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### FORESTS STANDS GROWING AFTER UNIFORM AND STRIP GRADUAL FELLINGS IN PINE FORESTS OF OKINCHITSKI FOREST STATION OF STOLBTSY EXPERIMENTAL FORESTRY ENTERPRISE

Pinetum vaccinosum, Pinetum pleuroziosum and Pinetum pteridiosum are renewed pine, spruce, birch and aspen. After creating a new pine forest on cuttings formed from a mixed of wood species (in the Pinetum vaccinosum – 7Pine2Birch1Aspen and 8Pine2Birch + Aspen, in Pinetum pleuroziosum – 9Pine1Birch + Aspen, in Pinetum pteridiosum – 6Pine4Spruce + Birch and 8Pine2Spruce + Birch). It is necessary to spend cuttings for formation of desirable specific structure on all sites.

**Introduction.** Principles of consistent, sustainable and multifunctional forest exploitation govern the main economic activities in the forestry branch of the Republic of Belarus. These principles make it possible to grow highly productive forest stands which are resistant to various negative natural and anthropogenic impacts as well as to conserve their biological diversity. Increased economic efficiency of forestry and rational utilization of forest resources cannot be implemented without some silvicultural justification of final cuttings. Modern silviculture places a great emphasis on forest stands formed by preserving natural undergrowth. Types of designated cuttings as well as their volumes [1] are determined by the presence of young growth of commercially valuable tree species under the canopy of maturity-approaching and mature forests, by the young growth distribution across the forested area and by the state of young trees.

**Research methodology.** Techniques common in silviculture and forest taxation were used to establish the experimental forest plots. The young growth was characterized in two transects of 1 x 50 m. The young growth was accounted by species, state (1 – excellent, 2 – good, 3 – depressed, 4 – weakened, 5 – very weakened and 6 – dead) and height groups (by 50 cm). The young trees were described by the canopy density and the average height of the young story.

**Main part.** Stolbtsy Experimental Forestry Enterprise of Minsk Public Production Forestry Association under the Ministry of Forestry of the Republic of Belarus is located in the western part of Minsk region, in the territory of Stolbtsy administrative district. The forest fund area of Stolbtsy Experimental Forestry Enterprise made up 89 803 ha as of 01.01.2010 with forested areas covering 81 339 ha. The total area of Okinchitsy forest station is 12 773 ha including 11 807 ha of forested areas. The allowable final cut comprises 216.2 ha for the pine stands of Okinchitsy forest station of Stolbtsy Experimental Forestry Enterprise with 36.2 ha (16.7%) of the allowable partial cut. Gradual cutting operations in the forests of Group I usually involve STIHL power saws for tree felling,

tree limbing and bucking. Amkodor-2661 Forwarder is employed for tree length skidding; KAMAZ-4310, KAMAZ-53212, MAZ-6303 and MZKT-6903 log trucks transport the tree lengths. Six experimental plots were allocated to study specific features of forest stands growing after uniform and strip gradual cuttings. The plots were situated in cowberry pine forest, mossy pine forest and bracken-type pine forest, their characteristics before cutting are shown in Table 1.

Cowberry pine forests were represented clean medium-dense 110- and 130-year-old stands of quality class II grown in A<sub>2</sub> conditions. Mossy pine forests were represented by clean medium-dense 110- and 140-year-old stands of quality class II grown in A<sub>2</sub> conditions. Bracken type pine forests included mixed medium-dense 85- and 105-year-old stands of quality class I grown in B<sub>2</sub> conditions. Experimental site 1 was created in the cowberry pine forest after uniform-gradual two-stage felling (forest growth conditions A<sub>2</sub>); experimental site 2 was created in the cowberry pine forest after strip-gradual three-stage felling (forest growth conditions A<sub>2</sub>); experimental site 3 was created in the mossy pine forest after uniform-gradual two-stage felling (forest growth conditions A<sub>2</sub>); experimental site 4 was created in the mossy pine forest after strip-gradual three-stage felling (forest growth conditions A<sub>2</sub>); experimental site 5 was created in the bracken-type pine forest after the first stage of uniform-gradual two-stage felling in 2009 (forest growth conditions B<sub>2</sub>); experimental site 6 was created in the bracken-type pine forest after the first stage of strip-gradual two-stage felling in 2011 (forest growth conditions B<sub>2</sub>).

