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EFFECTS OF THE CONTROL METHOD (GOČ VARIETY) IN SELECTION FOREST MANAGEMENT IN WESTERN SERBIA

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Abstract - The control method, one of the most reliable methods of selection forest management, has been applied in selection forests of western Serbia in a somewhat modified form (Goč variety) for fifty years. This paper analyzes the effects of the control method, i.e. its Goč variety, in the period from 1960/70 – 2000. It is based on the data of five successive complete inventories of the Forest Management Unit (FMU) "Tara", whose high selection forest of spruce, fir and beech (*Piceo-Abieti-Fagetum* subass. *typicum*) trees on diluvium, brown and illimerised soil on limestone, and on limestone in formation with hornfels, are the best quality and the most spacious forests in the Management Class MC 491/1. The effects were monitored through the changes in the distribution of the number of trees and volume per diameter classes, separately for fir as the protagonist of the selection structure, and collectively at the level of a compartment, a typical representative of MC 491/1. Also, the analysis included the changes in the number of trees, volume, current volume increment, yield, and number of recruited trees per unit area (1 ha) by tree species in MC 491/1, occupying an area of 2,648.78 ha. The study results show that in the study period the average volume in MC 491/1 increased by 18.8%, the percentage of conifers increased from 66.0% to 78.5%, and the bearer of the changes was fir. The volume of the mean fir tree increased by 35.9% and it attained 1.086 m^3. The volume increment increased by 15.7%. The selection structure of conifers was satisfactory, but there were problems with beech regeneration, in its stable presence and in its achievement of the targeted structure. The number of trees per unit area (1 ha) decreased, which in the long run could have detrimental consequences, but the sustainability in general was satisfactory. The levels of regeneration and recruitment were satisfactory. The health of the trees was improved; the stands were healthy, vital, and biologically and functionally stable. The study results point not only to a series of positive effects of the several-decades' long implementation of the Goč variety of the control method, but also to some problems, the understanding of which will have a corrective role in the future management of selection forests in western Serbia.

Key words: Control method, Goč variety, effects, selection forest

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INTRODUCTION

The theoretical bases for selection forests, the specificities of selection structure, recruitment, inventory stability and renewal, tree maturity and normal state have been reported by numerous authors (Liocourt, 1898; Mayer, 1943; Miletić, 1950, 1951, 1952, 1959; Banković, 1981; Jović et al., 1991, 1994; Tomanić et al., 1997a; Bagnaresi et al, 2002; Medarević et al., 2002, 2005, 2008). The specificities of selection forest management have also been dealt with in numerous papers (Schütz, 2001a, 2002; Bončina et al., 2002; O'Hara and Gersonde, 2004; control concept of the number of trees in uneven-aged forests; Govedar, 2005; Čavlović et al., 2006, etc.). In accordance with the main idea (Biolley, 1920), the control method, with some adaptations to site and stand conditions, was first applied in Serbia in the inventory of selection forests on the mountain Goč (Milojković, 1962, 1986) in 1958/1959. From 1960 to date this method has also been applied in selection forests on Mt. Tara – FMU "Tara". The method was not selected by chance. Due to the fact that in these selection forests (extremely heterogeneous groups from the statistical point of view) the real state is very difficult to estimate by partial measurement, the decision to use total inventory was unreservedly

accepted. Furthermore, this method leads to more reliable conclusions on the dynamics of change in the anthropogenically conditioned selection structure in mixed forests of conifers and broadleaves, by which, among other things, the management risk is reduced.

Main data on the Goč variety of the control method

This new variety of the control method was worked out during the measurement of the Faculty of Forestry's selection forests on Mt. Goč in 1958/1959. The new variety retained the essence and the leading idea of the basic Biolley method, i.e. all the postulates that were evaluated as positive, which are: frequently repeated inventories and attentive monitoring of the fluctuation of current volume increment and its relation to the volume from which it originates; reaching the maximal productivity of the best quality with the most economic inventory; and permanent experiments in each compartment (stand) in the search for the most favorable state and relationships.

The following principle was adopted from the variety of Schaeffer-Gazin-D'Alverny (1930): - that yield calculation should take into account the number of trees by comparing the real and the equilibrium curves of the number of trees (calculated after de Liocourt).

