Response reaction of Scots pine *Pinus sylvestris* L. after forest fire in forest site type *Vacciniosa turf. mel.* in Klīve forest district

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Background information

Scots pine *Pinus sylvestris* L. is one of the three economically significant tree species in Latvia occupying 35% (1,003,625 ha) of the Latvian forests. The statistics of forest fire in Latvia over last twenty years show that occasionally extreme of fire are observed. In 2006 when the last extreme of fire was observed 3.8 thousand ha or 0.13% of Latvian forests suffered from fire. It is expected that within the next 100 years air temperature in Latvia in spring and summer - the most inflammable period - will increase on average by 3°C and 2 °C respectively so it is necessary to pay more attention to forest fires and to analyse their impact on forest stand.

The topic is current because in the scale of Latvia there is no significant research about the fire impact on radial growth of trees.

Objective

The aim of the study is to evaluate the impact of forest fire on the growth of middle-aged Scots pine growing in forest site type *Vacciniosa turf.mel.*

It was reached caring out tree scientific tasks: comparison of the proportion of tree mortality in the area affected by fire and unaffected area of the stand, analysis of the impact of forest fire on the radial growth of trees as well as assessment of stand sanitary conditions affected by fire and unaffected area of the stand.

Methodology

Researched forest stand covers an area are 4 ha. Nine years ago in 2004 there detected a forest fire. A fire type – creeping ground fire combined with shallow subsurface fire, burnt area – 2 ha. The thickness of peat layer there was of an average of 22 cm.

Empirical data material was collected in five circular plots in the forest stand part affected by fire and five in unaffected part of the stand, each 500 m^2 large. For all of the trees in each plot diameter 1.3 m above root collar was measured, Kraft class was determined, for 25 trees drilling towards to the centre of the plot at the height of 1.3 m above the root collar using Pressler borer was made and tree height of all bored trees was measured. Maximum height of scorching was measured; trees with insect damage, bark openings at the root collar caused by fire, trees with exposed roots and cracked barks were listed. Height at the root collar, length and width of the cracked barks were measured. During data processing there was used computer software developed in Latvia University of Agriculture - VidesFIV (Evaluation of Environmental Factors' Impact).

Results

Comparison of the amount of tree mortality in fire affected part and unaffected part of the stand

Fire impact on the mortality of trees in forest stand is not significant in this object. Is confirmed by analysis of variance ($F_{stat.} = 0.29 < F_{crit.} = 5.32$, $p = 0.607 > \alpha = 0.05$).

