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FOREWORD

The proceedings of the international scientific conference „LANDSCAPE CREATION PROCESS" consists of scientific articles, issued as print (ISSN 2345-0002) edition.

The conference was held on October 18-19, 2018 at Kaunas Forestry and Environmental Engineering University of Applied Sciences, Liepų str. 1, Girionys, Kaunas distr., Lithuania.

The authors of the articles are landscape architects, scientists and experts from Lithuania, Latvia, Poland, Hungary and Ukraine.

A creative approach to landscape design, protection, management and project publicizing promotes the appearance of functional and aesthetic spaces in our living environment. Analysing questions and problems of green areas planning, establishing, maintenance and sustainable use contribute to quality development of Lithuanian and European greenery.

Each author is responsible for correct information of his/her article.

The articles are compiled for publishing by Kaunas Forestry and Environmental Engineering University of Applied Sciences.

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Editors

PRATARMĖ

Pranešimų rinkinys yra sudarytas iš tarptautinės mokslinės konferencijos „KŪRYBINIAI PROCESAI ŽELDYNUOSE" mokslinių straipsnių ir išspausdintas (ISSN 2345-0002) leidiniu.

Konferencija įvyko 2018 m. spalio mėn. 18–19 dienomis Kauno miškų ir aplinkos inžinerijos kolegijoje, Liepų g. 1, Girionys, Kauno r., Lietuva.

Pranešimus parengė kraštovaizdžio architektai, gamtininkai ir šios srities specialistai iš Lietuvos, Latvijos, Lenkijos, Čekijos ir Ukrainos.

Kūrybiškas požiūris į kraštovaizdžio projektavimą, apsaugą, tvarkymą, projektų viešinimą skatina funkcionalių ir estetiškų erdvių atsiradimą mūsų gyvenamojoje aplinkoje. Želdynų planavimo, formavimo, priežiūros bei tvaraus naudojimo klausimai, kylančių problemų analizė prisideda prie mūsų šalies bei Europos želdynų kokybės gerinimo.

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Redkolegija

THE ACCOMPANYING ELEMENTS PROPOSAL FOR PERSONS WITH REDUCED MOBILITY IN THE LOCATION OF THE „KE ŠKOLKÁM“ FOREST ROAD

Zuzana Daníčková, Jitka Fialová
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This article aims to explore the posibilities of recreation for motion disabled people. In the literature research part it states all the parameters, necessary to follow in order to enable recreation for these people. Further it describes the examples of existing projects, which aimed to allow for convenient recreation and nature stay of the target group. The proposal part of the article lays in the design of an educational path, localised on the forest road Ke Školkám, on the Masaryk Forest Enterprise Křtiny (property of the Mendel University in Brno), with consideration of the acquired knowledge, effected analyses and field inspections. The main idea of the concept is to outline the importance of the forest, respectively of the trees, to the visitors in a different form than they are used too. The proposed educational path aims to recall the importance of other forest functions besides production, namely social and recreational functions. The purpose of the educational path is to enable recreation to the disabled people and adapt the proposed elements to their requirements. The idea is based on the thought that the perceptions and experiences, that we encounter will resonate in us. The name of the path is Educational path “Forest echos“. Interactive elements that are part of the educational path are focused on the sound in different forms. The whole educational path is supposed to guide visitors to realize the feeling of well-being and peace, and bring them to perceive the forest not only by sight but by other senses.

Keywords: educational path, disabled people, recreation.

Introduction and purpose of work

The disabled people (people on the wheelchair) seek opportunities for traveling, learning and exploring the beauty of nature much like everyone else. Important part of the social life is also the possibility of recreation in nature, respectively in forest. Outdoor stay in the fresh air has very positive effect on the psyche and contributes to better coping of difficult living situations. Nature is an important element in every person's life. If we lose contact with nature, we lose connection with ourselves.

The reason why nature is so important, is remarkably interpreted by Eckthart Tolle (2009, p. 30):

„*Everything in nature - every flower, every tree*
and animal – teaches us something,
if we can
stop, watch and listen.“

If we wouldn´t allow disabled people to spend time in nature, it would mean, that we don´t give them the opportunity to learn from the processes in nature. We would also deny them the beauty of the forest, which is so inherent for us.

This project, which was created as part of the master thesis of the first author, is aiming to propose supporting facilities and the design of an educational path, so as to be allowed recreation for motion disabled people in the forest environment.

The term disabled people includes all people, who meet up with barriers in their surroundings, which are preventing them from active involvement in civil life. That includes people with disabilities, which can be long-term or temporary, mental, sensory, communication or physical, but also people with other motion limits, such as mother with a

stroller or small children (EC, 2005a). "*The international symbol of accessibility is blue square overlaid with stylized white figure sitting on a wheelchair and looking to the right. The minimum dimensions of the symbol are 100 mm x 100 mm*" (369/2001 Coll., on general technical requirements for securing use by motion disabled people and people with limited orientation).

Categorization of motion and health disabled people is complicated. The extent of the disability and the degree of disadvantage must be taken into account. Consequently, because of the disadvantage, people with a health or motion disability may have a problem with social life. It can prevent or restrict them from performing tasks, that are common to others (Fialová et al., 2015, p. 13). Restriction of motion abilities can be caused by various diseases of the motion system, motoric system or trauma. Disabilities could be also inherent because of genetic defects or difficulties in childbirth (UN Convention, 2012, In Fialová et al., 2015, p. 13).

Motion disabled people may also include older people, who often suffer a combination of various defects, limiting them. It also includes people, whose health disability is short term as a consequence of post-traumatic conditions (fractures, etc.) and even persons carrying an excessive burden, eg parents pushing a stroller (Fialová et al., 2015, p. 14).

The most commonly used division into groups based on barierlesness was defined by Sámová (2008) and divides people into three categories:

1) The first category includes people with mild physical disabilities. They walk with canes or forearm crutches. They have problems with high stairs, boarding transport vehicles, slippery terrain, etc.
2) The second category includes people walking with forearm crutches and orthopaedic and prosthetic devices. They have big problems with stairs, slippery terrain and boarding the means of transport.
3) The third category includes wheelchair users, among whom there are substantial differences. Their categorization derives from the way of using wheelchair and level of assistance provided by another person (e.g. use of a wheelchair only for long distances, use of the wheelchair without any assistance, use of a wheelchair with the assistance of another person only for certain activities, wheelchair – quadriplegics, etc.) (In Fialová et al., 2015, p. 14).

According to many experts (Łobożewicz 2000; Wolski 1979; Weiss 1979; Jakubis 2013, In Janeczko et al., 2016, p. 117) is recreation helpful for physically handicapped people and can also restrain hypokinesis as well as speed up and support the recovery process and regeneration of the body. Tourism also provides disabled people with social integration and adaptation to normal life (Junek, Fialova 2012, In Janeczko et al., 2016, p. 117). The charter of Fundamental Rights and Freedoms came into force in our country in 1993 and since then has protected the human rights of all citizens in Czech Republic, without difference of any kind. Shortly after the document came into force, the rights of people with disability began to gain ground in the public´s awareness. The issue of barrierlessness has been at the forefront since the beginning of these initiatives.

The situation is most difficult for wheelchair users, and so this work focuses on this group of people. Parameters for forest roads are primarily designed for haul away timber, but they have the other functions. They are used as hiking and biking trails, cross-country tracks and for hippotourism.

Minimum manoeuvring space for motion disabled people:

- People using a cane (crutches) need a minimum clearance width of 750 mm,
- People using a walking frame need a minimum clearence width of 900 mm,
- People assisted by another person need minimally 1,300 mm,
- Person in a wheelchair has a minimum manoeuvring space determined by the area required to make a 360-degree wheelchair turn. The average dimensions of a person in a wheelchair are defined as following: width 938 mm, height 1076 mm to 1374 mm, length 1200 to 1250 mm, length for the person with stretched legs 1500 mm. These dimensions determine the required maneuvering area - a circle with a minimum diameter of 1500 mm, and an optimum diameter of 1800 mm. People with assistance of a walking person at the side need a path width of 1500 mm (Fialová et al., 2015, p. 27-28).

The minimum width to allow two wheelchair users to pass each other is 1800 mm and the smallest space for wheelchair to make a 90 to 180 degree turn is a rectangle measuring 1200x1500 mm. The maximum surmountable height difference for a wheelchair user is 20mm. The maximum longitudinal slope is 1:12 (8.33%). The maximum cross slope may be no higher than 1:50 (2%) (Filipiová, 2002).

The value of the maximum longitudinal slope for persons on the wheelchair does not correspond to the maximum slope of the forest paths, which is 10% and 12% according to ČSN 73 6108. These values show that wheelchair users are able to use forest paths with maximum longitudinal slope only with assistance.

Forest haul roads are built as single lane ways. The width of the forest haul roads is sufficient for the wheelchair, but does not take into account the collision of a passing timber lorries with a wheelchair. Forest haul roads are often provided with tollgates, which are usually 900 mm high, and for the wheelchair users are an unbridgeable barrier. The possible modification of the tollgates is to create a raised frame, which allowes the wheelchair users to pass underneath even if the tollgate is closed. The width of this frame should be at least 900 mm and height at least 1300 mm.

The surface of the road, used by physically disabled people, should be even, non-slippery, free of obstacles, ditches and dangerous interruptions. The surface of the road can be left as local soil or made from another material. The natural surface of the road has its own risks. In rainy weather there is a danger of the wheelchair getting stuck in the mud or impairment of wheelchair control. Also, there is a risk conected to the unevenness and obstacles that are frequent on the local soil surface, for example, the roots of surrounding trees protruding to the surface.

Hiking trails include a variety of equipment, which facilitates the stay in a nature and makes it more attractive. It is mostly small constructions particularly made out of wood, usually having the character of portable outdoor facilities. They include information facilities (such as information boards and directional signs), structures facilitating movement (footbridge, bridges or stairs), equipment that makes the stay in the nature more enjoyable (sitting, shelters, campfire), as wall as social, hygienic and other facilities such as toilets, waste bins and containers, ticket selling places and such. These facilities can be located separately along the path or centered around entry or rest areas. If facilities are intended to be used by motion disabled people, then it is necessary to provide sufficient space for handling, moving and turning the wheelchair. The shape and location of these facilities must be designed so that they are suitable for all people and do not block and prevent the free and safe movement of the pedestrians.

Facilities, which need to be operated, should be positioned in the reachable zone of disabled people, which is between 900 and 1,400 mm. Information boards or direction signposts should be installed at a height of 900 mm to 1 800 mm above the groundlevel. Panels and boards should be sloping by 5 º to 10 º, because then they are better legible for the wheelchair users as well as for children.

Supporting equipment of the path and hiking trails must meet the appropriate dimensions, so that it can also be used for physically disabled people. The minimum height of table from the groundlevel to the top of the table should be 700 mm (optimal height is between 750 and 900 mm). Behind the table should be enough space for the movement of the wheelchair. The distance from the edge of the table to the legs of the table must be at least 600 mm and the maneuvering space must be at least 1000 mm (see Figure 4 Furniture dimensions for wheelchair users). All seating devices must meet ergonomic seat parameters: height between 400 and 480 mm, minimum width 500 mm. Each bench should provide free space for manipulation with wheelchair (or stroller) of minimum width 1 200 mm. Between campfire and the seating should be space at least 900 mm wide for wheelchair-manipulation. It is ideal to make the campfire above ground level (700 mm) to allow the acces of wheelchair users. The space between the fireplace and the bench should be at least 900 mm (Fialová et al., 2015, pp. 31 and 88).

Description of territory

The work was carried out in the locality Ke Školkám (Masaryk Forest Enterprise Křtiny, further just ŠLP ML Křtiny) between the municipalities Soběšice and Útěchov, on the cadastral territory of Soběšice. The village Soběšice belongs to the northern part of the statutory city of Brno and it´s cadastral area is 6.06 km^2 (Wikipedia.com). Forest road Ke Školkám is 1,443 km long and the altitude rises from 410 to 424 meters above sea level. Operator of the forest roads Ke Školkám is ŠLP ML Křtiny, Křtiny 175. The road is used by the ŠLP ML Křtiny as well as by broarder public for recreation. The owner of the land, where the road is located, is ŠLP ML Křtiny.

The educational path is well accessible from the city of Brno by public transport. The route takes about 41 minutes from the center of Brno by public transport. The locality is also accessible by car. The distance od the locality from the center of Brno is about 10 km, which takes about 17 minutes by car. At the beginning of the forest road is a car parking lot with capacity of 8 cars. The surface of the parking lot is compacted and sporadically are there the remains of the gravel. Only a lane of width 3 500 mm is reinforced with tarmacadam. The current state of the parking lot is appropriate, its capacity is sufficient.

The forest road falls to the 2nd class (2L) and is perpendiculary connected to the state communications of III. class, that are leading from the Brno-Soběšice to the Brno-Utěchov. The shield of exit is 45,05 m long, made of tarmacadam and its width is 4000 mm. Tollgate is located across the road at the end of this section and it creates an unbridgeable barrier for motion disabled people. The tollgate is 1100 mm high and 5700 mm long. The cover of the road is made of mechanically reinforced aggregates of the thickness 200 mm and the underlayer is a grit of the thickness 200 mm. The cross drainage is ensured by a roof slope of 4% and the longitudinal drainage is ensured by a left-hand drainage ditch of the trapezoidal shape. At the station of 0,73800 to 0,76200 km, the forest road is equipped with a passing loop. The extension is 2,5 m and the length of the raids is 10 m (Popelka, 2005, pp. 16-18).

The forest road is a single lane way and its configuration and necessary technical equipment allow seasonal operation by standard vehicle, winter service is not expected (ČSN 73 6108, 2016). At the end of the route is a circular turning point. The total length of the forest road is 1,443 km and width is 3500 mm. Along the whole route there are small potholes, as a consequence of use of the road by the heavy equipment. The road is suitable for recreation of motion disables people.

Methodology

The suitability of the forest road Ke Školkám was consulted in the field with the spokesperson of the League of wheelchair users Bc. Ladislavou Blažková. The technical solution of all designed elements and facilities were consulted with experts on this issue. Visualizations were made to show the proposed elements of educational path and individual stops. Visualizations were created in Adobe Photoshop CS.

Results

The main idea of the concept is to outline the importance of the forest, respectively of the trees, to the visitors in a different form that they are used too. The proposed educational path aims to recall the importance of other forest functions besides production, namely social and recreational functions. The purpose of the educational path is enable recreation to the motion disabled people and adapt the proposed elements to their requirements. The idea is based on the thought that the perceptions and experiences, that we encounter will resonate in us. The name of the path is Educational path “Forest echos“. Interactive elements that are part of the educational path are focused on the sound in different forms. The whole educational path is supposed to guide visitors to realize the feeling of well-being and peace, and bring them to perceive the forest not only by sight but by other senses. The theme of the educational path is also suitable for visualy impaired people, to whom it should help to experience the beauty of the forest without sight. Two interactive elements - "Sound Lab" and "Graduate Concert" - will be described in detail.

From the public transport stop in the direction of Soběšice-Útěchov there is proposed a pavement to ensure safe movement of the visitors to the educational path. The owner of the land, which the pavement is proposed on, is the statutory city of Brno. The pavement has width of 2000 mm and total length is 20 m. The pavement surface is created from concrete pavage 300 x 300 mm, which is laid on 50 mm layer of sand (fraction 0/4) and 150 mm layer of gravel (fraction 8/16). The pavement is on the both sides provided by concrete kerb. Parking is to be retained in its current form. Only the lane off tarmacadam of width 3500 mm is used as a stand for motion disabled people. The tollgate across the forest road Ke Školkám is redesigned so that visitors of the educational path can safely pass underneath it. The tollgate is provided with a frame, which is 900 mm wide and 900 mm high. The total height from the ground to the top edge of the frame is 2000 mm. Alteration of the tollgate is shown in Figure 1.

