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HEALTH STATUS OF FOREST EVEN – AGED STANDS ON AREA OF EASTERN BOSNIA

Zdravstveno stanje šumskih kultura na području Istočne Bosne

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Abstract

Total of 125,479 ha of different stated owned forest cultures were registered in the territory of Bosnia and Herzegovina (1990). Stability of forest even – aged stands and forest communities in genera has been endangered by damaging biotic and abiotic factors of local and global nature. The biggest damages on forest cultures have been caused by insects and fungi, biotic factors, and snow and wind, abiotic. The negative influence of global factors, that is, global climate changes has recently stood out.

The aim of this research was to determine of health status of forest even – aged stands. Research for the purpose of this work has been carried out in the territory of Forest management Jahorina, Pale with three forest even – aged stands: Norway spruce, Scots pine and forest even – aged stands of other coniferous (European larch and Douglas fir).

Research included 796 trees of Norway spruce, Scots pine, European larch and Douglas fir.

Presence of insects was identified on 15,58%; fungi on 2,14%, and mechanical damages on trunk and/or crown 11,06% of the total number of examined trees. Of the total number of examined trees, the share of mechanical damages on trunk and/or crown of trees is as follows: first crown, and then trunk. Share of trees with mechanical damages on both crown and trunk is rather small. Identified damaging biotic and abiotic factors do not cause significant damages on the analyzed forest even – aged stands.

Key words: *Norway spruce, Scots pine, European larch, Douglas fir, insects, fungi, mechanical damages, health status.*

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INTRODUCTION – *Uvod*

The forest even – aged stands represent communities raised artificially, by forestation or artificial rejuvenation, reconstruction or substitution (BODRUŽIĆ ET AL., 2011). Based on records dated 31 December 1990, the presence of 125,479 ha state owned forest even – aged stands were registered in Bosnia and Herzegovina (MUSIĆ, 2005).

Stability of forest even – aged stands and forest communities in general was endangered by effects of various damaging biotic and abiotic factors of local and global nature, resulting in disrupting basic forest functions as eco system: environmental, economic, and sociological. At local level they are: plant diseases (parasite fungi, phytopathogen bacteria, viruses, nematodes, parasitic flowering plants, etc.), insects, climate factors (extreme temperatures, snow, wind), local pollution (air-pollution, presence of damaging pollutants and heavy metals in soil and vegetative parts of plants) (KARADŽIĆ, 2008; TABAKOVIĆ ET AL., 2006).

Mistakes in economic management of forests in the past, lack of protective economic measures during last several decades influenced weakening of stability of forest eco system, which in the natural process of bonding of damaging agents allowed massive occurrence of diseases and pests (USČUPLIĆ AND DAUTBAŠIĆ, 1998). Generally speaking, it may be stated that the forest of Bosnia and Herzegovina are of rather poor health. Causes could be numerous, and some are hereditary. The health status has deteriorated nowadays so much that the destabilization and devastation of forests is current threat. The damage caused by bark beetle is particularly expressed (USČUPLIĆ AND DAUTBAŠIĆ, 1998).

As for the factors endangering stability of forest eco systems, the global thinking refers to climate changes (TABAKOVIĆ ET AL., 2006).

Damaging effect of these factors has been even more expressive on forest cultures as compared to natural one, of various age and mixed communities due to some specifics of production of wood mass in forest cultures. The most relevant shortcomings of forest cultures that reduce their resistance to the damaging effect of biotic and abiotic factors compared to natural forests are: raising single-age communities, raising single culture communities and raising species outside the area of natural communities.

The most important biotic factors that can endanger health of forest cultures and forest eco systems are: insects (KOLK AND STARZYK, 1996; STARZYK, 1999) and parasite fungi (DESPREZ-LOUSTAU ET AL., 2006). Insects are permanent members of forest eco system that do not affect negatively forests if their number is normal, as they only inhabit physiologically weak trees and dead trees. However, if insects over-multiply, they become primary pests and inhabit completely healthy trees causing large damage in forest communities. Consequences of damages on plants by damaging forest insects are: physiological weakness, deformation, lack of reproductive force and reduction of seed number, loss in growth and drying of plants.

The forest professional in Serbia face huge entomological problems, that is, damage caused by insects in natural forests, forest cultures, and trees of the species of *Picea, Pinus*, and *Abies* (MIHAJLOVIĆ, 2008).

Special attention in protection of natural communities and forest cultures should be focused on alochtonous species of insects and fungi, which in the area outside their natural spread cause significant damage as they have no natural enemies (MIHAJLOVIĆ AND STANIVUKOVIĆ, 2009).