The specificities of the new variety are as follows: complete inventory of all trees above the taxation limit of 10 cm, with obligatory and permanent marking of the point of diameter measurement; special recording of recruited trees; adoption of a ten-year cutting cycle, as silviculturally and economically rational; calculation of current volume increment already in the first forest inventory by the Goč variety, applying some of the methods based on the sufficient number of increment cores from the trees of individual tree species in each compartment; careful use of current volume increment as an exceptionally uncertain value in yield calculation; establishment of management classes (classes covering the compartments of similar site and stand conditions and with the same specific purpose) for which it is possible to select the common goals of future forest management, as well as the measures and means for their realization; definition of the goals of future forest management at the level of management classes, as well as the measures and means for their realization (the most favorable mixture, equilibrium volume (Miletić, 1951), diameter of felling maturity of individual tree species (Miletić, 1961)); and special procedure of yield calculation by compartments.

Current volume increment of a stand is calculated during the first inventory by taking increment cores of a sufficient number of trees, and it is based on the diameter increment method (Mirković, 1959) using the formula:

$$I_{vd} = \frac{\Delta v}{a} \cdot i_d \cdot N_d \qquad (1)$$

where I_{vd} is the current volume increment in the diameter class; Δv, the tariff difference of the volumes of two adjacent diameter classes ($V_d - V_{d-5}$); i_d, the fitted value of diameter increment in the diameter class; N_d, the number of trees in the diameter class; and a, the diameter class width in *mm*. The value of volume increment can also be verified by other formulas based on diameter increment, transition period, or period of retention.

The periodic stand yield is calculated by the formula:

$$E = V_w + I_v - V_n \qquad (2)$$

where E is the periodic yield, V_w the real stand volume, I_v the periodic volume increment and V_n the (normal) volume to be achieved at the end of the first management period in the process of attaining the equilibrium volume of the targeted mixture.

On average, in the selection system all the stands will eventually be felled by the end of the fifth year of the management period. It is at that point that the state before felling in the stand is realized. Immediately after felling, it is calculated as the state after felling. Consequently, the selection cutting cycle (ten years) lasts on average from the

middle of the first to the middle of the second management period. The volume before felling (V_{fin}) and the volume after felling (V_{in}) are calculated by the following formulas:

$$V_{fin} = V_w + \frac{I_{v_1} \cdot n}{2} \quad (3)$$

$$V_{in} = V_w + \frac{I_{v_1} \cdot n}{2} - E \quad (4)$$

where I_{v1} is the current volume increment of the state at the time of the inventory, computed both as an absolute value and as a percentage (p_i), and n is the number of years in the cutting cycle.

The volume before felling (V_{fin}) is obtained by adding the five-year volume increment at the time of the inventory (I_{v1}) to the initial compartment volume per ha (V_w). The state after felling (V_{in}) is established immediately after felling, which is usually done at the end of the fifth year in all compartments. It is assumed that in the following five years the stand will have a reduced production, because of the reduced growing stock (V_{in}). The stand production till the end of the management period is equal to the current increment of the state after felling (I_{v2}), obtained on the basis of unchanged increment percentage (p_i):

$$p_i = \frac{I_{v_1}}{V_w} \cdot 100 \quad (5)$$

$$I_{v_2} = V_{in} \cdot \frac{p_i}{100} \quad (6)$$

The periodic normal volume attainable at the end of the management period is calculated by adding the increment (I_{v2}) to the stand volume after felling (V_{in}), to calculate the:

$$V_n = V_{in} + \frac{I_{v_2} \cdot n}{2} \quad (7)$$

Because of the great uncertainty when forecasting volume increment in yield calculation, the following concerns must be considered: recruitment during the management period is not taken into account, and the progressive increase in volume increment due to the progressive increase in timber supply from the state (V_w) to the state (V_{fin}) is not taken into account. These same concerns must also be considered with regard to the increment after felling.

The goal of this method is the control of stand development, especially stand reaction to silvicultural measures aimed at the stationary, optimal state which is the most favorable for forestry purposes. The optimal state is achieved when the stand reaches the point of maximum production, i.e. when the production is simultaneously both maximal and permanent (Biolley, 1920). The control of stand development includes the complete control of the realization of the planned targets regarding tree species, number of trees and the attained volume (yield). The conditions for the successful use of this method are regular forest management practice and relationships, especially regarding the records and control of the planned selection felling (Medarević et al., 2008). In addition, because the periodic complete inventories ensure not only the most reliable information base for the analysis of forest state, forest inventory and productivity changes in time, but also the conclusions on the defined goals and sustainability as the imperative of forest management, the scientific significance of this method is also indisputable.

