

DENDROLOGICAL AND RECREATIONAL VALUES OF ARLAVISKĒS JUNIPER FORMATION

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Dendrological and recreational values of Arlaviskės juniper formation are being investigated in the study. For recreational values, method of questionnaire was used. Totally, 100 questionnaires were filled by visitors of the site. Arlaviskės juniper formation is positively valued by visitors because of quality of view (33.5%), attractive walking (27.7%) and convenient arrival (11.1%). According to responses, more walking paths are needed in the site (11%), better forest furnishing (19%), waste management (28%), and management of the stand (19%). For evaluation of dendrological status, 20 study plots, each of 400 m² were studied in the formation. In each plot all juniper (*Juniperus communis*) as well as other arboreal species were evaluated and characterized by their shape (a tree or shrub), diameter, height, age and health status. In 2008 the average parameters of juniper formation were D = 10.1 cm, H = 6.5 m, A = 55 years. The average density of juniper formation was 1232 units/ha and majority of junipers constitute the indigenous “bush” form of juniper (68%), the remaining 32% - “tree” form. The juniper formation consists of healthy individuals (10.8%), various levels of damaged (68.7%) and dead (20.5%). The main causes of damaged junipers: too high density of individuals within the group and the interaction between individuals (37.7%), various felling (46%), branches of makeup (11.1%), juniper disease (4.2%). In juniper formation were identified 22 arboreal species: 7 introduced, and 15 native. These shrubs and trees had average density of 33159 units/ha. The largest prevalence was of alien species (76.7%). The status of juniper formation deteriorated within 10 years, the status index changed from 2.9 to 3.2. Within 10 years the number of healthy junipers decreased and the number of average damaged plants increased.

Key words: *Juniper formations, state, recreational value, average density, introduced species.*

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INTRODUCTION

There are three native species of coniferous in Lithuania: Scots Pine (*Pinus sylvestris*), Norway Spruce (*Picea abies*) and Common Juniper (*Juniperus communis*). Scots Pine and Norway Spruce cover more than a half of country's forests

and are under serious studies, however, Common Juniper, as a species of undergrowth, still is not considered by any extensive study.

Common Juniper is a slow growing shrub or tree with a life span up to 2000 years, extremely sensitive to air pollution. It spreads big amounts

of phytoncides and is being used as fruity and medicinal plant. The species covers extensive habitat area, has a wide ecological flexibility and polymorphism of populations (Adams 2009) as well as typical sexual dimorphism (Ward 2007).

Common Juniper is a prevailing shrub species in the mountains of Spain, and various forms of the species are met in different parts of Alps, furthermore it can be used as indicator species. In plains of Northern and Central Europe the Common Juniper mainly grows in poor, dry and acid soils (Thomas et al. 2007). Juniper stands are being met in mountain areas in Central America, Africa, and Central Asia. Juniper stands in those areas reach 2000–3000 m above sea level (Лесная энциклопедия 1986). Except of mountainous areas, juniper stands are being met in stony and sandy plain wastelands as well as on the slopes of water bodies (Ozolinčius et al. 2003). About 80% of juniper stands are situated on the slopes, but some are found in plain areas. In Lithuania, totally 12 juniper stands are found, but none of them was investigated in more details.

One of the most impressive juniper stands in Lithuania is Arlaviškės juniper formation, established on the left bank of Nemunas River in the central Lithuania near Kaunas. Lands of Arlaviškės village comprised the left slope of Nemunas river and a strip of upper terrace. Up to 1958 the land was managed by collective farm „Taika“. There was an arable land on the upper terrace with groups of pines and juniper trees on the slope. Flatter areas of the slope were used for grazing and juniper grew in groups on the slope (Fig. 1). The height of most junipers was 1.5–2.0 m (Kažemėkas 2009).

In 1958, the area was transmitted to local foresters, and a plan for protective stands of upcoming Kaunas hydropower plant has been prepared. After building a dam on Nemunas river in 1959, the absolute level of the water was increased from 24.5 m to 44 m, and the length of the newly formed slopes was 20–130 m.

It was decided, that the slopes are not covered sufficiently by juniper groups. Therefore in the



Fig. 1. Arlaviškės juniper formation in 1959 m (Kažemėkas 2009).

upper part of the slope mixture of *Rosa canina*, *Rosa rugosa*, *Berberis thunbergii*, latter *Syringa vulgaris*, *Chaenomeles japonica*, *Cornus sanguinea*, *Crataegus monogyna* and other species were planted. In the lower part *Populus alba* ir *Fraxinus americana* plantations were established in 1960 – 1961 as well (Kažemėkas 2009).

