



The importance of and potential for stump treatment in Russian Karelia



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Abstract

The main goal of the work was detailed investigation in Republic of Karelia, which included literature observation, field study, laboratory analysis and interviewing in order to be able to suggest about possible market concerning stump treatments and its applying in perpetual perspective.

Literature observation included information concerning the current situation with tree species composition, age structure of the forests and silviculture regimes. The field work was done on harvested areas for detailed investigation Norway spruce (*Picea abies*) stumps were taken, totally 22 clear cuttings were examined with 1430 of visually observed stumps and 220 samples from the stumps were taken for laboratory analyses (10 samples per harvesting area). The survey was made among 3 groups of respondents (forestry enterprises, scientists and forest industry) to find out the actual problems concerning new forest legislation, forest certification, about general health problems and regarding the *Heterobasidion* spp., as main species, which causing butt and root rot. Interviewing the logging companies was done in order to apply automated stump treatment.

Field work shows that 36,4% from the totally visually observed stumps were rotten, although laboratory analysis shows that 6% from the total number of observed stumps were infected by *Heterobasidion* spp.. The results on survey demonstrate that real wood losses in forests between 3-5%. The proportion from total harvested volume of mechanized and manual harvesting both in thinning and in final felling were 59/41 and 13/87 percent respectively. The proportion of seasonal harvesting is shown that 54% of all operations are carried in winter time and 46% in summer time. Thus, Karelia has high technical potential of automate stump treatments, in spite of that situation with new Forest Legislation still unclear for forestry specialists, in term of responsibilities of main stakeholders. There are possibilities to gain stump treatments, but applying into the practical forestry can be done in two ways: by forcing from the governmental level, what was not done yet; by subsidizing of forest leasers to apply stump treatments after logging operations. Possible stump treatments are inhibited by the complex of factors and main are: financial and political.

1. Introduction

Work has high emphasize concerning the possible losses in the forests of Karelia due to *Heterobasidion* spp., which are the major root rot and butt rot causing fungi, infecting Norway spruce and Scots pine. It is causing various damages the trees of all ages (mostly sawlogs), impairs forest health and a reason for major economic losses to forests.

The Republic of Karelia has huge forest potential and one of the leading positions among the Russian regions in forest innovations and advanced forest exploitation systems. Many of them were tried out and introduced into the practical forestry as an imitation of the North European's countries experience. Active management has a lot of negative consequences, particularly on the current forest health situation. Thus, Karelia has high potential of applying stump treatments in order to improve the situation and to reduce possible damages by *Heterobasidion* spp. There is high competition in the forests of Karelia, so work was done in order to be able to argue the importance of applying stump treatments and presence the *Heterobasidion* spp. in the forests of Karelia.

The widespread basidiomycetes fungus *Heterobasidion* spp. is causing root and butt rot and mainly restricted to coniferous in the Northern Hemisphere (Hodges 1969, Korhonen & Stenlid, 1998).

The *Heterobasidion* spp. first time was described by Elias Fries in 1821, who called it *Polyporus annosus* (Fr.) (Kallio 1970). Later Oscar Brefeld gave generic name *Heterobasidion* in 1888. According to Alekseev (1969) during many years *Heterobasidion* spp. has been well known under 26 Latin names, the most used were: *Fomes annosus* (Fr.) Cke, *Fomitopsis annosa* (Fr.) Karst, *Poliporus annosus* Fr., *Trametes radiciperda* Hart and *Heterobasidion annosus* Bref. The research history on *Heterobasidion* spp. counts almost 200 years.

The first signal in former Russian Empire concerning damages in artificially regenerated pine stands caused by *Heterobasidion* spp. was found in an article, written by A. Birnbaum in 1914. Later on in 1926 after being connected disease to silvicultural practice by Samofal, specialist from different parts of the former USSR started to warn about the damages in pine stands (Alekseev 1969). In European part of USSR *Heterobasidion* spp. caused severe damages and consequently losses in wood for *Pinus sylvestris*, *Pinus banksiana*, *Picea* spp., *Abies* spp. and *Larix* spp. Deciduous trees: *Alnus glutinosa*, *Betula* spp., *Populus* spp., *Sorbus* spp., *Acer platanoides*, *Carpinus* spp., which are growing in pure deciduous and in mixture with coniferous are also injured by *Heterobasidion* spp. (Alekseev 1969).

During last few decades root rot fungus *Heterobasidion annosum* has been split into the several taxonomic species (Niemelä & Korhonen 1998). Thus, there are overlapping between the species, however differences in natural distribution, host preferences and morphologically features has been distinguished. The importance in European scale have: *Heterobasidion annosum* (Fr.) Bref. s. str. is fungus that causing root rot of pine stands all over the Europe, it is calling P (pine) group (Korhonen 1978); *H. parviporum* Niemelä & Korhonen attacks Norway spruce (*Picea abies* (L.) Karst.) and used to be S (spruce) group; *H. abietum* Niemelä & Korhonen mostly infected species of *Abies*, F(fir) group (Korhonen 1978).

Heterobasidion spp. can be dispersed by means of diaspores: basidiospores, conidia and mycelium fragments (Kallio 1970). The spores of *Heterobasidion* spp. dispersed mainly by wind introduce into Norway spruce fresh stumps and damaged trees created by harvesting operations (Rishbeth 1951a) during warm season whenever the temperature is above 0°C (Brandtberg et al. 1996). Rishbeth was first who discovered that *Heterobasidion* infecting the fresh stump surface (Rishbeth 1950). The fungus spreads by growth of mycelium to adjacent trees via root contacts and grafts (Rishbeth 1951b). *Heterobasidion* spores which could not reach the wood tissues can not survive in litter layer without wood substrate (Rishbeth 1950, Hodges 1969), soil bacteria and microorganisms located mostly in humus layer are showing antagonistic activity (Vasilias 1981). Infected after harvesting operations stumps, can provide physiological activity for fungus up to 30 years (Greig & Pratt 1976).

The incidence of decayed trees enormously varies between the stands. This variety is due to differences in penetrating ability, which mainly determined by history and age of the stand, forest management and type of soil (Stenlid 1987). The incidence of root infection highly correlated to previous land use, stands which were established on former arable lands inclines to more frequent infection than stands on old forest land (Rishbeth 1950, Fiodorov 1984, 1998). Rich soils show slightly more frequent infections than poor soils (Enerstvedt 1979). According to Vasilias (1989) infection in spruce stands mainly depends on soil moisture, thus fresh soils (sandy, sandy-loam) contain more infection than damp ones. Reported data by Vasilias (1981) concerning content of infection in certain conditions shows positive correlation between the age of trees and amount of infection, as main result that spruce in older stands were increasing the proportion of rotten wood, at the same time on young stages only single trees were infected, that could indicate accumulation of the infection. Rot frequency was positively correlated with increasing stump diameter (Enerstvedt 1979) and at the same time rot frequency decreased with increased proportion of deciduous trees in the stands (Enerstvedt 1979, Vasilias 1989). Epiphytical character of infection was registered with simultaneous general impairment caused by wounds on root, stem; damages on tree crown and insects activity. Enormously fast it spreads to adjacent trees when infection goes from different nidus inside of the root system (Alekseev 1969).

Reported vertical spread of inoculated *Heterobasidion annosum* (Fr.) Bref. in Norway spruce stems showed result vary from 18.5 cm per year to 28.9 cm annually (Huse & Venn 1993). Some Russian researchers reported quite fast spreading of infection in spruce stands upwards the stem up to 48 cm per year (Negrudsky 1973). In order to avoid emergence and further spread of *Heterobasidion* spp. in coniferous stands effective methods should be applied for prevention and control of the infection.

Thus, infections can be heavily reduced by application of a “biopesticides” based on *Phlebiopsis gigantea* for the applying on the stump surface on the cutting areas after thinning and final felling.

There is difference between Norway spruce and Scots pine whenever it is already attacked by *Heterobasidion* spp. In Pine stands fungus occurs only the root systems and decay in most cases is not visible on the surface of cut stumps. While in Norway spruce stems it ascends several meters up (Laine 1976).

Spruce was chosen as main objective, easy to distinguish discoloration on the stump surface and no need to dig root systems in order to reach the infection, whenever in pine it needed more time consuming work.

The main goal of the study is to investigate the importance of and potential of possible application of stump treatments in Russian Karelia. In order to achieve the main goal diversified methods were tried, such as, literature observation, field work, laboratory analysis of the samples, making surveys and interviewing. In spite of that for understanding of the importance of the stump treatments many factors have to be taken into account: transition forest period in Russia, general health forest problems, lack of domestic research concerning *Heterobasidion* spp., responsibilities in forestry, silviculture regimes etc.

Important issue to be considered is current forest legislation in Russia, which is closely related to the work in term of responsibilities of main stakeholders in forest relationships. New Russian Forest Code was adopted 24.06.2006 by State Duma, which have changed the whole system of forestry practices. Previous legislation had the state forestry enterprise (leskhoz) as a main actor responsible for all the main activities in the forest, but due to the fact of new legislation implementation process new actor appeared – leaser (or leasing company). Leaser has long term leasing rights 5-49 years and carrying out all responsibilities concerning forest management, forest regeneration, forest protection against fires and pests etc. Thus, considering the forest legislation is essential when speaking of importance and potential of stump treatments in terms of responsibilities in the forest.

2. Materials and methods

The study was divided in 5 parts: literature analysis; field work; laboratory analysis; making surveys for three groups of respondents and interviewing of logging companies.

2.1 Literature analysis

Analysis concerning theoretical information of the forests in Karelia, which consists of tree species composition, age structure and climatic conditions. The fully covered information about background may clarify the specific conditions of the forests in Karelia.

2.2 Field study - rotten stumps vs. healthy

The field study was carried out in 6 territorial-administrative districts, which are located in Southern part of Russian Karelia and correspond to the middle taiga (Table 1).