MATERIALS AND METHODS

The investigated MC 491/1 is a high selection forest of spruce, fir and beech (*Piceo-Abieti-Fagetum* subass. *typicum*) on diluvium, brown and illimerised soil on limestone and limestone formation with hornfels. It occupies an area of 2,648.78 ha in FMU "Tara" in the western part of Serbia. The bedrock of the complex consists of deep limestone of the Middle and Upper Triassic. There are all forms of soils on limestone, but the most common soil is the well-developed *terra fusca*. The climate is temperate continental, the mean annual precipitation is 991 mm, the mean annual tempera-

Table 1. Changes in the number of trees in MC 491/1

Tree species	Year of inventory							
	1970		1980		1990		2000	
	Number of trees per hectare							
	trees	%	trees	%	trees	%	trees	%
Fir	383.3	73.1	370.5	74.0	347.7	71.4	318.7	69.6
Spruce	50.6	9.7	52.3	10.4	54.6	11.2	52.0	11.3
Other conifers	0.6	0.1	0.7	0.2	1.1	0.2	0.7	0.2
Σ conifers	434.5	82.9	423.5	84.6	403.4	82.8	371.4	81.1
Beech	81.0	15.5	68.1	13.6	71.4	14.7	71.5	15.6
Ash	6.2	1.2	6.3	1.3	7.6	1.6	10.1	2.2
Other broadleaves	2.3	0.4	3.0	0.5	4.5	0.9	5.2	1.1
Σ broadleaves	89.5	17.1	77.4	15.4	83.5	17.2	86.8	18.9
Total	524.0	100.0	500.9	100.0	486.9	100.0	458.2	100.0

ture 7.9°C, and the average relative air humidity is 83.0%.

Based on the data of five successive forest inventories (1960, 1970, 1980, 1990 and 2000) stored in the information system database on Serbian forests, the development of diameter and volume structure was analyzed both for fir as the representative of the selection structure and collectively for Compartment 51, as a typical representative of MC 491/1. As MCs in the present form were established in 1970, the changes in the number of trees, volume, volume increment, yield, and number of recruited trees per tree species at the level of MC 491/1 were analyzed for the period 1970-2000.

RESULTS AND DISCUSSION

During the fifty-year period, the forests of FMU "Tara" were managed continuously and by the same method (by the principles of the Goč variety of the control method), resulting in the successful realization of the periodic goals set by this method, which was reflected in the achievement and maintenance of the typical selection structure, and in the improvement of the health and quality of these forests. The results of the forest management are best reflected in the changes in structure and tree species, number of trees, wood volume, increment, regeneration, recruitment, yield continuity, tree and stand health and quality during the study period.

Changes in the number of trees

The changes in diameter structure during the study period were analyzed in Compartment 51 as a typical representative of MC 491/1. We can observe the stability of individual diameter classes per inventory years. More significant fluctuation was observed only in the class 22.5-37.5 cm. All measurements were characterized by the width of the layer of medium-diameter trees (31-50 cm). In the layer of small-diameter trees, there was some differentiation between the trees belonging to the first class and the trees of the other classes in this diameter category.

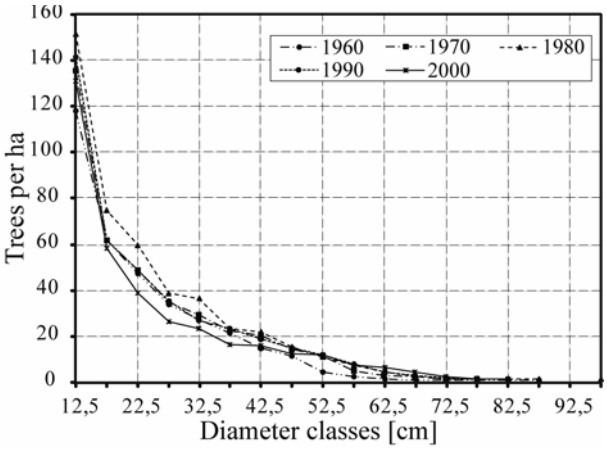

Fig. 1. Changes in the distribution of the number of fir trees in Compartment 51.