| Sample plots (SP)	Total number of trees measured in SP, pcs.	Number or healthy trees in SP, pcs.	Number of dead trees		Amount of dead trees, %	Volume of mean tree, m^3	Deadwood volume, m^3 ha^{-1}
			in SP, pcs.	pcs. ha^{-1}			
Fire affected part of the stand	219	212	7	28	3.2	0.4629	13.0
Fire unaffected part of the stand	196	191	5	20	2.6	0.4584	9.2
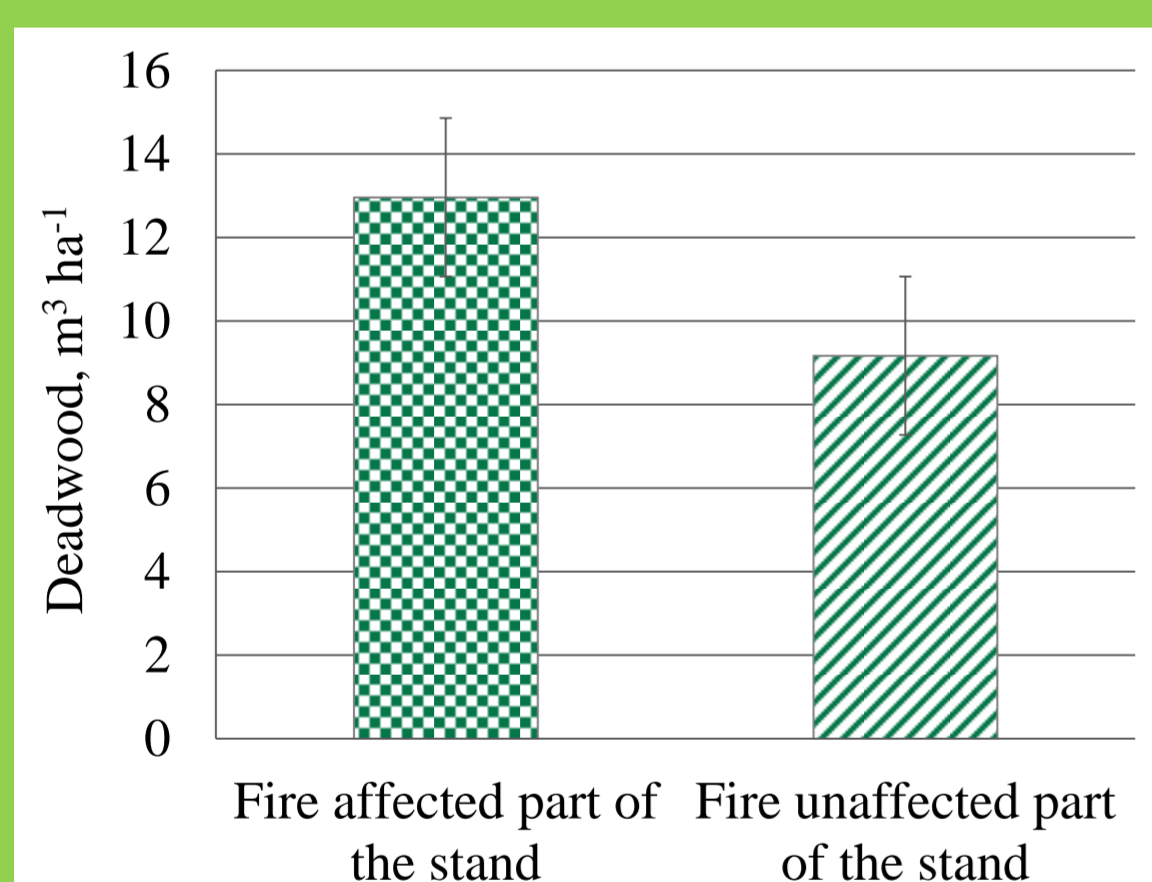
Graphical representation of comparison of deadwood volume shows that there is no significant difference between tree mortality in fire affected and fire unaffected area ($\alpha = 0.05$).