In addition to insects, health status of forest cultures may be endangered by fungi. The phytopathological problems in the forest even – aged stands of Austrian and Scots pine in Serbia and Bosnia and Herzegovina have been investigated and identified parasite fungi causing greatest damage (KARADŽIĆ AND STANIVUKOVIĆ, 2010).

The most important abiotic factors that may endanger health status of forest even – aged stands and forest eco systems are: extreme temperatures, snow, wind, air pollution, damaging pollutants and heavy metals above critical concentrations in soil and vegetative parts of plants (KARADŽIĆ, 2008; TABAKOVIĆ ET AL., 2006). The importance of global factors that disrupt stability of forest eco systems has been emphasized lately. These factors are global climate changes (TABAKOVIĆ ET AL., 2006). According to (LIOVIĆ AND ŽUPANIĆ, 2005), the notion global climate changes pertain to warming caused by anthropogenic increase of quantity of greenhouse gas emissions, which initiates ample negative effects on forest eco systems and positive effects on distribution and physiological status of insects and causes of plant diseases.

The forest fires play special role in forest helath of health status of forest even – aged stands and forest ecosystems (GLAVAŠ, 2013).

The latest research of the issue of forest deterioration include synergetic effects of climate changes, gradation of pests and air pollution. Analyzing reasons for drying of spruce in Croatia, concluded that current drying of spruce in Croatia is caused by extreme draught, unfavorable "chemical climate" and acid rains, and their spreading on inappropriate habitats along with inappropriate growth and regeneration (MATIĆ, 2011).

The aim of this study is determine the health status of forest even – aged stands and forest ecosystems on the Eastern Bosnia area.

MATERIAL AND RESEARCH METODS – *Materijal i metode istraživanja*

Research was carried out in the territory of Forest management Jahorina, Pale located in the eastern part of Bosnia and Herzegovina and covers the state owned forests of the municipality Pale. Total space of state owned forests and forest ground is 31,314.23 ha, and space of forest cultures is 1.418.24 ha.

Given that the pure and mixed forest even – aged stands of Norway spruce, Scots pine, Austrian pine and other coniferous (European larch and Douglas fir) are found in the territory of Forest management Jahorina, Pale, during the selection of

forest even – aged stands which would be subjected to research, one forest even – aged stands of Norway spruce was selected, as well as one forest even – aged stand of Scots pine and one that was registered as class of « forest even – aged stand of Scots pine and Austrian pine in the forest of mountain oak", which includes a large share of other coniferous like European larch and Douglas fir, for which reason this culture was selected. Given their age, all the forest even – aged stands in this area belong to two classes of age: "0-20" years and "21-40" years. Forest even – aged stands subjected to research were in the "21-40" class of age.

An experimental plot was placed in the selected forest even – aged stands, rectangle in shape of 100 m x 50 m dimension. Every plot registered trees belonging to the sample and they were marked with numbers at the breast height. Bordering trees were taken and omitted in turn from the sample. After the sample was set and trees registered, they were carefully examined. Tree examination in the experimental plot was carried out in July, August, and September 2012.

Data for the entire experimental plot ware gathered during the research, and for every individual tree inside the plot, and they were registered in manuals for data gathering. Following records were registered: general data on experimental plot (forest management, management unit, department, section, management class, age class); field characteristics of the experimental plot (exposition, angle, shape of micro relief); data on examined trees (number of examined trees, share of mixture, level of soil coverage by tree crowns); date on nursing care measures (cleaning of deciduous trees from the ground floor, alignment, forest line). Following data were registered for every individual tree: number, type, social position, and physiological status of tree. Then, mechanical damages and presence of plant diseases and/or insects were identified. Samples were taken from infected trees (developing stadium of insect and fungi) which were analyzed and determined in detail.

Identification harmful organisms were in laboratory on Faculty of Forestry University on Sarajevo.

RESULTS – *Rezultati*

Research health status of Norway spruce, Scots pine, European larch and Douglas fir was conducted on example of 796 trees.

The structure of number trees according to species and harmful organisms are shown in table 1 and chart 1.