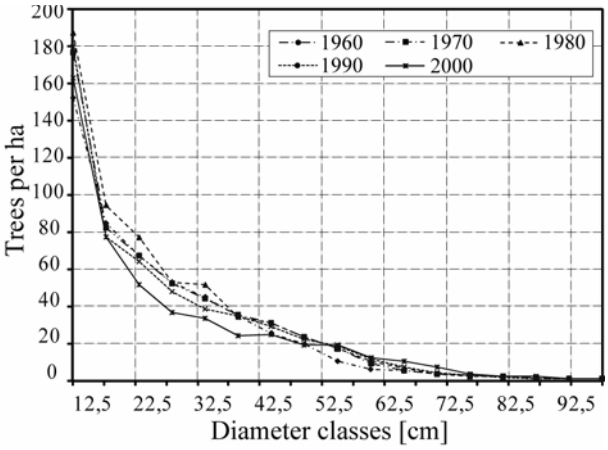

Fig. 2. Changes in the distribution of the total number of trees in Compartment 51.

During the study period, the distribution had a declining (hyperbolic) course. The number of trees in diameter classes 17.5-37.5 cm decreased in 2000 compared to the previous inventories, which was certainly a consequence of the decrease in the total number of trees during the last 20 years. This negative trend should be especially controlled and stopped in subsequent management periods. In general, the control of the number of trees points to the required management procedures which can change the number and distribution of trees in the stand. It is the basic element of selection (uneven-aged) forest management aiming for distribution of growth space (Schütz, 2001a; O'Hara and Gersonde, 2004). The result of the analysis of Compartment 51 (Fig. 2) is the distribution of fir by diameter classes and the changes shown by this tree species (Fig. 1).

Table 1 presents the changes in the number of trees in the entire MC 491/1.

The average number of trees per hectare in the last 40 years in MC 491/1 ranged from 524.0 measured in 1970 to 458.2 in 2000. However, regardless of the permanent decrease in the number of trees, the final state can be evaluated as close to optimal, because according to previous research (Milojković, 1986), the average number of trees from 450 to 480 per hectare is appropriate to these tree species and the structure of this group selection. The decreasing trend in the number of trees is also characteristic of fir (from 383.3 in 1970 to 318.7 in 2000). It was qualified as a negative trend, considering the conclusions reported by numerous authors (Miletić, 1951; Milojković, 1986; Jović et al., 1991; Schütz, 2001a) on the significance of fir as the dominant species in the selection structure.

Changes in volume

The distribution of volume per diameter class is directly conditioned by the distribution of the number of trees per the same diameter class. In "the first" 20 years it had a stable course and the maxima in diameter classes was 42.5 cm, i.e. 47.5 cm, with a steeper right part, i.e. a slight skewness of the distribution curve (Fig. 4). The inventory in 1990 shows that the maximum moved to 52.5 cm, and in 2000 the inventory movement to the right was even greater. The wavy bell-shaped line of distribution points to group-selection layers of forests in 2000. The total distribution volume is primarily the result of the change in fir inventory as the dominant tree species and in this compartment (Fig. 3).

The inventory changes in MC 491/1 are presented in Table 2.

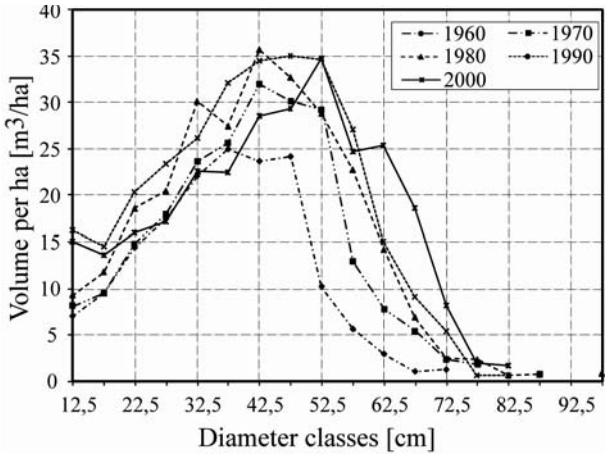

Fig. 3. Changes in the distribution of the total number of trees in Compartment 51.