Fig. 1. Visualization of the tollgate (source: author)
1 pav. *Užtvaro vizualizacija (šaltinis: autorius)*

Information panels are proposed to be made from acacia wood. The panel has a rectangular shape of dimensions 750 x 25 x 450 mm and is tilted upwards at an angle of 10 ° towards the visitor. The surface is embedded and attached by screw into a 800 x 100 x 500 mm frame, thus providing an opportunity to easy replacement of the panel surface in that case of damage or wear. The frame is secured on two balks 850 x 80 x 80 mm. The balks are provided with an anchor flapt U to prevent rotting of the balk. In the terrain, the balks are anchored by the flapt into concrete foundations of 300 x 300 x 500 mm. Total height of the information panel from the terrain is 900 mm. Each information panel is located in an area of 1000 x 1000 mm, which is reinforced with a layer of vibrated gravel (fraction 0/8 and fraction 8/16). There are 5 information panels on the route. The text is bilingual in Czech and English. There is also a plate with braille for blind visitors.

"Sound lab"

The interactive elements and the information panel are placed on an area of 12 m^2, which is reinforced with a layer of vibrated gravel (fraction 0/8 and fraction 8/16). Visitors will be able to experience the sounds of different types of wood on the "Forest xylofon", which is proposed in the module off the information panel. 6 sticks (maple, oak, beech, larch, spruce, pine) are attached by two chains in a frame of 800 x 100 x 500 mm, tilted at an angle of 10 °. Dimensions of one stick are 250 x 70 x 20 mm. On each stick will be burned the name of the tree, which they will be made of. On the side of the frame a mallet with a chain is secured, which allows the visitors to play on the xylophone. The frame is secured on two wooden ramps of 850 x 80 x 80 mm. The balks are provided with an anchor flapt U to prevent rotting of the balk. In the terrain, the balks are anchored by the flapt into concrete foundations of 300 x 300 x 500 mm. Total height of the information panel from the terrain is 900 mm.

Another interactive element is "Chime" in two versions. One is proposed to be made out of stones that are hung on steel wire, and the other is to be made of lime wood. Dimensions of one stick are 400 x 20 x 20 mm. Chimes are hanged each separately on the construction of two balks 1900 x 80 x 80 mm and 500 x 80 x 80 mm, which have a strut of

224 x 50 x 80 mm. The construction is provided with an anchor flapt U to prevent rotting of the balk. In the terrain, the balks are anchored by the flapt into concrete foundations of 300 x 300 x 500 mm. Total height of the "Chime" from the terrain is 2000 mm. Visualization of the Sound Lab is shown in Figure 2.

Fig. 2. Visualization of the ″Sound Lab″ (source: author)
2 pav.. "Garsų laboratorijos" vizualizacija *(šaltinis: autorius)*

"Graduate concert "

The grassland scaterred with trees is the fourth stop of the educational path. In this stop an imaginary auditorium is proposed in the form of three seating elements, which are situated on the edge of the area with a view on the trees and bushes that grow here. Access to the seating elements is ensured by a gravel path from a layer of vibrated gravel (fraction 0/8 and fraction 8/16). The width of the path is 1500 mm and length is 22 m. At the entrance and information panel is located, which informs visitors about the possibility of sitting and listening to the sounds of the forest that will change depending on the season. From spring to autumn, the visitors will be able to listen to the birds singing, the whisper of leaves and in the winter to the sound of bare branches.

Seating elements are proposed in two version – two seating elements without a backrest and one with a backrest. The seating is made of modules, whose connection is ensured by screws. One module will have dimensions of 500 x 425 x 1500 mm. Each module is provided with three metal frames, to which acacia boards are attached. The three sides are formed by 100 x 25 x 1500 mm boards and two smaller sides by 100 x 25 x 500 mm boards. The underside of the module stays open. The backrest is formed of two modules (500 x 425 x 1500 mm), that are placed on the down low modules. The connection is ensured by a metal angle brace (100 x 10 x 3000 mm), which is screwed to the both modules.

The approximate total length is about 3000 mm and the width is always 1500 mm. All seating elements are placed on a layer of vibrated gravel (fraction 0/8 and fraction 8/16). Visualization of the Graduate concert is in Figure 3.

Fig. 3. Visualization of the "Graduate concert" (source: author)
***3 pav**.”Gamtos garsų koncerto” vizualizacija (šaltinis: autorius)*

The realization of the educational path is an expensive matter, so it is often necessary to search for external sources of funding. External method of financing include co-financing and subsidies. One of the options is funding by own resources, where the resources for the building of the educational path are covered by the founder. The Mendel University in Brno is the founder of the "Forest echo" educational path in the locality Ke Školkám. Another option is to get financial support from businesses or is possible to co-finance with cities and municipalities. If businesses are located close to a project, financing may be a benefit for them in advertising. The business logo, that contributed to the project, can be placed on the information panel.

Another option is, for example, obtaining subsidies from the Integrated Regional Operational Program (IROP). The realization of the educational path falls into the second priority axis - Improving public services and living conditions for the inhabitants of the regions. The aim of the projects in this area is to eliminate social inequalities and to provide better access to public services in cities and country. The specific aim that the educational path meets are: increasing quality and availability of services leading to social inclusion, developing infrastructure for providing health services and health care, increasing quality and availability of infrastructure for education and lifelong learning. The subsidies may be requested by the public-benefit corporation of organizational units of the state, region, municipalities, voluntary associations of municipalities, organizations established or founded by regions/municipalities, involuntary associations of municipalities. (Strukturalni-fondy.cz, 2012).

Discussion

The educational path "Forest Echo" is proposed on the forest road Ke Školkám. The difficulty of usage may be in conflict with visitors and heavy equipment. The surrounding forest stands are managed by standard techniques. The load factor of the road by transport of wood is considerable. To ensure the safe use of the educational path, it would be necessary to regularly check the state of the road surface and in the period of the intense movement of heavy equipment to restrict the movement of visitors on the educational path. The

surrounding vegetation is according to the forest map 2013-2022 mainly in the V. age class 81-100 years and IV. aged class 61-80.

Another problem lies in the collision of wheelchair users and horse riders. Horses pollute the road with their excrements. For wheelchair users it can be unpleasant to pass the polluted spots, because it is highly probable that the dirt will be catching to the wheels of the wheelchair.

Because the educational path is situated in the forest stands near the municipalities of Soběšice, the total price for the building of the educational path is debatable. Beforehand, it is necessary to consider the possibility of damaging elements of the educational path by vandals. To reduce the costs, it would be possible to use wood with a more raw look instead of the proposed boards. It would save the costs, but on the other hand, the total form and look of the educational path would suffer.

The educational path is proposed for primary use by motion disabled people. This fact is very important because all the parameters of proposed elements, facilities, and paved areas are adapted to their needs. Other people are also allowed to explore the educational path. Recreation is very important in the lives of motion disabled people. It is important in the prevention of health risks related to the lack of realization of physical activities, which many experts such as Łobożewicz (2000), Wolski (1979), Weiss (1979), Jakubis (2013), In Janeczko et al., (2016) agree with. Along with the physical health, also the psyche of the visitors is affected. Schneider et al. (2008) mention that green colour has positive influence on the organism and Janeczko et al., (2016) attribute soothing effects to stay in the nature.

Conclusion

In the extent of this project analyzes of the territory were carried out, which contributed to the understanding of the locality where the educational path is proposed. The main basis for the proposal was a terrain survey, without which it would not be possible to properly use the possibilities that locality Ke Školkám offers. The educational path is primarily proposed for motion disabled people and, as an extention, adds recreation possibility for the visualy impaired people. Thanks to the studied literary sources, which are focused on the recreation of motion disabled people, it was possible to propose an educational path, which with its parameters and parameters of the proposed elements corresponds with needs of motion disabled people.

The proposed Educational path "Forest echo" is back and forth 2,886 km long and has five stops. The main theme of the educational path is the perception of the forest not only by sight but also by other senses. To the visitors it outlines the importance of the forest for their physical and mental health. Individual stops offer visitors the opportunity to try out different interactive sound elements.

The realization of the project may be financed by own resources where the resources for the construction are paid by the founder. The Mendel University in Brno is the founder of the "Forest echo" educational path on the locality Ke Školkám. Another option is to obtain financial support from external sources, namely the co-financing of the Statutory city of Brno and subsidies.

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Pagalbiniai rekreaciniai elementai riboto mobilumo asmenims „Ke Školkám“ miško kelio prieigose

Santrauka

Šio straipsnio tikslas - ištirti neįgaliųjų judėjimo laisvalaikiu galimybes. Literatūros apžvalgos dalyje nurodomi visi parametrai, kurių reikia laikytis norint sudaryti šiems žmonėms sąlygas rekreacijai. Toliau apibūdinami esamų projektų pavyzdžiai, kurie skirti patogiam tikslinės grupės poilsiui ir buvimui gamtoje. Šiame straipsnyje siūlomas edukacinis takas miško kelio "Ke Školkám", esančio Masaryk miškų urėdijoje, prieigose (Mendelio universiteto Brno mieste nuosavybė) projektavimas, atsižvelgiant į įgytas žinias, atliktas tyrimus ir vietos apžvalgą. Pagrindinė koncepcijos idėja yra apibūdinti miško ir medžių svarbą lankytojams kitokia forma nei jie yra įpratę. Siūlomu edukaciniu taku siekiama priminti ne tik gamybos funkcijų miškuose svarbą, bet ir socialines bei rekreacines funkcijas. Edukacinis tikslas – sudaryti sąlygas neįgaliųjų rekreacijai ir pritaikyti siūlomus elementus pagal jų poreikius. Idėja remiasi mintimi, kad suvokimai ir patirtis, su kuriais mes susiduriame, rezonuoja mumyse. Kelio pavadinimas yra edukacinis takas "Miško aidas". Interaktyviais elementais, kurie yra edukacinio tako dalis, daugiausia dėmesio skiriama įvairiems garsams. Numatyta, kad visas edukacinis takas leis lankytojams patirti gerovės ir ramybės jausmą, miškus suvokti ne tik akimis, bet ir kitais jausmais.

Raktažodžiai: edukacinis takas, neįgalieji, poilsis.

THE EVALUATION OF HISTORIC ALLEYS ON THE EXAMPLE OF THE 19TH CENTURY ALLEY'S ENSAMBLE IN RADZIEJOWICE (MAZOVIA, POLAND) – THE METHODOLOGICAL CASE STUDY

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The case study of the ensamble of historic alleys in Radziejowice, Mazovia served to determine its exceptional cultural and natural values as a valuable form of roadside plantings, which are a remnant of the former, historical system of local highways.

The aim of the study was to determine existing stand's resources of selected avenues (in terms of taxonomic, spatial, quantitative and qualitative) for needs of current maintenance and the further preservation. The degree of preservation of the original historical stand's resources was also assessed, including estimation of age of the original, historical trees. The dating of origins of the ensamble of historical alleys in Radziejowice based both on historical research (archival material query) and field data collection – by assessing the age of representative trees forming alleys. As the result of research, particularly valuable trees were indicated –veteran trees (due to their condition, habit and landscape values), as well as relicts – remains of the original nineteenth century plantings.

The study involved alleys along the streets of Lipowa Avenue, Henryka Sienkiewicza street, Główna street, Jakuba Kubickiego street, which were included in the detailed dendrological inventory. In addition, the assessment of tree health status was carried out (September – October 2015).

The alleys ensamble which is the object of study, was developed in the 1820s and 1830s. The avenues nowadays are characterized by a considerable diversity of the stand and the distinct character of the streets and roads along which they are located. More than half of the trees are small-leaved limes (*Tilia cordata* Mill.) accompanied by common maples (*Acer platanoides* L.), horse chestnuts (*Aesculus hippocastanum* L.), common hornbeams (*Carpinus betulus* L.), common ashes (*Fraxinus excelsior* L.). There are 31 trees with trunks (measured at 1.3 m dbh) over 300 cm and reaching ca. 180 years old (valuable material resources). The degree of preservation of the avenues system as a spatial form is estimated at about 36%.

Keywords: alleys' tree stand, cultural heritage, historic alleys, Masovian landscape, natural values, roadside tree-shelters.

Introduction

Historic ensamble of avenues in Radziejowice, Masovia Province - its creation and current course are closely related to the palace and park in Radziejowice – a former seat of the Radziejowski and Krasiński families. The case study of the site (Fortuna-Antoszkiewicz, et al., 2015) was aimed at identifying its exceptional cultural and natural value as a valuable form of roadside tree-shelter, a remnant of an old historical network of local highways and roads.

The aim of the research was to determine current resources of the historic alleys' tree stand (in terms of its taxonomic, spatial, quantitative and qualitative features) for the needs of its ongoing care and further maintenance. The degree of preservation of the original layout of historical alleys was also assessed, including estimation of the age of constituent trees. Trees' age and date of the establishment of the alleys ensamble in Radziejowice was determined based on historical research (query of archival materials) and direct in situ research - by assessing the age of the trees forming the alleys. The most valuable trees were identified (representative specimens – in terms of condition, habit and landscape values), as well as relict specimens - remnants of the original nineteenth-century plantings (Fig. 1.; Fig. 2.; Fig. 3.).

The research covered alleys along the following streets: Lipowa Avenue, Henryk Sienkiewicz street, Główna street. During fieldwork, a detailed dendrological inventory was carried out together with the assessment of the health condition of trees (September - October 2015).

Fig. 1. Lipowa Avenue (sector A) – fragments of about 200-year old tree stand (in the foreground, lindens No. 16–18) (author: P. Wiśniewski, April 2016)
1 pav. *Lipowa alėja (A sektorius) – maždaug 200 metų amžiaus medyno fragmentai (priekyje – liepos, Nr. 16–18) (autorius: P. Wiśniewski, 2016 m. balandžio mėn.)*

Fig. 2. Henryk Sienkiewicz street (sector B). General view of the avenue stand towards the south – leafless state in early spring. The silhouettes of trees are very slender due to competition with the tree stand of the park and because of the raising of crowns (author: P. Wiśniewski, March 2015)
2 pav. *Henryk Sienkiewicz gatvė (B sektorius).Bendras alėjos medžių vaizdas pietų kryptimi – medžiai be lapų anksti pavasarį. Medžių kamienai ilgi ir ploni dėl konkurencijos ir dėl apatinės medžių dalies nugenėjimo (autorius: P. Wiśniewski, 2015 m. kovo mėn.)*

Fig. 3. Jakub Kubicki street (sector D). General view of the old tree stand of the alley towards the south – from the church towards the roundabout (author: P. Wiśniewski, May 2015)

3 pav. *Jakub Kubicki gatvė (D sektorius). Bendras senų alėjos medžių vaizdas pietų kryptimi – nuo bažnyčios iki žiedinės sankryžos (autorius: P. Wiśniewski, 2015 m. gegužės mėn.)*

Alleys in the landscape

Rigorous, regular plantings of trees along roads leading to residences have always testified to the prestige of the site and importance of the landlord (Fortuna-Antoszkiewicz, 2002). In Poland trees have been planted along straight highways connecting manors and farms since the 16th century. Until the 18th century, this was practiced particularly along private roads. Public roads began to be planted with trees from the middle of the 18th century, and it remained a common practice since the 19th century (Łuczyńska-Bruzda, 1995).

Baroque and subsequent Enlightenment period brought fundamental changes in how alleys had been used are. The17th and the 18th century witnessed changes in the landscape all-over Europe which are clearly visible in urban spatial layouts of modern times. One of the instruments of landscape's transformation on such a large scale were alleys which became monumental and presentable in character. During this period, the alleys were formed following strict rules concerning the structure of plantings and selection of species of trees (Siewniak, 1990, Majdecki, 1993, Fortuna-Antoszkiewicz, 2004).

As a result, alleys were established in the open areas at a massive scale. Precursors of this were the French kings who, setting up trees in regular ranks, emphasized the power of their absolute reign. Then this fashion spread all over Europe, quickly reaching Poland. First great alleys were founded by King Jan III Sobieski, and soon he found a number of followers (Fortuna-Antoszkiewicz, 2002).