In 1970-ies the juniper stand suffered from fungi diseases, some individuals dried off. In 2007, a nature management plan has been prepared for the juniper formation. According to the plan, cuttings of non – native species were being carried out. In 2010, walking path of 1.3 km length was set. In 2006, Arlaviškės juniper formation was approved as a Natura 2000 territory, type of habitat – „5130 juniper stand“, so conservation and proper management of the site remains as the task of EU and national importance.

At the moment, Alaviškės juniper formation occupies area of 5 ha and has a particular role because of aesthetic and recreational values. Arlaviškės juniper formation is abundantly visited both by local people and tourists. Consequently, a heavy anthropogenic impact is found, such as waste disposal, cutting of branches, damage on litter, etc.

The aim of the study – to clarify importance of Natura 2000 site under the recreational point of view, to evaluate current status of the stand as well as trends of the changes and the problems in order to plan future measures for protection and preservation of the site.

MATERIAL AND METHODS

The evaluation of Arlaviškės juniper formation was carried out, taking into account life forms, dendrometric characteristics and status of individuals in 20 sample plots (20x20 m) in 2008. In the sampling plots all woody plants were inventoried, life forms of junipers were assessed (tree or bush, form of crown) and status as well as the reasons of damage of individuals were determined (Žiogas 2005):

- I – conditionally healthy individuals, without outer symptoms of damage;
- II – individuals with slight damage up to 1/3 of crown and separate dry branches;
- III – moderately damaged individuals up to 2/3 of crown damage, with dry branches and tops, including stem and root damage;
- IV – strongly damaged individuals with more than 2/3 of crown damage, including branches and stem damages;
- V – fresh dried individuals with yellow or brown needles or without needles;
- VI – old dried individuals without needles, bark and small branches.

Dendrometric characteristics of the stand were estimated in every sample plot, by measuring diameter of 10 average trees at 1,3 m, height of 3 individuals using „SILVA“ height-meter and age of individuals. Diversity of woody plants, density, state of the plants and causes of damage were estimated.

In order to evaluate recreational attractiveness of the stand, a questionnaire was worked out (Riepšas 2007). It was distributed to visitors, and 100 questionnaires were filled and returned. In the questionnaire, visitors were asked about importance of the site, frequency of visiting and requests of the visitors. Information about occupation of visitors, age, background and knowledge about protected areas was also collected.

For characterization of junipers and other woody plants, average values of the measurements, variation and standard errors were calculated. Statistically significant differences between the

groups analyzed were estimated by F (ANOVA) criterion. The criterion shows the significance of difference of average meanings in each group. For statistic evaluation software Statistica 6.0 was used.

RESULTS AND DISCUSSION

Data about respondents. Most of the respondents (50%) were persons of age between 20 and 29 as well as average age was 38. Among visitors, 42% were men and 58% women, their education was high (83%) or higher (17%). Prevailing occupation of the visitors was officers – 41.6%.

Predilections of visitors. Most of the visitors like being in natural environment, especially in woody areas, close to the water. They use to stay in forest recreational sites on weekends and holidays (75%). For such a short rest they choose landscape quality (66.7%), near (up to 20 km) from home (58.3%). They enjoy natural environment (74.6%), picking up mushrooms (64.3%) and berries (50%).

Attractiveness of the site. Arlaviškės juniper formation was widely attended because of attractiveness of the site (33.5%), convenience of walking in the upper part of the slope (Fig. 2). Part of the visitors (19.4%) regards the site as a place for short rest. The site is easy to reach, because it is near from urbanized area (11.1% of respondents). It is a pity, 8.3% of visitors were coming to pick up twigs of juniper. They were damaging the stand and usually didn't care about formal regulations. The total number of visitors in Arlaviškės juniper formation reached about 10 000 per year. Most of the persons were returning visitors. As much as 40% of visitors were staying at the site 2–5 times a year, 20% - more often. Other 40% came to the site for the first time.

Types of site management. Visitors asked for better waste management (Fig. 3) (28%), One fifth of the respondents (19%) would like more shades and fireplaces. There were also suggestions concerning removal of fallen and dry trees and branches (19%). The visitors were strict concerning violation the regulations. As much

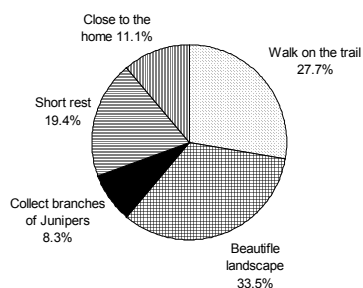


Fig. 2. Reasons for visiting Arlaviškės Junipers formation.

as 15% of respondents suggested applying more penalties to persons harming the nature. According to responses, twigs and berries of juniper should be picked up only with special permits obtained for an appropriate fee. Some respondents would like to admire the site not only from the top of the slope, they suggested installing walking paths in the lower parts of the slope (11%).