Forest fire impact on the dynamics of radial growth of tree stand

Changes of the overall width of annual rings in the fire affected plots and unaffected plots showing that forest fire has negative effect on radial growth of the stand.
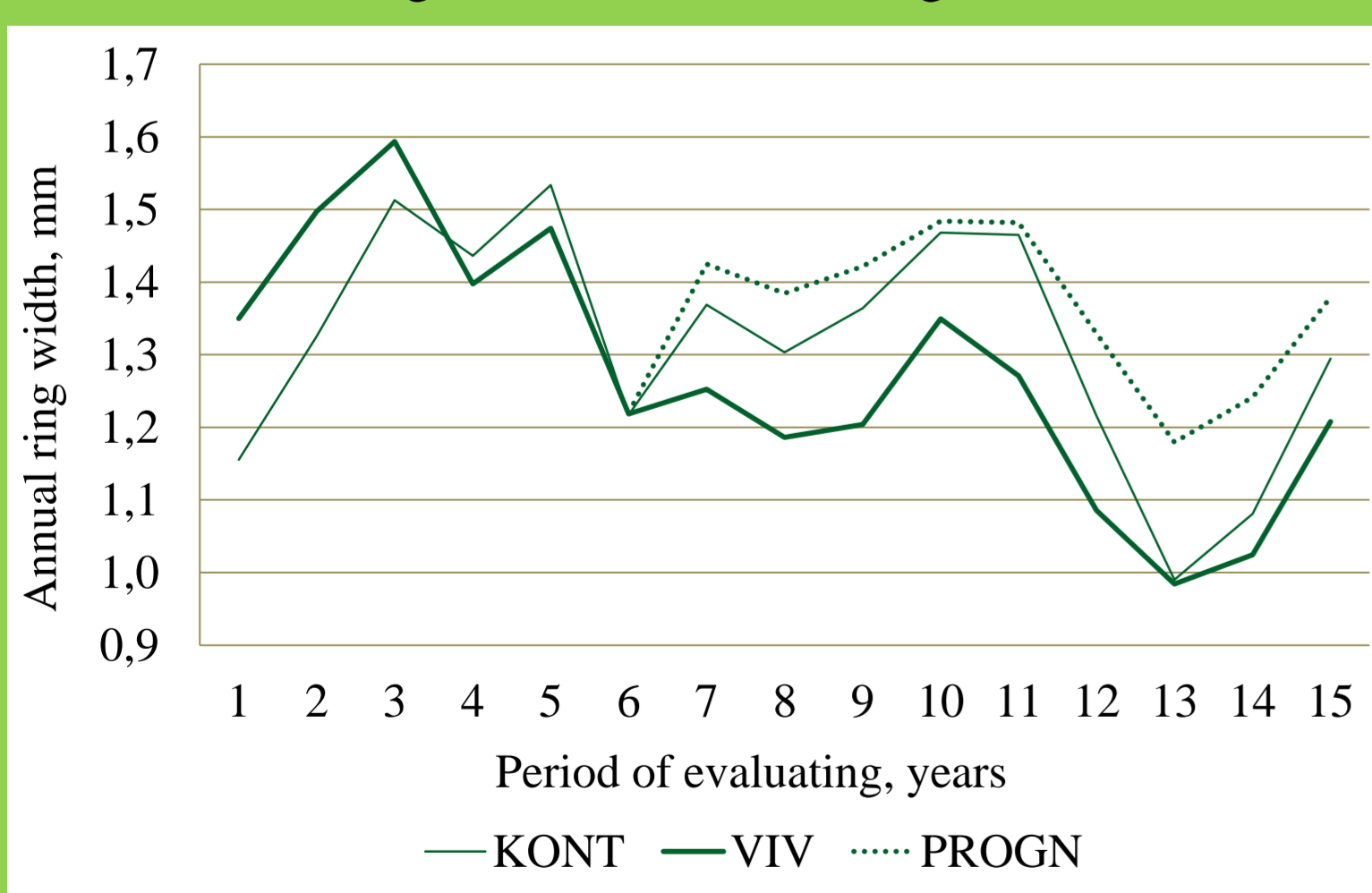