Table 1: Location of the stands in Karelia

No	District	Location (Lat./Long.)
1	Prionezhsky	61°42'47"N/34°14'35"E
2	Prionezhsky	61°42'24"N/34°14'32"E
3	Prionezhsky	61°42'44"N/34°12'45"E
4	Prionezhsky	61°42'46"N/34°12'25"E
5	Prionezhsky	61°29'29"N/35°00'52"E
6	Prionezhsky	61°47'50"N/34°03'40"E
7	Prionezhsky	61°47'31"N/34°04'05"E
8	Pryazhinsky	61°44'44"N/33°49'06"E
9	Pryazhinsky	61°44'41"N/33°50'15"E
10	Pryazhinsky	61°24'59"N/33°18'39"E
11	Pryazhinsky	61°38'04"N/32°38'34"E
12	Pryazhinsky	61°38'04"N/32°39'38"E
13	Pryazhinsky	61°38'32"N/32°38'01"E
14	Kondopozhsky	62°06'28"N/34°30'09"E
15	Kondopozhsky	62°06'36"N/34°31'45"E
16	Kondopozhsky	62°06'45"N/34°31'39"E
17	Olonetsky	61°15'08"N/32°19'45"E
18	Olonetsky	61°15'20"N/32°18'41"E
19	Suoyarvsky	62°00'51"N/32°27'40"E
20	Suoyarvsky	62°00'52"N/32°28'02"E
21	Pitkyarantsky	61°42'16"N/31°34'56"E
22	Pitkyarantsky	61°42'16"N/31°35'03"E

The main objectives of the field work were fresh Norway spruce (*Picea abies* (L.) Karst.) stumps on the fresh clear cuts, which were harvested during the winter or spring time of the same year.

The field work includes the visual observation of the stump surfaces, establishing the sample plots and cutting discs from the stumps.

The number of visually observed stumps was adjusted in order to present 10% of the area. Stumps were verified into 2 categories: healthy and decayed. The established

sample plots 10 to 10 meters by systematic sampling within the clear cut area. Inside of the sample plots tree species compositions were identified with measuring the diameters on the stump height. Five plots were assigned per clear cutting irrespectively from the size of the clear cutting area. Sample discs were cut from the stump, 10 discs per clear-cutting area

Measuring equipments which have been used during field work were: chain saw (sampling) measuring tape (revealing the distance), caliper (measuring the diameters), colored sticks (marking the edges of the sample plots).

The detailed description of the stand and location on the territory of each leskhoz (state forestry enterprise) presented in the table 2. The size of the clear cutting area varied from 1.0 to 23.7 hectares (Table 2). The average age of the spruce trees was from 70 to 150 years. Most of the clear cuts were previously spruce dominated stands, but no pure stands at all (Table 2). Stand density varied between 540 and 1280 stumps per hectare (Table 2).

Table 2: Characteristics of the stands. “No” number of the stand. “Leskhoz” name of State forestry enterprise. “No of Compartments, units” numeration of compartments and compartment’s units inside of leskhoz. “Size, ha” the felling area, in hectares. “Species composition” species composition of the stand, where: P – pine, S – spruce; B – birch; A – aspen. “Mean diameter on stump height” mean diameter on stump height of tree species in cm. “Age” mean age of spruce trees in years. “No of stumps” number of stumps per hectare.

No	Leskhoz	No of Compartments, units	Size, ha	Species composition	Mean diameter on stump height	Age*	No of stumps
1	Petrozavodsky	47 (6)	5,8	1P-7S-2B	34P-25S -27B	130	660
2	Petrozavodsky	47 (9)	3,3	8S-1B-1A	29S-39B-45A	130	660
3	Petrozavodsky	37 (14)	4,3	1P-8S-1B	38P-25S-28B	150	600
4	Petrozavodsky	36 (23)	4,5	1P-8S-1B	35P-27S-25B	150	600
5	Ladvinsky	2 (1)	7,4	6S-3B-1A	27S-32B-30A	130	620
6	Khvoiny Voenny	47 (2)	1,5	2P-4S-4B	26P-21S-27B	110	960
7	Khvoiny Voenny	32 (8)	1,0	5P-3B-2A	27P-24B-32A	80	840
8	Pryazhinsky	63 (13)	2,0	6S-2B-2A	32S-25B-29A	70	620
9	Pryazhinsky	64 (2)	4,5	8S-2B	33S-31B	110	540
10	Pryazhinsky	132 (31)	6,8	9S-1B	24S-19B	110	580
11	Pryazhinsky	18 (1)	23,7	1P-3S-4B-2A	26P-19S-28B-33A	80	540
12	Pryazhinsky	17 (14,27,26)	18,6	4S-5B-1A	18S-25B-35A	70	600
13	Pryazhinsky	17(6,7)	16,8	5S-3B-2A	24S-27B-40A	70	580
14	Kondopozhsky	115 (7)	3,6	1P-7S-1B-1A	33P-27S-27B-39A	140	960
15	Kondopozhsky	113 (9,13,19,20)	3,7	1P-6S-2B-1A	45P-27S-23B-27A	110	740
16	Kondopozhsky	113 (1,10)	3,9	2P-5S-3B	33P-33S-34B	110	750
17	Olonetsky	130 (9)	7,7	8S-1B-1A	29S-17B-38A	120	1040
18	Olonetsky	130 (9)	3,1	2P-4S-4B	38P-26S-21B	120	1280
19	Suoyarvsky	249 (6)	8,5	7P-3S	41P-23S	90	780
20	Suoyarvsky	250 (1)	3,8	6P-2S-2B	20P-14S-16B	90	1180
21	Pitkyarantsky	69 (31,35)	3,7	7P-1S-2B	31P-19S-22B	110	580
22	Pitkyarantsky	69 (26)	11,9	6P-1S-3B	27P-22S-23B	95	600

* Age of the stand was taking from Forest plan, which are made for every Forestry enterprise by State forest inventory companies for 10 years period.

2.3 Sampling and laboratory analysis

According to the methodology 10 sample discs have been taken from every clear cut. The technique of taken discs from the spruce stumps with chainsaw was: firstly the upper part of the stump was cut to waste; then 1-2 cm thick disk was cut and immediately transferred into the plastic bag to insulate from outside infection. After being incubated for 7-10 days at room temperature the discs were analyzed. Presence of *Heterobasidion* spp. at the conidial stage was used as main assessment. No attempts were made to identify the species inside of the genus. During the analyzing of the samples I assumed only the fact of presence of *Heterobasidion* spp. mycelium without counting the number of infection on the sample and measuring the coverage area on the surface of the discs. Binocular with 25-fold magnification was used for identifying *Heterobasidion* spp. on the conidial stage. No attempts were made to identify the origin of other fungi.

2.4. Interviewing – butt & root rot occurrence

The survey consists of 20 questions: 8 questions about personal information and 12 concerning the forestry issues. Additionally survey includes the description of the work in order to inform the respondents with the main goal of the work and to give the recommendations of how to fill application. The entire questions in special part elaborated in logical chain that is why answering in the right order is essential for the respondents. Important was to explain that respondents had to answer truthful and serious, because the reliability of the result is crucial. It has to be made individually and it does not time consume much time (10-15 minutes), we assumed that in every question only one correct answer has to be chosen. The surveys were made separately for the forestry enterprises, scientists and forest industry (Appendix I, II and III respectively). The respondents were interviewed by direct interviewing, via post and by phone. Total number of respondents which were directly interviewed, by post and phone were 53, 144 and 5 respectively. Among group of respondents: state forestry enterprises (38/82/2), forest industry (12/51/2) and scientists (3/11/1) were respectively by direct interviewing, via post or by phone.

2.5 Interviewing – mechanization level of logging operations

The mechanization level of the harvesting operations is important in the perspective of automated stump treatments. To get to know the mechanical level a number of companies were visited and questions were asked. Questions were asked about the number of employees, harvested volumes, number of harvesters, proportions of harvested volumes at final cutting in relations to thinning, number of thinning during the rotation and proportion of harvested volume in winter compared to summer time. The questions were compiled into the questionnaire in order to make easier the interviewing process (Appendix IV).

3. Results

3.1 Literature analysis

The tree species composition is dominated by coniferous. About half of the territory in the Republic of Karelia is occupied by forests, more than 50% are pine dominated (Figure 1), one-third are spruce forests and about 10% are deciduous forests (Khlustov et al 2007).

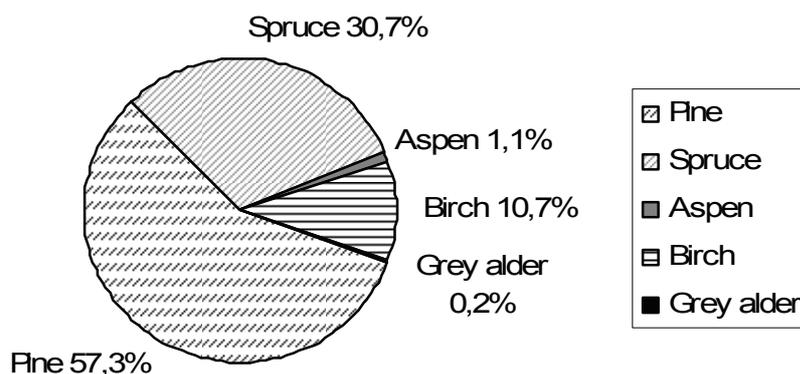


Figure 1. Tree species composition in republic of Karelia

The tree species composition has great importance in term of possible stump treatments in Karelia as a prevention measure, which can be applied against *Heterobasidion* spp..

The proportion of deciduous and coniferous tree species is fluctuating due to the prevailing preference of harvesting coniferous species, especially since the mid of 20s of previous century after the revolution time. Annual clear cutting area was increasing very rapidly and in most cases ecological requirements were not considered. However, decreasing the proportion of coniferous and at the same time increasing the deciduous giving us evidences about insufficient regeneration of clear cutting which previously were occupied by coniferous, but later on replaced by deciduous pioneer species. The proportion of the coniferous has been decreasing since 1956, but during last few decades situation started to stabilize due to the increased share of artificially regenerated clear cuttings (Khlustov et al 2007).