Respondents of the study gave some suggestions concerning management of the juniper formation. It would better meet the needs of the visitors. More information panels should be installed about history of the site, about rare flora and fauna and concerning the visiting regulations. Big part of responses (62%) was related to removing of slash. Another part of respondents would like to remove alien species, especially shoots of bushes. Besides, visitors need fireplaces, dustbins, new walking paths to get to the shore of Kaunas reservoir. There were suggestions to ban picnics and other events in this unique place.

Summarizing the recreational attractiveness of Arlaviškės juniper formation can be concluded, that the site was heavily attended, especially during weekends and holidays. The mostly attractive was panoramic view of the site from the top of the slope. However, visitors were aware of the state of the stand. According to their opinion, slash and dry wood as well as alien species that shade junipers should be removed. More information and better conditions for short staying at the site were also required.

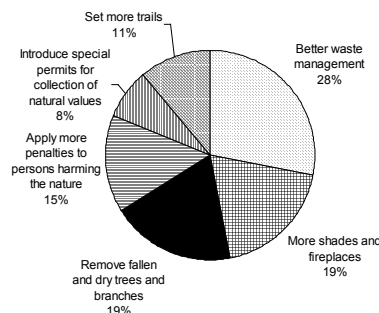


Fig. 3. Types of management proposed by visitors.

The status and dendrometric characteristics of Arlaviškės juniper formation. Bush life form of Common Juniper was prevailing in Arlaviškės juniper formation (68%). Other part (32%) of junipers were growing as trees. In some sample plots, form of tree was prevailing. It was concluded, that junipers were growing in groups, average density was 1232 individuals per hectare, in separate groups the density fluctuated from 900 to 1950 individuals per hectare.

The highest density of junipers was found in the middle of the slope, in lower area of the upper part, and the lowest density was found at the bottom of the slope ($F=4.79$; $p<0.02$). It can be explained by abundance of alien bush species in the upper part of the formation. In the bottom part, the amount of junipers was limited by wet soil conditions and former plantations of poplar.

Average diameter of junipers was 10.1 cm DBH. The highest diameter was at the bottom of formation - 17-22 cm. The average diameter was decreasing with the increase of altitude. At the top of the slope, the average diameter was 6-10 cm. Average height of junipers was 6.5 m. At the bottom of the slope, the height reached 12.5 m. Average age of junipers was 55 years, but some individuals were 90-95 years old.

Most of junipers in the formation were moderately damaged (~32%), less junipers were heavily or slightly damaged (Fig.4). Healthy and damaged junipers comprised 79.5%, and as well as dry

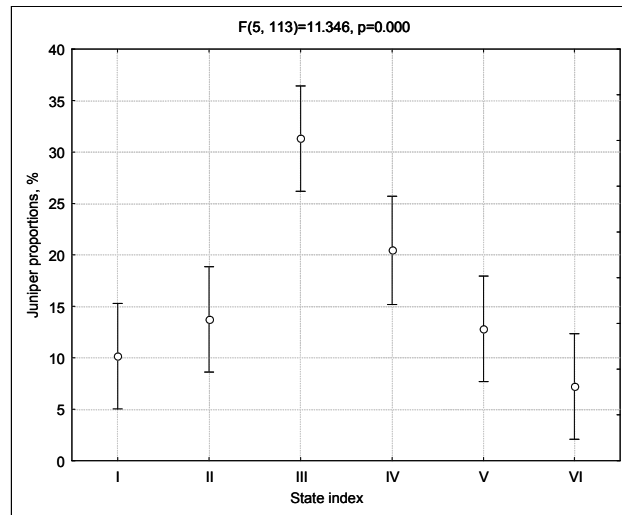


Fig.4. State index of Junipers health (I – undamaged, ... , VI – dead).

junipers - 20.5%. There were found only 10.8% of conditionally healthy junipers, and plants with various level of damage comprised 68.7%, dry and fallen plants comprised 20.5%. As much as 23% of junipers were found with serious damage. It can be concluded, that the status of the stand was rather weak.