Over the centuries, numerous species of trees have been planted in alleys, depending on current fashion and country. In Europe in various historical periods, limes were particularly valued as alley trees. For example, dutch lime (*Tilia ×europea* L.) and broadleaf lime (*Tilia platyphyllos* Scop.) were often planted in England, France and Germany (Pigott, 1989,

Siewniak et al., 1991). In Poland small-leaved lime (*Tilia cordata* Mill.), a native and common species, was often used (Fig. 4.). Apart from the lime trees, common maples (*Acer platanoides* L.), rowans (*Sorbus* sp.), poplars (later hybrids of poplars) (*Populus* sp.) were also used to create alleys. At the end of the 19th century a fashion for planting fruit trees began (*Juglans regia* L., *Malus* sp., *Morus* sp., *Prunus* sp., *Pyrus* sp.) (Fortuna-Antoszkiewicz, Łukaszkiewicz, 2012a), the Pennsylvania ash (*Fraxinus pensylvanica* Marshall) and white robinia (*Robinia pseudoacacia* L.) (Łuczyńska-Bruzda, 1995). Horse chestnut (*Aesculus hippocastanum* L.) was also considered a valuable species, as well as beech (*Fagus sylvatica* L.) and stalk elm (*Ulmus laevis* Pall.), and less frequently used - common ash (*Fraxinus excelsior* L.). In Western Europe, the most often planted tree species was and still is maple plane (*Platanus* x*hispanica* Mill. ex Münchh. 'Acerifolia') (Majdecki, 1993).

Fig. 4. An example of a 19th century avenue tree – an old small-leaved lime fully vital and with a model silhouette (inv. No. 9, subsector A1, Lipowa Avenue)
(author: P. Wiśniewski, September 2015)
4 pav. *19 amžiaus alėjos medis – puikios išvaizdos sena, bet sveika mažalapė liepa (inv. Nr. 9, A1 sektorius, Lipowa alėja)*
(autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)

In the landscape of Mazovia, old alleys fulfil particularly important spatial functions. Together with other forms of woodlots, they enrich the physiognomy and alleviate the monotony of lowland areas. They also have important historical and cultural value. Alleys are very often the only "(...) *remnants of native nature, relics of the rural landscape .... Their*

historical role should not be left unmentioned. After all, they were the main routes connecting mansions, hamlets, villages and towns carrying news of the world both joyful and anxious. They also witnessed Polish history galloping by" (Szwarc-Bronikowski, 2000).

Characteristics of the site

The establishment

In the second half of the 18th century (1782), Radziejowice, the former seat of the Radziejowski family, was owned by the Krasiński family (Barbasiewicz, 2016). In the 18th century, there without a doubt were regular alleys along the road towards Warsaw. It is documented, among others in Jakub Sokołowski's 1820 painting - at that time, the trees along the road were already old and about to dieback, growing mainly on one side of the road, on the other side only individual trees remained - the remnants of an analogous row (Fig. 5.).

Fig. 5. The panorama of Radziejowice from the north-east side, watercolor by Jakub Sokołowskiaround 1820 (Sokołowski, 1820)

5 pav. *Radziejowice vietovės panorama žiūrint iš šiaurės rytų pusės. Akvarele tapyta Jakubo Sokołowskio maždaug 1820 m. (Sokołowski, 1820)*

At the beginning of the 19th century, under the ownership of Józef Wawrzyniec Krasiński, the Castle in Radziejowice was restored and the palace was rebuilt (designed by arch. Jakub Kubicki). **In 1817** the neo-classical palace was surrounded by the new park - the former regular garden was transformed into a landscape park (designed by Colonel Alexander d'Alphonce de Saint Omer - a friend of the house, a cartographer and a lover of gardening). In the grange part, after 1820, a larch house was built – the lands administrator's seat. In the years **1820-1822**, Krasiński funded a new, neo-classical church in Radziejowice (designed by arch. Jakub Kubicki) (Barbasiewicz, 2016). The church was located on the opposite side of the village, by the road leading to Warsaw. In accordance with the prevailing trends of that time, a large-scale spatial structure typical for neo-classical style was arranged within the site - the main architectural dominants (the palace and church) were connected by a **representative alley ensamble** with entry and exit points of the property. One of the fragments (present H. Sienkiewicz street) was used to separate the main residence (palace) from farm buildings and the administrator's mansion. Popular avenue tree species included linden and chestnut, the remainder or formal continuation of which exists to this day.

The boundaries of the area covered by the research

Borders of the area covered by the research are delimited by communal streets (historical roads), which can be divided into four separate fragments (Fig. 6.):

- fragment 1 (length 1.4 km) - **Lipowa avenue** from the junction with the S8 expressway and the intersection with Przemysłowa street (sector A);
- fragment 2. (length 0.6 km) **- Henryk Sienkiewicz street** - between the intersection with Przemysłowa street and the intersection with Główna street (by the palace and park in Radziejowice) (sector B);
- fragment 3 (length 0.35 km) - **Główna street** between the intersection with H. Sienkiewicz street and the roundabout at the intersection with J. Kubicki street (sector C);
- fragment 4. (length 0.37 km) - **Jakub Kubicki street** from the roundabout to the intersection with Ogarów Polskich street (sector D).

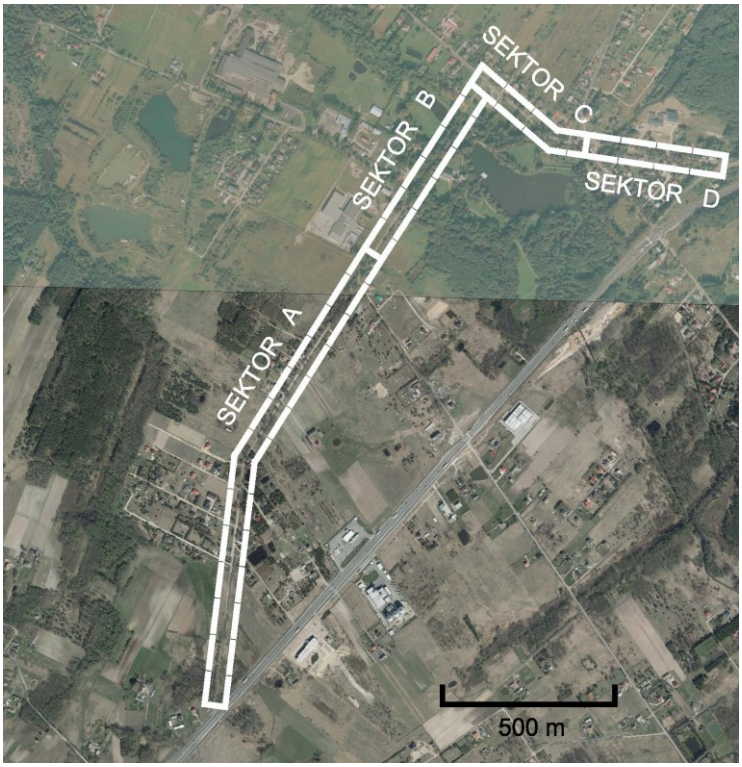

Fig. 6. The location of the alleys' layout in Radziejowice, developed by P. Wiśniewski on the basis of: Orthophotomap in scale 1: 5000 (Issued by the Office of the Marshal of the Mazowieckie Voivodeship in Warsaw, Department of Geodesy and Cartography)
6 pav. *Alėjos išsidėstymo planas Radziejowice vietovėje, kurį nubraižė P. Wiśniewski remdamasis 1:5000 mastelio ortofotožemėlapiu (išleistas Geodezijos ir kartografijos skyriaus prie Mazowieckie vaivadijos Varšuvoje)*

Contemporary form of use and functions

The analysed alleys are local vehicular and pedestrian communication routes with a hardened gravel-ground surface (fragment 1) and a bituminous surface (fragments 2-4) – with an increased, and periodically intensive, traffic. Currently, the alleys fulfil various functions:

- **historical** - as an important remnant of the former ensamble of roadside tree-shelters located in the south-western Mazovia;
- **cultural** - one of the basic traditional forms of woodlots in the agricultural landscape; the alleys were established not only for communication purposes, but also they served as compositional and scenic axes, often connecting parks established near manors with other dominant objects in the surrounding landscape (eg churches, chapels, granges and others); some of alleys' features such as rhythm, chiaroscuro, uniformity of the massif of trees may be viewed as analogous to features of architectural structures (Siewniak et al., 1991, Majdecki, 1993);
- **natural / biocenotic** – alleys along roads improve environmental conditions for fauna (constituent of a system of ecological corridors among fields and populated areas, a space for birds, insects, etc.; shaping the environment of pollinating insects);
- **technical -** alley, as one of the classic forms of midfield woodlots and roadside tree-shelters, fulfils certain protective functions (Hejmanowski et al., 1964; Łuczyńska-Bruzda, 1995): providing shade from sun in summer, protecting from strong side-wind and blown in snow, delimiting the road during snowy winters (Gradowski, Budzyński, 1963), increasing water retention in the environment, protecting arable crops against traffic pollution, enhancing the resistance of the environment against pests of crops;
- **recreational and touristic** - the presence of alleys, especially of valuable historic tree stands, definitely increases tourist and recreational appeal of the area.

Legal status

The historical assembly of alleys in Radziejowice is under protection - in the register of monuments, it is listed under the following numbers:

- ash alley - by the road from the west side of the palace / 400 m / registry number 545 dated 05.05.1980;
- lime alley along the road in front of the palace / 300 m / registry number 545 dated 05.05.1980;
- lime-maple-chestnut alley - along the road to the church / 300 m / registry number 545 dated 05.05.1980;
- lime alley - Radziejowice-Parcel / 700 m / registry number 545 dated 05.05.1980;
- lime alley - along the old highway to Warsaw (1-sided alley) / 300 m / registry number 545 dated 05/05/1980 (Study of conditions and directions of spatial development of the Radziejowice commune, 2006).

Results – the characterization of the alley stands

Collection of data - field work

In the period of September-October 2015, a detailed inventory of the alleys stand was carried out (Fig. 7.). A cirometer / measuring tape, an altimeter and a laser rangefinder

with a distance and height measurement function were used for measuring trees. The scope of fieldwork included:

- identification of individual specimens of trees, with an indication of their location on the inventory map together with assigned ordinal numbering;
- determination of taxonomic names of trees on the basis of morphological features, in accordance with the applicable botanical nomenclature (Seneta, Dolatowski, 2012);
- measurements of tree parameters:
    - trunk circumference at the standard dbh height of 1.3 m [cm]; if the measurement of the circumference at a typical height was not possible due to trunk-shape abnormalities, the measurement was carried out at a different altitude according to the rules adopted by ISA[1];
    - inclination of the trunk [angular degrees]
    - total height - measurement with an accuracy of 0.25-0.5 m [m];
    - average width of the crown projection [m];
    - extent of surface and depth damage of trunks [m / cm];
    - distance between trees (spacing) [m];
- determination of health - each inventoried specimen was subject to an overall assessment of the health, including existing defects, damage and disease symptoms (pathogen impact); the habit of the trees and conditions of their surroundings were characterized;
- estimation of the age of representative trees on the basis of the number of annual wood rings counted on stumps of cut or fallen trees (Zielski, Krąpiec, 2004) to estimate the average age for defined fragments of the alley stand; identification of specimens of high natural, historical (the oldest ones) and landscape values (specimens with outstanding habit features, vigorous);
- geographic coordinate measurements for the characteristic points along the alleys (using GPS);
- photographic documentation.

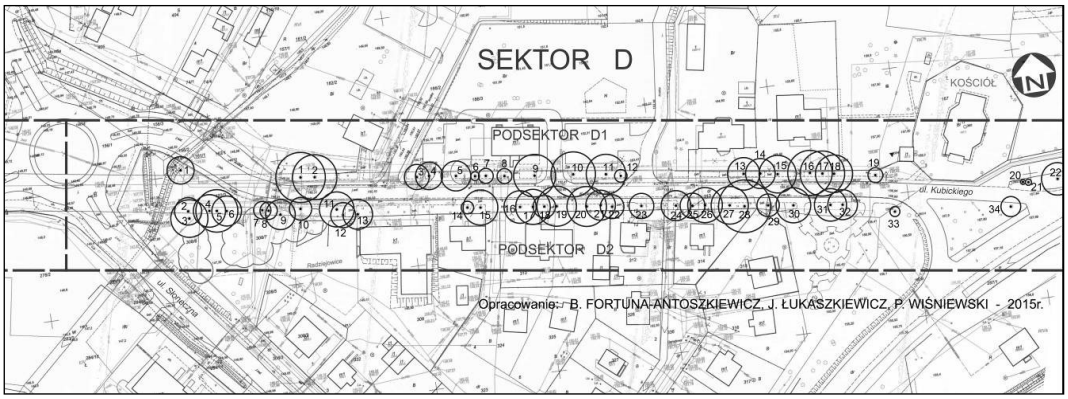

Fig. 7. A part of the detailed inventory map of the avenue stand in Radziejowice – Jakub Kubicki street (sector D) (Fortuna-Antoszkiewicz et al., 2015)

7 pav. *Dalis detalaus medžių inventorizacijos žemėlapio Radziejowice – Jakub Kubicki gatvės alėjoje (D sektorius) (Fortuna-Antoszkiewicz ir kt., 2015)*

[1] International Society of Arboriculture. Tree Ordinance Guidelines

Methods of result analysis

Data collected during field work is summarized in the inventory tables. The tables contain sequential numbering according to the numbering on the inventory map in the scale 1:500 (prepared on the situation and altitude map in the scale 1:500 (topographical map, scale 1:500, 2015, precinct: Radziejowice, Radziejowice - Parcel , Kuranów, published by the Poviat Eldership in Żyrardów). Each inventoried tree has an assigned Latin and Polish botanical name for taxon, as well as certain parameters: the circumference of the trunk (or trunks), total height, and the average width of the crown. In addition, the table contains information on, among others habit of the trees, defects and damage as well as health of trees. A map of the stand inventory (graphic part) shows individual fragments covered by a detailed inventory. The analysis of data collected during fieldwork included the characteristics of stand resources and landscape values of the alleys ensamble in Radziejowice. The degree of preservation of the original, historical alleys' layout was also assessed, with an indication of the estimated age of the trees forming it.

Species composition and valuable specimens in the alleys

Currently, the alleys ensamble in Radziejowice is characterized by a mixed species composition of the stand. Alleys consists of 213 trees and 19 species, of which more than half (108 pcs.) are small-leaved limes (*Tilia cordata* Mill.). This clearly indicates that the alleys ensamble in Radziejowice was originally largely made up of linden trees (Fig. 8.).

Fig. 8. Lipowa Avenue – small-leaved lime (stem circumference: 361 cm), inv. No. 25, subsector A1 (author: P. Wiśniewski, September 2015)
8 pav. *Lipowa alėja – mažalapė liepa (kamieno apimtis: 361 cm), inv. Nr. 25, A1 sektorius (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

The species composition of the whole researched alley tree stand **in quantitative terms** is as follows:

- small-leaved lime **is a dominant** species (*Tilia cordata* Mill.) - 108 pcs. (about 50% of all trees in alleys);
- common maple (*Acer platanoides* L.) appears as **a complementary** species - 33 pcs. (15%);
- a few species grow **in smaller numbers** , among others: chestnut *(Aesculus hippocastanum* L.) - 13 pcs. (6%), hornbeam (*Carpinus betulus* L.) - 10 pcs. (ca. 5%) and common ash (*Fraxinus excelsior* L.) - 7 pcs. (ca. 3%);
- other species **occur individually**, forming a group of total 31 pcs. (ca. 15% of all trees in alleys) - eg English oak, pear, Dutch linden, broad-leaved lime, black alder, white robinia, late poplar, white willow (Fig. 9.).

Fig. 9. Lipowa Avenue – an old pear tree with a broad and symmetrical crown (inv. No.14, subsector A1). In Sector A there are also other specimens of this species – planted as supplements in the alley (author: Wiśniewski, September 2015)
9 pav. *Lipowa alėja – sena kriaušė su išsišakojusia simetriška laja (inv. Nr.14, A1 sektorius). A sektoriuje yra ir kitų šios rūšies atstovų, pasodintų atkuriant alėją (autorius: Wiśniewski, 2015 m. rugsėjo mėn.)*

The most valuable part of the tree stand is located along a section of Aleja Lipowa (sector A) – it is mainly in this section where oldest, original plantings can be found. For this reason, **this article focuses mostly on this fragment** (Table 1.).

In sector A, two subsectors were identified: subsector A1 - covering the western side of the road and subsector A2 with the eastern side of the road.