The age structure of the stands has high importance, particularly the normal forest age structure providing the forest management in the sustainable way, without any gaps. At the same time it has great importance for possible applying stump treatments in order to supply the object of possible application for the long term perspective. The age structure of the forests in Karelia presented in figure 2.

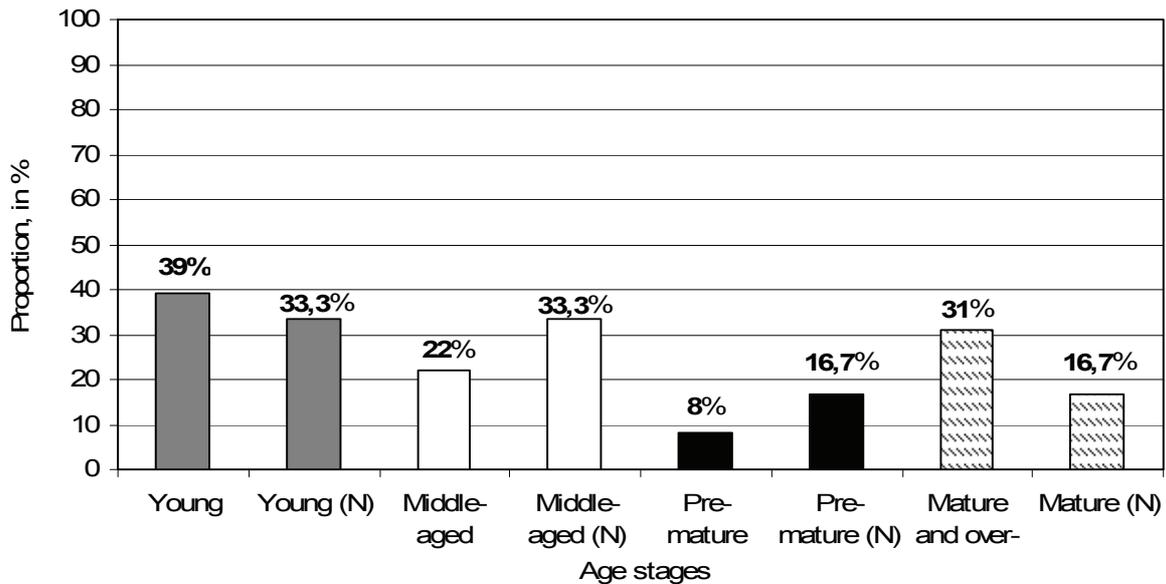


Figure 2. Comparison of the normal and current age structure in Karelia. “(N)” age structure corresponds to normal forestry and without “(N)” mark corresponds to the current age structure of the forests.

The current forest structure looks close to normal structure on young and middle-aged stages, vice versa it looks whenever in pre-mature stands it is twice less than suppose to be and proportion of mature stands is twice higher than according to normal forestry structure. That might have negative consequences for perpetual application of stump treatments.

3.2 Field study - rotten stumps vs. healthy

During the field work totally 1430 stumps were examined on 22 clear cuttings, hence in average 65 stumps per clear cut were observed. Number of the stumps verified from 20 to 114 (Table 4). As we can see from the table 909 stumps were evaluated as visually healthy from the surface and 521 were identified as rotten, in percentage 63,6 and 36,4 respectively. The proportion of rotten stumps varies from 13% up to 55%. Observation was made without identifying the possible causes for such proportion. Roughly situation looks that number of rotten stumps is evidently high, which has respective consequences to the wood losses.

Table 4: Results of the visually observed stumps. “No” stand number. “Number of stumps” number of visually observed stumps. “% of health/decayed” percentage of stumps which were evaluated as visually healthy or decayed. “Characteristics of felling” shows type of applied final harvesting and possible cause for that.

No	Number of stumps	% of health/decayed	Characteristics of felling
1	63	57/43	Sanitary clear cutting*
2	60	57/43	Sanitary clear cutting
3	83	72/28	Sanitary clear cutting
4	89	71/29	Sanitary clear cutting
5	111	45/55	Clear cutting after wind throw
6	33	61/39	Clear cutting
7	20	75/25	Clear cutting
8	36	64/26	Clear cutting
9	65	82/18	Clear cutting
10	95	87/13	Clear cutting
11	114	68/32	Clear cutting
12	81	59/41	Clear cutting
13	108	56/44	Clear cutting
14	82	67/33	Sanitary clear cutting
15	49	59/41	Selective cutting
16	38	66/34	Selective cutting
17	72	74/26	Clear cutting
18	61	69/31	Clear cutting
19	61	46/54	Clear cutting
20	43	56/44	Clear cutting
21	20	45/55	Sanitary clear cutting after fire 2003
22	46	46/54	Sanitary clear cutting after fire 2003
Sum	1430	909/521	
%	100	63,6/36,4	

*Sanitary clear cutting - type of felling which is carrying out in order to improve sanitary condition of the stand, when impaired, damaged and dying tree are removed within the felling area (selective sanitary) or the whole stand (clear sanitary); then applied method respectively is selective or clear felling).

Figure 3 shows demonstratively the result of the table 4.

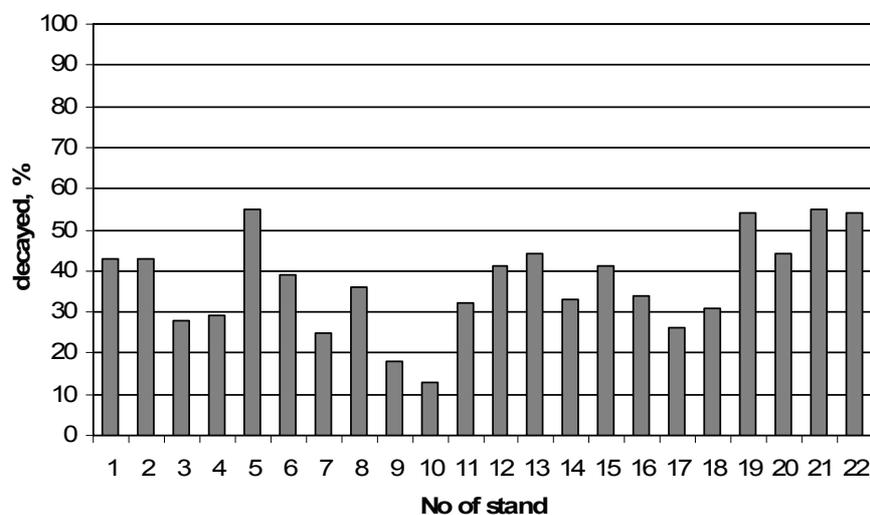


Figure 3. Percentage of decayed stumps from totally observed number on each site

3.3 Laboratory analysis - incidence of *Heterobasidion* spp.

According to the results (Table 5) 97% of examined samples are rotten in different extents. The amount of infected samples varies from 0 up to 30%. The proportion of samples infected by other agents is up to 90%, this number includes also mold fungi, if its mycelium was found on the surface of the stumps.

Table 5: The incidence of *Heterobasidion* spp. infection on the samples. “No” stand number “Mean diam” the mean diameter of samples, in cm. “Number of stumps/total number of stumps” total number of investigated stumps on each site is 10 sample discs. “Without mycelium” samples without mycelium. “Mycelium of *Heterobasidion* spp.” samples on which mycelium of the fungus was found. “Mycelium of other agents” samples with myceliums of other agents, includes also mould fungi. “No decay” no visual decay was found on the surface. “Spotted decay” small clusters of sample were decayed. “Decay <50%” visually decayed less than 50% of surface. “Decay >50%” decayed more than 50% of the surface.

No	Mean diam.	Occurrence of mycelium on the stump's surface number of stumps/total number of stumps			Visual distribution of decayed samples			
		Without mycelium	Mycelium of <i>Heterobasidion</i> spp.	Mycelium of other agents	No decay	Spotted decay	Decay <50%	Decay >50%
1	23	3	0	7	0	7	2	1
2	23	3	0	7	4	3	1	2
3	21	1	0	9	0	0	5	5
4	20	2	1	7	0	3	5	2
5	26	2	0	8	0	2	3	5
6	22	3	0	7	0	1	3	6
7	23	1	0	9	0	4	2	4
8	29	2	3	5	1	4	3	2
9	23	2	1	7	0	5	4	1
10	22	2	1	7	0	3	4	3
11	19	3	0	7	0	7	3	0
12	20	2	0	8	0	4	3	3
13	20	3	1	6	1	7	2	0
14	23	2	2	6	0	5	4	1
15	42	0	1	9	0	6	4	0
16	38	2	2	6	0	3	5	2
17	25	2	0	8	0	4	5	1
18	25	3	1	6	0	4	3	3
19	26	1	0	9	0	4	2	4
20	20	3	1	6	1	4	3	2
21	33	5	0	5	0	3	1	6
22	31	2	0	8	0	3	1	6
Sum		49/220	14/220	157/220	7/220	86/220	68/220	59/220
%		22	6	72	3	39	31	27

Figure 4 demonstratively shows the results of table 5.

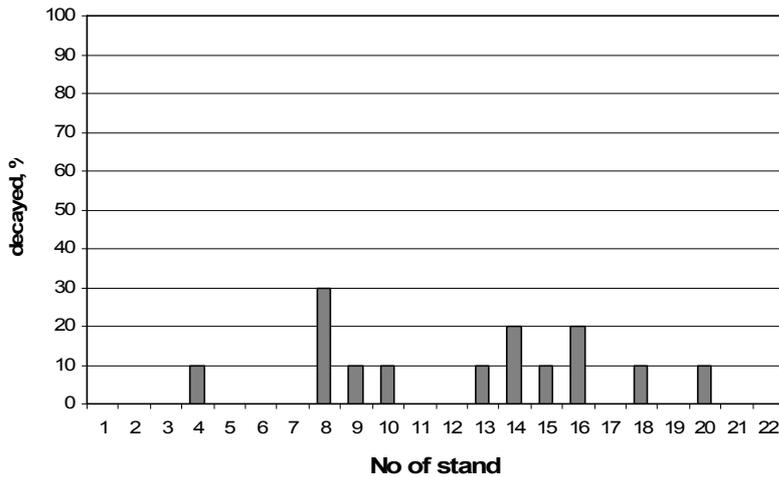


Figure 4. The incidence of *Heterobasidion* spp. on the samples

3.4 Interviewing – butt & root rot occurrence

Total number of answered questionnaires is 85. It corresponds to 40% of total number of questionnaires which have been sent: 58 responds from forestry enterprises (48%); 9 responds from scientists (60%) and 18 from forest industry (28%). Results regarding background of the respondents are presented in Figure 5, 6, 7 and 8. All the age groups are presented (Figure 5); among the groups of respondents high percentage of women is presented, which varied from 33 to 44 % (Figure 6) and respondents with high education are dominated (Figure 7).