After evaluation of plant distribution, according to state index, the average index was 3.2. This index shows, that the state of the formation matches average level of damage (Шяпятеня 1987) within the range from 2.6 to 3.5. Reasons of plants damage were also evaluated. The most damage was made by visitors and mechanically by workers that were managing the site (11.1%), partial cutting of the area (15.9%), cutting separate trees (31.1%). The state of the stand was also negatively influenced by interaction of individuals in the most dense groups (37.7%).

In sampling plots the inventory of all trees and bushes was carried out (Table 1). Groups of planted trees and bushes were recorded in different places of the site. Average density of the plants exceeded 33 individuals per hectare. Except of junipers, 22 species of woody plants were observed, among them 15 were native and 7 alien species.

The mostly frequent of in the formation was

Rosa rugosa. This bush was spreading by root shoots, and cutting of the bush leads to increase of its density. The distribution of this species was uneven, totally it was found in 14 sample plots. The highest amount of the species was found in the upper part of the slope. In one sample plot the density of individual shoots reached 80 thousand individuals per hectare, and the average amount in the formation was 13049 individuals per hectare.

The second species according to the density in the formation was *Syringa vulgaris*. The species was found in the upper part of the slope. It was also spreading by root shoots, and the density was increasing after cutting. In average, the amount of the bush reached 7082 individuals per hectare, and in the mostly dense spots – up to 29250 individuals per hectare.

Chaenomeles japonica grew in lower places or in blank areas, where no junipers found. It didn't formed overgrowths, but its average density was as high as 4500 individuals per hectare.

An easily spreading alien species in the formation was *Populus alba*, it covered a lowest part of the area, mostly on the bank of the reservoir. Apparently, it limited the spread of the junipers, because there were no junipers in the places where poplar was populated. At the moment,

Table 1. The statistical characteristics of arboreal species found in study plots

Species	Valid N	Frequency, %	Mean density units/ha	Maximum density units/ha	Standart deviation $\pm SD$	Standart error of mean $\pm SE$
<i>Syringa vulgaris</i>	20	45	7082.5	29250.0	9899.6	2213.6
<i>Rubus idaeus</i>	20	10	3225.0	37500.0	10071.4	2252.0
<i>Qercus robur</i>	20	10	58.8	400.0	92.2	20.6
<i>Betula pendula</i>	20	5	57.5	1150.0	257.1	57.5
<i>Rosa canina</i>	20	65	220.0	1400.0	336.4	75.2
<i>Rosa rugosa</i>	20	70	12923.8	81250.0	19123.2	4276.1
<i>Crataegus monogyna</i>	20	5	37.5	750.0	167.7	37.5
<i>Salix cinerea</i>	20	5	57.5	1150.0	257.1	57.5
<i>Acer platanoides</i>	20	25	22.5	200.0	57.3	12.8
<i>Pyrus pyraster</i>	20	35	20.0	125.0	38.6	8.6
<i>Corylus avellana</i>	20	15	18.8	325.0	72.5	16.2
<i>Tilia cordata</i>	20	15	50.0	500.0	136.9	30.6
<i>Symphoricarpos albus</i>	20	5	625.0	12500.0	2795.1	625.0
<i>Malus sylvestris</i>	20	10	5.0	75.0	17.4	3.9
<i>Pinus sylvestris</i>	20	15	8.8	75.0	23.3	5.2
<i>Berberis thunbergii</i>	20	45	60.0	350.0	101.4	22.7
<i>Cornus sanguinea</i>	20	20	3432.5	33750.0	8175.8	1828.2
<i>Chaenomeles japonica</i>	20	15	4500.0	40000.0	11372.9	2543.1
<i>Sambucus nigra</i>	20	75	52.5	150.0	45.1	10.1
<i>Sorbus aucuparia</i>	20	10	53.8	825.0	189.9	42.5
<i>Populus alba</i>	20	20	56.3	500.0	137.6	30.8
<i>Fraxinus excelsior</i>	20	10	280.0	4500.0	1023.2	228.8
Totally:	20	100	33158.8	130900.0	32449.4	7255.9

the poplars were cut, but their sprouts already reached 2.5 m height. In more dense areas the amount of white poplar reached 500 individuals per hectare and had tendency to increase.

Comparing to the species mentioned above, other species – *Rosa canina*, *Crataegus monogyna*, *Corylus avellana*, *Sorbus aucuparia*, *Tilia cordata*, *Cornus sanguinea* - were not so abundant and made no danger to junipers. From the species mentioned, *Cornus sanguinea* was mostly spreading in the upper part of the slope with average density of 3433 individuals per hectare, and in the most dense groups up to 33750 individuals per hectare. Except of planted trees, various native species were also found at the site. The following species regenerated naturally: *Qercus robur*, *Betula pendula*, *Salix sp.*, *Pyrus pyraster*,

Acer platanoides, *Pinus sylvestris*. The species were not abundant and made no any danger for junipers.