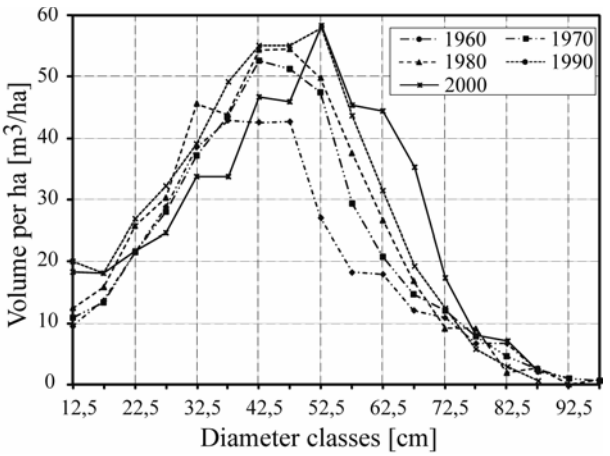

Fig. 4. Changes in the distribution of total volume in Compartment 51.

The analysis of volume shows its permanent increase in the study period. The volume of the mean tree also increased, from 0.799 m^3 (1970), to 0.862 m^3 (1980), 0.984 m^3 (1990) and 1.086 m^3 in 2000. This can result in the change from the hyperbolic to the sigmoid form of stand structure. The average volume increased by 78.7 m^3/ha, i.e. from 418.9 m^3/ha in 1970 to 497.6 m^3/ha in 2000. Some authors (Miletić, 1950, 1951; Schütz, 2001a) are of the opinion that the selection system can be realized only by a permanent control of wood volume, and that its surplus compared to the equilibrium volume leads to a reduction in regeneration and recruitment. According to previous research (Milojković, 1961), the equilibrium (normal) volume in these forests was 410 m^3/ha, with a ratio of conifers to broadleaves of 80:20%. Already in 1970, the value of average volume slightly exceeded this amount, and the ratio of conifers and broadleaves differed from the predicted optimum. In later inventories, the normal volume increased to 500 m^3/ha (Medarević et al., 2003).

The analysis of the ratio among the volumes of small-diameter trees (10-30 cm), medium- (31-50 cm) and large-diameter trees (>51 cm) in the investigated period (Fig. 5) shows that in the first three management periods there were no considerable oscillations in the volumes of these tree categories. However, the last inventory showed an increase in the volume of large-diameter trees, less in medium-diameter trees, and more in the volume accumulation in large-diameter trees. There were no essential changes in the category of small-diameter trees which attained its smallest value in 2000, i.e. the lower limit in this category. According to Schütz (2001b), selection forests should have 15-34% of their volume in smaller-diameter trees (up to 30 cm), 22-42% in medium-diameter trees (31-50 cm) and 24-57% in large-diameter trees (above 50 cm). At the end of the study period, the volume ratio of individual tree categories in MC 491/1 ranged within the above values, i.e. it accounted for 15:35:50%.

Changes in volume increment

As the control method provides data on the volume at different moments, it is possible to calculate the volume increment in the most methodically correct way – from the difference of the volumes. However, the volumes must be determined in the same way (by using the same volume tables or tariffs), and there should be reliable records on the volume of trees removed from the stand in the meantime (Mirković, 1959).

The changes in current volume increment, the percentage of individual tree species, and the chan ge in increment percentage in the study period are presented in Table 3.

Table 2. Changes in volume and percentage of conifers and broadleaves in MC 491/1

Tree species	Year of inventory							
	1970		1980		1990		2000	
	Volume per hectare							
	m^3	%	m^3	%	m^3	%	m^3	%
Fir	238.5	56.9	276.9	64.1	317.0	66.2	324.7	65.3
Spruce	36.8	8.8	47.9	11.1	61.1	12.7	64.6	13.0
Other conifers	1.1	0.3	1.0	0.2	1.3	0.3	1.4	0.2
Σ conifers	276.4	66.0	325.8	75.4	379.4	79.2	390.7	78.5
Beech	130.9	31.3	96.7	22.4	89.7	18.7	95.0	19.1
Ash	9.4	2.2	8.0	1.8	8.0	1.7	9.5	1.9
Other broadleaves	2.2	0.5	1.5	0.4	2.0	0.4	2.4	0.5
Σ broadleaves	142.5	34.0	106.2	24.6	99.7	20.8	106.9	21.5
Total	418.9	100.0	432.0	100.0	479.1	100.0	497.6	100.0