Thinline shows the width of annual rings of control stand (KONT), black line – widths of annual rings of trees affected by fire (VIV) but dash line – predicted widths of annual rings in the absence of fire impact. On the X-axis interval of years when annual rings were measured is given - the first six years is the period of retrospection but the next nine years is the period of the assessment of fire impact. On the Y-axis the widths of annual rings are given.
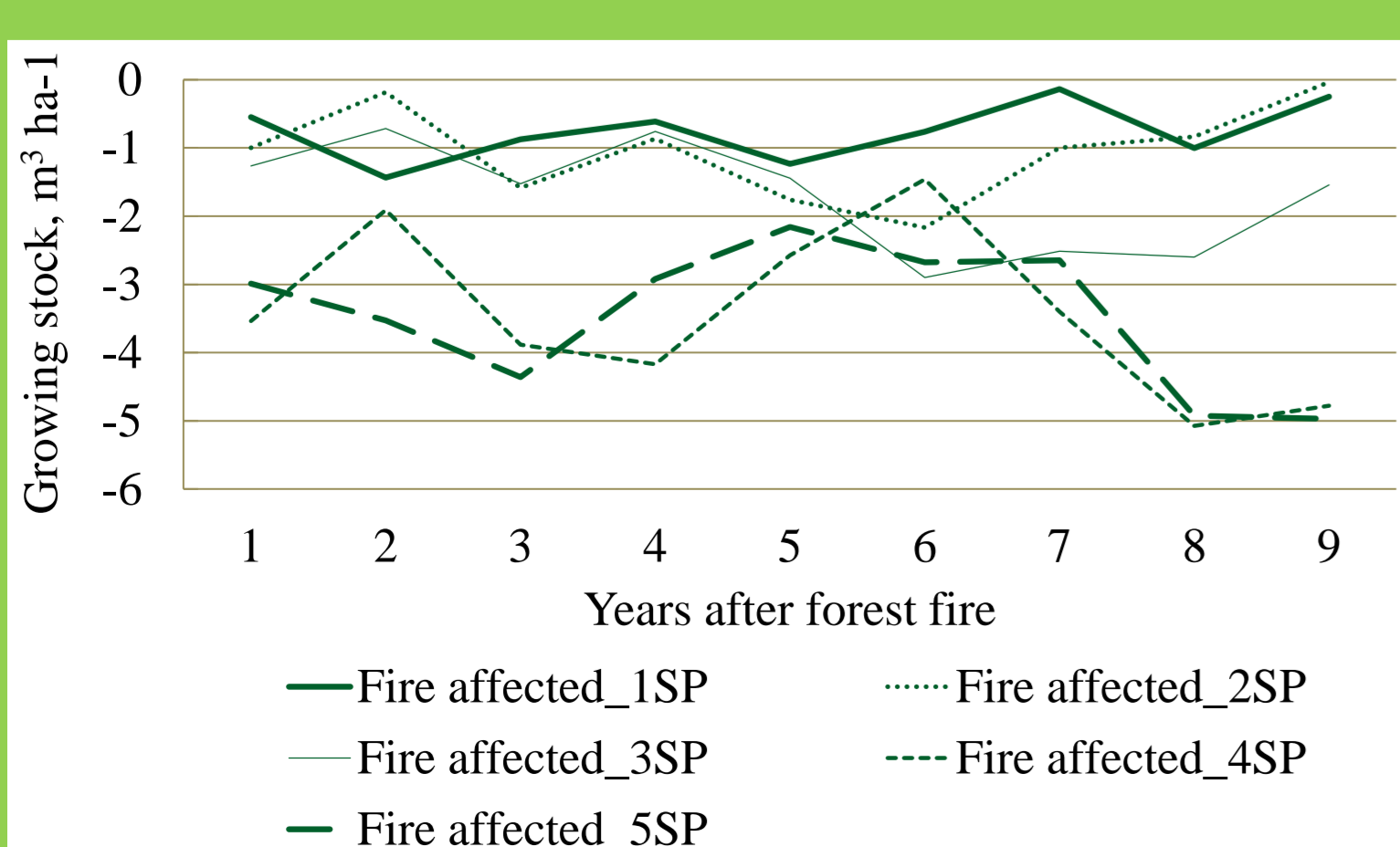
The effect of fire impact illustrates the negative impact of forest fire on trees in the research object. Plots are encrypted under the following names: the first plot in fire affected area - „ Fire affected_1SP", the second – „ Fire affected_2SP" and as follows.

As the result of forest fire an average of 2 m^3 ha^{-1} of additional growth are lost every year, in nine years since the forest fire makes a total of 18.7±0.21 m^3 ha^{-1}.