Table 1: The structure controlled of trees according to species and harmful organisms
Tabela 1: Raspodjela pregledanih stabala prema vrstama drveća i štetnim agensima

	Species of trees	Density of trees	Number of examined trees	Registered presence of insects	Registered presence of fungus	Registered presence mechanical damages of stem or crown
Forest even – aged of Norway spruce	Norway spruce	1,0	291	78	2	37
	Total	1,0	291	78	2	37
Forest even – aged of Scots pine	Scots pine	1,0	340	23	7	28
	Total	1,0	340	23	7	28
Forest even – aged of other conifers	Scots pine	0,2	34	1	0	2
	European larch	0,6	95	22	3	17
	Douglas fir	0,2	36	0	5	4
	Total	1,0	165	23	8	23
Total			796	124	17	88

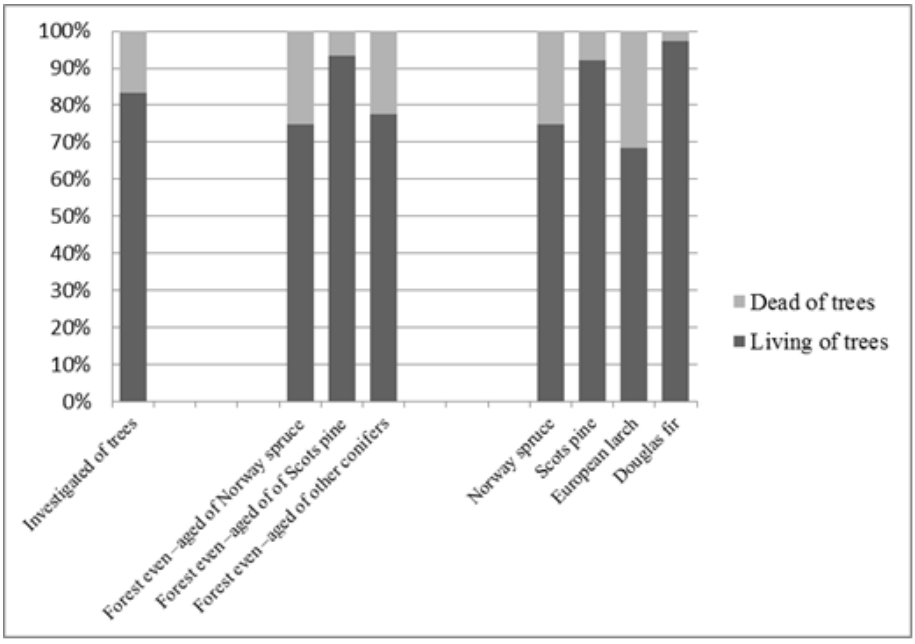

Chart 1: The structure of trees according to physiological status of tree
Grafikon 1: Raspodjela stabala prema fiziološkom statusu

The structure of trees in percentage according to species of trees and harmful organisms are shown in chart 2., the structure of trees according with mechanical damages and according to type damages are shown in chart 3.

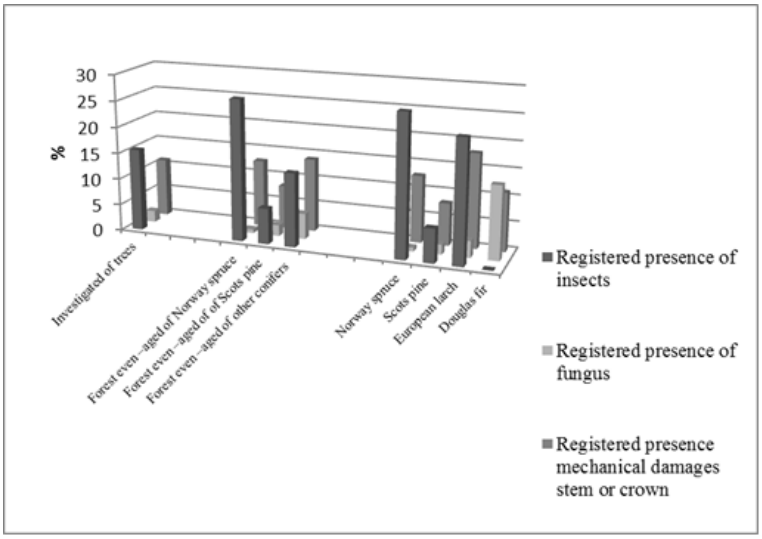

Chart 2: The structure of trees according to species of trees and registered presence of insects, fungus and machanical damages

Grafikon 2: Procentualna struktura stabala prema vrsti drveća i registrovanim prisustvom insekata, gljiva i mehaničkim oštećenjima