Table 3. Changes in current volume increment and increment percentage in MC 491/1

Tree species	Year of inventory											
	1970			1980			1990			2000		
	Volume increment per hectare											
	m^3	p_i	%	m^3	p_i	%	m^3	p_i	%	m^3	p_i	%
Fir	7.42	3.11	67.8	7.11	2.57	70.3	6.66	2.10	63.1	7.53	2.32	64.4
Spruce	1.19	3.24	10.9	1.35	2.81	13.3	1.81	2.97	17.2	1.88	2.91	16.1
Other conifers	0.01	-	0.1	0.01	-	0.1	0.03	-	0.3	0.02	-	0.2
Σ conifers	8.62	3.12	78.8	8.47	2.60	83.7	8.50	2.24	80.6	9.43	2.41	80.7
Beech	2.12	1.62	19.4	1.48	1.53	14.7	1.77	1.98	16.8	1.94	2.05	16.6
Ash	0.15	-	1.4	0.13	-	1.3	0.19	-	1.8	0.24	-	2.0
Other broadleaves	0.04	-	0.4	0.03	-	0.3	0.08	-	0.8	0.09	-	0.7
Σ broadleaves	2.31	1.62	21.2	1.64	1.53	16.3	2.04	1.98	19.4	2.27	2.05	19.3
Total	10.93	2.61	100.0	10.11	2.34	100.0	10.54	2.20	100.0	11.70	2.35	100.0

The highest value of current volume increment amounting to 11.70 m^3/ha was measured in 2000. In the last management period, the increment increased by 1.15 m^3/ha, the highest increase since this management class was defined. The exponent of the site potential is fir. Its percentage in the productivity per management periods ranged from 63.1% to 70.3%. The highest increment percentage

Table 4. Changes in recruitment in MC 491/1

Tree species	Year of inventory							
	1970		1980		1990		2000	
	Number of recruited trees per hectare							
	trees	%	trees	%	trees	%	trees	%
Fir	58.7	77.1	55.7	73.0	55.4	68.1	49.1	67.3
Spruce	7.9	10.4	9.4	12.3	9.6	11.8	8.6	11.8
Other conifers	-	-	-	-	0.1	0.1	-	-
Σ conifers	66.6	87.5	65.1	85.3	65.1	80.0	57.7	79.0
Beech	7.8	10.2	8.7	11.4	13.2	16.2	11.1	15.2
Ash	1.0	1.3	1.2	1.6	1.8	2.2	2.7	3.7
Other broadleaves	0.7	0.9	1.3	1.7	1.3	1.6	1.5	2.1
Σ broadleaves	9.5	12.5	11.2	14.7	16.3	20.0	15.3	21.0
Total	76.1	100.0	76.3	100.0	81.4	100.0	73.0	100.0

Table 5. Changes in periodic (ten-year) felling volume in MC 491/1

Tree species	Management period								
	1971-1980			1981-1990			1991-2000		
	Felling volume	Felling intensity		Felling volume	Felling intensity		Felling volume	Felling intensity	
	m^3	% V	% I_v	m^3	% V	% I_v	m^3	% V	% I_v
Fir	128,987	22.0	70.7	184,554	23.6	91.9	187,574	23.0	109.6
Spruce	15,992	17.7	54.5	26,244	19.4	69.1	35,927	22.9	77.0
Pine	935	33.0	247.4	468	16.6	120.3	330	10.3	38.0
Beech	118,793	36.9	227.6	68,733	25.2	164.3	42,038	18.2	92.2
Ash	5,581	24.3	150.5	4,192	18.6	111.1	2,744	13.2	56.9
Other broadleaves	1,951	35.3	182.8	1,516	34.1	166.0	1,213	23.8	57.5
Σ	272,239	26.4	101.1	285,707	23.4	100.0	269,826	21.9	99.5

during the last inventory was attained by spruce (2.91%) and fir (2.32%), and the lowest by beech (2.05%). These values are close to the values of increment percentage in selection forests of fir,