After each stage of strip-gradual felling natural reforestation was assisted by soil screening with plough PKL-70. The results of the study are given in Table 2. All experimental naturally reforested (second growth) sites were dominated by the stand-forming tree species, i.e. pine, its share varying from 62% of excellent and good trees (experimental site 5) to 88% (experimental site 6).

Table 1

**Silvicultural-taxation description of pine forests before final cut**

No.	Forest type	Condi-tions	Composition	Age, years	$H_{av}$ , m	$D_{av}$ , cm	Density	Quality class	Stock volume, $m^3/ha$	Composition; average height, m; young trees quantity, trees/ha
1	cowb.p	A <sub>2</sub>	10P	130	26.5	42.0	0.64	II	299	6P3B1As; 1,20; 9 500
2	cowb.p	A <sub>2</sub>	10P	110	26.1	39.2	0.63	II	284	7P3B; 0,50; 3 200
3	moss.p	A <sub>2</sub>	10P	140	26.7	41.4	0.66	II	306	10P; 0,40; 6 200
4	moss.p	A <sub>2</sub>	10P	110	25.7	37.9	0.60	II	266	10P; 0,50; 3 500
5	br.t.p.	B <sub>2</sub>	8P2S + B	105	30.3	36.5	0.63	I	353	5S4P1B; 1,20; 2 200
6	br.t.p.	B <sub>2</sub>	10P + S, B, A	85	28.2	31.0	0.68	I	339	9P1S+B; 0,40; 3 500

Table 2

**Description of natural reforestation in final cut forested areas**

Exp. site Forest type	Tree species	Number of trees by categories						Total.	Total thickness, trees./ha
		1	2	3	4	5	6		
<u>1</u> Cowb. p.f.	Pine	69	32	15	8	9	16	149	14 900
	Birch	31	2	1	–	2	–	36	3 600
	Aspen	15	3	2	–	–	–	20	2 000
<u>2</u> Cowb. p.f.	Pine	94	38	47	7	–	1	187	18 700
	Birch	47	–	–	–	–	–	47	4 700
	Aspen	1	1	2	–	–	–	4	400
<u>3</u> Mossy p.f.	Pine	101	33	11	4	2	2	153	15 300
	Birch	9	1	1	–	–	–	11	1 100
	Aspen	1	–	–	–	–	–	1	100
<u>4</u> Mossy p.f.	Pine	141	13	21	–	–	–	175	17 500
	Spruce	4	–	–	–	–	–	4	400
	Birch	14	–	–	–	–	–	14	1 400
	Aspen	7	–	1	–	–	–	8	800
<u>5</u> Bracken- type p.f.	Pine	46	22	17	9	1	15	110	11 000
	Spruce	43	3	16	–	2	12	76	7 600
	Birch	10	–	–	–	–	–	10	1 000
<u>6</u> Bracken- type p.f.	Pine	30	21	15	8	–	1	75	7 500
	Spruce	15	–	–	–	–	–	15	1 500
	Birch	1	–	–	–	–	–	1	100

The species composition of experimental site 1 was registered as 73Pine18Birch9Aspen, the average height of common birch was 1.49 m, that of European white birch – 1.28 m, aspen – 1.20 m; the forest thickness comprised 20 500 trees per 1 ha. Undergrowth story was comprised by common spruce, English oak and common juniper, the thickness being 2 600 trees per 1 ha, the average height – 1.67 m and crown density – 0.20.

The species composition of the stand being formed in experimental site 2 was 76Pine20Birch4Aspen; the average height of common pine was registered 0.70 m, that of European white birch being 1.84 m, that of aspen being 0.75 m with the stand thickness of 23 800 trees per 1 ha. Undergrowth story was comprised by common spruce, English oak, common juniper and forest raspberry (9 400 plants per 1 ha, the average height – 0.91 m, the crown density – 0.53).