In the **subsector A1** there are 43 trees belonging to 5 species. **The dominating species** is small-leaved lime (*Tilia cordata* Mill.) - 35 pcs. (about 90% of all trees in the subsector). Pear trees (hybrids) appear in **smaller numbers**. An interesting category are **the older trees**, which as evidenced by their size and age were probably parts of the original historic alley tree stand - this group includes as many as 14 small-leaved limes, with a breast circumference ranging from 301-400 cm. The largest of them on this side of the road has grown to **447 cm(!)** in trunk circumference (Fig. 10.).

Fig. 10. Lipowa Avenue – the largest in this subsector (circumference: 447 cm), very vital old linden with a regular, symmetrical crown, but also with serious damage – a place after a broken leader (inv. No. 41, subsector A1) (author: P. Wiśniewski, September 2015)
10 pav. *Lipowa alėja – didžiausia šiame sektoriuje (apimtis – 447 cm) sveika sena liepa, turinti taisyklingą ir simetrišką lają, bet ir rimtą sužalojimą – nulaužtą viršūninį ūglį (inv. Nr. 41, A1 sektorius) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

It is easy to identify trees having an **outstanding landscape value** due to their size, habit and vitality - this category includes 13 small-leaved limes and 2 pear trees. There are also **remnants (relics)** of original alley trees (lindens) in the form of old carp (leftovers of stumps) - 3 pcs. and "wreathed" groups / clusters (11 pcs.) of lime's coppices well grown from the base of old coppice stools (Fig. 11.). They have an **inalienable historical value** - they indicate the location of the original plantings and constitute a **valuable gene pool**.

Fig. 11. Lipowa Avenue – "wreath" (cluster) of coppice lime trees grown from the base of old coppice stool where the mother tree was located (inv. No. 12, subsector A1) (author: P. Wiśniewski, September 2015)

11 pav. *Lipowa alėja – liepos atžalynas, išaugęs toje vietoje kur augo motininis medis (inv. Nr. 12, A1 sektorius) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

In the A2 sub-sector, 40 trees belonging to 6 species. **The dominating species** is small-leaved lime (*Tilia cordata* Mill.) - 28 pcs. (ca. 70% of all trees in the subsector). The following species grow **in smaller numbers**: black alder (4 pcs.), Hornbeam (3 pcs.). **Individual** specimens include white robinia (2 pcs.) and field pear (2 pcs.). In the category of **older trees** (remnants of the original, historic tree stand), 6 small-leaved limes can be mentioned, with breast circumference of trunks of range 301-400 cm and 2 limes with circumferences in the range of 401-500 cm. The largest lime in the A2 subsector (and **the largest lime** of all alleys) reached the trunk circumference of **533 cm(!)** (Fig. 12.).

The category of trees **with outstanding landscape qualities** (due to their size, habit and vitality) includes 11 lindens. There are **also remnants (relics)** of the original alley trees (lindens) growing from old carp (leftovers of stumps) (1 pc.) and "wreathed" groups / clusters of coppice lime trees grown from the base of old coppice stools (4 pcs.).

Table 1. Species structure of alley stand – sector A (subsector A1 and A2), Lime alley, Radziejowice

1 lentelė. *Alėjos medžių rūšinė sudėtis – A sektorius (A1 and A2), Liepų alėja, Radziejowice*

Botanical name	**[pcs.]**
Tilia cordata	63
Pyrus sp.	5
Alnus glutinosa	4
Carpinus betulus	3
Tilia xeuropaea	2
Robinia pseudoacacia	2
Salix alba	2
Quercus robur	1
Total [pcs.]	**82**

Fig. 12. Lipowa Avenue – the largest small-leaved lime in the alleys' layout – a tree qualifies as a natural monument (circumference: 533 cm / inv. No. 36, subsector A2) (author: P. Wiśniewski, September 2015)

12 pav. *Lipowa alėja – didžiausia mažalapė liepa alėjoje – medis gamtos paminklas (apimtis: 533 cm / inv. Nr. 36, A2 sektorius) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Other sectors (B, C and D) include individual trees in the category **of the oldest, historical trees**:

- **subsector B1** - 5 common maples, 2 limes and 2 horse chestnuts with circumference of trunks in the range of 201-300 cm; 1 maple and 1 lime with a circumference in the range of 301-400 cm; 1 lime with a circumference of **409 cm(!)**;
- **subsector B2** - 5 limes and 1 common ash with circumference of trunks in the range of 201-300 cm; 1 lime with a circumference in the range of 301-400 cm;
- **sector C** - 2 limes, 1 common maple and 1 robinia with circumference of trunks in the range of 201-300 cm;
- **subsector D1** - 5 common maples, 2 limes and 2 horse chestnuts with circumference of trunks in the range of 201-300 cm; 1 common mapleand 1 lime with circumference of trunks in the range of 301-400 cm; 1 lime with a circumference of **409 cm(!);**
- **subsector D2** - 4 limes, 3 common maples and 1 horse chestnut with circumference of trunks in the range of 201-300 cm; 2 limes with circumference of trunks in the range of 301-400 cm (Fig. 13).

Fig. 13. The largest tree at Jakub Kubickiego street (subsector D2) – small-leaved lime, 349 cm in circumference (inv. No. 28) (author: P. Wiśniewski, September 2015)
13 pav. *Didžiausias medis Jakub Kubickiego gatvėje (D2 sektorius) – mažalapė liepa, kamieno apimtis -349 cm (inv. Nr. 28) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Assessment of the condition of trees

A few trees growing in alleys in Radziejowice show signs of various kinds of damage and symptoms indicating a deteriorated health condition (Fig. 14):

- 52 trees (nearly 1/4 – ca. **24%** of all trees) show signs of deteriorated vitality, eg: crown dieback, deteriorated foliage, deadwood branches, fruiting bodies of wood parasitic fungi and others;
- 75 trees - **35%** (over ⅓) have various types of trunk damage, e.g. surface bark peeling with wood necrosis, cracked trunks (closed deep cavities), and hollows (open deep cavities) with wood decay symptoms (e.g. various types of rot with necrosis and rotting wood), caused by, among others by fungal pathogens and microorganisms (Fig. 15);
- **6%** of trees having both characteristics occur in the whole alleys ensamble (Table 2).

Table 2. Alleys in Radziejowice – assessment of the condition of trees located in the subsectors

2 lentelė. *Radziejowice vietovės sektoriuose esančių alėjų medžių būklės įvertinimas*

Category	Sector A1	Sector A2	Sector B1	Sector B2	Sector C	Sector D1	Sector D2	To-tal
Trees in sectors - total [pcs.]	**43**	**40**	**47**	**15**	**15**	**21**	**33**	**213**
Strong damage and defects [pcs.]	18	15	15	1	4	7	15	**75**
percentage [%]	42	38	32	7	27	33	45	**35**
Deteriorated vitality [pcs.]	9	9	10	4	3	7	10	**52**
percentage [%]	21	23	21	27	20	33	30	**24**
Trees with both features [pcs.]	3	3	3	-	-	1	2	**12**
percentage [%]	7	8	6	-	-	5	6	**6**

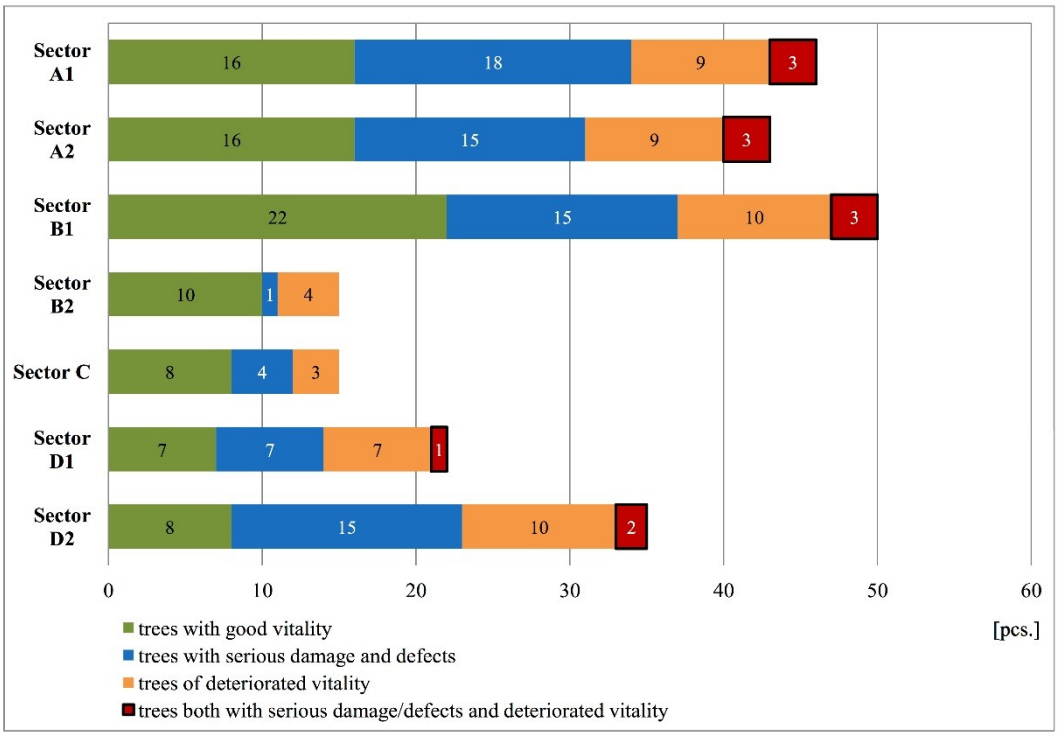

Fig. 14. Trees of good vitality, heavily damaged or with diminished vitality – alleys in Radziejowice with division into sectors (Fortuna-Antoszkiewicz et al., 2015)

14 pav. *Sveiki, labai pažeisti, arba prastos būklės medžiai Radziejowice alėjose pagal sektorius (Fortuna-Antoszkiewicz ir kt., 2015)*

Fig. 15. Lipowa Avenue – an example of a tree with a serious damage – a huge cavity after a broken leader → a hollow with an internal wood decay (inv. No. 20, subsector A1) (author: P. Wiśniewski, September 2015)

15 pav. *Lipowa alėja – stipriai pažeisto medžio pavyzdys – didžiulė ertmė, atsiradusi nulaužus viršūninį ūglį → tuščiaviduris medis su puviniu (inv. Nr. 20, A1 sektorius) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Some alley trees show deteriorated condition due to their developmental stage (the oldest trees - the senile phase). However, some of the symptoms of poor health condition are largely connected with ongoing in recent years (especially the 1970s and 1980s) treatments of so-called "tree surgery" or "tree cure" (Fig. 15, Fig. 16).

Decisive factors influencing condition of trees, especially of those in the senile phase are their habitat and spatial conditions.

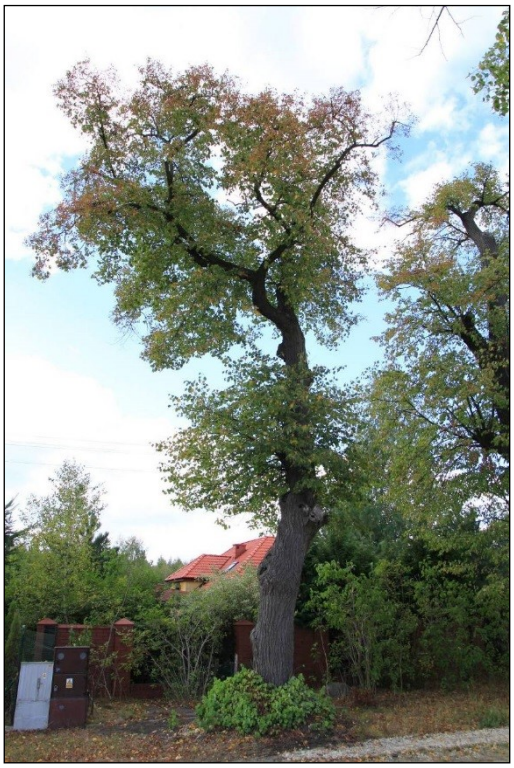

Fig. 16. Lipowa Avenue – in the foreground the old small-leaved lime with a drastically raised crown (inv. No. 24, subsector A1) (author: P. Wiśniewski, September 2015)
16 pav. *Lipowa alėja – pirmame plane sena mažalapė liepa su aukštai iškelta laja (inv. Nr. 24, A1) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Alleys established as roads intended for pedestrian or horse traffic, with low intensity of use, have, over the years, evolved into busy communication routes (Majdecki, 1993). The gradual increase in the volume of vehicular traffic is often the result of changes in the ways of managing the surroundings (eg intensification of housing development). The related road modernization (reconstruction of the surface, establishment of underground technical infrastructure) carried out in the immediate vicinity of roadside trees causes reduction and damage of root systems. This results in a significant weakening and irreversible degradation especially of old trees (the so-called "spiral of death"). Construction works (moving of heavy equipment, storage of construction materials, soil pollution, etc.) usually impact a much wider area than just the road. Negative effects of construction works are usually irreversible (Fortuna-Antoszkiewicz, Łukaszkiewicz, 2012b).

Increased intensity of vehicular traffic is also the cause of numerous mechanical damages of trees, eg as a result of road collisions or caused by cars with a size exceeding what the avenue allows. These types of incidents often become the pretext for unjustified, excessive crowns' pruning of roadside trees (Fig. 17, Fig. 18).

Fig. 17. Jakub Kubicki street (sector D). A part of the avenue currently in the zone of increased local traffic. Raised crowns and slender silhouettes of trees – the result of a strong pruning of thick branches and branches interfering the road's vertical clearance (author: P. Wiśniewski, September 2015)

17 pav. *Jakub Kubicki gatvė (D sektorius). Dalis alėjos, kuri šiuo metu yra intensyvaus eismo zonoje. Aukštai iškeltos lajos ir ploni kamienai yra intensyvaus užstojančių matomumą šakų genėjimo padarinys (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Trees growing in unfavourable road conditions are exposed to many negative factors that cause a decrease in the efficiency of physiological processes and a clear shortening the lifespan of trees. The health condition of alley trees depends on several factors related to ground conditions affecting the root systems of trees. These are: excessive compaction, reduction of humidity, chemical pollution, salinity of the soil.

Excessive soil compaction is considered as most harmful to tree growth. The increase in soil compaction results in the destruction of the crumb structure, which is the result of the natural process of soil formation. The average size of air filled pores (the non-capillary spaces present in the soil) decreases. As macropore space decreases, water infiltration and gas exchange decrease, oxygen concentration in the soil decreases, and carbon dioxide concentration increases, even to toxic quantities.

Negative changes in the degree of soil compaction around alleys trees occur especially in the top layer of soil with a thickness of 0.0-1.0. This is particularly important considering the fact that most tree species develop the main root mass (even 70-90% of the entire root system) just below the ground, in the upper 30-cm soil layer (Bernatzky, 1979; Zimmermann, Brown, 1981, Tomanek, 1997, Szczepanowska, 2001, Fortuna-Antoszkiewicz, Łukaszkiewicz, 2012b).

The properties of the soil in the root zone of trees in road conditions depend on the type of land cover (eg grass surface, ground surface or impermeable paved surface), as well as the distance of the road edge from tree trunks.

Excessive compaction of the soil and reduction of the root range result in:

- a clear deterioration of general health condition of trees (forming deadwood, intensification of pathogen activity, tree dying) (Fig. 18);
- disturbance of tree stability and a major increase in the risk of windthrow occurring (Fortuna-Antoszkiewicz, Łukaszkiewicz, 2012b).

Fig. 18. Jakub Kubicki street (sector D). Pollarded ancient small-leaved lime with a large stump 4.0 m of height above the street and the remains of the crown with an old rope tie (inv. No. 7, subsection D1) – the effect of the tree location on a modern, busy street – the former course (author: P. Wiśniewski, September 2015)

18 pav. *Jakub Kubicki gatvė (D sektorius). Sena nugenėta mažalapė liepa su 4.0 m aukščio kelmu ir pririšta likusia viršūnės dalimi (inv. Nr. 7, D1 sektorius) – medžio vaizdas naujoje, judrioje gatvėje (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

A gradual disappearance of the alley layout observed in the research site can be attributed to such conditions, especially within the centre of the village - in this area, on the section of Główna street (sector C), there is a clear regression of alley trees (Fig. 19).

