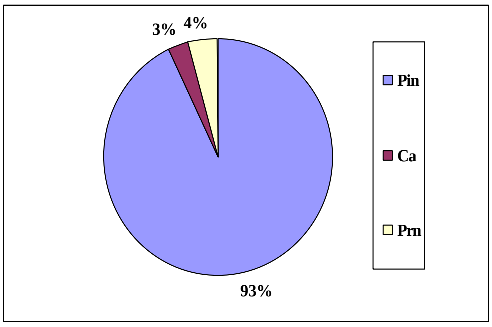
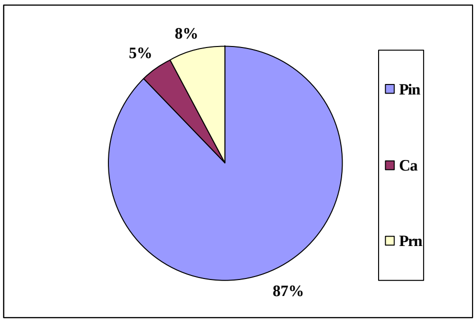


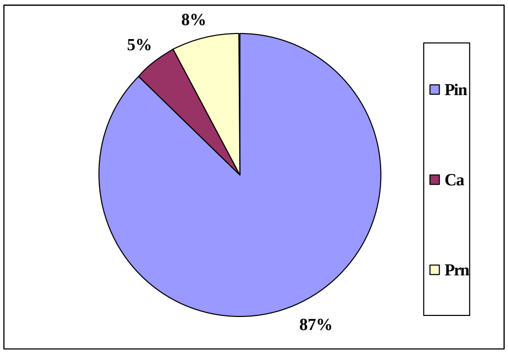
Fig 1. Distribution of the number of trees on categories of diameter-class per hectare in the stand of 58A





From the analysis of the chart in fig. 1 it is observed that several elements of the stand will be analyzed.

a) number of trees b) basal area



c) volume

Fig. 2. Composition for the stand of the u.a. 58A

In view of the diagram in fig. 2 it is observed that the present composition of the stand will be studied on a number of trees, on the basal area and on volume 9Pin 1Prn, common hornbeam being disseminated.

Table 4

The intensity of intervention on the number of trees, basal area and volume per hectare in the stand of the u.a. 58A, which will be completed with thinnings

D cm	**$A_{initial}$ arb./ha**	**$A_{extract}$ arb./ha**	**$A_{remaining}$ arb./ha**	**$G_{initial}$ m^2/ha**	**$G_{extract}$ m^2/ha**	**$G_{remaining}$ m^2/ha**	**$V_{initial}$ m^3/ha**	**$V_{extract}$ m^3/ha**	**$V_{remaining}$ m^3/ha**
10	40	30	10	0.31	0.24	0.08	1.980	1.500	0.480
12	10	10	0	0.11	0.11	0.00	0.750	0.750	0.000
14	70	19	51	1.08	0.29	0.78	7.700	2.090	5.610
16	80	10	70	1.61	0.20	1.41	12.240	1.530	10.710
18	150	32	118	3.82	0.81	3.00	30.600	6.528	24.072
20	210	41	169	6.59	1.29	5.31	55.230	10.783	44.447
22	150	0	150	5.70	0.00	5.70	53.700	0.000	53.700
24	80	0	80	3.62	0.00	3.62	31.920	0.000	31.920
26	90	10	80	4.78	0.53	4.25	42.140	4.560	37.580
28	40	0	40	2.46	0.00	2.46	16.830	0.000	16.830

Table 4 (continuation)

The intensity of intervention on the number of trees, basal area and volume per hectare in the stand of the u.a. 58A, which will be completed with thinnings

D cm	**A $_{initial}$ arb./ha**	**A $_{extract}$ arb./ha**	**A $_{remaining}$ arb./ha**	**G $_{initial}$ m^2/ha**	**G $_{extract}$ m^2/ha**	**G $_{remaining}$ m^2/ha**	**V $_{initial}$ m^3/ha**	**V $_{extract}$ m^3/ha**	**V $_{remaining}$ m^3/ha**
30	30	0	30	2.12	0.00	2.12	25.410	0.000	25.410
32	30	0	30	2.41	0.00	2.41	21.050	0.000	21.050
34	0	0	0	0.00	0.00	0.00	0.000	0.000	0.000
36	10	10	0	1.02	1.02	0.00	9.860	9.860	0.000
Total	**990**	**162**	**828**	**35.62**	**4.49**	**31.13**	**309.410**	**37.601**	**271.809**