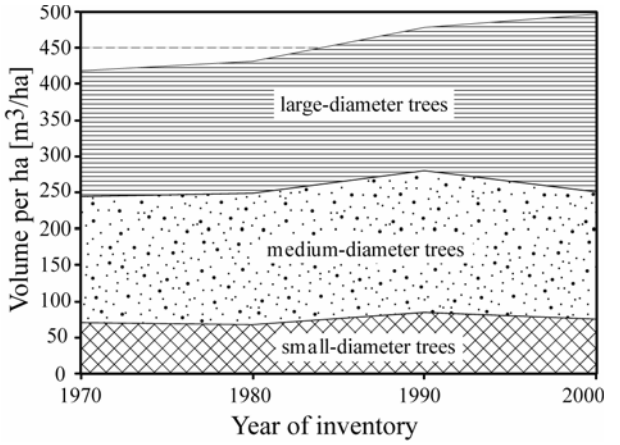

Fig. 5. Changes in volume of individual tree categories

spruce and beech at other sites in Serbia (Vamović, 2005).

Regeneration and recruitment

The sustainability of selection forest management, among other things, also depends on the scope of regeneration and recruitment, as well as on the ratio of the number of recruited and harvested trees (Milojković, 1986). Special attention was devoted to this problem in the elaboration and application of the technology of selection felling in the Goč variety of the control method. Recruitment includes juvenile trees activated by light and growing into the higher part of the stand, which ensures the equilibrium number of trees per diameter class. Compared to regeneration, recruitment has an advantage because it is quantitatively defined, i.e. it represents the number of trees that exceeded the inventory threshold during the management period (Miletić, 1959). Recruitment depends on tree species, regeneration, site quality, completeness of the selection structure, and the volume and duration of the cutting cycle. In the study period, the recruitment was calculated directly by special recording of these trees, which is one of the principles of the Goč variety of the control method.

Table 4 presents the changes in recruitment in the forests of MC 491/1 in the period 1970-2000.

The analyses show the relative stability of recruitment in the past periods. In the first two management periods, it was 7.6, in the third period it was 8.1, and in the fourth period it was 7.3 trees per hectare per year. Miletić (1959) found that selection structure could be maintained by 5.9 to 9.2 recruited trees per year. Similar results were also reported by other authors (Tomanić, 1997b; Klepac, 2001). Aiming for continuity of regeneration, the recruitment of 7 trees per hectare per year is considered the minimum for sustainable selection structure.

Felling volume

The control method gives quite reliable data on the changes in volume and its structure, and on changes in volume increment in the past. Based on the past development, probable forest development in the near future can be predicted. The previous relations and conditions that brought about the given state should be considered, as should the possibilities of enhancement and the requirements that should be satisfied.

Table 5 presents the changes of periodic felling volume, percentage of tree species and felling intensities.

Harvesting in this management class was equal to (1981-1990), greater by 1.1% (1971-1980) and slightly lower by 0.5% (1991-2000) than the current volume increment. Felling intensity compared to volume decreased by period, from 26.4% (1971-1980) and 23.4% (1981-1990) to 21.9% in the last analyzed period (1991-2000). The analysis of felling volume per tree species shows that: harvesting of beech and broadleaves in general in the first two management periods was considerably higher than the current volume increment of the same tree species, and in contrast to beech, conifer harvesting (fir and spruce) at the beginning was lower than the current volume increment.

The basic principle in selection felling, especially in the conditions on Mt. Tara, is that each felling, with the exception of regeneration, should also have a sanitation-silvicultural character. Adhe-

rence to this principle in the past has had a positive effect on the state of the forest ecosystem in general. The forests are characterized by good health, a rich appearance, and vitality, and they are biologically and functionally stable.

CONCLUSIONS

The stability of hyperbolic distribution of the number of fir trees per diameter classes and the distribution of the total number of trees in Compartment 51 as the typical representative of the forests in MC 491/1 indicate that the priority goals - primarily silvicultural goals - of forest management in the past period have been realized, which is reflected in the maintenance of the selection structure of these forests. However, the decrease both in the number of trees per hectare in MC 491/1 and in the number of fir trees, as well as its approximation to the lower level of the determined optimum of 450-480 trees per ha can lead in future to greater disturbances of the selection structure of these forests, thus requiring permanent control and the stopping of this negative trend.