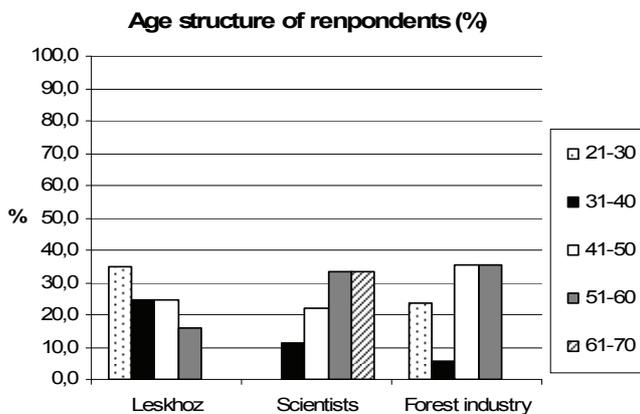


Figure 5. Age structure of respondents

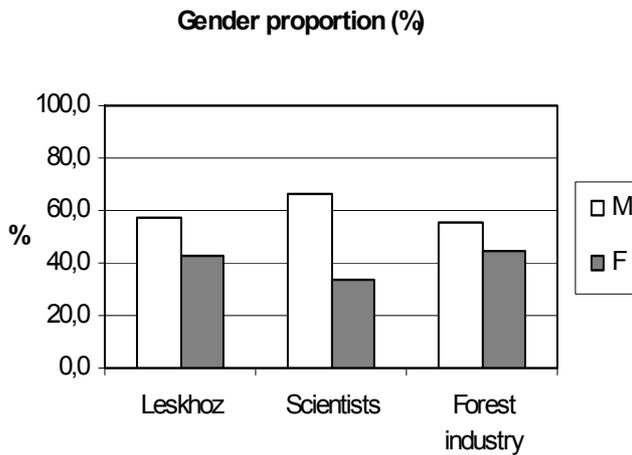


Figure 6. Gender proportion

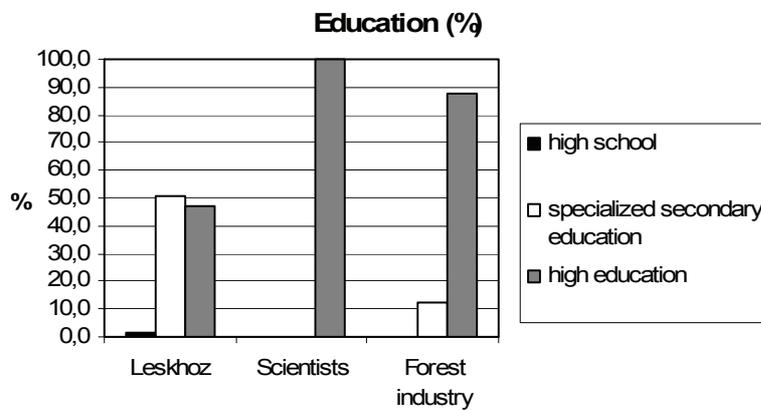


Figure 7. Education of respondents

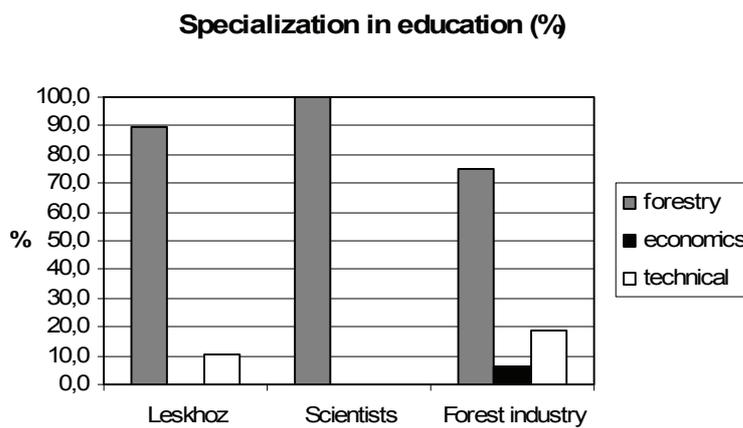


Figure 8. Specialization in education

According to the results on general information we have complete picture about the respondents, furthermore reliable and honest answers can be expected due to the high degree of forestry specialization of the respondents (Figure 8).

The results regarding specialized forest questions listed in graphs below: Figure 9-20. Most of the respondents estimated their knowledge concerning the forest health issues as “normal” and “high” (Figure 9). Almost all of them are aware of the problem concerning *Heterobasidion* spp. (Figure 10), and estimated knowledge concerning the fungus problem recognized by majority as “normal” (Figure 11).

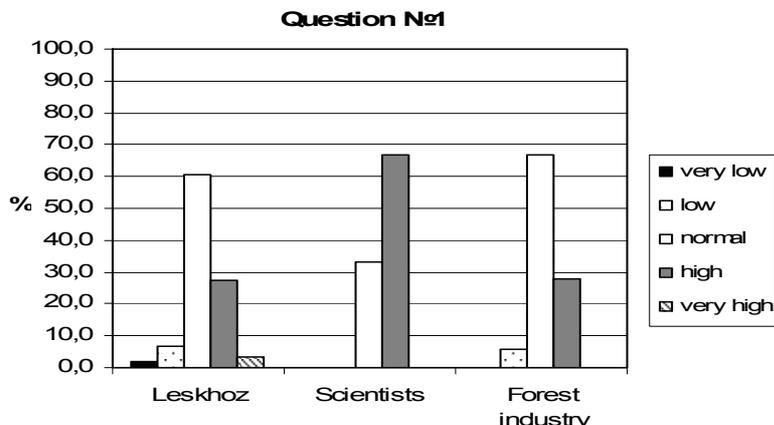


Figure 9. Question №1: How you can estimate your knowledge concerning forest health issues? Scale from 1 to 5 (1 - very low; 2 - low; 3 – medium; 4 – high; 5 – very high)

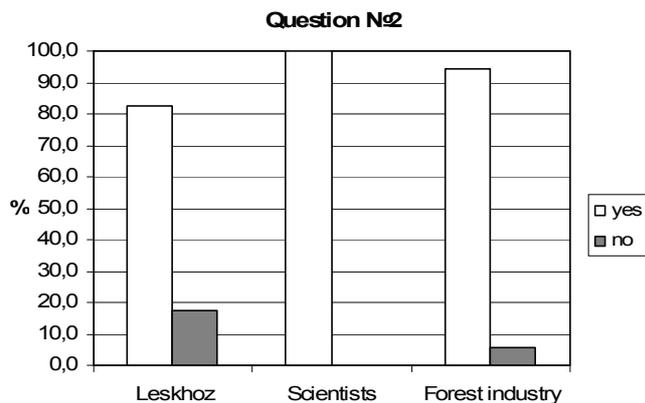


Figure 10. Question №2: Have you heard about the problem with root and butt rot caused by *Heterobasidion* spp.?

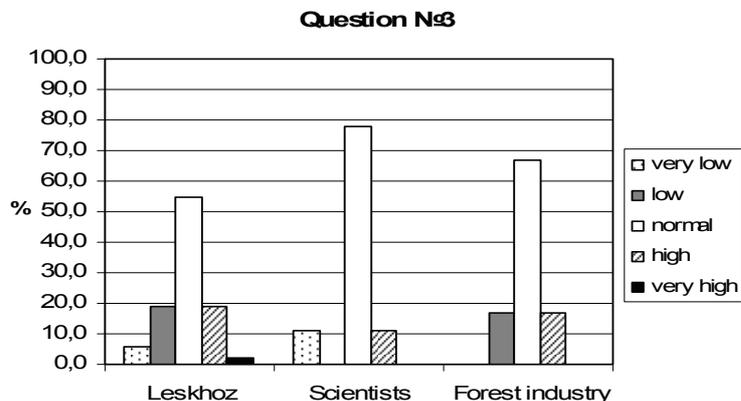


Figure 11. Question №3: If you heard (look on the previous question), how you can estimate your knowledge particularly about problems with *Heterobasidion* spp.? (scale is the same as in Part II; question 1)

Estimated possible losses due to the *Heterobasidion* spp. recognized by majority as “normal” (Figure 12) and real losses in forestry correspond to 3-5% from the total harvested volume (Figure 13). The majority is not aware of impact on forest health issues of the new legislation (Figure 14). Additionally question №6 (Figure 14) was asked to be specified and comments of the respondents are listed in Appendix V.