Sanitary conditions in the fire affected part and unaffected part of the stands territory
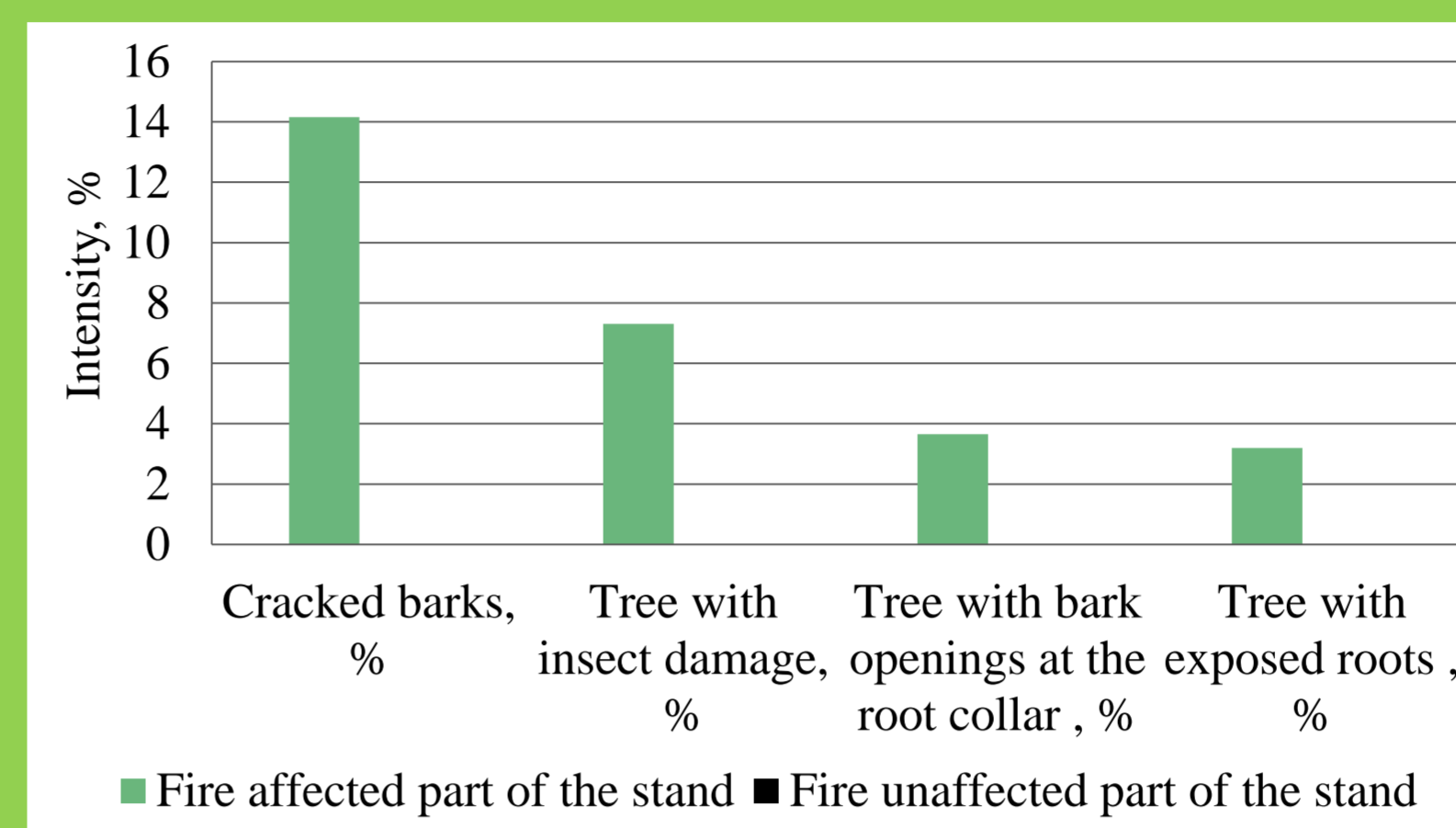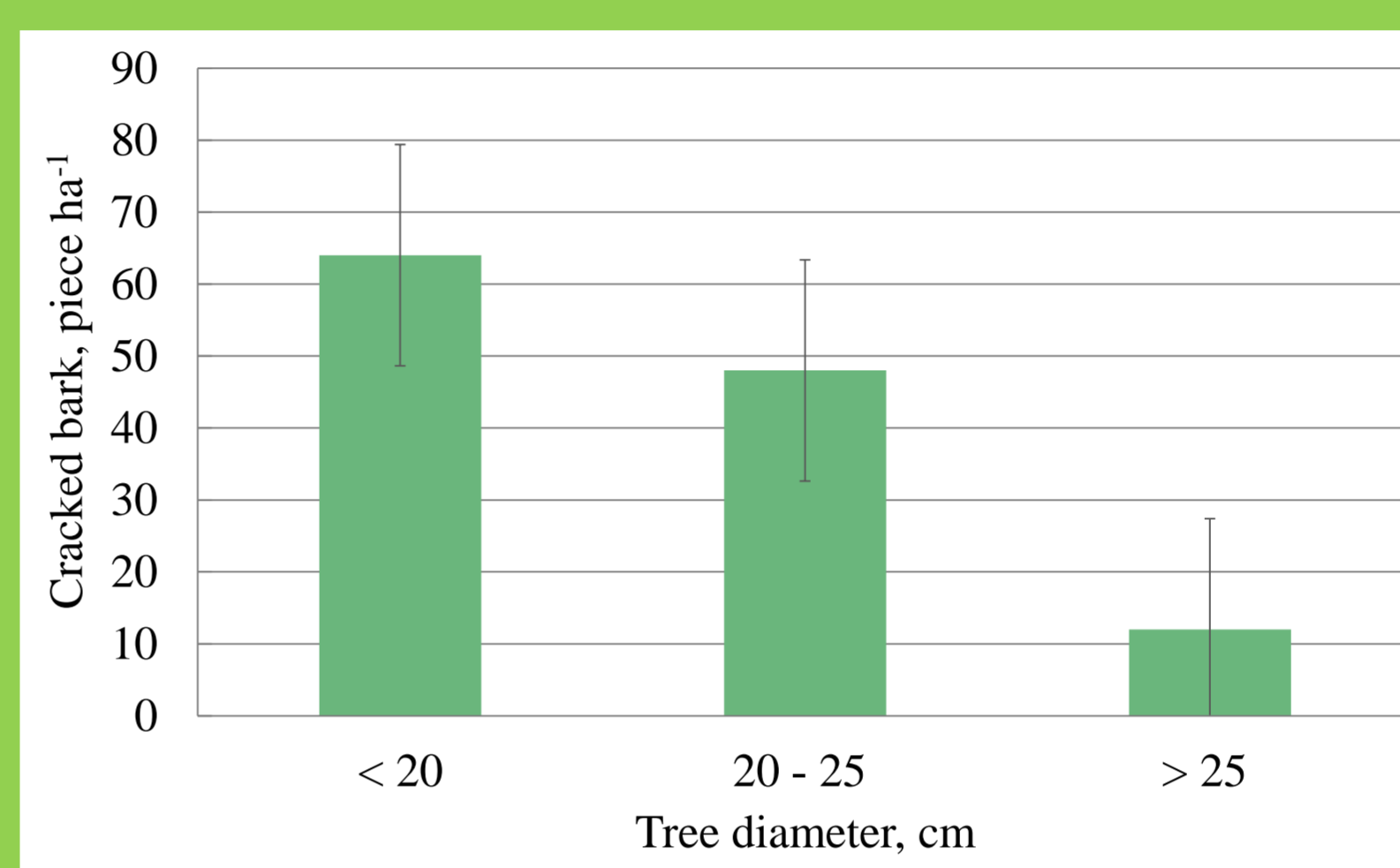