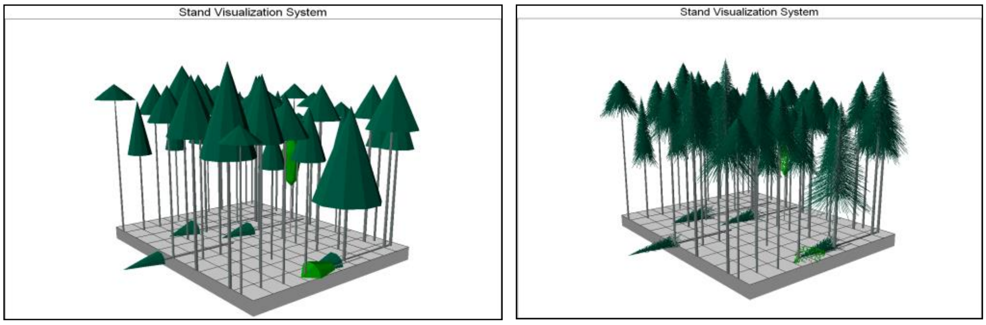
$$I_N = \frac{162}{990} x100 = 16\%,\ I_G = \frac{4.49}{35.62} x100 = 13\%,\ I_V = \frac{37.601}{309.410} x100 = 12\%,$$

where

I_N – intensity of intervention on the trees number

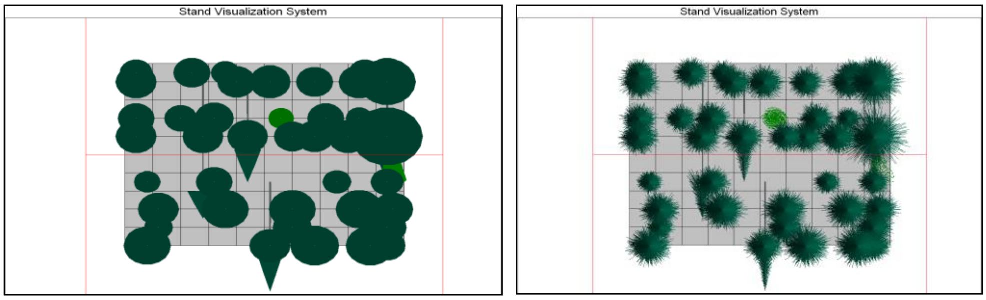
I_G - intensity of intervention on the basal area;

I_V – intensity of intervention on the volume.



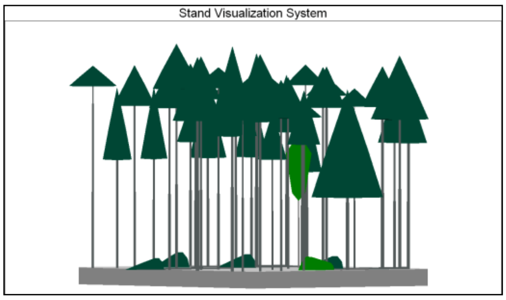
a) using geometrical corps b) using realistic representation

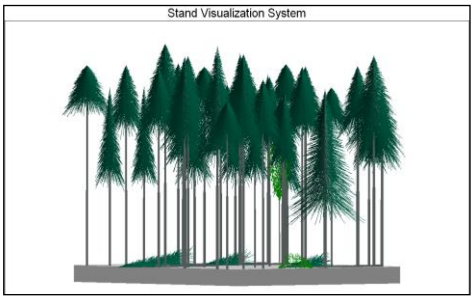
Fig. 3. Simulation of thinnings in the stand of the three-dimensional space in u.a. 58A



a) using geometrical corps b) using realistic representation

Fig. 4. Simulation of thinnings in the stand of the horizontal profile in u.a. 58A





a) using geometrical corps b) using realistical representation

Fig. 5. Simulation of thinnings in the stand of the vertical profile in u.a. 58A

CONCLUSIONS

The analysis of study and research results has led to a series of conclusions concerning the simulation possibilities of assistance silviculture with help from the specialty programs.

