

УДК 630\*231:630\*221.0:630\*181

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### **ANALYSIS OF PROSPECTS NON-CLEAR CUTTING AND NATURAL REPRODUCTION OF FORESTS IN BELARUS**

Cutting of and forest renewal are considered from the standpoint of modern forestry paradigm. The ecosystem approach to felling focuses on the rejection of clear cuttings. The ecosystem approach to renewal of forests involves natural self-renewal to cut down stand.

The analysis of the progress of natural regeneration of forests in Belarus. Recommended methodical approaches to the creation of the district bank stands forest fund. 9 groups of stands are marked on the suitability of the methods for felling and forest regeneration methods. Justified ways cutting and forest renewal on the basis of environmental and economic approaches.

Discusses the strategic plan between natural and artificial (forest plantations) recovery techniques main cuttings. Forest cultures have the advantage of growing stock (up to 10–15%). Natural stands have higher stability and preservation of biodiversity.

Non-use of non-clear cutting during the development of forest fund leads to a revenue loss of forest industry in significant volumes. Renunciation of the use of natural regeneration in favor of planting leads to environmental risks. Possible loss of the natural gene pool  $\approx 20\%$  of mature stands of natural origin.

**Key words:** non-clear cutting, natural reproduction of forests, methods of logging and renewal, evaluation stands of natural and artificial origin, bank of mature stands.

**Introduction.** The fundamental principle of the main wood management and subsequent forest regeneration is the sustainable management of the forest ecosystem at the stage of “cutting – renewal of the forest”. This principle is based on modern forestry paradigm “of sustainable forest management within ecosystems”. Ecosystem approach to forest felling involves the refusal (in the longer term – full) from clear felling in favor of non-continuous, ensuring the continuous performance of forest environmental functions. Ecosystem approach to reforestation involves the orientation of the maximum possible conservation of natural forest ecosystems. In the case of radical destructive impact that occurs in the process of cutting down the main element of the forest ecosystem – forest, maximum use should be made of the genetic resource of self-renewing historical data of the natural conditions of the forest ecosystem.

The determining factor in the choice of the main felling method and technology of logging operations is the selection of the manner of resumption of cut down tree stand, efficient in ecological and economic respect. The latter in turn depends on the progress of natural regeneration of important tree species under the canopy of mature stands.

**Main part.** Analysis of natural regeneration in the forests of Belarus suggests the following. The most successful is the renewal without change of the species in Heather and cranberry pine forests – 35–55% by area. Pure pine undergrowth with a small admixture of birch and spruce in the amount of 3–5 thousand PCs./ha with an average height of 1.0–1.5 m dominates.

Bilberry, fern and Oxalis pine can be described as having a good renewal ability, but the process of

forest restoration is focused on the change of species. In the Northern part of Belarus on 60–70% of the studied areas the spruce undergrowth in the amount of 4–6 thousand PCs./ha with an average height of 2.0–2.5 m dominates. In the subzone of spruce-hornbeam oak spruce the deciduous undergrowth prevails with density of 4–6 thousand PCs./ha with the average height of 1.5–2.0 m. In the southern part of Belarus in 40–55% of the area there is the oak undergrowth, with the participation of other species in an amount of 1.5–2.5 thousand PCs./ha with a height of 1.0–1.5 m. There is no undergrowth on large areas (up to 50%).

In the mossy pine forests of the Northern and Central parts of Belarus the undergrowth dominated by pine trees occupies 8–15% of the area, in the South – 30%, the average height of undergrowth is 1.5–2.0 m, the average number – 2–3 thousand PCs./ha. On the 45–50% of the area there is no undergrowth.

The presence of significant areas, well and satisfactorily secured by the undergrowth of pine predescent, says about the feasibility of using felling with preservation of undergrowth on the 20% of the area with upland pine stands, which are secured by the undergrowth. When using a gradual and selective logging, this area increases significantly, as in addition to the undergrowth of preliminary origin, in the formation of a new generation of forest concomitant subsequent reforestation will be involved.