The sanitary conditions in fire unaffected area are good, but in fire affected part of the stands is observed not so good sanitary conditions.
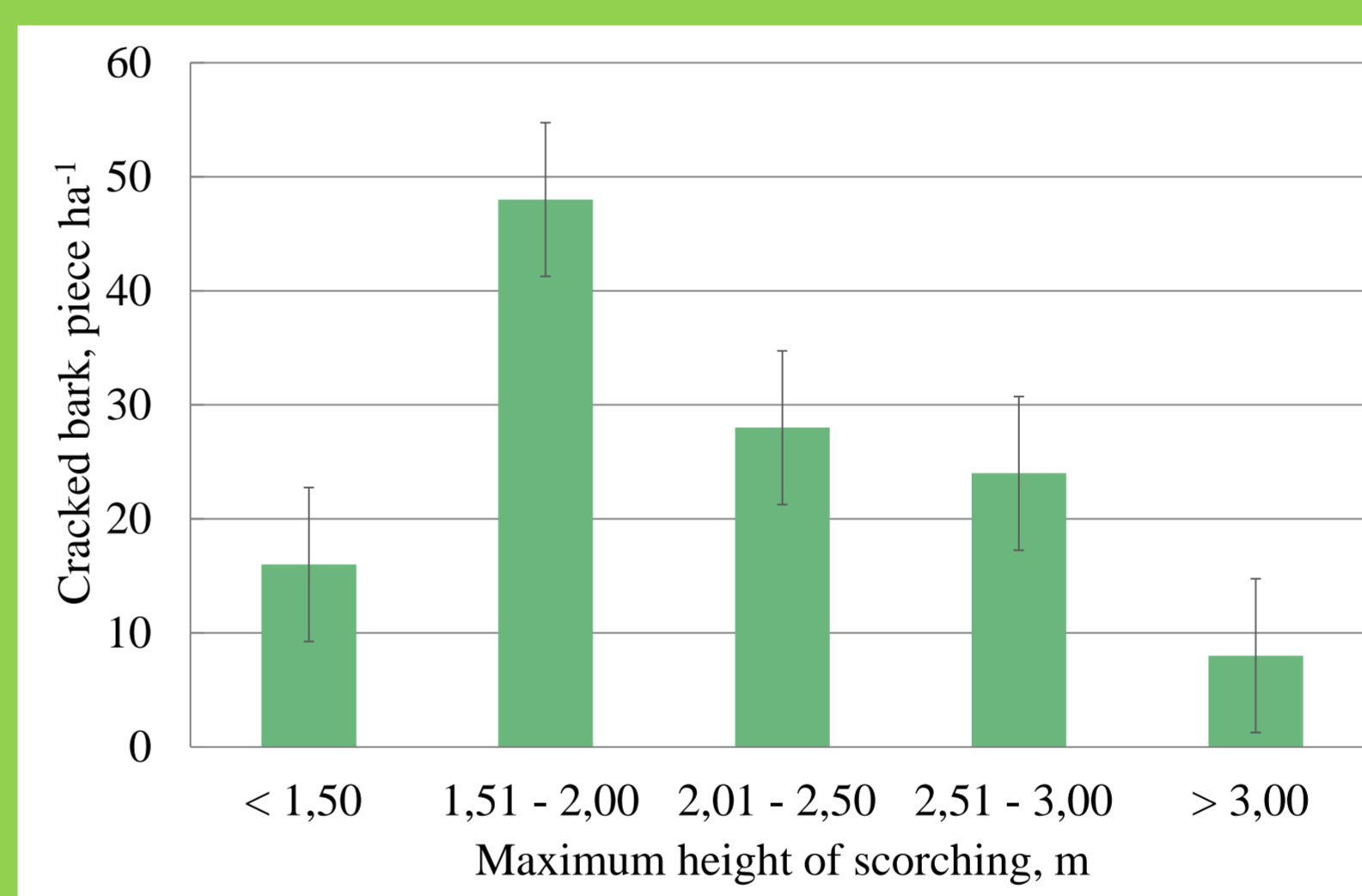
Cracked bark is opened, by bark unprotected wood which is bounded by wood lumps and formed in the result of mechanical abrasion of bark, as well as in the result of fire.