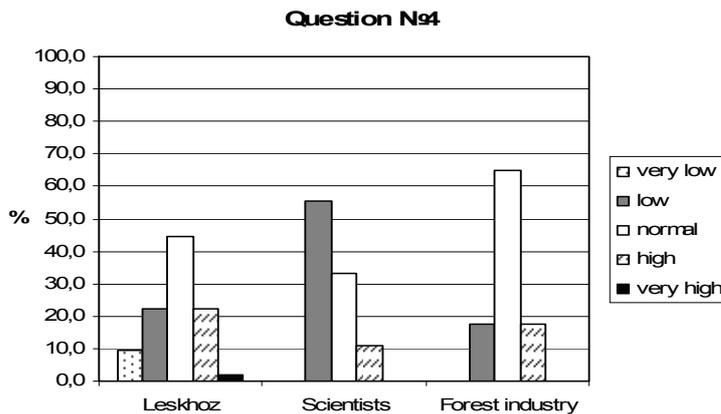


Figure 12. Question №4: How you can estimate losses in forestry/forest sector/forest industry due to the rot caused by *Heterobasidion* spp. based on you knowledge and experience concerning this issue? Scale from 1 to 5 (1 – negligible (very low); 2 – low; 3 – medium; 4 – high; 5 – very high)

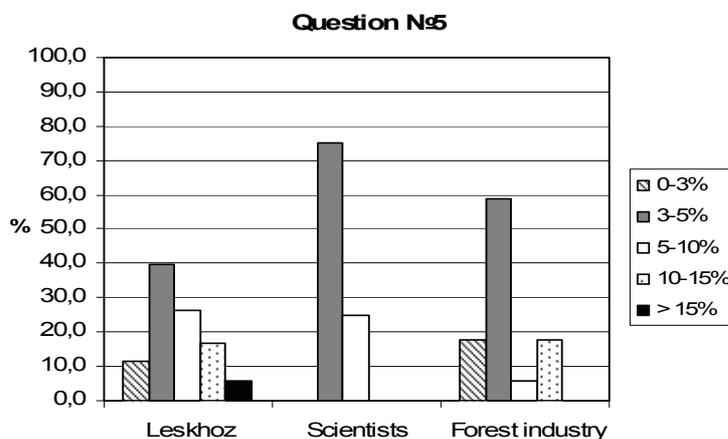


Figure 13. Question №5: How you can estimate roughly real losses in forestry caused by *Heterobasidion* spp. in percent from the total harvested volume in republic of Karelia? Scale from 1 to 5 (1 – around 0%; 2 – 3 to 5%; 3 – 5 to 10%; 4 – 10 to 15%; 5 - >15%).

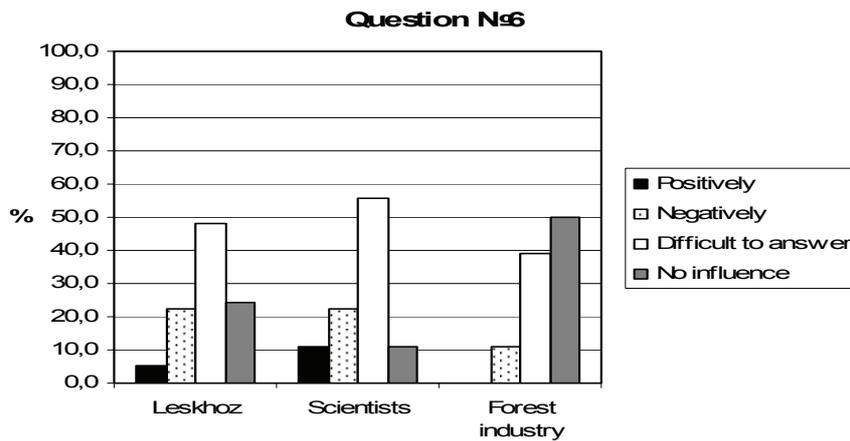


Figure 14. Question №6: How do you think new adopted Forest Code will influence on the forest health issues in general?

Leaser has to take over the responsibility for stump treatments (Figure 15) and the majority of respondents agreed that treatments should be applied only if the costs will be lower of possible losses due to the rot (Figure 16). Forest certification has obviously positive impact on the forest health conditions; however many of respondents have difficulties to answer on the question (Figure 17), especially concerning the particular impact of the certification on the problem with rot caused by *Heterobasidion* spp. (Figure 18).

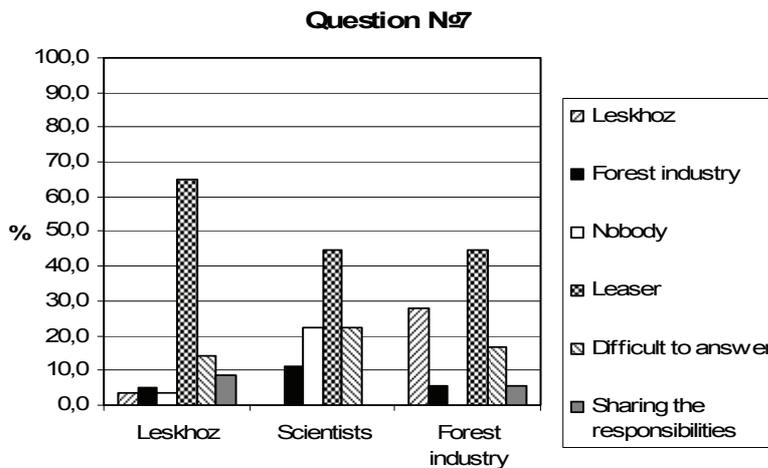


Figure 15. Question №7: Who should be responsible for stump treatment after final cutting and after thinning due to new forest legislation for prevention of spreading the infection?

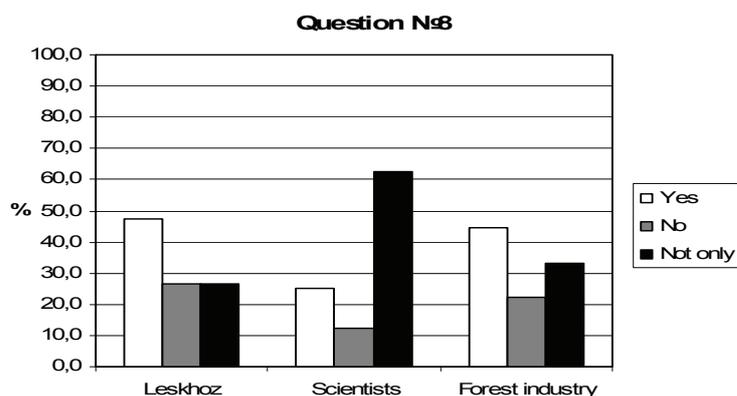


Figure 16. Question №8: Do you think that stump treatment should be applied only if the costs for it will be lower than possible wood losses due to the rot caused by *Heterobasidion* spp.?

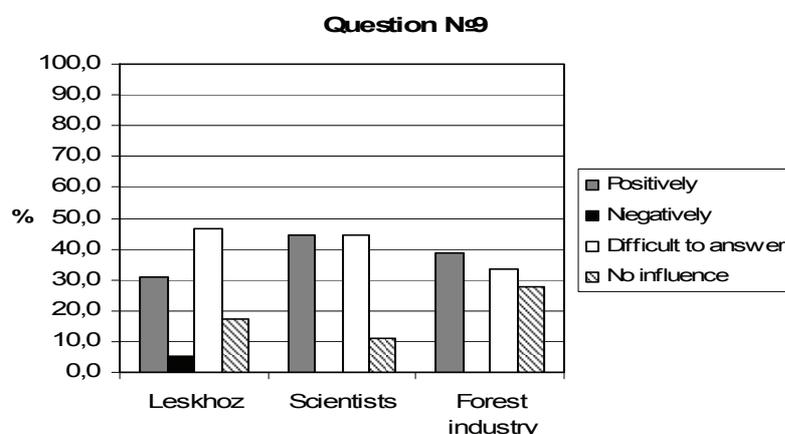


Figure 17. Question №9: How do you think certification will influence on health condition of the forests?

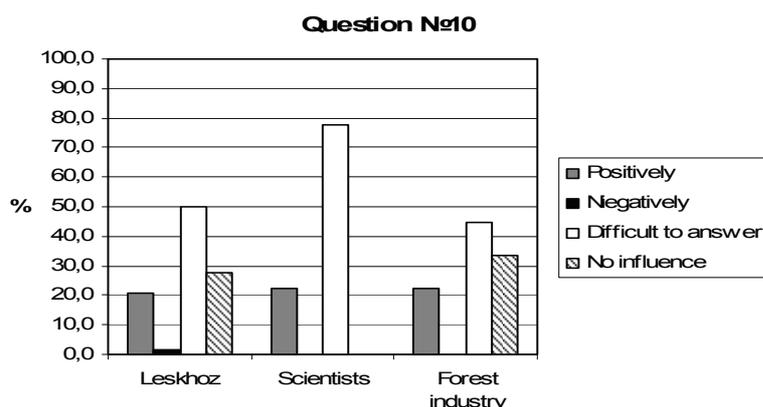


Figure 18. Question №10: How do you think the certification particularly will influence to problem with rot caused by *Heterobasidion* spp.?

Majority agreed that there is need of legislation in order to prevent spreading of the infection (Figure 19). The “complex” of problems recognized as the main for legalizing the stump treatments in Karelia (Figure 20).

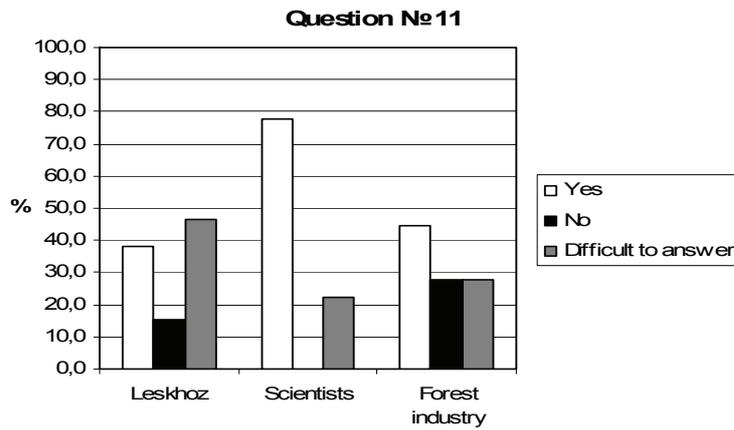


Figure 19. Question №11: Should there be legislation for controlling of butt and root rot by stump treatments to prevent the spreading of the infection from rotten to healthy adjacent trees?

