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THE RESOURCE POTENTIAL OF THE ABOVEGROUND PHYTOMASS OF LICHEN PINE FOREST AND RELATED MEASURING METHODS

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The significance of using the non-timber resources of the taiga forest is becoming more apparent year by year. This generates a need for reliable methods for measuring the volume of the aboveground phytomass of the forest communities, cultured phytocenoses in particular. This subject is the focus of continued scientific research ([1–4, 6–9], etc.).

We investigated this subject matter at the Yemetskoye Integrated Logging Enterprise in the Arkhangelsk Region. The forests of this logging enterprise belong to the southern segment of the northern subzone of the taiga. The subject of the experiment in our investigation consisted of clean 50-year old specimens of yield class Va pine planted by seeding. The initial density of the specimens was 5500 seed beds per hectare, with a seed bed size of 2.0×0.9 m. Their survivability rate as of the investigation year was 81.1%. On average, 2.6 specimens grow in one seed bed, giving us 11900 specimens per hectare. Their average parameters are as follows: pine diameter – 4.00±0.09 cm, height – 6.4 m, and relative density – 1.11. The mensurational description of the phytocenosis was acquired after repeated counting of specimens on the sample plot created as per the OST 56-69–83 requirements. The forest type is lichen pine forest, with A_1 type habitat conditions.

The investigation involved studying the phytomass of 190 trees collected during clean felling of two plant rows, later converted into the equivalent of one hectare (actual weight control). The weight of dry snubs, live branches and the foliage, bark and trunk wood of the trees was determined for each model tree using a platform scale within an accuracy of 25 g.

The actual phytomass values were then compared with the results acquired using the following methods:

1) method of proportional graded representation described in [1], with sampling of 100 model trees whose distribution by diameter grade is identified in Table 1;
2) method of graphical adjustment of the initial data;
3) method of average tree, with sampling of 5, 10, 15 and 19 models with average diameter, height and crown size for the entire phytocenosis;
4) integrated method with two scenarios: *a* – random selection of the models within one thickness grade and sampling of five models average for the entire phytocenosis; and *b* – selection of average models for a given thickness grade, to include five average models for the entire stand.

The results of measuring the phytomass of the 50-year old stand are provided in Table 2. According to this table, the total standing quantity of freshly-cut phytomass amounts to 109 tonnes per hectare, of which 67.5% is trunk wood, 13.5% – foliage, 11.2% – bark and 3.1% – dry snubs.

As we can see, the average tree method understates the total standing quantity of the stand by some 33.0% to 37.9%. According to L.K. Pozdnyakov et al. [5], the difference might be as high as 52% to 110%. The deviation from the true weight is smallest for dry snubs (−12.1% to −33.8%). The difference between the stock of branches determined using this method and the quantity acquired by clean felling reaches some 50.2% to 71.1%. Increasing the number of model trees to 15–19 does not increase the accuracy of the phytomass measurement. Authors A.I. Utkin, N.F. Kaplina and N.A. Ilyina [10] do not recommend using the average tree method to study the biological productivity of the forest.

The proportional graded representation method proved satisfactory, with overstatement of the weight of fractions from 5.9% to 14.4%, with an average of 8.0% for the entire phytomass.

The total phytomass value acquired by the graphical adjustment method is 2.9% higher than the true value and the differences for individual fractions vary from −26.7% to 22.9%. Similar results were obtained when the initial data was processed using the first scenario of the integrated method.

The highest accuracy was achieved when the phytomass was measured using the second scenario of the integrated method. The difference for the entire phytocenosis in this case does not exceed 1.0%, reaching some 10.7% for individual fractions.