The species composition of the stand being formed in experimental site 3 was 92Pine7Birch1Aspen; the average height of pine was registered 1.04 m, that of European white birch being 2.50 m, that of aspen being 0.25 m with the stand thickness of 16 500 trees per 1 ha.

Undergrowth story was comprised by English oak, common juniper, forest raspberry and alder buckthorn (2 800 trees per 1 ha, the average height – 0.85 m, the crown density – 0.15).

The species composition of the stand being formed in experimental site 4 was 88Pine7Birch5Aspen; the average height of pine was registered 1.15 m, that of European white birch being 2.14 m, that of aspen being 0.75 m with the stand thickness of 19 700 trees per 1 ha. Undergrowth story was comprised by common pine, English oak, common juniper, forest raspberry and alder buckthorn (10 000 trees per 1 ha, the average height – 0.98 m, the crown density – 0.58).

The young stand composition in experimental site 5 was 56Pine39Spruce5Birch; the average height of common pine was registered 0.97 m, that of European white birch being 0.88 m, that of common spruce being 2.10 m with the stand thickness of 19 600 trees per 1 ha. Undergrowth story was comprised by ashberry, common juniper and alder buckthorn (species composition – 63Juniper31Buckthorn6Ashberry; 1 600 plants per 1 ha; the average height – 1.43 m; the crown density – 0.08).

The young stand composition in experimental site 6 was 82Pine16Spruce2Birch; the average height of common pine was registered 0.86 m, that of European white birch being 1.75 m, that of common spruce being 0.65 m with the stand thickness of 9 100 trees per 1 ha. Undergrowth story was comprised by alder buckthorn, common hazel and common ashberry (species composition – 57Hazel29Buckthorn14Ashberry; 700 plants per 1 ha; the average height – 1.5 m; the crown density – 0.06).

The analysis of the species composition and structure of the ground cover in cowberry pine forests after partial cuts showed that total projective cover of grass-shrub stratum had increased due to the spread of open-space species such as *Poa annua* L., *Calamagrostis epigeios* (L.) Roth., *Carex sylvatica* Huds., *Polygonatum officinale* All., *Nardus stricta* L. The ground cover diversity was ranging from 16 to 18 species, the projective cover making up 48.4–49.6% (grass-shrub stratum) and 24.0–62.0% (moss-lichen stratum).

Trees removal in the process of cutting the mossy pine forests resulted in their microclimate change and increased their projective cover by 51% (grass-shrub stratum) and by 15.6–43.8% (moss-lichen stratum). Some new species appeared such as *Calamagrostis epigeios* (L.) Roth., *Lotus corniculatus* L., *Geranium robertianum* L., *Erigeron canadensis* L.

Mature bracken-type pine forests of experimental site 5 had 34.6% of grass-shrub stratum and

37.4% of moss-lichen stratum in their projective cover before cutting. In experimental site 6 these figures comprised 41.6 and 22.0% respectively. After uniform-gradual cutting experimental site 5 had 40.4% of grass-shrub stratum and 19.6% of moss-lichen stratum in the projective cover. After strip-gradual cutting these figures made up 47.4 and 22.6% respectively. Grass-shrub stratum was dominated by such species as *Vaccinium myrtillus* L. и *Pteridium aquilinum* (L.) Kuhn.

**Conclusion.** The results obtained allow us to conclude that uniform-gradual and strip-gradual cuts in both cowberry and mossy pine forests lead to the formation of natural mixed forests with dominating common pine (stand thickness – 15 000 trees per 1 ha, height range – 1.0–1.5 m). As there are some soft-leaved trees in the stand composition it becomes very necessary to carry out timely improvement thinning which will assist successful stand formation of targeted species composition. The young stand composition of bracken-type pine forest after the first stage of uniform-gradual two-stage cut was registered 56Pine39Spruce5Birch (experimental site 5). The species composition after the first stage of strip-gradual two-stage cut was 82Pine16Spruce2Birch (experimental site 6). These facts prove the necessity of proper silvicultural activities for final stages of gradual cuts that will maximally preserve the young growth of commercially valuable species which are currently in sufficient amount to form new naturally-reafforested stands.

#### References

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