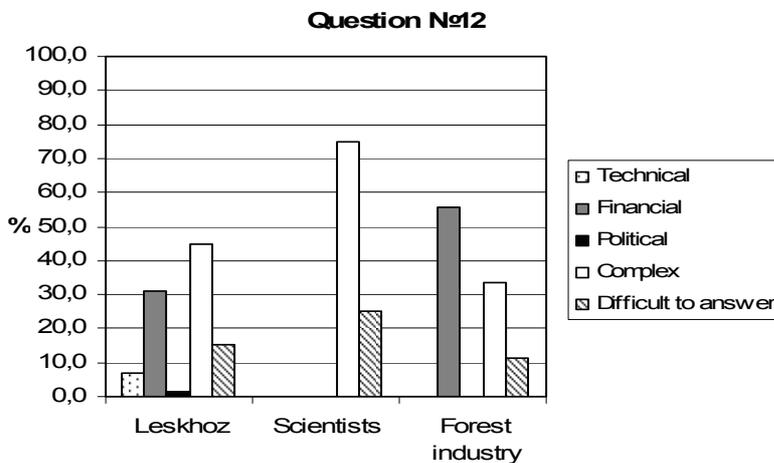


Figure 20. Question №12: If it is a real problem to legalize stump treatment practice, how do you think what could be the real reason for it?

General attitude of the respondents showed positive trend concerning stump treatments, however there are high variety of answers, in many questions the respondents have difficulties to answer: №6, 9, 10 and 11 (Figure 14, 17, 18 and 19 respectively). Nevertheless, most of the respondents recognized level of possible wood losses in forestry caused by *Heterobasidion* spp. corresponds 3-5%. The majority of respondents agreed that stump treatment should be applied as prevention measure after thinning and final harvesting in Karelia (Figure 19).

The general advises and comments both concerning the structure and content of the survey are listed in Appendix V

3.5 Interviewing – mechanization level of logging operations

Totally 9 logging companies were interviewed, the results of it compiled into the table 6.

Table 6: Mechanization level of logging companies. “Company” name of the company. “Empl.” number of employee. “Harv. volume” harvested volume in m³ per year. “No of harv.” number of harvesters. “Harvested m³/year in final felling” proportion of harvested m³ in final felling - “harv.” by harvester; “chainsaw” by chainsaw. “Harvested m³/year in thinning” proportion of harvested m³ in thinning - “harv.” by harvester; “chainsaw” by chainsaw. “Sil. reg.” silviculture regime. number of thinning, which applied during the rotation by logging company. Harvested m³ during the year: “winter” applied harvesting during the period 1.10-31.03. “summer” applied harvesting during the period 1.04-31.09.

Company	Empl.	Harv. Volume m ³ /year	No of harv.	Harvested m ³ /year in final felling		Harvested m ³ /year in thinning		Sil. reg.	Harvested m ³ during the year	
				harv.	chainsaw	harv.	chainsaw		winter	summer
OAo Ladenso	246	228785	7	203437	5320	3893	16135	3	126340	102445
OAo Olonetsles	-	289956	6	-	-	-	-	-	129099	160857
ZAO Zapkareles	1533	469846	3	328892	140954	-	-	-	269077	200769
OAo FHE Ledmozerskiy	206	129614	3	65746	63868	-	-	1	56436	73178
OAo Muezerskiy LPH	365	219000	3	111163	103437	2600	1800	1	131360	87640
OAo LPH Lahdenpohsky	167	49500	-	-	40500	-	9000	2	24000	25500
OAo LHC Karellesprom	2398	813300	6	292870	175120	-	-	-	452290	361010
FGU Khvojny Voenny leskhoz	133	23476	-	-	10398	-	13078	3	8438	15038
OAo LPH Kondopozhskoye	231	166313	-	-	161154	-	5159	4	89705	76608
Sum	5279	2389790	28	1002108	700751	6493	45172		1286745	1103045
Average	-	-	-	-	-	-	-	1,4	-	-
%	-	-	-	58,8	41,2	12,6	87,4	-	53,8	46,2

According to the results (Table 6) harvesting operation applied during the whole year quite evenly, 54% during the winter and 46% during the summer time that might have high risk of infected stump during the warm period. Almost 60% of the total volume in final felling made by harvesters that makes possible automates applying of stump treatments, in spite of that 13% in thinnings harvested by machinery. During the whole rotation of the stands the thinning operations applied 1-2 times.

4. Discussion

The data collected from the literature revealed the predominance of the coniferous, totally 88% of the total forest covered area. Vast areas covered by coniferous and evenly-distributed age structure of the forests make possible applying the stump treatments in perpetual perspective as prevention and control measure.

In addition, improvement of knowledge concerning *Heterobasidion* spp. might have positive influence in practical forestry. According to Korhonen & Piri (1994) general distribution of P and S type and host preferences have high potential and possibilities to control infection in Finland. Neighboring location of Russian Karelia with Finland has high importance in term of similarities of climatic conditions; so we can suggest the possible distribution of the S and P type in Karelia based on Finnish data. Thus, correctly chosen tree species on certain forest sites may heavily decrease possible losses caused by *Heterobasidion* spp.

Possible alternatives for stump treatments should be considered. Thus, silviculture management supposes assumption of biology and interaction of fungus and its host (Korhonen et. al., 1998). Thereby enhanced proportion of deciduous trees and replacement to more resistant coniferous can decrease wood losses and accordingly

susceptibility of the stands to the agent. Decreasing of initial density of the stand may reduce possible losses; wider spacing bounds the spread of fungus via root contacts (Enerstvedt 1979, Vasiliauskas 1989, Korhonen et. al., 1998). Noteworthy silviculture methods can be complicated and not effective at all especially in pine stands, where infection has hidden character, so in this case biological stump treatments might be in favor (Alekseev 1969).

The field work results showed high percentage of decayed stumps during the visual observation, thus 36% of the totally examined stumps on the felling areas were rotten. The proportion of rotten stumps varies from 13% up to 55%. It can be explained by great variety of many factors: tree species composition (spruce proportion varies from 10% up to 90%), age of the stand - from 70 up to 150 years, stump density – from 540 up to 1280, number of observed stumps – from 20 up to 114 depending on the size of clear cut and local condition. However, considering great variety of factors on investigated harvesting sites, over 30% of pre-mature, mature and over mature spruce trees are rotten. It indicates insufficient sanitary conditions of spruce forests and existence of many pathogens. However, evidences to compare with obtained results were found neither in Karelian nor in Russian official statistics or research.

The result of the laboratory work showed 6% of samples are infected by *Heterobasidion* spp.. However the incidence of *Heterobasidion* spp. varied up to 30%, evidences of pathogen's presence were found on 45% of harvesting sites. Laboratory analysis was carried out according to given methodology, but some of samplings were done in rainy weather conditions. Thus, during the incubation period there were a lot of grown mold fungi on the samples and increased the percentage of "mycelium of other agents" (Table 5), which have negative impact on final results of *Heterobasidion* spp frequency. Noteworthy, that during laboratory analysis identification was done only for *Heterobasidion* spp., the rest of fungi species were selected into "mycelium of other agents" group without identifying. The lack of research, no data concerning this issue and low level of proficiency have had impact on the final results of the field work and laboratory analysis, but at the same time obtained results close to survey results, which makes it comprehensive.

Noteworthy that roughly 200 surveys were distributed, nearly 40% of responds which were received back. As a main result of the forest specialists interviewing was that 3-5% of the possible wood losses is due to the *Heterobasidion* spp. from the total amount of harvested volume in spruce stands. Furthermore the survey demonstrated the high interest of forestry specialists concerning the problem of the root and butt rot caused by *Heterobasidion* spp., many of respondents agreed that stump treatments should be applied even if the costs for that will be higher than possible wood losses. In spite of that results showed many uncertainties in answers, especially the fact of great variety of responds to the questions. Moreover they were choosing quite often as an option when answering the questions "difficult to answer". It might be connected to the lack of knowledge and awareness of the problem concerning *Heterobasidion* spp., so the current forest policy and its implementation is not clear for the specialists, in term of responsibilities of main stakeholders, forest health issues etc.

The results on interviewing of logging companies clearly showed the high technical potential; 58% of harvesting operations are made by machinery in final felling, this fact is favorable in order to apply automated stump treatments. In spite of that only 13% of the total volume is mechanized in thinning operations. Low percentage of harvesters use makes cause of difficulties in automated stump treatments during thinnings

operation. In addition to that, number of commercial thinnings which are applied during the rotation in average 1-2 times. It does not seem so optimistic as well for perpetual applying of stump treatments. Finally, we need to take into consideration continuous increasing share of mechanized logging operation and more active forest management and those trends already can be seen and are in favor for automated stump treatment.

The study was done according to given methodology, but during the work many problems have been faced, which might have influence on the results of field work, laboratory analysis and interviewing. The representativeness of the sampling has crucial importance for the reliable results and there is risk of possible result deviation; however the research is unique, relevant and highly applicable. Stump treatments against *Heterobasidion* spp. are highly important to be implemented in every day forestry practice, and quite complicated at the same time due to many factors (e.g. transition forestry period, lack of information, no data concerning *Heterobasidion* spp. in Karelia, lack of research concerning particular pathogen) and there is need to establish new research and to collaborate with foreign specialists in order find appropriate solution concerning this problem. Conclusively, there are possibilities to gain stump treatments, furthermore Karelia has high technical potential in order to introduce it, but applying into practical forestry can be done in two ways: by forcing from the governmental level or by subsidizing from the state budget of the forest leasers to apply stump treatments after logging operations. Possible stump treatments are inhibited by complex of factors: main are financial and political. In order to make right decision concerning stump treatment in Russian Karelia more detailed and comprehensive research have to be done to be able to reduce possible risks of unjustified decision.

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Appendix I. Survey for forestry enterprises

Questionnaire form regarding the butt and root rot problems in the forests of Karelia

Kindly advice to you before filling the survey to read the description on the back site of the questionnaire

Part I. General information

- 1) Interviewee's name.....
 - 2) Name of forest enterprise.....
 - 3) Age.....
 - 4) Sex Male [] Female []
 - 5) Background (e.g. technical, forestry, economical and so on...).....
 - 6) Education: Secondary school [] High school []
 Professional college [] High education []
- Or specify if none of them is correct.....
- 7) Experience in forest sector (in years).....
 - 8) Job status.....