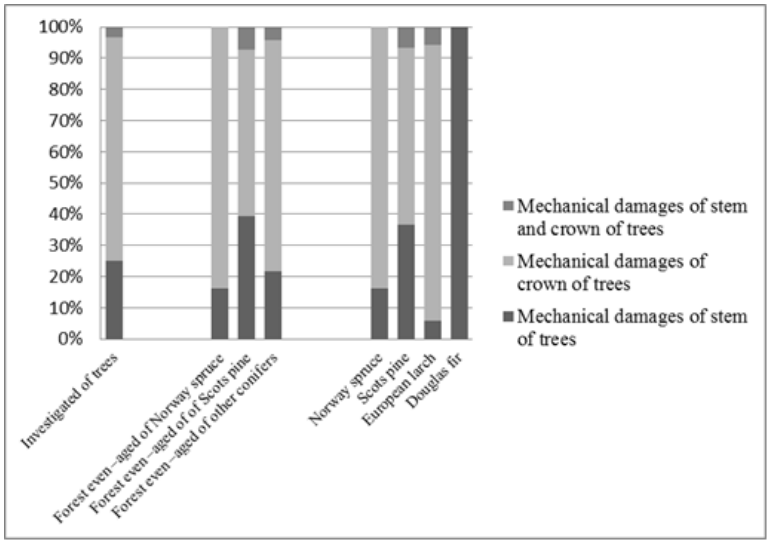

Chart 3: The structure trees with mechanical damages according to type of damages

Grafikon 3: Struktura stabala sa mehaničkim oštećenjima prema kategoriji oštećenja

DISCUSSION – *Diskusija*

Research included 796 trees of Norway spruce, Scots pine, European larch and Douglas fir in selected forest cultures. The ratio of mixture was determined for each type of trees, number of trees per registered presence of insect type, number of trees with registered presence of fungi per type of tree and number of trees with registered mechanical damages on trunk and/or crown of trees (Table 1).

During the field research, the physiological status was determined for every tree. According to criterion "physiological status of tree", trees were classified into two groups: "live trees" and "dried standing tree". Lie trees had 83.29% share in the total number of examined trees. The biggest percentage of live trees was registered in the forest even – aged stands of Scots pine and Douglas fir, and the smallest in the forest even – aged stands of Norway spruce and European larch (Chart 1).

Presence of the following insects was registered in the examined forest even – aged stands: *Pityogenes chalcographus* L. on Norway spruce (KNIZEK ET AL., 2005), *Chermes viridis* Ratz. on Norway spruce, *Polygrahus polygraphus* L. on Norway spruce, *Dendrolimus pini* L. on Scots pine, *Diprion pini* L. on Scots pine, *Coleophora laricella* Hb. on European larch, *Acantholyda* sp. on Scots pine, *Leucaspis* sp. On Scots pine, *Cerambycidae* on Scots pine, Norway spruce, and European larch, and *Scolytidae* on Scots pine.

Based on the research in forest even – aged stands and natural habitats of pine, spruce, and fir in Serbia MIHAJLOVIĆ, 2008) and results of investigation other autors (KOLK AND STARZYK, 1996; STARZYK, 1999) pointed out the most dangerous insects for forest even – aged stands of Norway spruce: *Chermes viridis* Ratz. and *Pityogenes chalcographus* L., and *Neodiprion sertifer* Geoffr., *Diprion pini* L. and species from the family *Scolytidae* (*Blastophagus piniperda* L., *Blastophagus minor* Hart., *Ips sexdentatus* Boern. and *Ips acuminatus* Gyll.) in the forest even – aged stands of pine. According to (MIHAJLOVIĆ AND STANIVUKOVIĆ, 2009) the registered *Coleophora laricella* Hb. in Bosnia and Herzegovina, in the area of Borje Teslić (Hajdučke vode) and Šeković (Bišina).

Following fungi were registered during the research of forest even – aged stands: *Fomitopsis pinicola* (Fr.) Karst on Norway spruce and European larch, *Phaeolus schweinitzi* (Fr.) Pat. on Norway spruce, *Lophodermium pinastri* (Schrad) Chév on Scots pine, *Trichaptum abietinum* (Pers.:Fr.)Ryvarden on European larch, and *Phaeocryptopus gäumannii* Rohde on Douglas fir.