In order of the reliable selection of the main method of felling and subsequent forest renewal method, you must create per-unit bank (database) of mature stands according to the results of basic forest management. The database can also include suitable plantings for the purpose of planning for

the period basic facilitation measures prior to the resumption of important tree species under the canopy of maturing stands. The purpose of creating per-unit bank is to obtain objective information about cutting stock in the context of the suitability of forest stands for conducting environmental – and cost-efficient methods of felling and forest regeneration. The task of the per-unit bank is to establish the areas of forest cutting to plan ways of felling and reforestation operations of the felling of mature stands for the auditing period.

Below there are recommended methodological approaches to the creation of per-unit bank plantings of forest cutting for reproduction of young stands of natural origin of the main wood formers of Belarus.

The central element when choosing a method of logging and forest regeneration is the choice between continuous and non-continuous systems of felling and between natural and artificial methods of reforestation. In this regard, special attention should be paid to plantings that are most promising for the application of selective harvesting and associated with these logging methods of the natural regeneration.

The most appropriate for non-continuous cuttings are the plants with a favorable course of natural regeneration of important tree species mainly in the forest types:

- pine heath;
- cowberry and mossy pine and spruce woods;
- bilberry, Oxalis, Aegopodium and nettle pine, oak and spruce forests;
- hornbeam oak forests, spruce-hornbeam, and fern floodplain;
- complex linden involving hardwood;
- derivatives softwood forest stands in the forest types: aspen fern; birch, aspen and olsy nettle; if, under the canopy of trustworthy undergrowth or second tier softwood or hardwood, the relevant data of forest site conditions;
- grey alder plantations in the presence of tiers of spruce and other native species;
- indigenous forest stands and other deciduous species, with a focus on the conservation of undergrowth of valuable or indigenous tree species.

The final result of the analysis of forest cutting (ripe, if necessary, and maturing, stands included in the calculation of the amount of the main use) is the statement of distribution (area, reserve) spaces for groups suitability for methods of felling and reforestation operations. It is recommended to define the following groups of plants:

- Oxalis pine forest, a completeness of 0.6 and above, with undergrowth of spruce and oak;
- Heather, cranberry, fern, blueberry, and mossy, politric pine with a completeness of 0.5 and above, with undergrowth of pine;

- Heather, cranberry, fern, blueberry, moss, Oxalis and politric pine with a fullness of 0.7 and above, there is no undergrowth;

- spruce, a completeness of 0.6 and above, with spruce undergrowth and the second spruce layer;

- birch, aspen and servalence, density of 0.8 and above, the composition of stands to 4 pieces of spruce, pine or oak;

- birch, aspen and servalence various Aegopodium, blueberry and fern with young spruce or oak or second tier of spruce;

- stands, completeness of 0.4 and above, with saplings of important tree species;

- other stands.

Based on the obtained distribution of forest cutting we recommend the following methodological approaches for choosing the method of felling and method of reforestation.

Objects of non-continuous felling can be, primarily, stands with undergrowth or second tier target species. These can be defined as stands with the following characteristics:

- pine forests of the fullness of 0.5 and above with undergrowth of pine forest types in the Heather, cranberry, fern, blueberry, and mossy and politric;

- spruce with a completeness of 0.6 and above with undergrowth of spruce, rarely oak and other hardwood or spruce subcanopy;

- birch, aspen and servalence with undergrowth of spruce, rarely oak and other hardwood or spruce subcanopy (or density of 0.8 and higher with participation in the composition of trees up to 4 units major species), fern, Oxalis, and Aegopodium blueberry forest conditions;

- pine moss-grass forest with the fullness of 0.6 and above a young spruce, rarely oak, where spruce and oak can be considered target species, like pine.

The objects of selective logging can be also pine and spruce forest stands of 0.7 and above without the presence of undergrowth. Holding evenly (group)-gradual felling in 3–4 doses with thinning the tree canopy and promote measures we can create conditions for concomitant natural regeneration of pine and spruce, which is one of the aims of the selective logging.

It is not economical to carry out selective logging in complete pine, spruce and deciduous stands with square footage less than three hectares; these areas can be seen as a common vision of the fund of non-continuous felling.