Part II. Forestry questions

- 1) How you can estimate your knowledge concerning forest health issues?
Scale from 1 to 5 (1 - very low; 2 - low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 2) Have you heard about problem with root and butt rot caused by *Heterobasidion* spp.?
Yes [] No []
- 3) If you heard (look on the previous question), how you can estimate your knowledge particularly about problems with *Heterobasidion* spp..? (scale is the same as in Part II; question 1) 1 [] 2 [] 3 [] 4 [] 5 []
- 4) How you can estimate losses in forestry due rot caused by *Heterobasidion* spp. based on you knowledge and experience concerning this issue?
Scale from 1 to 5 (1 – negligible (very low); 2 – low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 5) How you can estimate roughly real losses in forestry caused by *Heterobasidion* spp. in percent from total harvested volume in republic of Karelia?
Scale from 1 to 5 (1 – around 0%; 2 – 3 to 5%; 3 – 5 to 10%; 4 – 10 to 15%; 5 - >15%)
1 [] 2 [] 3 [] 4 [] 5 []
- 6) How do you think new adopted Forest Code will influence on problem of forest health in general?
Positively [] Negatively [] Find difficulty in replying [] No influence []
Please specify.....
.....
.....
- 7) Who should be responsible for stump treatment after final cutting and after thinning due to new forest legislation for preventing spreading the infection?

Appendix II. Survey for scientists

Questionnaire form regarding the butt and root rot problems in the forests of Karelia

Kindly advice to you before filling the survey to read the description on the back site of the questionnaire

Part I. General information

- 1) Interviewee's name.....
- 2) Name of research centre or institution.....
- 3) Age.....
- 4) Sex Male [] Female []
- 5) Background (e.g. technical, forestry, economical and so on...)
- 6) Education: Secondary school [] High school []
 Professional college [] High education []
- 7) Experience of teaching or scientific practice, in years (if both of them it can be written as sum).....
- 8) Scientific degree
 Senior lecturer [] Associate professor [] Doctor []
- 9) Specialization in research work (e.g. silviculture, forest management, forest ecology and so on...).....

Part II. Forestry questions

- 1) How you can estimate your knowledge concerning forest health issues?
Scale from 1 to 5 (1 - very low; 2 - low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 2) Have you heard about problem with root and butt rot caused by *Heterobasidion* spp.?
Yes [] No []
- 3) If you heard (look on the previous question), how you can estimate your knowledge particularly about problems with *Heterobasidion* spp..? (scale is the same as in Part II; question 1) 1 [] 2 [] 3 [] 4 [] 5 []
- 4) How you can estimate losses in forest sector due rot caused by *Heterobasidion* spp. based on you knowledge and experience concerning this issue?
Scale from 1 to 5 (1 – negligible (very low); 2 – low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 5) How you can estimate roughly real losses in forestry caused by *Heterobasidion* spp. in percent from total harvested volume in republic of Karelia?
Scale from 1 to 5 (1 – around 0%; 2 – 3 to 5%; 3 – 5 to 10%; 4 – 10 to 15%; 5 - >15%)
1 [] 2 [] 3 [] 4 [] 5 []
- 6) How do you think new adopted Forest Code will influence on problem of forest health in general?
Positively [] Negatively [] Find difficulty in replying [] No influence []
Please specify.....
.....
.....

- 7) Who should be responsible for stump treatment after final cutting and after thinning due to new forest legislation for preventing spreading the infection?
 Forestry enterprise [] Forest industry, which is buying the wood []
 Nobody [] Leasing company [] Find difficulty in replying []
 Responsibilities should be shared between all the interested sides []
- 8) Do you think that stump treatment should be applied only if the costs for it will be lower than possible wood losses due to the rot caused by *Heterobasidion* spp.?
 Yes [] No [] Not only, because we should think about health of future generations of trees and high costs at the beginning will be negligible in the future []
- 9) How do you think certification will influence on health condition of the forests?
 Positively [] Negatively [] Find difficulty in replying [] No influence []
- 10) How do you think certification particularly will influence to problem with rot caused by *Heterobasidion* spp.?
 Positively [] Negatively [] Find difficulty in replying [] No influence []
- 11) Should there be legislation for controlling of butt and root rot by stump treatments to prevent the spreading of infection from rotten to healthy adjacent trees?
 Yes [] No [] Difficult to answer []
- 12) If it's a real problem to legalize stump treatment practice, how do you think what could be the reason for it?
 Technical [] Financial [] Political [] Complex [] I don't know []

General advises and comments to the questionnaire (can be both according to structure and content of the questions)

.....

Description:

- 1) Please take it serious, for me the reliability of the result is very important
- 2) It won't take so much, approximately 10-15 min
- 3) Please read the questions very careful
- 4) In every question choose only one the most relevant answer
- 5) Please fill the answers individually
- 6) Please start to feel it in offered order, because it creates in logic chain

About the work: Work basically is about losses in forestry due to *Heterobasidion* spp., which are the major root rot and butt rot causing fungi, infecting Norway spruce and Scots pine. It's causing various damages the trees of all ages (mostly sawlogs), impairs forest health and a reason for major economic losses to forestry. Spore infections on fresh stumps created by thinnings and clear-cutting during the vegetation period is a major entry point for *Heterobasidion* spp.. Spreads via air-borne spores, which are abundant in the forest during the summer period and fungus is able to spread from infected trees into healthy trees via roots and from infected stumps into seedlings on the regeneration site. Infections can be reduced by application of a "biopesticides" based on *Phlebiopsis gigantea* for the applying on the stump surface on the cutting areas (= stump treatment), it's natural (=biological) antagonist to *Heterobasidion* spp..

Appendix III. Survey for forest industry.

Questionnaire form regarding the butt and root rot problems in the forests of Karelia

Kindly advice to you before filling the survey to read the description on the back site of the questionnaire

Part I. General information

- 1) Interviewee's name.....
 - 2) Name of forest enterprise.....
 - 3) Age.....
 - 4) Sex Male [] Female []
 - 5) Background (e.g. technical, forestry, biological, economical and so on).....
 - 6) Education: Secondary school [] High school []
 Professional college [] High education []
- Or specify if none of them is correct.....
- 7) Experience in forest sector (in years).....
 - 8) Job status.....

Part II. Forestry questions

- 1) How you can estimate your knowledge concerning forest health issues?
Scale from 1 to 5 (1 - very low; 2 - low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 2) Have you heard about problem with root and butt rot caused by *Heterobasidion* spp.?
Yes [] No []
- 3) If you heard (look on the previous question), how you can estimate your knowledge particularly about problems with *Heterobasidion* spp..? (scale is the same as in Part II; question 1) 1 [] 2 [] 3 [] 4 [] 5 []
- 4) How you can estimate losses in forest industry due rot caused by *Heterobasidion* spp. based on you knowledge and experience concerning this issue?
Scale from 1 to 5 (1 – negligible (very low); 2 – low; 3 – medium; 4 – high; 5 – very high)
1 [] 2 [] 3 [] 4 [] 5 []
- 5) How you can estimate roughly real losses in forestry caused by *Heterobasidion* spp. in percent from total harvested volume in republic of Karelia?
Scale from 1 to 5 (1 – around 0%; 2 – 3 to 5%; 3 – 5 to 10%; 4 – 10 to 15%; 5 - >15%)
1 [] 2 [] 3 [] 4 [] 5 []
- 6) How do you think new adopted Forest Code will influence on problem of forest health in general?
Positively [] Negatively [] Find difficulty in replying [] No influence []
Please specify.....
.....
.....
.....

- 7) Who should be responsible for stump treatment after final cutting and after thinning due to new forest legislation for preventing spreading the infection?
 Forestry enterprise [] Forest industry, which is buying the wood []
 Nobody [] Leasing company [] Find difficulty in replying []
 Responsibilities should be shared between all the interested sides []
- 8) Do you think that stump treatment should be applied only if the costs for it will be lower than possible wood losses due to the rot caused by *Heterobasidion* spp.?
 Yes [] No [] Not only, because we should think about health of future generations of trees and high costs at the beginning will be negligible in the future []
- 9) How do you think certification will influence on health condition of the forests?
 Positively [] Negatively [] Find difficulty in replying [] No influence []
- 10) How do you think certification particularly will influence to problem with rot caused by *Heterobasidion* spp.?
 Positively [] Negatively [] Find difficulty in replying [] No influence []
- 11) Should there be legislation for controlling of butt and root rot by stump treatments to prevent the spreading of infection from rotten to healthy adjacent trees?
 Yes [] No [] Difficult to answer []
- 12) If it's a real problem to legalize stump treatment practice, how do you think what could be the real reason for it?
 Technical [] Financial [] Political [] Complex [] I don't know []

General advises and comments to the questionnaire (can be both according to structure and content of the questions)

.....

Description:

- 1) Please take it serious, for me the reliability of the result is very important
- 2) It won't take so much, approximately 10-15 min
- 3) Please read the questions very careful
- 4) In every question choose only one the most relevant answer
- 5) Please fill the answers individually
- 6) Please start to feel it in offered order, because it creates in logic chain

About the work: Work basically is about losses in forestry due to *Heterobasidion* spp., which are the major root rot and butt rot causing fungi, infecting Norway spruce and Scots pine. It's causing various damages the trees of all ages (mostly sawlogs), impairs forest health and a reason for major economic losses to forestry. Spore infections on fresh stumps created by thinnings and clear-cutting during the vegetation period is a major entry point for *Heterobasidion* spp.. Spreads via air-borne spores, which are abundant in the forest during the summer period and fungus is able to spread from infected trees into healthy trees via roots and from infected stumps into seedlings on the regeneration site. Infections can be reduced by application of a "biopesticides" based on *Phlebiopsis gigantea* for the applying on the stump surface on the cutting areas (= stump treatment), it's natural (=biological) antagonist to *Heterobasidion* spp..

Appendix IV.

The mechanization level of logging operations

Part I. General information

1. Name of respondent.....
2. Name of enterprise.....
3. Specialization of industry (pulp & paper, logging, wood processing and so on)
.....
4. Age.....
5. Gender Male [] Female []
6. Specialization in education (technical, forestry, economical and so on)
.....
7. Education: Secondary school [] High school []
 Professional college [] High education []
8. Experience in forest sector (in years).....
9. Job status.....