Fig. 19. Głowna Street (sector C) – general view towards the roundabout. The trees grow in very irregular intervals; from the side of the park fence (south side) – practically no trees (author: P. Wiśniewski, September 2015)

19 pav. *Głowna gatvė (C sektorius) – bendras vaizdas važiuojant link žiedinės sankryžos. Medžiai auga labai nevienodais atstumais; nuo parko tvoros pusės (pietinės) medžių praktiškai nėra (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Dating of the tree layout

The assessment of the age and date of the establishment of the alleys ensamble in Radziejowice was based on historical research (query of archival materials) and *in situ* research - by assessing the age of alley trees (based on the measurement of tree trunks and the number of annual increment rings marked on old felled carps) (Fig. 20.) (Łukaszkiewicz, 2010).

Fig. 20. Lipowa Avenue – one of stumps after old lindens – trace of the original avenue planting (subsector A1) (author: P. Wiśniewski, September 2015)

20 pav. *Lipowa alėja – vienas iš senų liepų kelmų – pirmųjų pasodintų alėjos liepų pėdsakas (A1 sektorius) (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

As mentioned earlier, the **Radziejowice avenue ensamble** - in the form of a complex system - **was in its greatest part established ca. 1820**. This is clearly confirmed by results of alley's stand studies, including the age of trees - especially the group of the oldest specimens of limes growing in Lipowa avenue (sector A).

The age of the trees was estimated by counting the annual increments of wood on the felled trunks (old carps); the extrapolation was performed in the internal cavities; stem circumferences were measured at the base, then the value was **reduced by about 10%** to obtain probable mean trunk girth at the standard height of 1.3 m [cm]:

- stump circumference of 446 cm measured at 0.7 m over ground → estimated trunk's girth at 1.3 m: approx. 400 cm / number of rings: approx. 190 = **approx. 190 years old;**
- stump circumference of 334 cm measured at 0.5 m over ground → estimated trunk's girth at 1.3 m: approx. 300 cm / number of rings: approx. 180 = **approx. 180 years old.**

Therefore, it can be assumed that lindens with current trunk circumferences exceeding 300 cm at 1.3 m height **are about 180-190 years old** (the range takes into account the different growth rate of individual tree specimens - the result of individual features).
In the alleys ensamble, there are currently **31 trees** with trunk circumferences bigger than 300 cm, which means they achieved **age of over 180 years (→ valuable material assets)**.

The extent of preservation of the alley ensamble

Classic **alley -** it is a pedestrian or vehicular road lined with rhythmic rows of trees. It is one of the basic components (*garden element*) of arranged garden compositions, as well as urban-garden ensambles. It can be isolated as a form of landscaping (eg a *mid-field alley*) or a representative area (eg *urban alley*). It is then a distinctive, independent garden arrangement with a rigorous compositional structure (Fortuna-Antoszkiewicz, 2012).

In the research site the inevitable process of falling out of old trees is observed (Fig. 21.). In many places, the original rhythm of old plantings disappears, original specimens of trees (eg lime trees in Lipowa alley) fall out. Many specimens considered valuable (botanical, compositional and landscape aspects) are in bad health condition or gradually lose their decorative qualities (habit deformities). Therefore thinning of the stand and dissolution of the distinct compositional structure of the system – its rigorous, regular spatial form – can be observed.

Fig. 21. Lipowa Avenue – windbreak after the storm (July 2015), sector A; such factors are primarily exposed to trees with significantly reduced vitality, severely damaged, with deteriorated statics (author: P. Wiśniewski, September 2015)
21 pav. *Lipowa alėja – audros nulaužti medžiai (2015 m. liepa)), A sektorius; tokie klimato faktoriai labiausiai pakenkia medžiams, kurie yra ligoti ar smarkiai pažeisti puvinio (autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

The field research shows that the **original spacing of trees** (the distance between adjacent trees) in the best preserved section i.e. in Lipowa alley (as evidenced by spacing of original 190-year-old lime trees) was **about 8.0 m**. The minimum spacing of trees in this section is 7.0 m; with intermediate values: 7.5 / 7.7 / 8.0 (most often) / 8.5 m; the maximum value is 9.0 m.

Using the average distance between adjacent trees (about 8.0 m) the number of existing trees (regardless of their age and species) and number of fallen trees in the alleys has been calculated, taking into account required gaps for entrances, intersections, etc. On this basis, **the degree of the alley ensambe's preservation as a spatial form**, functioning in particular contemporary spatial layout, was determined. This proves that the analysed **alley system** (Lipowa Avenue - H. Sienkiewicza street - Główna street - J. Kubickiego street) **is currently preserved in approx. 36%.**

Throughout the entire length of the alley ensamble trees are distributed unevenly: in some fragments trees they are scattered, or grow individually; in other fragments - their arrangement (a linear form and a specific rhythm – spacing of trees) remains distinguishable. The oldest trees are found mainly in sector A (Lipowa Avenue) - here the rhythm of the alley is distorted in the highest degree and in some places it’s completely unrecognizable. In sector C (Główna street), the alley form is not preserved anymore. In both sectors originally the alleys were formed by lindens.

Within sectors B (H. Sienkiewicza street) and D (J. Kubickiego street), where the younger and mixed species stand prevails, the layout and the rhythm of planting (spacing of trees) are preserved to a greater extent (Fig. 22.; Fig. 23.).

Fig. 22. Jakub Kubicki street (sector D). General view of the avenue from the church towards the south; in the foreground the largest tree in this sector – small-leaved lime with a circumference of 349 cm (inv. No. 28, subsector D2) (author: P. Wiśniewski, September 2015)
22 pav. *Jakub Kubicki gatvė (D sektorius). Bendras alėjos vaizdas einant nuo bažnyčios į pietus. Pirmame plane – didžiausias medis šiame sektoriuje –349 cm apimties mažalapė liepa (inv. Nr. 28, D2 sektorius)(autorius: P. Wiśniewski, 2015 m. rugsėjo mėn.)*

Fig. 23. Jakub Kubicki street (sector D). General view of the old avenue stand towards the north. At the end of the viewing axis – a symbolic dominant – a towering Italian poplar growing in the vicinity of a historic church (author: P. Wiśniewski, April 2016)
23 pav. *Jakub Kubicki gatvė (D sektorius). Bendras senos alėjos vaizdas į šiaurę. Žiūrėjimo ašies gale – dominuojantis simbolis – aukšta itališka tuopa šalia istorinės bažnyčios (autorius: P. Wiśniewski, 2016 m. balandis)*

Conclusions

- Generally, it can be stated that the alley ensamble in Radziejowice is an extremely valuable and unique example of a relatively well-preserved historical large-scale arrangement that still binds village elements - connects architectural and landscape dominating elements (palace - church), binds important public buildings (Municipal Office, 2 schools, etc.), delimits main communication routes.
- It has inalienable **historical** (uninterrupted 200 years of existence), **natural** (preserved original fragments of plantings - presence of old, still vital tree specimens), **landscape** (alleys, as an element of a preserved and still recognizable neo-classicist spatial composition: the palace-park ensamble ↔ alleys, as a system of connections ↔ church) value.
- The site, still preserved and recognizable, is in the phase of progressive degradation - the whole analysed alley layout (Lipowa Avenue - H. Sienkiewicza street - Główna street - J. Kubickiego street) is currently preserved in approx. 36%.
- The losses in the alley tree stand (tree dieback, tree felling) are caused by all changes taking place in its surroundings, especially changes in road functions (intensification of traffic). Therefore, actions are necessary to **improve the living conditions of trees** [Majdecki 1993]. Their **proper maintenance** is of key importance.
- It is recommended that protection measures of the alleys ensamble include **preservation of the most valuable relic trees** (the oldest - vital, specimens with valuable habits), as well as the use of natural plant material (original genetic material) - by selecting and leaving the overgrown, properly shaped outgrowths of historical lime carps.

Old alleys in the agricultural landscape of Mazovia and the whole country are extremely valuable today for various reasons - they have undeniable landscape values, but also an extraordinary historical value - they are **a living bridge** between the past and the present, constitute an important record – of the past traditions, people and events. It is of utmost importance to **preserve the historical spatial form** and **the original substance**, consisting of ancient trees growing in these sites.

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Istorinių alėjų vertinimas 19 a. alėjų ansamblio Radziejowice vietovėje (Mazovija, Lenkija) pavyzdžiu. Metodologinis tyrimas

Santrauka

Istorinių alėjų ansamblio Radziejowice vietovėje Mazovijoje tyrimas pasitarnavo nustatyti jų išskirtines kultūrines ir gamtines vertybes, kaip vertingą pakelės želdinių formą, kurios yra senųjų istorinių vietos kelių sistemos palikimas.

Tyrimo tikslas buvo nustatyti pasirinktų alėjų išlikusių medžių išteklius (taksonų, erdviniu, kiekybiniu ir kokybiniu požiūriais) siekiant vykdyti jų tinkamą priežiūrą šiuo metu ir išsaugoti ateičiai. Įvertintas ir senųjų istorinių medynų išsaugojimo laipsnis, įskaitant ir pirmųjų istorinių medžių amžiaus nustatymą. Istorinių alėjų ansamblio pradžios data Radziejowice vietovėje buvo nustatoma tiek remiantis istoriniu tyrimu (archyvine medžiaga), tiek renkant lauko duomenis – nustatant alėjose augančių medžių amžių. Mokslinių tyrimų išdavoje buvo išaiškinti ypač vertingi medžiai – veteranai (dėl savo būklės, augimo pobūdžio, vertės kraštovaizdžiui), o taip pat ir išlikę 19 a. sodinti medžiai.

Tyrimas buvo atliekamas alėjose, esančiose skirtingose gatvėse: Lipowa alėja, Henriko Sienkiewicza gatvė, Główna gatvė, Jokūbo Kubickiego gatvė, kuriose buvo atlika detali dendrologinė inventorizacija. Be to, buvo atliktas medžių sveikatos būklės vertinimas (2015 m. rugsėjo-spalio mėn.).

Alėjos ansamblis, kuris yra tyrimo objektas, buvo įkurtas 1820–1830-aisiais. Šiuo metu šioms alėjoms yra būdinga didelė medžių įvairovė ir išskirtinis gatvių bei kelių, kuriuose jos yra, pobūdis. Daugiau nei pusę medžių sudaro mažalapės liepos (*Tilia cordata* Mill.), kartu su klevais (*Acer platanoides* L.), kaštonais (*Aesculus hippo-castanum* L.), skroblais (Carpinus betulus L.), uosiais (*Fraxinus excelsior* L.). Ten auga 31 medis, kurių kamienai (imatuota 1,3 m krūtinės aukštyje) siekia virš 300 cm, o amžius – maždaug 180 metų (vertingi materialieji ištekliai). Apytikris alėjų sistemos kaip erdvinės formos *išsaugojimo laipsnis - maždaug 36 proc.*

Raktažodžiai: alėjos medžiai, kultūros paveldas, istorinės alėjos, Mazovijos kraštovaizdis, gamtos vertybės, pakelės medžiai.

CULTURAL PARKS AS A FORM OF LANDSCAPE PROTECTION IN POLAND

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The landscape is an element of the natural and cultural heritage of society, affects the quality of human life and plays an important role in various areas of public life, from culture to ecology and social issues. At the same time, not only in Poland, but also in other European countries, a gradual decline in the diversity of landscapes, their impoverishment and unification, as well as the destruction of cultural landscapes have been observed for a long time. The threats to the landscape include, among others, economic and social modernization processes, intensification, concentration and specialization of production processes, mass tourism as well as architecture that does not take into account aesthetic and environmental conditions. Care for high quality landscapes requires cooperation for their protection, economy and planning. In Poland, cultural parks as a form of cultural landscape protection appeared relatively recently, because only sixteen years ago. However, understanding of the need to create them, as evidenced by the analysis of the planning documents presented above, is large, especially among planners, local government and politicians. On the other hand, among the general public, knowledge about cultural parks, the goals of their creation, and the rules of functioning seems insufficient. Effective protection of the landscape, both natural and cultural, is possible only with full understanding and acceptance of these activities by local communities. Hence, a key task facilitating the harmonization of environmental, social and business needs is to promote and teach values related to landscapes, its shaping, both in the formal dimension, carried out by educational institutions, and informal implemented by various organizations and associations.

Keywords: cultural parks, landscape protection.

Introduction

Landscape, according to the European Landscape Convention (Journal of Laws from 2006 No. 14 item 98), is an area perceived by people whose character is the result of the action and interaction of natural and /or human factors. In the Polish law, they function alongside the above-mentioned The definition of landscape also includes terms such as cultural landscape, priority landscape and landscape values. The cultural landscape in the Act on the Protection of Monuments and Guardianship of Monuments (Journal of Laws of 2017, item 2187, Article 3, point 14) is defined as "space perceived by people, containing natural elements and products of civilization, historically shaped in result of natural factors and human activities. "In turn, the priority landscape should be understood, in accordance with the Act on spatial planning and development (Article 2, point 16f), a landscape particularly valuable to the public due to its natural, cultural, historical, architectural, urban, rural or aesthetic-look values, and as such requiring the preservation or specification of the principles and conditions of its shaping. In turn, landscape values in the light of the Act on Nature Conservation (Journal of Laws of 2004 No. 92 item 880) are: "natural, cultural, historical, aesthetic and scenic values of the area and related relief, creations and components nature and civilization elements, shaped by the forces of nature or human activity".

From the above definitions, the concept of landscape combines two thematic layers: material (natural and cultural) and physiognomic (Gawroński 2010). The material nature layer is created by resources that are used economically and with which specific forms of land use are associated. The material cultural layer refers to the material products of individuals, societies and all humanity. On the other hand, the physiognomic layer is a subjective reception, mainly visual, on the basis of which the relationship between people and the en-

vironment is shaped. Landscape protection, in the light of the European Landscape Convention and the Nature Conservation Act, means actions to preserve and maintain important or characteristic features of the landscape, so as to direct and harmonize changes that result from social, economic and environmental processes. The Nature Conservation Act introduces several legal forms of nature landscape protection: a national park within which the whole natural and cultural environment with physiognomic values is protected, then a landscape park, a nature and landscape complex, a protected landscape area and a nature reserve. However, detailed regulations in the context of cultural landscape protection are set out in the Act on the Protection of Monuments and Guardianship of Monuments. According to this act, the cultural landscape, like parks, gardens and other forms of designed greenery, urban and rural layouts and building complexes, architectural and construction works, or defensive construction works, has been included in the group of immovable monuments. The forms of protection of monuments, provided for in the above mentioned The Act (Journal of Laws of 2017, item 2187, Article 7) is: entry into the register of monuments, recognition as a historical monument, establishing protection in the local spatial development plan as well as establishing cultural parks.

The aim of the article is to characterize cultural parks in Poland, in terms of their number, date of creation, purpose of protection, etc., as well as an attempt to answer the question regarding prospects for their further development.

Cultural parks in Poland - current status

A cultural park is one of the statutory forms of monument protection in Poland (Article 7 point 1 of the Act of 23 July 2003 on the protection and care of monuments (Journal of Laws of 2017, item 2187, as amended). in order to preserve the cultural landscape and preserve landscape areas with immovable monuments characteristic of the local building and settlement tradition (Article 16.1. of the Act). The creation of a cultural park belongs to commune initiatives. As a result of another amendment to the Act, the obligation to conduct public consultations preceding the adoption of a resolution regarding the park was introduced. The resolution of the municipality defines the name of the park, its boundaries, protection method as well as appropriate prohibitions and restrictions (Article 16 point 2). If the park area exceeds the limits of one municipality, it can be created and managed on the basis of compatible resolutions of several municipal councils (municipal association). In the area of the cultural park, bans and restrictions established may refer in particular to conducting construction works as well as commercial, service and industry activities. in particular, conducting construction works and commercial, service, industrial and agricultural activities, changing the use of immovable monuments, storing or storing waste and placing boards, inscriptions and advertisements and other signs unrelated to cultural park protection, with the exception of road signs and signs related to protection order in public safety, as well as the principles and conditions for locating landscaping facilities. For each cultural park established, the commune head (mayor, president of the city), in agreement with the voivodship heritage conservator, draws up a cultural park protection plan, which requires approval by the commune council. The cultural park protection plan is prepared in accordance with the document adopted in 2005 and recommended by the Monuments Protection Council at the Ministry of Culture. "Rules for creating a cultural park, managing it and drawing up a protection plan". It has been handed over to all voivodship heritage restorers with a request to make it available to interested entities (Lipińska 2011). The document established provides for such components of the cultural park protection plan as: diagnosis, prognosis and findings and guidelines. The diagnosis consists in identifying representative characteristics

of the preserved cultural landscape (specifying the reasons for which a given area has been protected), registering the landscape resource and processes occurring in it, and valorizing them. The forecast includes: analysis of chances, conflicts and threats, analysis of the primary, secondary and future landscape (taking into account two variants - a situation where the park will not be created, and the situation in which it will be created) and protective zoning of the area. A summary of both parts are arrangements and guidelines referring to the designation or correction of the boundaries of the park's boundaries, allowing to determine the directions and scope of activities in individual zones, ways of resolving conflicts and mitigating hazards, and providing guidelines for local spatial development plans.