The other stands are, as a rule, the objects of clearcuttings.

Solving the problem of the methods of forest regeneration after felling depends on the correct strategic choice of the ratio of natural and artificial (planting) methods for the rehabilitation of main felling. Among scholars and practitioners of forestry, there is no consensus on the advantages of any

one method of reforestation. Most often called the benefits in the productivity of forest crops yield benefits in terms of sustainability, increased genetic diversity and lower costs for the production of young stands of natural origin.

We have adopted the attempt of evaluation of taxation parameters of pine stands of natural origin and forest crops. We obtained the average of all stands of the Brest and Mogilev GPLHO for upland forest types. Within each age class we determined the average age, height, relative completeness, the stock per hectare, inventory change (average increase), the average composition (in stock).

The analysis of this information suggests the following. Growth in height and the site class of pine stands of artificial and natural match forest conditions (forest type) and do not depend on the origin of forest stands. These stands also do not differ in the formulations. The only difference is the relative completeness of forest crops, which on average is 10–15% higher than in stands of natural origin. Accordingly margin and change of reserves (average increase) of forest plantations on 10–15% above, than in stands of natural origin.

The cause of increased completeness of forest plantations are, in our opinion, the drawbacks of reforestation in the stage of formation unclosed canopy of young stands of natural origin. No steps are taken to promote natural regeneration, in particular, sowing seeds, planting seedlings in the amount of up to 2,000 PCs./ha (“a partial forest of culture”). It should be paid a great attention to.

Analysis of the structure of forest stands and applied methods of felling makes it possible to recommend following methods of natural regeneration fellings of the main using.

Natural regeneration of pine stands is possible in the following conditions:

- after partial cutting in pine stands of Heather, cranberry, fern, blueberry, mossy, secured by undergrowth of the pine to the beginning of the main felling;
- by encouraging progress and a concomitant renewal in process 3–4-foster the gradual cutting with measures to promote natural regeneration in close pine forest with no undergrowth before the start of the main felling;
- preservation of pine undergrowth while clear felling Mature stands, usually incomplete.

Given the above, the share of natural regeneration of young stands of pine in the total volume of

reforestation can be 20%. This does not mean to conclude that the decrease in the volumes of silvicultural production in the use of methods of natural regeneration. It is necessary to reorient the silvicultural fund in the production of forest crops. Today, pine plantations are mainly on solid clearings in upland pine stands of the habitat conditions. This problem can be solved by methods of natural regeneration of pine forests, as discussed above. The production of forest crops of pine should contribute to expanded reproduction pine formation. Seedlings of pine, you need to create clearings in deciduous stands, primarily birch. You want to suspend unwanted dynamics of birch formations in the forests.

The progress of natural regeneration of spruce under the canopy of plants is highly favorable, which creates good prospects for the formation of spruce young stands of natural regeneration methods. A selective felling in forest areas with presence of spruce undergrowth in sufficient quantities allows you to predict the successful resumption of spruce young stands to 11% of the total area of forest cutting.

The formation of oak stands through natural regeneration may be estimated to be 2.1% of the total area of the main cabin. Promising stands of oak plantings Gomel, Mogilev and Brest regions, as well as pine forests, Oxalis, fern, rarely blueberry with oak undergrowth under the canopy of mature stands.

**Conclusion.** Environmentally feasible possibility to increase the share of selective felling of natural reproduction of main forest-forming tree species (pine, spruce, oak) is established. The objective criteria for allocation of forest cutting in the context of the methods of felling and regeneration of the forest, allowing to obtain objective information about cutting stock planning methods of felling and reforestation operations the felling of mature stands for the auditing period are recommended.

The rejection of the use of partial cutting methods in the development of forest cutting is fraught with loss of the profit of the forestry sector in significant volumes.

The non-use of planned volumes of natural regeneration with measures that promote the establishment of forest plantations is fraught with environmental risks in terms of loss of gene pool  $\approx 20\%$  of mature stands of natural origin. This will negatively affect the sustainability of pine plantations, partly with fir and oak, formations.

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*Received 10.02.2015*