It was established that it could represent with great fidelity the structure of stands studied by hardwood and softwood, using the program Stand Visualization System (SVS) for that purpose.

As a result, the trees were present in several regions or geometric figures as realistic elements.

The studied stands were presented horizontally, vertically and in 3D, thus obtaining a series of elements relevant to their particular structure and with a special register even coenetic relations.

You can also simulate the extraction of trees in connection with the implementation of the various interventions in this regard with precisely the direction of the knockdown.

A necessary condition for the achievement of the structures stand faithfully represents the fairness with which the data was collected on the ground and were put into the program.

The land registry needs to be written properly otherwise, unless there are sufficient elements required by the algorithm, the processing of records is not feasible.

The sample plots shall be placed in areas where the stand is relatively uniform in order to capture all aspects of structural-functional complexity.

The use of specialized programs in order to obtain the structure of stands that can be a simulation of various silvicultural interventions represents a strict concern for the forestry sector, which attracts attention by the scientific and practical way to solve the problem.

It is recommended to simulate the improvement cutting in the resinous hardwood stands for the settlement with discernment of technical solutions to be proposed for application.

To achieve accurate results, which reflect the reality on the ground, it is recommended the location of the sample plot areas in portions of the stand, with a proper accessibility.

The structural indicators of stands by quantitative and qualitative needs to be correlated with the profile in the space of 1D, 2D and 3D of the stand and at the same time with the reality on the ground.

It is recommended that the use of similar calculation system with varying degrees of interactivity, to capture the various features of the process of simulating the realities on the ground targets.

REFERENCES

1. Cenuşă R., Popa C., Teodosiu M., 2002: Cercetări privind relaţia structură-funcţie şi evoluţia ecosistemelor forestiere naturale din nordul ţării. Analele ICAS 45(1):1-20.
2. Crainic Gh. C, 2009, Silvicultură Vol. II - Silvotehnica - Note de curs, Universitatea din Oradea, Facultatea de Protecţia Mediului, Catedra de Silvicultură.
3. Crainic Gh. C, 2008, Silvicultură Vol. I - Silvobiologia - Note de curs, Universitatea din Oradea, Facultatea de Protecţia Mediului, Catedra de Silvicultură.
4. Crainic Gh. C, 2007, Îndrumar de lucrări practice, Universitatea din Oradea, Facultatea de Protecţia Mediului, Catedra de Silvicultură.
5. Doniţă N., Borlea F., Turcu F., 2006: Cultur pădurii (Silvicultura în sens restrâns) – Note de curs, Editura Eurobit, Timişoara.
6. Florescu, I.I., Nicolescu, N.V., 1996, Silvicultura, Vol. I, Studiul pădurii, Editura Lux-Librix, Braşov.
7. Florescu, I.I., Nicolescu, N.V.,1998, Silvicultura, Vol. II, Silvotehnica, Editura Universităţii Transilvania din Braşov.
8. Jula A., 2011, Lucrare de diplomă, Universitatea din Oradea, Facultatea de Protecţia Mediului, Specializarea Silvicultură.
9. Jula A., 2011: Modificarea structurii spaţiale a unui arboret de pin negru, prin aplicarea răriturilor, în u.a. 58A, O.S. Săcuieni, U.P.I Sîniob, Simpozionul Stdenţesc „Pădurea mediu al generaţiilor viitoare”, Universitatea din Oradea, Facultatea de Protecţia Mediului, Catedra Silvicultură, Oradea (pg 76-83) .
10. Nicolescu, N.V., 2009, Silvicultură, Editura Aldus, Braşov.
11. Nicolescu, N.V., 2003, Silvicultură, Editura Aldus, Braşov.
12. Oliver C.D., Larson B.C., 1990: Forest stand Dynamics, McGraw-Hill, NewYork.
13. xxx,1986, Norme tehnice privind îngrijirea şi conducerea arboretelor, Ministerul Silviculturii, Bucureşti.
14. xxx, 2002, Manual de utilizare a programului Stand Visualization System (SVS), V.3.36.
15. xxx, Amenajamentul U.P. I Sîniob, Ocolului Silvic Săcuieni, Direcţia Silvică Bihor, Studiul General.