The last element is particularly important in view of the fact that in accordance with the Monuments Act, mandatory for the areas on which the cultural park was created, a local spatial development plan is drawn up. The commune council has the possibility to create a special organizational unit to manage the park. Appointed individuals usually take the form of a separate cell in the commune office and act on the basis of office regulations (eg in Kraków, Wrocław). The second form of cultural park management is a commercial law company (eg a limited liability company operating in the Fortress Cultural Park in Srebrna Góra). The park can also be managed by the foundation, as is the case of the Cultural Park of the Jelenia Góra Valley or the Cultural Park of Kalwaria Pakoska. It also happens that at the park's management a separate opinion-making body is appointed (its example is the Social Consultative Council at the Cultural Park "Dolina Trzech Młynów" in Bogdaniec) (Lipińska 2011).

Cultural parks have been designated in thirteen provinces in Poland. Only in the following provinces: Podlasie, Zachodniopomorskie and Lubelskie there are currently no cultural parks. Most (six) cultural parks have been designated in the province of Lower Silesia. Five parks were created in the Kuyavian-Pomeranian Voivodeship, four in the Łódzkie and Śląskie provinces. Three cultural parks were created in the following provinces: Małopolskie, Mazowieckie and Pomorskie. Two parks have been designated in the Lubuskie Voivodeship. In turn, in the Wielkopolskie, Świętokrzyskie, Podkarpackie, Opolskie and Warmińsko-mazurskie voivodeships, one cultural park was created. In the years 2002-2007 a total of eleven cultural parks were created. In the years 2008-2013, another 11 parks were created, and in Fortress Cultural Park in Srebrna Góra (Lower Silesia). The youngest parks established in 2016 include: Cultural Park for the Old Town Area in Bieruń and the Cultural Park for the Dike Area in Bieruń (both in the Silesian Voivodeship) and the Cultural Park Książęce Miasto Brzeg (Opole Voivodeship) and the Cultural Park Krupówki in Zakopane (voivodeship) Lesser).

All 35 cultural parks can be qualified to one of seven groups, taking into account the type of resources covered by this form of protection (https://www.dworniczak.com/parki-kulturowe-w-polsce-rozmieszczenie-i-typologia/). The most numerous group (8 objects) are parks established to ***protect relic cultural landscape resources*** (castles, archaeological objects or remnants of historical resources). This group includes, among others, the Wietrzychowice Cultural Park, the "Three Mills" Cultural Park in Bogdaniec, the Grodzisko Cultural Park in Wicino, the „Wzgórze Zamkowe" Cultural Park in Sieradz and the "Osada Łowców Fok" Cultural Park in Rzucewo. The next two groups (7 parks) are cultural parks created to protect ***the cultural landscape of Old Town centers and non-urbanized areas.*** The urban landscape is protected by, among others: the Old Town Cultural Park in Wrocław, the Old Town Cultural Park in Krakow, the Old Town Cultural Park and the OO Team. Dominikanów in Jarosław, or the Cultural Park Książęce City Brzeg and the Cultural Park of the area of Krupówki Street with Zakopane (Fig. 1). In turn, the cultural landscape of non-

urbanized areas is protected by the establishment of cultural parks such as the Cultural Park of the Jelenia Góra Valley, the Cultural Park of the Zakopane Basin, the Cultural Park of the Warmia Landscape Route Gietrzwałd-Woryty, and the Mickiewicz Cultural Park. Four of 35 parks were created to protect the ***cultural landscape associated with religious worship***. These are, among others, the Cultural Park of Kalwaria Pakoska, the Cultural Park of the Jewish Cemetery in Żory, and the Cardinal Stefan Wyszyński's Cultural Park. The next four cultural parks protect the ***cultural landscape of historical building complexes located outside the strict city centers***. This group includes: Cultural Park Tkaczy City in Zgierz, Kultura Park Stary Radom, Wilanowski Cultural Park in Warsaw and Cultural Park of Piotrowska Street in Łódź. Two parks were established to protect ***sites and facilities related to the activities of historical figures and events:*** Cultural Park of the ethnographic subregion of Kutno associated with the Romantic poet Józef Bohdan Zaleski and Kultura Park "Ossów Wrota Bitwy Warszawskiej 1920". Cultural parks are also referred to for the protection ***of the cultural landscape of fortress complexes***. This group is represented by two parks: Fortress Cultural Park in Srebrna Góra (Fig. 2) and Fortress Cultural Park Twierdza Kłodzka.

Fig. 1. The Cultural Park of the area of Krupówki Street in Zakopane
1 pav. *Kultūrinis parkas Krupówki gatvėje Zakopanėje*

Fig. 2. Fortress Cultural Park in Srebrna Góra
2 pav. *Tvirtovės kultūrinis parkas Srebrna Góra*

The benefits of establishing a cultural park are diverse. Kruczek and Maciąg (2017) point out that the creation of a cultural park, in addition to the legal protection of objects in range, allows the area to be protected from chaotic investments, it also increases the prestige for the town, facilitates access to financial resources from the Ministry of Culture and National Heritage programs, as well as an additional argument in the efforts for EU subsidies. The cultural park is also a new tourist attraction on the basis of which you can create more tourist products, thus cultural parks can also be used to promote a place or region. For example, the City of Weavers in Zgierz is already a recognizable tourist product. The Fortress Cultural Park of the Kłodzko Fortress is also a tourist attraction. In several parks, recreational infrastructure develops, such as, for example, ecological paths or viewpoints (PK "Twierdza Gdańsk", PK "Hałda Popłuczkowa" PK "Dolina Trzech Młynów"). The Mickiewiczowski Tourist Center operates in the Mickiewiczowski PK, in PK Grodzisko in Wicino - the Scientific-Research-Educational-Tourist Center, and in PK Kalwaria Pakoska in Pakość - Tourist Information Center. Museum plan, reconstruction of the battle has already been developed for PK "Ossów Wrota Bitwy Warszawskiej"

Establishment of a cultural park can contribute to the revitalization of a given area. This allowed many cities to successfully overcome the onerous problem of advertising media that "flood" the very centers of Polish cities. An example of such an activity is Krakow, which established in 2011 a cultural park in the area of the Old Town. Undoubtedly, this decision has contributed to the increase of tourist values of the city and the development of tourism. Another cities are going along Krakow, including Wrocław or Radom (Kruczek and Maciąg 2017). Despite undoubtedly considerable benefits resulting from the creation of a cultural park, there are also examples when this type of cultural landscape protection was abolished. . It is not always the local community that fully supports the need to apply restrictive prohibitions or restrictions resulting from the establishment of a park. For example, on August 5, 2010, the Provincial Administrative Court in Szczecin annulled the decision to establish the Chwarszczany Culture Park, colloquially called the Templars' cultural park (the

area of the former establishment of Templars and Knights of the Knights, together with the modern farm) established in 2005. Another example is the Zwierzyniec Culture Park in Krakow, created in 2006. By decision of the Supreme Administrative Court of December 7, 2007, the Krakow City Council was dismissed from April 3, 2007 regarding the establishment of the Zwierzyniec Cultural Park, maintaining the decision of the Provincial Administrative Court on annulment of the challenged resolution of the City Council of Krakow on July 6, 2006. Other examples are Osieczek Park Kulturowy in Osieczek, created in 2014, Cultural Park Church of Sts. Maria Magdalena in Łopki, established in 2014 (Myczkowski, Marcinek, Siwek 2017).

National Parks – development perspectives

Poland is determined on the one hand by planning documents such as, for example, spatial development plans of voivodships, and on the other - a social understanding for the idea of the functioning of such facilities. Taking into account the development plans of individual voivodships, it turns out that the postulates regarding the creation of new cultural parks are reported by the vast majority of voivodships. For example, in a spatial development master of the Podkarpackie Province (No 290/5800/17), There is a proposal to create nine cultural parks. Four parks have a linear character, two of them include the narrow-gauge railway route on the section Przeworsk-Dynów and Cisna-Komańcza, and two further fragments of river valleys: the Wiar and San River rivers. One of the cultural parks would allow more effective protection of the existing military facility - the Przemyśl Fortress. Other cultural parks in the Podkarpacie region are a park protecting the ruins of Sobień Castle and a park covering the former village of Bieszczady - Łopienka. The spatial development of the Masovian Voivodship (No 180/14) also includes nine proposals for new cultural parks, měni for the area within the Modlin Fortress, the area around the Castle in Liwa and in Czersk, Iłża-Sienno, and the Kultura Park. M. Chełmoński, "Szwedzkie Góry" Cultural Park, Otwock Spa Culture Park, Reduta Cultural Park 1939 and Folklór Kołbielski Culture Park. The Lubelskie Voivodeship is an unquestionable leader when it comes to the number of areas to be covered by the cultural pitch. In the spatial development plan of the Lubelskie Voivodeship (No XI/162/2015) one can find an indication of the creation of fifty-six new cultural parks. Similarly, in the case of the Pomeranian Voivodship, which in its spatial development plan (No 318/XXXX/16) indicates 51 proposals for new cultural parks. The spatial development plan for the Lubuskie Voivodeship (XXII/191/12) indicates forty new locations of cultural parks. There are, among others, several palace and park complexes (in Bojadle, Iłów Żegańska, Mierzęcin), churches (in Biedrzychowice Dolne, Chlastawa, Gościków), characteristic urban complexes (in Drezdenko, Kożuchów, Lubsko, Nowe Miasteczko) and other objects such as for example, historic buildings around the market with an adjacent area of the parish church, former Evangelical school and cemetery with tombstones from the seventeenth century in Bytom Odrzańskie, or Villa of the factory (now a museum), secession with the garden and so-called. New Town in Gorzów Wlkp. In other voivodships, for example Małopolskie - in the spatial development plan (No XLVII/732/18), it is recommended to create twenty new cultural parks, in turn in Wielkopolska (No XLII/628/2001) - 23 new cultural parks, including six Cistercian parks cultural events: Owińska - Radojewo; Łekno - Tarnowo Pałuckie - Wągrowiec; Przemęt - Kaszczor - Wieleń; in Ołobok; Cysterski Nadwarciański PK Ląd - Zagórów and Cysterski Obrzański PK.

Despite the relatively large number of existing cultural parks, as well as, as demonstrated by the analysis of existing voivodeship spatial development plans, several times more

planned cultural parks, in the Polish society knowledge about the role and importance of cultural parks to preserve the quality of cultural landscape is small. Based on a pilot survey conducted among students of the Warsaw University of Life Sciences (a total of 195 people), it can be stated that 53% of respondents knew about the existence of cultural parks, 11% of the respondents had never heard of them before, and the certainty as to whether the parks there are no cultural ones or 36% of respondents. At the same time, 14.2% of students were able to identify only one existing cultural park, 7.7% - three, 2.9% - two, while 75.2% of the respondents were unable to give a single example of a cultural park. At the same time, the majority of respondents (45.8%) answered the question about the purpose of establishing cultural parks, that these types of objects serve the protection of cultural heritage. About 11% of the respondents knew that cultural parks are used to protect the landscape. Quite a large group of respondents (19%) were convinced that cultural parks are created in order to provide leisure opportunities for city residents (7.1%). Protection of the natural environment as an objective of the establishment of a cultural park indicated 5.8%, and other goals - 1% of respondents. The most famous, most often mentioned in the study of cultural parks are: Wilanów Cultural Park, Cultural Park "Krupówki in Zakopane", Cultural Park "Zakopiańska Basin", PK "Old Radom" and Fortress PK in Srebrna Góra.

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Emilia Janeczko

Kultūriniai parkai kaip kraštovaizdžio išsaugojimo forma Lenkijoje

Santrauka

Kraštovaizdis yra visuomenės gamtos ir kultūros paveldo elementas, daro įtaką žmogaus gyvenimo kokybei ir atlieka svarbų vaidmenį įvairiose viešojo gyvenimo srityse, nuo kultūros iki ekologijos ir socialinių klausimų. Tuo pačiu metu ne tik Lenkijoje, bet ir kitose Europos šalyse ilgą laiką buvo pastebėtas laipsniškas kraštovaizdžio įvairovės mažėjimas, jo nuskurdimas ir suvienodėjimas, taip pat kultūrinių kraštovaizdžių sunaikinimas. Grėsmės kraštovaizdžiui apima, be kita ko, ekonominius ir socialinius modernizavimo procesus, gamybos procesų intensyvėjimą, koncentraciją ir specializaciją, masinį turizmą, o taip pat architektūrą, kurioje neatsižvelgiama į estetines ir aplinkos sąlygas. Rūpinimasis kokybišku kraštovaizdžiu reikalauja jo apsaugos, ekonomikos ir planavimo. Lenkijoje kultūriniai parkai, kaip kultūrinio kraštovaizdžio apsaugos forma atsirado palyginti neseniai, vos prieš šešiolika metų. Tačiau supratimas apie poreikį juos kurti, kaip matyti iš pirmiau pateiktų planavimo dokumentų analizės, yra didelis, ypač tarp planuotojų, vietos valdžios institucijų ir politikų. Kita vertus, plačioji visuomenė turi nepakankamai žinių apie kultūros parkus, jų kūrimo tikslus ir veiklos taisykles. Veiksminga gamtos ir kultūros kraštovaizdžio apsauga įmanoma tik tada, kai vietos bendruomenė supranta ir pripažįsta šią veiklą. Todėl pagrindinė užduotis, padedanti suderinti aplinkosaugos, socialinius ir verslo poreikius, yra šviesti ir mokyti apie vertybes, susijusias su kraštovaizdžiu, jo formavimu, tiek formaliai, ką daro švietimo institucijos, tiek neformaliai, ką įgyvendina įvairios organizacijos ir asociacijos.

Raktažodžiai: kultūros parkai, kraštovaizdžio apsauga.

HISTORICAL PARK RECONSTRUCTION IN ĶEMERI

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Ķemery historical park has long history and different events have shaped this dual territory that is in the same time nature and culture monument. The aim of this paper is to share experience of project making process for park territory, that is part of nature park and in the same time cultural historical monument. The research method is descriptive writing and literature review. The idea about park territory reconstruction and Ķemeri city development have formed already some time ago, but due to the size of territory and complexity of elements, it have not been easy process. Research paper reviels Ķemery park development steps from year 2009 till 2018.

Keywords: historical park, construction project, visualisation, development.

Introduction

The aim of this paper is to share experience of project making process for park territory, that is part of nature park and in the same time cultural historical monument. In last year's European Union funding (European Regional Development Fund) have given opportunity to restore and rebuilt many parks in Latvia. It means opportunity to preserve different values and make qualitative outdoor space for people. Park development and reconstruction is possible due to infrastructure development. In Riga for example in 2015 were reconstructed three historical parks – *Grīziņkals, Ziedoņdārzs, Miera dārzs* (Realised projects, 2015).

Method

The research method is descriptive writing and literature review. In research is described project process, based on literature and materials from project team. Also in description is included historical overview with aim to show long history of resort territory and importance of it in different times.

History of Ķemeri

Ķemery historical park has long history and different events have shaped this dual territory that is in the same time nature and culture monument. The name "Ķemeri" in historical documents first time is mentioned in 1561. One of the versions about name is that it comes from local forester house name Ķemeres, where forester started to heal people with giving swamp spring healing water baths. In the moment people started to come back from healing bath cured, doctors from that time started to show interest. Firs chemical analyses for the water where made in 1801 year by alchemic from Petersburg - Lovics (Šidrovska, Karpoviča, 2018).