Part II. Specialized questions

- 1) Number of working people
- 2) Volume of harvested m3 per year (or treated m3 for pulp and paper and wood processing)
.....
- 3) Number of harvesters used in thinning and final cutting.....
- 4) Proportion of harvested cubic meters in final harvesting, which made by:
 Harvester m3 Chainsaw m3
- 5) Proportion of harvested cubic meters in thinning operations, which made by
 Harvester m3 Chainsaw m3
- 6) Number of thinnings, which applied during the rotation of the stands
 0 [] 1 [] 2 [] 3 [] 4 []
- 7) Proportion of harvested volume in m3 during the year in periods with snow cover and without:
Winter cutting (1.10-31.03) m3
Summer cutting (1.04-31.09) m3

Description:

- 1) Please take it serious, for me the reliability of the result is very important
- 2) It won't take so much, approximately 10-15 min
- 3) Please read the questions very careful
- 4) In every question choose only one the most relevant answer
- 5) Please fill the answers individually

Appendix V. Comments to the surveys

I. Comments of forestry enterprises

Specified question №6

1. Lack of control for the implementing of efficient protection in the forests, in spite of this there are too much freedom in renting contracts for forest leasers for gaining their own commercial extra benefits, but not concentrating on the main goal of managing of the forests in sustainable way. (Simanova Ekaterina, Pitkyarantsky leskhoz, 27 years old)
2. The new Forest Code has nothing about protection of forests. (Loginov Roman, Pitkyarantsky leskhoz, 33 years old)
3. The new legislation is not accomplished yet, without any attempts of deep analyzing. No real assessment – will it be better or worse? There are a lot of mistakes concerning forest issues. (Buron Ludmila, Lahdenpohsky leskhoz, 56 years old)
4. There is no paper version of Forest Code yet, so we do not know exactly how to deal with that. (Suxoreva Irina, Lahdenpohsky leskhoz, 32 years old)
5. New Forest Code has a lot of negative aspects for the forestry issues, because it is made without any logic. (Kulinova Tatiana, Lahdenpohsky leskhoz, 51 years old)
6. New Forest Code looks like document, without any connections between the parts inside of it, not well developed. (Belova Julia, Lahdenpohsky leskhoz, 49 years old)
7. New Code seems to be “naked” without any connections and relations inside of it. (Asabina Nadegda, Lahdenpohsky leskhoz, 47 years old)
8. It seems for me that the Code made without forestry educated people. (Bevza Galina Lahdenpohsky leskhoz, 48 years old)
9. The Code leads to the collapsing of the whole system. (Chernishova Galina, Lahdenpohsky leskhoz, 40 years old)
10. New Forest Code is adopted, but still is not working out. (Plechanov Alexey, Ladvinsky leskhoz, 24 years)
11. The Code adopted by losers...idiocy. (Krichovcov Vladimir, Suoyarvsky leskhoz, 44 years old)
12. The Code itself is not ready to work and made by non-foresters. (Kondratenko Vladimir, NP Vodlozersky, 52 years old)
13. The new Forest Code is not giving any details yet. (Oskin Dmitry, Pryazhinsky leskhoz, 32 years old)
14. The legislation is not considering the forest health issues in corpore. (Zanko L, Kostomushsky leskhoz, 39 years old)
15. The Code itself can't work yet, too many contraventions. (Porubensky Aleksey, Pudozhsky Leskhoz, 27 years old)
16. The Forest Code, particularly item №55 says about giving responsibilities for the forest health issues to the leaser. (Tatiana, Petrozavodsky leskhoz, 26 years old)
17. The legislation is not giving the full vision of the problems concerning protection and health issues. (Danilov Vladimir, Muezersky leskhoz, 51 years old)
18. The Code contains lack of information concerning controlling of the protection and afforestation of the forests. (Berdjaev F., Muezersky leskhoz)
19. I have not read myself the Forest Code in details. (Shutikova Nadegda, Muezersky leskhoz, 48 years old)

General comments

1. The problem of root and butt rot caused by *Heterobasidion* spp. is not relevant for Karelia. (Ulyanov S., Suoyarvsky leskhoz, 44 years old)
2. The main cause of the butt and root rot is anthropogenic factor. The highest percentage of wood loses caused by incorrect applying of harvesting operation, which causing damages on the stems and root systems. (Migas Alexander, Kondopogsky leskhoz, 30 years old)
3. Some of the questions are made or expressed not correctly. (Mudrov Sergey, Pryazhinsky leskhoz, 40 years old)
4. I'm against of applying the stump treatments, because there's no 100% guarantee that it will be successful. (Os'kin Dmitry, Pryazhinsky leskhoz, 32 years old)
5. Questions №9, 10, 11 and 12 are not precisely formulated. (Nerush Igor, Petrozavodsky leskhoz, 37 years)
6. Questions №4 and 5 are not correct; questions suppose to be asked concerning the situation in leskhoz, but not in the scale of the whole Karelia. (Plechanov Alexey, Ladvinsky leskhoz, 24 years old)
7. Problem with *Heterobasidion* spp. is not significant, because there are a lot of different agents which are more aggressive and wildly expanded. (Danilov Vladimir, Muezersky leskhoz, 51 years old)

II. Comments of scientists

Specified question №6

1. The governance almost took away the responsibilities from forestry enterprises regarding applying forestry operations. (Matushkin V. Forest research institute, 60 years old)
2. All the responsibilities concerning forest activities are given to leasers, but decision making process needed in long term experience and specialization in order to make knowledgeable result finally. (Gavrilov V., Forest research institute, 50 years old)
3. Adopted new forest legislation is not oriented on the forest health issues, no real program is provided. (Ananyev Vladimir, Forest research institute, 60 years old)
4. Many questions are not covered in the new rules about forest health problems. (Krutov Vitalij. Forest research institute, 69 years old)
5. The regulations, which are contained in the Code are not published yet. (Charitonov Alexander, Petrozavodsk State University, 54 years)
6. The actions concerning the procedure of control are not determined. (Uryeva Anna, Petrozavodsk State University, 31 years old)

General comments

1. In the question №4 I could not understand the main idea, so I relied upon of my own experience. (Uryeva Anna, Petrozavodsk State University, 31 years old)
2. The question №12 is not understandable. (Matushkin V. Forest research institute, 60 years old)
3. In my own opinion the health problems is the state responsibility, it should take the control of making afforestation activities and by giving the claims to the leasers. Some of the questions in the legislation have to be reviewed once again. (Gavrilov V., Forest research institute, 50 years old)
4. I'm specializing on the old-growth and drained forests, so I was concentrated on that in aswers. (Ananyev Vladimir, Forest research institute, 60 years old)

The question №2: we have no problems with *Heterobasidion* spp., it is not relevant; question №4: no data; question №5: no data; question №7: no need; question №8: no need. (Krutov Vitalij, Forest research institute, 69 years old)

III. Comments of forest industry

Specified question №6

1. The questions concerning health issues are not well developed yet, lack of research. (Mastrukov A., Karellesproekt, 45 years old)
2. The sanitary conditions of the forests were in competence of forestry enterprises during the long time. The Code is not bringing anything new. (Tishevich Olga, Karellesproekt, 46 years old)
3. The methods in order to improve the forest conditions have not changed. For the leaser there is no economical benefits to treat the stands against *Heterobasidion* spp.. (Sentyabrev Leonid, Karellesproekt, 51 years old)
4. The Forest Code is reflecting very poorly on the forest health problems. (Zapulnikov V., OAO Muezersky LPH, 42 years old)
5. The Code is not describing in details this problem; there are a lot of uncertainties. (Pasledskov S., OAO Kondopozhsky LPH, 60 years old)
6. It is difficult to answer precisely, because the paper version of the Code will appear in the mid of summer. (Juliya, OAO Kondopoga, 22 years old)
7. We have not got all the regulatory documents until the recent moment. (Gurshtin T., OAO LHC Karellesprom, 57 years old)
8. In order to improve the legislation we could give the possibility in the decision making process to the forestry specialists, we have enough of them. (Yasinskaya Elena, OAO Lahdenpohsky LPH, 53 years old)
9. The new legislation should be adopting after consulting with the regional representatives, so regional regulations have to be adopted first. (Grigorjev Andrey, OAO Lahdenpohsky LPH, 33 years old)

General comments

1. I think this topic is useful for the detailed studying. (Pasledskov S., OAO Kondopozhsky LPH, 60 years old)
2. You should emphasize the questions more on the forest health problems, questionnaire looks like separate units. (Mastrukov A., Karellesproekt, 45 years old)
3. Question №11: there is legislation already, regulations concerning the forest health issues. Question №12; stump treatment allowed and recommended, but introducing this method as obligatory everywhere in Russian Federation in the current situation seems to be impossible due to many factors.
4. Implementation of the Forest Code is collapsing the traditional system of forestry activities and previous experience. I have negative attitude to the new legislation. (Tishevich Olga, Karellesproekt, 46 years old).
5. Question №12: the meaning of the questions is not clear (Petrukh Inkeri, Karellesproekt, 42 years old)
6. You need to reformulate question №12, because there's no problem of legalization of biopesticide, but there is problem of applying it obligatory according to the sanitary conditions. (Sentyabrev Leonid, Karellesproekt, 51 years old)
7. The problem concerning *Heterobasidion* spp.. is not relevant. During 20 years of working in the Petrozavodsky leskhoz, only one clear-cutting was harvested because of it (about 30 ha). There are many other agents more harmful, which are

causing different types of decaying. (Voronkova G., Upravlenie Rosprirodnadzor po RK, 43 years old)

8. I think that is not objective if I am evaluating myself. (Juliya, OAO Kondopoga, 22 years old)
9. Question №7: Leskhoz and leaser have to share responsibilities, because all the forests are still state owned and maintaining them in good sanitary conditions is owner's interest. Question №5: from 0-3%, this corresponds to total amount of losses, not only to the spruce volume. (Gurshtin T., OAO LHC Karellesprom, 57 years old)