Craked bark. Photo by L. Freimane, 2012.

Number of cracked barks ($N\pm S_{\overline{x}}$) in diameter rating groups

Number of cracked barks ($N\pm S_{\overline{x}}$) in the groups of maximum height of scorching

As the most common damage is cracked bark incidence of it in different tree diameter and maximum height of scorching groups was analysed.

Evaluating different diameter groups it should be marked that cracked barks are the most observed in group up to 20 cm and 20-25 cm but analysing cracked bark by maximum height of scorching the most part of cracked barks was observed in height group 1.51 to 2.00 m.

Dead wood and lost potential wood increase after forest fire in the evaluated forest stand reach 704.14 LVL i.e. 950.25 EUR.

Lost timber volume, m^3 ha^{-1}	Timber price, m^3, LVL	Timber price, m^3, EUR	Potential loss, LVL	Potential loss, EUR	Total potential loss, LVL	Total potential loss, EUR
Lost potential wood increase after forest fire	18.7±0.21	27.00	38.16	504.90±5.67	713.64±8.01	704.14	950.25
Volume of dead wood	7.4	27.00	38.16	199.24	281.61		

Conclusion

1. In researched stand forest fire does not significantly affect the amount of tree mortality ($F_{stat.} = 0.29 < F_{crit} = 5.32$, $\alpha = 0.05$).

2. In the fire affected part the annual tree rings is narrower than in unaffected part of the stand, difference reach 0.18±0.030 mm.

3. Forest fire has a negative effect on the growth of researched stand. Each year the average wood loss reaches 2 m^3 ha^{-1}. Nine years after the forest fire forest owner has already lost 18.7±0.21 m^3 ha^{-1} or 704.14 LVL i.e. 950.25 EUR from the stand.

4. Fire exposure in researched stand not only has a negative impact on growth but it also worsens sanitary condition of stand. After forest fire caused cracked barks (14%), insect damage (7%), bark openings at the root collar (4%) and exposed roots (3%) are observed.

5. The number of cracked barks is significantly different in several diameter groups and maximum height of scorching groups.

6. Most cracked barks are found in diameter groups up to 20 cm and 20-25 cm and the maximum height of scorching group from 1.51 m to 2.00 m.