First small guest house was built in year 1825. Later, when count Pālens was sure about mineral water of Ķemery influence, he asked Russian imperator Nikolaj I to give support. Imperator gave 700 ha of land. Officially the date of establishment of resort is year 1838, when here was build state swimhouse (figure 1), resort administration and was improved sulphur stream. The origins of the park are connected with a landscape gardener Wagner, who made the improvement works of the park in 1839–1846. Before World War I,

the park was planned as landscape parks –with a network of winding paths, natural landscape spots and recreation buildings (Strategy and Action).

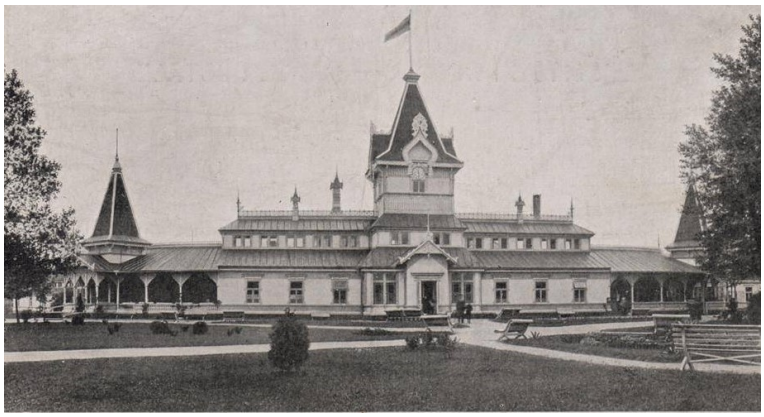

Fig. 1. Ķemeri resort before First World War (Ķemeru vēsturiskās fotogrāfijas)
1 pav. *Ķemeri kurortas prieš Pirmąjį pasaulinį karą (Ķemeru vēsturiskās fotogrāfijas)*

Fig. 2. Ķemeri around year 1930 (Ķemeru vēsturiskās fotogrāfijas)
2 pav. *Ķemeri maždaug 1930-aisiais metais (Ķemeru vēsturiskās fotogrāfijas)*

Fig. 3. Swimming house at start of 20th century (Ķemeru vēsturiskās fotogrāfijas)
3 pav. *Plaukimo baseinas XX-ojo amžiaus pradžioje (Ķemeru vėsturiskās fotogrāfijas)*

New start was after World War I. In year 1924 was build modern swimhouse (figure 2, 3) with mud baths, in year 1929 water tower with view platform. And in year 1936 was opened newly built hotel "Ķemeri" with 100 comfortable rooms and pompous hall (figure 4).

Fig. 4. Hotel "Ķemeri", view from water tower (Ķemeru vēsturiskās fotogrāfijas)
4 pav. *Viešbutis "Ķemeri", vaizdas nuo vandens bokšto (Ķemeru vėsturiskās fotogrāfijas)*

After World War II all buildings in Ķemeri came in ownership of state. In 1945 was organized resort reconstruction. The first patients of resort were World War II veterans. In

soviet time resort was highly demanded. In front of the hotel, facing west, a wide square with lawns and greenery was formed. The park was also transformed (Strategy and Action).

When Soviet Union collapsed in 1991, it finished to finance resort, and with strong visa regime decreased number of resort clients. With time the staff was cut down and in the end, resort stopped work.

In 1997 was establisher Ķemeri National Park and resort territory also is included, as in park could be found different plant and animal species. Kemeri National Park has big territory (38 165 ha) and is special for its great biological diversity, the unique Kemeri Bog, mineral waters and therapeutic mud found here (Ķemeru nacionālais parks). From 2004 this is also Natura 2000 territory.

Territory reconstruction project

The idea about park territory reconstruction and Ķemeri city development have formed already some time ago, but due to the size of territory and complexity of elements, it have not been easy process. In 2010 there was made technical project for the park renovation, water tower and bridge reconstruction, but was not realized. Park project authors Ivara Šļivkas design Office and Ltd "L4"", and for the landscape part Ltd „Tagete" (figure 5). On 17 March, 2009, Jūrmala City Council signed a contract with VA "Investment and Development Agency of Latvia" about the project "The Reconstruction and Renovation of Ķemeri Park with Park Architecture". Work on this project had stopped because of lack of financing, but Jūrmala City Council was regularly seeking other alternatives of attracting EU funds to implement restoration works of the Park, as all the technical documents have had already been prepared (Strategy and Action).

Fig. 5. Park project by Ivara Šļivkas design Office, Ltd "L4" and Ltd „Tagete"
5 pav. *Ivara Šļivkas projektavimo biuro parengtas parko projektas, Ltd "L4" and Ltd „Tagete"*

In 2011 was developed detailed development plan for sustainable tourism development (Strategy and Action). In September of 2012 Jurmala city council decided, that in year 1998 given away to private persons buildings and lands, that are badly maintained have to be taken back in state ownership (Šidrovska, Karpoviča, 2018). In 2014 has been approved Ķemeri development vision, that includes list of needed steps, there is defined key object and territories for Ķemeri city (Tematiskais plānojums). These documents and other planning documents and also council decisions have helped to form idea about Ķemeri development and needed steps.

In 2017 was organised open competition "Development of Construction project "Ķemeri park reconstruction and restoration" and construction work and field supervision" by Jurmala municipality. The participant had to have experience in similar projects (historical park) in last three year period apart from more standard qualification needed in project team – project manager, architect, landscape architect, civil engineer, water supply and sewage system designer, heating and cooling system designer, electricity system designer, civil engineering research specialist, road designer, bridge designer, hydro-mechanical construction on river designer, melioration system designer, dendrologist.

Participant needed to give price to the planned development project and also sketch and visualisations to planned idea. Criteria for the participants were price, which included project price and field supervision price, and offer quality, which included work list, load for project leader, time limit and also park sketch and visualisations (table 1).

Table 1. Criteria for the participants
1 lentelė. *Dalyvavimo kriterijai*

No	Assessment criteria	Maximal value in points
1.	**PRICE – C**, which includes:	**50**
1.1.	Construction project price $\mathbf{C_1}$	45
1.2.	Field supervision price $\mathbf{C_2}$	5
2.	**OFFER QUALITY – K**, which includes:	**50**
2.1.	Planned construction project work list $\mathbf{K_{dd}}$	**5**
2.2.	Planned working load for construction project leader $\mathbf{K_{pv}}$	**15**
2.3.	Construction project time limit **T** (calendar days)	**5**
2.4.	Ķemeru park sketch and visualisations $\mathbf{K_{skice}}$	**25**

Financial offer needed to be supplemented by detailed estimate of the cost. For each of assessment criteria was more detailed point dividing justification.

For the sketch requirements were – sketch in scale 1:1000 with functional zoning and planned compositional offer and at least 10 visualisations. Point dividing justification for sketches was divided in three parts 25 points excellent, 15 points good, and 5 points satisfactory assessment. Quality was evaluated by urban, architectural and compositional planning and also by functionality of park plan (table 2).

Table 2. Point dividing justification for sketches
2 lentelė. Projektų įvertinimas taškais

Assessment	Points	Justification of evaluation
Excellent	25	The specification from municipality have been taken into account of Ķemeri park plan, plan is functional and has excellent quality of urban, architectural and compositional planning.
Good	15	The specification from municipality have been taken into account of Ķemeri park plan, plan is functional and has good quality of urban, architectural and compositional planning, but needs some changes.
Satisfactory	5	The specification from municipality have been taken into account of Ķemeri park plan, plan is functional, but has low quality of urban, architectural and compositional planning.

Total evaluation was given by even more formulas (Konkursa nolikums). The authors of winning idea gets the opportunity to make technical project. There was two participants and Ltd "Livland Group" team won. Ltd "Livland Group" won with the idea of landcape architect Natalija Ņitavska (figure 6).

Fig.6. Landscape development vision from landscape architect N.Ņitavska in open competition (Authors: N.Ņitavska, A.Mengots)
6 pav. *Kraštovaizdžio vizija pagal kraštovaizdžio architektę N.Ņitavska atviro konkurso metu (Autoriai: N.Ņitavska, A.Mengots)*

Important part was visualizations, which had to be at least 10. In park with more than 20 ha area and varied landscape making of visualisations was challenging. In this case there was not made a model, but the separate parts of park, making more accent on elements and view lines.

April of 2017 technical project started by "Livland Group", landscape architect Natalija Ņitavska. The main task is to restore historical planning, based on conception of year's 1933.-1936.

Project base ideas, which were used to achieve the task:

- Landscape composition is compromise between plan of year 1936 and existing nature and landscape values, that needs to be preserved, based on specialist opinion;
- Park project spatial, compositional and functional main elements are existing cultural historical objects that needs to be added with planned greenery, with not making accent on newly made elements;
- Walkway system is made with taking into account pedestrian flow. Accessibility is important;
- Greenery system planning is based on first resort gardener Wagner idea about vast variety of perennials and trees, but taking into account natural environment.
- Architectural elements are divided in two parts. Parter zone is with white elements, close to historical. Park zone is historical replica.

There was quite a big team of specialist involved in park project. Specialists involved in project process: project manager; bat specialist (in park found nine species); dendrologist (many tree plants); road engineer; building engineer; bridge specialist; architect; landscape architect; electrician; water and sewerage engineer; biologist; cultural historical expert; geologist; melioration expert; etc.

In the final part of project was defined four different parts: parter, active, forest park and forest (figure 7).

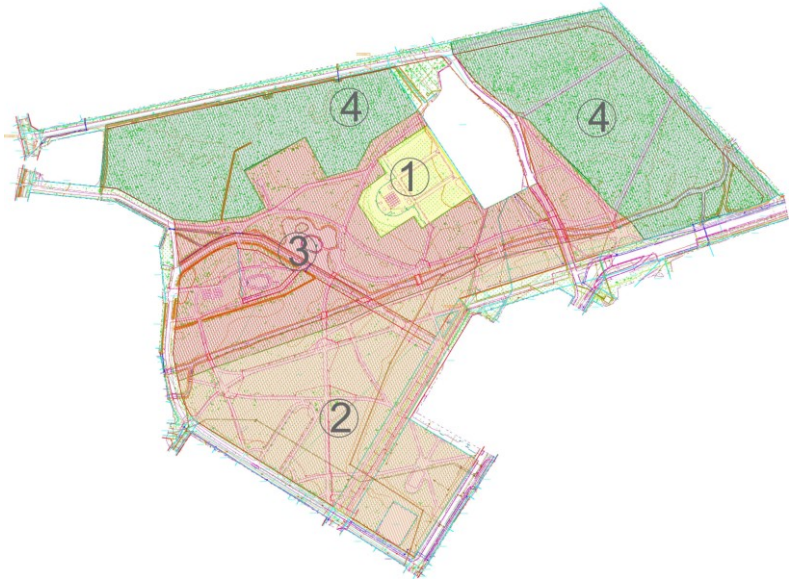

Fig.7. Technical project zoning (1 -"parter" zone; 2 - "active park" zone; 3 - "forest park" zone; 4 -"forest" zone (Authors: N. Ņitavska, A. Mengots)

7 pav. *Techninio projekto zonavimas (1- parterinė zona; 2 - aktyvaus parko zona; 3 - miško parko zona; 4 - miško zona (Autoriai: N. Ņitavska, A. Mengots)*

“Parter” zone – Ķemeru hotel is spatially connected cultural historical part, that could be seen as one. This zone has clear composition, open space, especially authentic place (figure 8).

Fig. 8. Visualisation of “Parter” zone (Author: A.Mengots)
8 pav. *Parterinės zonos vizualizacija (Autorius: A.Mengots)*

“Active park” zone – the most spatially open part with clear historical structure by ways, greenery, elements, viewlines. Planned greenery is typical for resorts. Activity zone includes walkways, trading places, resting places with benches. Also is planned children playground. Near playground is labyrinth from hedge and herbs. This zone also is near former swimhouse. Near former swimhouse is placed symmetrical garden – open sunny park space, which historically was representative part of swimhouse. Important object is water tower, which is planned to renovate and give the opportunity to use view platform on its top. Also here will be information centre.

“Forest park” zone – spatially it is partly opened part, this part historically was with small lawns and tree groups. In this part is placed several cultural historical objects. Main task of this part is to be connection between “active park” zone and “forest” zone. Planned greenery is selected accordingly to local flora. Important for this part is to preserve stream with natural coasts. Also it was important to think about existing fauna – bats, insects especially. The most important visual dominant for this part was “Love island” (Mīlestības saliņa). It is planned to renovate it with restoring rotunda and boat pier and implementing perennials near water.

“Forest” zone – spatially closed park zone, which really is a forest with few path ways and elements. In “forest” zone is aim to preserve existing biotopes as much as it is possible. In this part are planned pathways with giving opportunity to listen bird songs, and to observe nature.

In park is planned many perennials putting them in big mixed groups. Park project idea was presented also as digital perspective drawings for better understanding of two-dimensional landscape plan for municipality and citizens. Simple site 3D model was made in SketchUp and generated as a base for digital perspective drawings to get real scale and

space. Textures, lightning, people, vegetation and materials were added in Photoshop to present more proposed design.

Also in project it was important to do two separate documentation - for roads and separate for other park parts, because of possible finances involved. EU in projects gives some funding for green infrastructure, when there is made improvement of road/ street infrastructure. This funding is in percentage for roads and green infrastructure.

In addition in future there will be need for playground elements, as in this project municipality decided to build only playground zone and plants, but not the elements itself (figure 9).

Fig. 9. Visualisation of playground (Author: A.Mengots)
9 pav. *Žaidimų aikštelės vizualizacija (Autorius: A.Mengots)*

It was planned to start reconstruction works in park autumn of 2018. At this moment works have still not started. Park renovation works have to be finished till 2020. Hotel will probably open also in 2020. In opposite street side in the future is planned nature science centre. The technical project for the science centre is in the process.

Conclusions

Importance and need for the park territory in Ķemeri have changed through the times. From the idea till the realisation of the construction project, can be made many steps. To get till the reconstruction works need to be made many decisions. The more precise is the idea of development, the more productive is work for the development.

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Istorinio Ķemeri parko rekonstrukcija

Santrauka

Ķemery istorinis parkas turi seną istoriją, o skirtingi įvykiai formavo tą dvejopos paskirties teritoriją, kuri tuo pačiu metu yra gamtos ir kultūros paminklas. Šio tyrimo tikslas – pasidalinti patirtimi, susijusia su parko teritorijos, kuri yra gamtos parko dalis ir tuo pačiu metu kultūros istorijos paminklas, projekto rengimo procesu. Tyrimo metodai – aprašomasis bei literatūros apžvalga. Idėja dėl parko teritorijos rekonstrukcijos ir miesto plėtros buvo jau seniai kilusi, tačiau dėl teritorijos dydžio ir elementų sudėtingumo tas procesas nebuvo lengvai įgyvendinamas. Šis tyrimas apžvelgia Ķemery parko plėtros etapus nuo 2009 iki 2018 m.

Raktažodžiai: istorinis parkas, pertvarkymo projektas, vizualizacija, plėtra.

SELECTED ASPECTS OF THE PROCESS OF LANDSCAPING THE HISTORIC PARK IN PIEKARTY, POLAND

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The project preparation works for the revival of the historic park in Piekarty, Poland, have brought to light a number of issues that need to be addressed. Our analysis clearly indicates that the major problem is reconciling the interests of the current owner on the one hand and the conservation guidelines on the other. The scope and methodology of the study were compliant with the commonly accepted procedures and practices in landscape architecture. The resulting series of designs were subject to consultations and subsequent modifications. This article describes four different design plans that have met the owner's expectations.

Keywords: landscape architecture, historical park, creation process.