After the evaluation of abundance of native and alien plant species in juniper formation it was concluded, that native species were prevailing by number of species (68.2%), but according to density, some alien species dominate. Alien species dominate over the junipers as they comprise 77% of the area. Those species grow in dense groups and were distinguished by fast regeneration. The species were especially spreading in the upper part of the formation and replace the juniper stand. It was also noticed by visitors. The season for cutting of the shrubs was very important, because if the plants were cut in winter time, they usually sprout 30 or more shoots in spring.

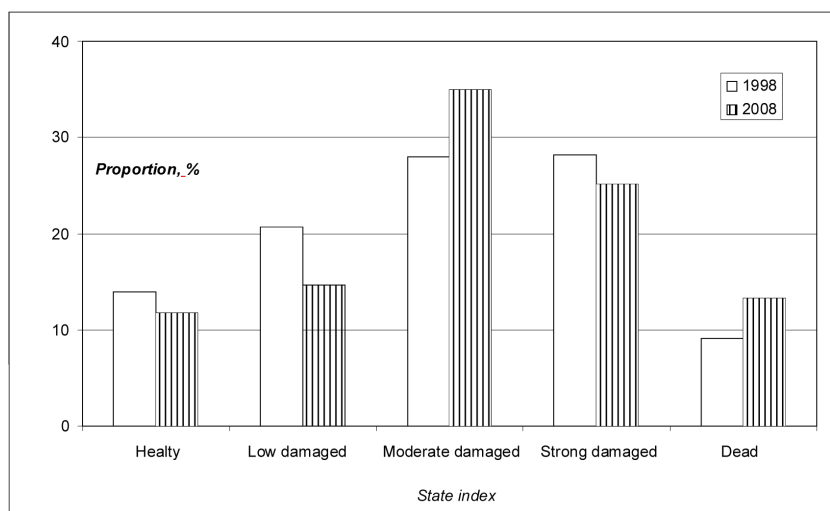


Fig 5. The state of junipers formation between 1998-2008 years.

It can be concluded, that groups of alien species were becoming a problem of management of Natura 2000 territory.

A comparison of state of Arlaviskės juniper formation was made, comparing the data from 1998 (Mirinas 1998, Kazlovas 1998) (Fig. 5). In 10 years, the decrease of conditionally healthy and slightly damaged trees and a significant increase in the number of moderately damaged individuals was observed. The number of dead plants was also increased, but there was some decrease of heavily damaged individuals. The results show, that overall state of the juniper formation was getting worse. At the moment, the stand can be characterized as moderately damaged. In 10 years, the state of the formation is approaching to the category of heavily damaged stand. The state index of the formation moved from 2.9 to 3.2.

Summarizing the trends of changes in state of the juniper formation, it can be concluded, that visitors only slightly (11%) influence damage of the junipers, and it is not the main cause of declining of the state of the formation. However, more information should be provided to the visitors concerning regulations and behavior at the recreational site. The highest influence on the junipers was made by spread of alien bush species.

CONCLUSIONS

1. Arlaviskės juniper formation is positively valued by visitors because of quality of view (33.5%), attractive walking (27.7%) and convenient arrival (11.1%). For higher quality of short rest, more walking paths are needed (11%), better forest furnishing (19%), waste management (28%), and management of juniper stand (19%).

2. In juniper formation, bush form of juniper dominates (68%), other 32% are of tree form. Average diameter of junipers was 10.1 cm, height - 6.5 m, age - 55 years. The tallest junipers reach 12.5 m, thickest - 22.5 cm, oldest are of 95 years.

3. Juniper formation can be valued as moderately damaged. Healthy individuals comprise 10.8%, damaged by various level 68.7%, dry - 20.5%. Main causes of damage: visitors - 11.1%, cuttings - 47%, interaction of individuals - 37.7%, diseases - 4.2%.

4. State of juniper formation in 10 years got worse. Average state index decreased from 2.9 to 3.2. In 10 years, the number of healthy junipers decreased, and the number of moderately damaged junipers increased.

5. 22 species of woody plants were found in the formation, 7 of them are alien species, and 15 – native species. Average density of the trees and bushes is 33159 individuals per hectare. Abundant spread of alien species (76.7%) is getting aggressive and dangerous to junipers.

6. To improve the state of the juniper formation as Natura 2000 area, better information and education of visitors is needed as well as removal of alien plant species is required.

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