According to (USČUPLIĆ, 1996; USČUPLIĆ, 2004) fungi *Fomitopsis pinicola* (Fr.) Karst, *Phaeolus schweinitzi* (Fr.) Pat. and *Trichaptum abietinum* (Pers.:Fr.) Ryvarden cause decay on coniferous trees in Bosnia and Herzegovina. He also stated that fungus *Fomitopsis pinicola* (Fr.) Karst is the most relevant destructing fungus, for which reason it is referred to as cleaner of forests. According to (USČUPLIĆ, 1996) fungus *Phaeocryptopus gäumannii* Rohde can be found on all trees of Douglas fir in Bosnia and Herzegovina, without any negative effect for the development of trees. According to (KARADŽIĆ AND STANIVUKOVIĆ, 2010), fungus *Lophodermium pinastri*

(Schrad) Chév is one of the species which causes the worst damage in the forest even – aged stands of Austrian pine and Scots pine in Serbia and Bosnia.

The detail data for fungus on Scots pine, Norway spruce and Silver fir are presented (GLAVAŠ, 1981, 1992; GLAVAŠ AND DIMINIĆ 2001 AND DIMINIĆ ET AL. 1996).

Presence of insects was registered on 15.58% of the total number of examined trees; fungi on 2.14% of total number of examined trees.

Differences were analyzed in percentages and compared to the trees with registered presence of insects or fungi per different types of trees and analyzed forest even – aged stands.

The biggest percentage of infected trees was registered in forest even – aged stands of Norway spruce, and the smallest in the forest even – aged stands of Scots pine (Chart 2). The biggest percentage of infected trees was registered on the trees of Norway spruce, and the smallest on the trees of Scots pine. Insects were not registered on Douglas fir (Chart 2). The biggest percentage of infected trees was registered on the forest even – aged stands of other coniferous, and the smallest on the forest even – aged stands of Norway spruce (Chart 2).

The most frequent damaging organism in the forest even – aged stands of Norway spruce is *Chermes viridis*, in the forest even – aged stands of Scots pine *Leucaspis* sp., and in the forest even – aged stands of other coniferous the species from the family *Cerambycidae*.

Presence of mechanical damages on trunk and/or crown was registered on 11.06% of the total number of examined trees.

The biggest number of damaged trees was registered on the forest even – aged stands of other coniferous, and the smallest on the forest even – aged stands of Scots pine (Chart 2). The biggest percentage of damaged trees was registered on larch-tree, and the smallest on Scots pine.

As for the total number of trees with registered mechanical damages on trunk and/or crown, the biggest percentage goes to trees with mechanical damages of crown, then trees with mechanical damages on trunk. Share of trees with mechanical damages on trunk and crown is insignificant (Chart 3). The same results have been found in other authors (ZUBIZARRETA-GERENDIAIN ET AL., 2012).

Percentage of trees with mechanical damages on crown is the biggest on the forest even – aged stands of Norway spruce and the trees of spruce. The examination of forest even – aged stands of Norway spruce identified the level of covering of soil by crowns of the community 1,0, for which reason trees in community have a good slenderness, and the breaking of crowns occur under the influence of snow.

Percentage of trees with mechanical damages of the trunk is the biggest in the forest even – aged stands of Scots pine (Chart 3).

During the field research, social status of trees was identified for every tree. According to criterion “social status of a tree”, trees were classified in two groups: “dominant floor” and “ground floor”. Insects were registered on the trees of dominant and ground floor in almost equal percentages. Fungi were registered on trees of dominant floor in a major percentage as compared to the trees of ground floor.

Mechanical damage of trunk and/or crown were registered in bigger percentage on the trees of ground floor than on the trees of dominant floor.

CONCLUSIONS – *Zaključci*

During the research on forest even – aged stands of Norway spruce, Scots pine and other coniferous, damaging biotic and abiotic factors endangering stability of forest even – aged stands were identified. The analyzed forest even – aged stands identified presence of following species of insects: *Pityogenes chalcographus* L., *Chermes viridis* Ratz., *Polygrahus polygraphus* L., *Dendrolimus pini* L., *Diprion pini* L., *Coleophora laricella* Hb., *Acantholyda* sp., *Leucaspis* sp., *Cerambycidae*, and *Scolytidae* and fungi: *Fomitopsis pinicola* (Fr.) Karst, *Phaeolus schweinitzi* (Fr.) Pat., *Lophodermium pinastri* (Schrad) Chév, *Trichaptum abietinum* (Pers.: Fr.) Ryvarden, and *Phaeocryptopus gäumannii* Rohde.

Insects *Pityogenes chalcographus* L., *Polygrahus polygraphus* L., *Cerambycidae*, and *Scolytidae* and fungi *Fomitopsis pinicola* (Fr.) Karst, *Phaeolus schweinitzi* (Fr.) Pat., and *Trichaptum abietinum* (Pers.: Fr.) Ryvarden were registered on mechanically damaged trees, dried standing trees due to competing relations in the community and other physiologically weak trees, and it may be concluded that these insects and fungi do not cause significant damages in forest even – aged stands.

