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VARIABILITY OF YIELD CLASS AND STAND DENSITY WITH AGE

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The article discusses the variability of yield class and stand density in the generations of forest stands of specific predominant species in order to reveal the general nature of their alterations with age.

An in-depth analysis was performed with regard to the generations of forest stands of two coupes of Krasnovishersk District Forestry Administration representing a part of virgin forests of the northern areas of the Perm Region. The coupes under consideration are characterized by the following average taxation rates: 1 – spruce-fir coupe: $F_{gen} = 965$ ths. ha; $S_{av} = 6$ spruce 3 fir 0.5 cedar 0.5 birch + aspen; average yield class III, 7; $P_{av} = 0.56$ and $A_{av} = 134$ years; 2 – soft-wooded broadleaved coupe: $F_{gen} = 261$ ths. ha; $S_{av} = 7$ birch 1 aspen 1 spruce 1 pine; average yield class III, 3; $P_{av} = 0.63$ and $A_{av} = 64$ years.

Table 1 below provides data on the distribution of forest stands of various age classes with regard to yield classes.

Table 1

Yield classes	Distribution of forest stands of various age classes with regard to yield classes, % of the total area							
	I	II	III	IV	V	VI	VII	VIII
Spruce-fir coupe								
Ia–I–II	14	14	14	15	16	15	9	2
III	72	65	58	49	46	42	39	35
IV	14	19	24	24	24	25	32	39
V–Va	–	2	4	12	14	18	20	24
Soft-wooded broadleaved coupe								
Ia–I	–	2	4	13	8	3	1	–
II	20	25	23	19	23	18	18	17
III	73	57	49	38	38	44	42	41
IV	7	15	19	23	24	20	21	22
V–Va	–	1	5	7	7	15	18	20

Within the spruce-fir coupe, with an age increase up to class VIII, the overwhelming majority of forest stands gradually transit into subsequent lower yield classes. Within the soft-wooded broadleaved coupe, with an age increase up to class IV, the processes of transition of part of the forest stands of II–III yield classes to higher yield classes and part of the forest stands of III–IV yield classes to

lower yield classes are clearly manifested. In forest stands with an age over class IV, the yield class is significantly reduced.

The change in the yield class of individual forest stands with age is reflected in the values of average yield classes in the aggregate of forest stands of a given class (generation).

This stems from the fact that the physiological properties of trees in forest stands change with age and that, in turn, causes a change in the energy of their growth and development and that of the forest stands as a whole.

Table 2 provides data on the distribution of forest stands of individual age classes with regard to stand density as a percentage of the total area of forest stands of the classes under consideration.

Table 2

Stand density	Distribution of forest stands of various age classes with regard to stand density, % of the							
	I	II	III	IV	V	VI	VII	VIII
Spruce-fir coupe								
1.0÷0.7	16	25	36	37	39	24	21	18
0.6	20	26	26	26	27	34	36	37
0.5÷0.3	64	49	38	37	34	42	43	45
Soft-wooded broadleaved coupe								
1.0÷0.7	40	62	67	68	65	53	50	46
0.6	28	18	14	16	23	23	25	27
0.5÷0.3	32	22	19	16	12	24	25	27

Within the spruce-fir coupe, the following changes occur with age:

1) the proportion of forest stands with a stand density of 0.7÷1.0, while rarely increasing up to the III age class inclusively (2.4-fold), in the III–V age classes remains almost at the same level and then decreases (2.2-fold);

2) the proportion of forest stands with a stand density of 0.6 under the conditions of the II–V age classes remains the same and then, having risen sharply in class VI, remains almost unchanged;

3) the proportion of forest stands with a stand density of 0.3÷0.5 decreases up to the V age class and then, having risen sharply in class VI, slightly increases.

Within the soft-wooded broadleaved coupe, similar changes occur.

Additional study of changes in the stand density of generations of predominant species of aspen, birch, pine and spruce with the territory of Gainsky District Forestry Administration and other forestry enterprises revealed that the increase in the average stand density in the initial period and its decrease starting from the III–IV age class is a typical natural phenomenon.

Table 3 provides brief data on the Gainsky District Forestry Administration.

Forest stands with different stand density behave differently: the higher the stand density at the beginning of development or at a younger age, the earlier

and more intensively their stand density is reduced after the III–IV age classes. In contrast, the lower the stand density, the longer the process of its increase and the less intensive its reduction thereafter.

Table 3

Average composition of coupes	Average stand density with regard to age class					
	I	II	III	V	VII	XI
6 aspen 3 birch 1 spruce	0.58	0.76	0.78	0.75		
6 birch 2 aspen 2 spruce	0.59	0.71	0.75	0.72	–	–
9 pine 1 spruce + birch	0.61	0.68	0.64	0.62	0.56	0.47
8 spruce 1 fir 1 birch	0.62	0.63	0.66	0.61	0.57	0.47

Two inseparable but opposite processes take place simultaneously in all forest stands throughout their entire life: an increase in the stand density due to growth and development and a decrease in the stand density due to loss of some trees. In forest stands with a higher stand density, stand density begins to decrease after the III age class since, from that time, the sum of cross-section areas of lost trees increases, while its increase (increment) in the remaining trees sharply decreases.

In any large coupe containing only one generation of trees above the III–IV age class, an increase in the stand density in one part of the coupe (with a lower stand density) and a decrease in the other part (with a higher stand density) is simultaneously observed. The overall result for the coupe depends on the predominance of one part or the other.

Moreover, analyses have shown that the stand density of forest stands with different yield classes changes with age in different ways and to different degrees.

Based on the patterns of changes in stand density in different forest stands, it is easy to explain the increase in the relative percentage of wood growth with a decrease in stand density: the density of forest stands with lower and especially artificially reduced stand density is increased due to high rates of increase in the diameters of individual trees and the sum of cross-section areas of forest stand much faster than in forest stands with higher stand density, which have lower growth rates with regard to the diameters of individual trees.

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