The analysis of the change in volume points to the following facts: a permanent increase in the average volume, and also fir volume, and its approximation to the determined optimum of 500 m^3/ha although the average number of trees per hectare decreased; a permanent increase in spruce percentage in the volume; a declining trend till 2000 in the percentage of beech in volume due to the felling of over-mature trees, after which there was a slight increase in its percentage' a ratio of conifers and broadleaves close to the estimated optimum of 80:20%; a positive effect on stand stability by the increase in average volume of a tree (representative of MC) up to 1 m^3 - but a further increasing trend would endanger the sustainability of the selection structure.

Current volume increment did not show major fluctuations and was relatively high - during the entire period it was above 10 m^3/ha. The bearer of volume increment in this management class, analogous to the number of trees and the volume, was fir whose percentage in the production accounted for up to 70.3% (1980).

The number of recruited trees at 7-8 trees per hectare was almost the same annually, and considered to be sufficient in light of the need for the continuous regeneration of the inventory and thereby the permanent maintenance of the selection structure.

Felling intensity had a very mild decreasing trend in the past period.

Based on the previous conclusions, the overall conclusion is that the multiannual application of the Goč variety of the control method has led to a series of positive effects on selection forests of spruce, fir and beech in western Serbia, and resulted in both their vitality, and their structural, biological and functional stability. Some problems, such as the negative trend in the decrease in the number of fir trees (the dominant species of the selection structure) and the total number of trees per hectare, impose further control of this, and also of other potentially destabilizing processes and the necessity of a timely management response. Finally, permanent control and experiments in forests as dynamic systems are the basic principles of the control method and its Goč variety.

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ЕФЕКТИ ПРИМЕНЕ КОНТРОЛНОГ МЕТОДА (ГОЧКЕ ВАРИЈАНТЕ) У ГАЗДОВАЊУ ПРЕБИРНИМ ШУМАМА ЗАПАДНЕ СРБИЈЕ

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Контролни метод, као један од најпоузданијих метода газдовања пребирним шумама, у извесној мери модификован (Гочка варијанта) примењује се већ педесет година у пребирним шумама западне Србије. Користећи податке пет узастопних потпуних премера шума газдинске јединице (ГЈ.) "Тара", којом су, између осталог, обухваћене и најквалитетније и површински најзаступљеније шуме газдинске класе ГК. 491/1 – високе пребирне шуме смрче, јеле и букве (*Piceo-Abieti-Fagetum* subass. *typicum*) на дилувијуму, смеђем и илимеризованом земљишту на кречњаку и на кречњаку у формацији са рожнацем, у овом раду анализирани су ефекти примене контролног метода, односно његове Гочке варијанте у периоду 1960/70-2000 год. Ови ефекти посматрани су кроз промене (развој) дистрибуције броја стабала и запремине по дебљинским степенима, посебно за јелу као носиоца пребирне структуре и збирно на нивоу једног одељења, типичног представника ГК. 491/1. Такође, анализиране су и промене броја стабала, запремине, текућег запреминског прираста, реализованог приноса и броја ураслих стабала на јединици површине (1 ha), посматрано по врстама дрвећа на нивоу ГК. 491/1, која заузима површину од 2.648,78 ха. Резултати истраживања показали су да је у поменутом периоду просечна запремина ГК. 491/1 повећана за 18,8%, удео четинара у њој порастао је са 66,0% на 78,5%, а носилац тих промена је јела. Запремина средњег стабла јеле на нивоу ГК. повећана је за 35,9% и сада износи 1,086 m^3. Запремински прираст се повећао за 15,7%. Изграђена је задовољавајућа пребирна структура код четинара, али и даље постоје проблеми са обнављањем букве, њеним стабилним присуством и изградњом жељене структуре. Констатовано је смањење броја стабала на јединици површине (1 ha), што дугорочно гледано може имати негативне последице, али садашње стање у односу на принцип одрживости у целини је задовољавајуће. Подмлађивање и урастање је на задовољавајућем нивоу. Санирано је здравствено стање, те су састојине здраве, виталне, биолошки и функционално стабилне. Добијени резултати указују на низ позитивних ефекта вишедеценијске примене Гочке варијанте контролног метода, али и на извесне проблеме који ће имати корективну улогу у будућем газдовању пребирним шумама западне Србије.