Insects *Chermes viridis* Ratz., *Dendrolimus pini* L., *Diprion pini* L., *Coleophora laricella* Hb., *Acantholyda* sp., *Leucaspis* sp. and fungi *Lophodermium pinastri* (Schrad)Chév and *Phaeocryptopus gäumannii* Rohde are primary pests which occur on completely healthy trees. However, intensity of the attack by these species of insects on fungi against individual trees is weak, so that it may be concluded that they do not cause significant damage on forest cultures.

The most frequent damaging organism in the forest even – aged stands of Norway spruce is *Chermes viridis*, in the forest even – aged stands of Scots pine *Leucaspis* sp., in the forest even – aged stands of other coniferous species from the family of *Cerambycidae*.

As for the total number of trees with registered mechanical damages on trunk and/or crown, the biggest percentage goes to trees with mechanical damage on the crown. Percentage of trees with mechanical damage on the crown is the biggest in the forest even – aged stands of Norway spruce.

In this forest even – aged stands, the level of coverage of ground with the tree crowns is so big that it causes breakage and damages of crown under the influence of snow.

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SAŽETAK

Na području Bosne i Hercegovine registrovano je ukupno 125 479 hektara raznih šumskih kultura u državnoj svojini (1990. godina). S obzirom na to da se ś ciljem povećanja površina pod šumama i proizvodnje drvne mase, podižu nove šumske kulture prvenstveno autohtonih i alohtonih četinarskih vrsta drveta, neophodno je istraživati faktore koji narušavaju njihovu stabilnost i onemogućavaju ostvarivanje osnovnih funkcija šume kao ekosistema: ekoloških, ekonomskih i sociooloških. Stabilnost šumskih kultura i šumskih sastojina uopšte, ugrožena je djelovanjem raznih štetnih biotskih i abiotskih faktora lokalne i globalne prirode. Najveće štete u šumskim kulturama uzrokuju insekti i gljive od biotskih faktora, te snijeg i vjetar od abiotskih. U posljednje vrijeme se sve više ističe negativan uticaj globalnih faktora, odnosno globalnih klimatskih promjena.

Istraživanje za potrebe ovog rada provedeno je na području Šumskog gazdinstva "Jahorina" Pale u tri šumske kulture: šumskoj kulturi smrče, šumskoj kulturi bijelog bora i šumskoj kulturi ostalih četinara (ariš i duglazija). U odabranim šumskim kulturama postavljena je ogledna ploha u obliku pravougaonika, dimenzija 100 m x 50 m. Tokom istraživanja prikupljeni su podaci za oglednu plohu u cjelini, kao i za svako pojedinačno stablo unutar ogledne plohe. Istraživanje je provedeno tokom jula, avgusta i septembra 2012. godine.

Istraživanjem je obuhvaćeno 796 stabala smrče, bijelog bora, ariša i duglazije. Procentualni udio živih stabala je 83,29% od ukupnog broja pregledanih stabala. U analiziranim šumskim kulturama je utvrđeno prisustvo sljedećih vrsta insekata: *Pityogenes chalcographus* L., *Chermes viridis* Ratz., *Polygrahus polygraphus* L., *Dendrolimus pini* L., *Diprion pini* L., *Coleophora laricella* Hb., *Acantholyda* sp., *Leucaspis* sp., *Cerambycidae* i *Scolytidae* i gljiva: *Fomitopsis pinicola* (Fr.) Karst, *Phaeolus schweinitzi* (Fr.) Pat., *Lophodermium pinastri* (Schrad) Chév, *Trichaptum abietinum* (Pers.:Fr.) Ryvarden i *Phaeocryptopus gäumannii* Rohde.

Prisustvo insekata je registrovano na 15,58%, prisustvo gljiva na 2,14% i prisustvo mehaničkih oštećenja debla i/ili krošnje na 11,06% stabala od ukupnog broja pregledanih. U ukupnom broju stabala sa registrovanim mehaničkim oštećenjem debla i/ili krošnje u najvećem procentu participiraju stabla sa mehaničkim oštećenjem krošnje, zatim ona sa mehaničkim oštećenjem debla. Udio stabala sa mehaničkim oštećenjem krošnje i debla je neznatan. Identifikovani štetni biotski i abiotski faktori ne uzrokuju značajne štete u analiziranim šumskim kulturama.