Table 1

Thickness grade, cm	No. of tree count observations	No. of models processed	Phytomass distribution in fractions					Total
			Dry snubs	Live branches	Foliage	Bark	Trunk wood	
1	66	11	67 1.7	–	71 0.5	126 1.0	293 0.4	557 0.5
2	130	22	324 8.3	73 1.3	459 2.9	683 5.3	2 104 2.6	3 643 3.1
3	117	20	471 12.1	345 6.1	1 015 6.5	1 227 9.4	5 031 6.3	8 086 6.8
4	82	14	399 10.3	348 6.1	1 176 7.5	1 239 9.5	6 789 8.5	9 951 8.4
5	66	11	625 16.1	867 15.3	2 241 14.3	1 902 14.7	10 761 13.5	16 396 13.9
6	48	8	384 9.9	864 15.3	1 779 11.4	1 557 12.0	10 119 12.6	14 703 12.5
7	28	5	312 8.0	411 7.3	2 442 15.6	1 404 10.8	10 011 12.6	14 580 12.4
8	26	4	330 8.5	995 17.6	1 941 12.4	1 983 15.3	11 202 14.1	16 451 14.0
9	13	2	270 7.0	546 9.6	1 056 6.8	792 6.1	5 847 7.3	8 511 7.2
10	8	1	162 4.2	276 4.9	810 5.2	558 4.3	4 290 5.4	6 096 5.2
11	5	1	168 4.3	330 5.8	1 105 7.1	618 4.8	5 094 6.4	7 315 6.2
12	2	–	–	–	–	–	–	–
13	3	1	375 9.6	603 10.7	1 533 9.8	882 6.8	8 133 10.2	11 526 9.8
16	1	–	–	–	–	–	–	–
Total	595	100	3 887 100	5 658 100	15 628 100	12 968 100	79 674 100	117 815 100

Note: Numerator – kg per ha; denominator – %.

With this method, 15 model trees are selected. Five of them are average in the entire phytocenosis in terms of the basic mensurational parameters. This number is dictated by the requirements of forest mensuration (study of growth in height, timber volume, etc.). An essential requirement is to take two models of the thickest grades: analysis of these will provide additional information for placing a specific stand in a certain category of natural development. The remaining eight models are selected with average diameter, height and crown size for specific grades. The initial data of all models is subject to regression analysis. Where necessary, the parameters of the lowest thickness grades are graphically adjusted. Next, the optimal equation is found for each

fraction of the phytomass, which is used to calculate the weight of one tree in each thickness grade, and the resulting value is multiplied by the corresponding number of trees of that thickness grade.

Table 2

Phytomass fraction	True weight, kg	Phytomass obtained using the following methods							
		Proportional graded representative	Graphical adjustment	Average tree, with number of models				Integrated	
				5	10	15	19	Scenario 1	Scenario 2
Dry snubs	3 396	3 887 +14.4	3 969 +8.8	2 986 −12.1	2 249 −33.8	2 788 −18.0	2 733 −19.6	3 120 −8.2	3 359 −1.1
Live branches	5 130	5 658 +10.2	3 761 −26.7	2 558 −50.2	1 487 −71.1	2 360 −54.0	2 098 −59.2	3 323 −35.3	5 278 +2.8
Foliage	14 747	15 628 +5.9	18 134 +22.9	10 055 −31.9	9 817 −33.5	9 698 −34.3	9 018 −38.9	16 859 +14.3	16 332 +10.7
Bark	12 227	12 968 +6.0	12 170 −0.5	9 163 −25.1	8 954 −26.8	9 222 −24.6	8 846 −27.7	13 106 +7.1	11 363 −7.1
Trunk wood	73 554	79 674 +8.3	74 561 +1.3	48 314 −34.4	47 719 −35.2	47 024 −36.1	45 110 −38.7	75 942 +3.2	73 583 0.0
Total	109 055	117 815 +8.0	112 322 +2.9	73 076 −33.0	70 226 −35.7	71 092 −34.9	67 805 −37.9	112 350 +3.0	109 915 +0.8

Note: Numerator – kg per ha; denominator – % of true weight.

The suggested method of model selection and phytomass volume measurement should be tested with pine cultures and young stock of natural origin growing in specific regions.

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