Introduction: objectives, scope and methodology of the study

The aim of this article is to identify the basic problems to be addressed in redesigning the landscape of a historical estate park for the current landowner, as well as to discuss possible solutions for developing the area. In order to achieve these goals, standard procedures for designing landscape architectural objects were adopted. The project preparation works encompassed a series of analyses on natural, functional, compositional and historical layouts. The preparatory and project works covered the estate and park complex and its surroundings in the village of Piekarty, Mazowieckie Voivodeship, Poland. The works took place in the conservation area in the years 2015-2017, and involved the evaluations recommended for the revalorization of historical residential estates (Majdecki, 1993). Given the lack of specific historic plans, documents and iconographic sources, the functional and spatial design as well as suggestions for materials to be used were intended to match those used in the region at the time of the park's establishment. The project was also informed by the evidence of other estates that preserved their original character in similar topographical circumstances.

Adaptation of the historical park area to contemporary users' needs

Fortunately for today's designers, old parks were mostly fashioned to serve the demands of private landowners. After long years of modifications (especially in the decades of socialist economy, when they were turned into centrally controlled farming cooperatives and state collective farms or seats of welfare centres, schools and museums), many have now been transferred again into private hands. In this way, they are returned to their original use, and their adaptations are usually more or less consistent with the roles they were meant to fulfil in the first place. However, while their representative and recreational functions are again relevant, the facilities such as stables, barns, vegetable patches, orchards and bee gardens have been eliminated or extensively altered. Horses and carts have been replaced with agricultural machinery and cars. Consequently, outbuildings should be converted and land developed to adjust to this change. All too often traffic routes that are protected under conservation law do not meet the requirements entailed by the size, weight and turning radii of today's vehicles. Moreover, while the base of roads may be improved with regard to expected load values, it is not possible to widen an avenue which is lined with trees. It is therefore recommended to integrate the physical elements of the new functional plan into the existing landscape. For example, a horse paddock may be turned into a helicopter landing

platform, but it would be a good idea to keep the old paddock fencing, even if it is no longer necessary from the practical point of view. Such considerations will be different for each historical site, therefore no routine procedures can be proposed.

Conservation area policy versus the investor's plans

Among the many determinants to be considered, the most cited problem is the one of reconciling the investor's plans and the restrictions imposed by the conservation area policy. The preservation of historical and natural values demands not only extensive knowledge and skills but also enormous financial resources. These values, together with their long-standing effects and outcomes, can usually be identified by means of a historical analysis. It is often difficult, however, to select the ones that have to be preserved intact, improved, or recreated. The recognized indelible values pose both an opportunity and a hazard for the designer. The former undoubtedly includes the chance to highlight the unique character of the site; the latter, in turn, consists in the necessity to preserve and integrate into the setting certain animate and inanimate features which are rarely (if ever) to be found in contemporary gardens. A botched, unskilful adaptation of the location is likely to cause some inconvenience in use and be even perceived as ludicrously incongruous. Unfortunately, contemporary users, with all their respect for tradition, often fail to understand why they should not enjoy their own property in ways typical for a 21-century user, let alone allocate money to meet the objectives that are contrary to their own. If that is the case, the designer has to simultaneously achieve three challenging tasks: act in line with legal regulations (both state and local); develop a project that meets the requirements of conservation authorities; and deliver on the contract with the ordering party at the same time.

Below, we outline four design project for the Piekarty park together with alternative plans for land development. Due consideration was given to the area's significant historical values and features, the current owner's needs, and the guidelines of the Polish historic preservation officer as well as the local spatial management plan.

Area under discussion: historical outline

The object of the present analysis is the estate and park complex in the village of Piekarty, Mazowieckie Voivodeship, Poland. Field studies and library research (focused on the extent of preserving the historical area) proved that the park has not been used in accordance with its original purpose for many years, which led to the ruin of many features that were still in existence before the Second World War. As historic plans, documents and iconographic sources are missing, it can be assumed that this loss is permanent: there is no possibility to reverse such changes. Moreover, these modifications were intensified in specific periods when both the park and the buildings were neglected in respect of maintenance and conservation works. Back in 1869, the site featured grange buildings (an integral part of the farm) arranged in a horseshoe shape that could be accessed from the eastern side via an avenue; a pond; a stream; and a park with its boundaries lined with trees. Before WW2, there were also stables for race horses and granaries. The residential building was private property only till 1945; in 1957, the premises were handed over to the Local Education Authority. There is evidence that the south-eastern area of the park was turfed and featured single old trees in 1977. The available literature [Wiśniowska, Śledziński 1977, Tomaszewska 2015] and field studies allow to conclude that the grounds have seen no major changes since the end of the 1970s. The most important of these was the purchase of the historical area (including the terrain protected under conservation law) by a private owner. Thus, the original function of the premises was largely restored. This will entail a number of spatial alterations

and allow to undertake revitalisation activities in the park and its surroundings. The solutions employed will draw on those previously used in the old estate and park complex.

Layout modifications within the park

The historical analysis of the layout, its development and modifications as well as their comparison against the actual physical arrangement as of 1977 allows to draw the following conclusions, which need to be considered in further design activities: park boundaries have remained unchanged since 1939; two brick buildings, the pond and the access avenue have been preserved; stables for race horses and the granary have been demolished; new brick sheds have been added (Wiśniowska, Śledziński, 1977). The most recent analysis of the layout and spatial reconfiguration, carried out in 2015 by the authors of the present article, points to the conclusion that major layout alterations have been caused by dismantling the old wooden manor house, stables and granaries. The cleared ground has not been built on and thus, both in terms of spatial composition and function, it diverges most from the original design. The existing sheds have only a minor impact on the compositional design and have no functional value while their condition is bad. Once they are dismantled, the features of the old layout will be more or less restored in the area under discussion. The lack of a clearly defined line of trees have brought about very significant layout changes; the alterations to the park's compositional layout, resulting from the natural plant succession, may be classified as significant. The dendrochronological analysis, developed within the framework of the site's historical overview, has proven that the composition of the park has been undergoing changes as a result of tree growth and the disappearance of the original road and path system. The oldest tree stand in the park dates back to the 19th- and early 20th centuries.

General design plan for the estate and park complex in Piekarty

The general design plan for the park in Piekarty accommodates both the guidelines of the Provincial Conservator of Monuments as well as the expectations of the ordering party. The requirements concerning conservational protection outlined below remained unchanged in the course of the works. By contrast, the requirements of the investor kept changing as the owner was being provided with new concepts for area development, varied in respect of the existing natural and other conditions, and informed by consultations with the Conservator and experts in construction, among others. The plans as to the tree-lined avenue alone were modified several times.

Conservator's requirements:

Throughout its course, the project has kept to the Guidelines of the Provincial Conservator of Monuments for the Mazowieckie Voivodeship as of 9 March 2015. They are general in character and not confined to a specific area, which opens up vast opportunities for interpretation by the Conservator as well as the landowner.

Ordering party's requirements:

a) as regards natural features:

- the requirements concerning the historical park and the tree-lined avenue have not been defined.

b) as regards architectural and construction features:

- possible demolition of the existing residential buildings;
- possible conversion of the existing residential buildings (one or two in number);
- essential requirement of designing new functional buildings (e.g., a conference and office centre, garage buildings, a hunter's shelter, a caretaker's lodge, dog kennels);

- designing a small vegetable garden, planting a number of fruit trees and a small private vineyard;
- planning a daytime enclosed dog run area;
- positioning a helicopter landing platform;
- positioning a vintage car display;
- positioning an outdoor fireplace;
- installing a lighting system over the area under discussion.

The area to be developed consists of two parts:

- a section with pronounced historical features, rich in tradition-related elements such as an old tree stand and a pond adjacent to the Borówka river;
- a section technically undeveloped but with a considerable access advantage (connected to a district road).

Both sections are linked by one common historically-relevant element: the remnants of the old tree avenue.

Given the fact that the investor's property encompasses not only the park, but also larger grounds directly adjacent to the historical site, the design plan covered the whole area and included a number of different options (Ozimkowska, Wojtatowicz, Wojtatowicz, 2015). They varied in respect of the location of particular structures and road surfaces; however, the aim each time was to preserve the original landform and landscape, which could be described as heritage, in its entirety (Wojtatowicz, Ozimkowska 2009). The two sections – the one under conservational protection and the adjacent one – were invariably to be integrated in terms of the compositional layout. The system of walking paths is rather simple and natural, in accordance with the guidelines for designing landscape parks. The project allows for further development of the site, including a possibility to build more visual interrelations between the north-western features without a necessity to introduce any radical changes. No new trees were planted in the northern and north-western parts of the area; still, the project can accommodate planting more trees in the future should the need arise. As evidenced by field studies and the dendrochronological analysis, it is also possible to recreate in their general shape the park's clearings in the place of post-WW2 poplar plantings, now covered with a relatively young deciduous forest. The conceptual designs were intended not to impact too much on the protected tree stand. The guidelines that were followed included the directions on tree care in forestry management, in particular sanitary pruning and removal of diseased or hazardous trees. Apart from the addition of jetties and a gazebo, no other shoreline alterations were proposed. Design options varied as to the arrangement of buildings and the resulting changes in the course of traffic routes and the related vegetation arrangement. The project also included the pathways around the wooded areas and the pond as well as the construction of a gardener's lodge, garage buildings, enclosed dog run area with kennels, a hunter's shelter, an outdoor barbecue area, a tennis court, and a waterside meeting place with a fireplace and benches. Suggested water features encompassed a floating bridge, a jetty with a gazebo on top, and a bird island. Nest boxes for birds were recommended for the wooded area. The southern section was designed to feature a plant-lined herb and vegetable garden with fruit shrubs, grapevine and other climbers supported by a trellis. A composter is to be located nearby. Surface materials comprised grey-coloured sett, basalt paving stones, clinker bricks, wood and field stones; dirt paths and grass paths (to be mowed 2-3 times in spring and summer) were also planned. The area under discussion, particularly the front and the access road to the building, is to be illuminated with three types of lighting: park lamps, 4 to 5 metres in height; park lamps, up to 1.3 metres in height; and outdoor floodlights to accentuate notable details and dominant landscape features. All design options involve the

construction of a multi-purpose conference and office centre (together with an access road and a car park) outside the conservation area, as well as an apiary for decorative and functional purposes.

The four design plans outlined below were selected from a number of suggested development solutions (Ozimkowska, Pietrzykowska, Wojtatowicz, Wojtatowicz, 2017). They vary in respect of the fate of the tree-lined avenue and of the existing buildings that are not covered by the Conservator's protection. All the remaining differences were but a result of decisions taken on these two major features.

Design Plan 1: preserving the existing buildings, restoring the access avenue

Basic features that follow the ordering party's requirements:

- converting two existing residential buildings;
- designing new functional buildings (an administrative and training centre, garage buildings,
a hunter's shelter, an enclosed dog run area with kennels, an extension to an existing residential building);
- designing a vegetable garden with a number of fruit trees and a small vineyard;
- positioning an outdoor fireplace;
- illuminating the area;
- restoring the access avenue.

It is not possible to fully recreate the original layout of the area if the investor decides in favour of preserving the buildings that date back to the 1950s and 1960s. The axis of the old tree-lined avenue mapped out the access route to the manor house that is no longer in existence; should the avenue (a valuable feature) still be intended to serve as an access road, the area's traffic system should be considerably extended to form connections to and from the existing buildings. The driveway was designed to meet the functional needs of the contemporary user and provide car access to both buildings. Moreover, a garage and outbuildings for maintenance, repair and security need to be added; these facilities could be located between the old schoolhouse and the fence. There is also a herb and vegetable garden. The spatial design is not architecturally related to the original layout. This option involves extending the garden area along the building's axis towards the pond. The parts of the garden (necessarily intersected with transverse paths for functional purposes) will be integrated by means of a pergola, specially designed axial flowerbeds and a part of the jetty, projecting apron-like over the water. The project also envisages a terraced slope towards the pond, and a lounge terrace between the garden and the old schoolhouse – a good access point for the park, the loop road, and the pond to be approached under a latticed, climber-covered pergola. The terrace may be roofed or even glazed, similar to an orangery in both its form and function. The rather undistinguished surroundings of the former teachers' residence present an opportunity to extend it both eastward and westward. The widest road with a reinforced substructure serves as the loop road; it stretches between the driveway of the already existing building by the pond, and the yard by the outbuildings (to be constructed).

The driveway and garden layout draws subtly on the Art Nouveau-style gardens of the pre-WW2 period. The southern fence of the area will be lined with tall trees and shrubs, aimed as an isolation boundary from extensive orchards on the other side. When entering the park via the avenue, visitors will see the climber-covered pergola, situated on the former site of the old manor house.

Fig. 1. Design plan featuring preserved existing buildings and restored access avenue
1 pav. *Išsaugotų esamų pastatų ir atkurtos alėjos projektas*

Design Plan 2: preserving the existing buildings, redirecting the access avenue

Basic features that follow the ordering party's requirements:
- converting two existing residential buildings;
- designing new functional buildings (e.g. a conference and training centre, garage buildings,
a hunter's shelter, an enclosed dog run area with kennels, a garden tool shed);
- designing a vegetable garden with a number of fruit trees and a small vineyard;
- positioning an outdoor fireplace;
- illuminating the area;
- redirecting the access avenue.

In terms of functionality, this option is largely similar to Design Plan 1. It involves the preservation of the former schoolhouse and adapting it for residential use as well as connecting it by means of an access road, lined at places with the remaining old avenue trees. A terraced garden will extend axially from the school building to the pond. The course of the loop road across the park will be only slightly modified. The plan includes the outbuildings and garages. Vegetable patches, other growing plots and vine trellises are planned in the same places, though they will be vaster than in the above version. The area between the schoolhouse and the pond will feature terraced parterres.

The essential element of this design plan is redirecting the access road and repositioning the buildings' driveway. The driveway itself, definitely more practical and simpler in form, is consistent with the Neoplasticism-style building surroundings, which include the existing forecourt on the south side with surface colours and patterns modelled on Gerrit Rietveld's and Piet Mondrian's works for their pure colours (red, blue, yellow, black, white and grey) and the accent they put on the vertical and the horizontal. Also the closest vicinity

of the residential building will be designed in line with Neoplasticism. Shrubs and perennial plants in the domestic garden will grow in rectangular and square patches. The boundary between the garden and the park will become a geometric-shaped recreational area with an outdoor table and seats. Yet another touch will be geometric flowerbeds in the enlarged garden adjacent to the building on the side of the park. The natural waterside character of this part of the park is ensured by the randomly situated trees (already in existence).

The protected historical section of the park is largely allowed to continue as it is with the exception of planting heliophytes over areas deprived of trees, and part-shade plants in wooded areas. As in Design Plan 1 above, the isolation boundary along the fence will be lined with shrubs and perennial plants.

Fig. 2. Design plan featuring preserved existing buildings and redirected access avenue
2 pav. *Išsaugotų esamų pastatų ir pakoreguotos alėjos krypties projektas*

Design Plan 3: constructing a new building on the site of the manor house (aligned with the access avenue), demolishing the former schoolhouse, preserving the former teachers' residence, adding a building to complete the symmetrical design of the access avenue

Basic features that follow the ordering party's requirements:
- converting one of the existing residential buildings;
- designing a residential building on the site of the manor house;
- designing new functional buildings (e.g. a conference and training centre, garage buildings, a gardener's lodge, a hunter's shelter, an enclosed dog run area with kennels);
- designing a vegetable garden with a number of fruit trees and a small vineyard;
- positioning an outdoor fireplace;
- illuminating the area;
- preserving the course of the access avenue.

This plan involves demolishing the former schoolhouse and constructing a building closer to the pond, on the site of the old foundations. The new edifice will be aligned with the access avenue, which will thus retain the present course and be lined with regular rows of avenue trees (as it used to be the case in the past). Likewise, the nearest vicinity of the building will be regular in design, with a terraced slope towards the pond on the northern side and a symmetrical surface pattern culminating in a simple climber-covered pergola to the south. To the front of the building, an oval driveway will surround a lawn with ornamental plants arranged in flowerbeds and patches of perennials. Placed symmetrically to each side of the driveway there will be the former teachers' residence and, opposite, a new building to house garages and other facilities. The herb and vegetable garden as well as the vineyard are planned in the same location as in Design Plan 2; however, the outbuilding is repositioned so that it could serve not only the gardening needs, but also the ones related to the tennis court. In this version of the project, the loop road extends as far as the front gate. The park is inspired by solutions adopted in natural landscape parks as regards the road layout, tree planting, and areas with undergrowth.

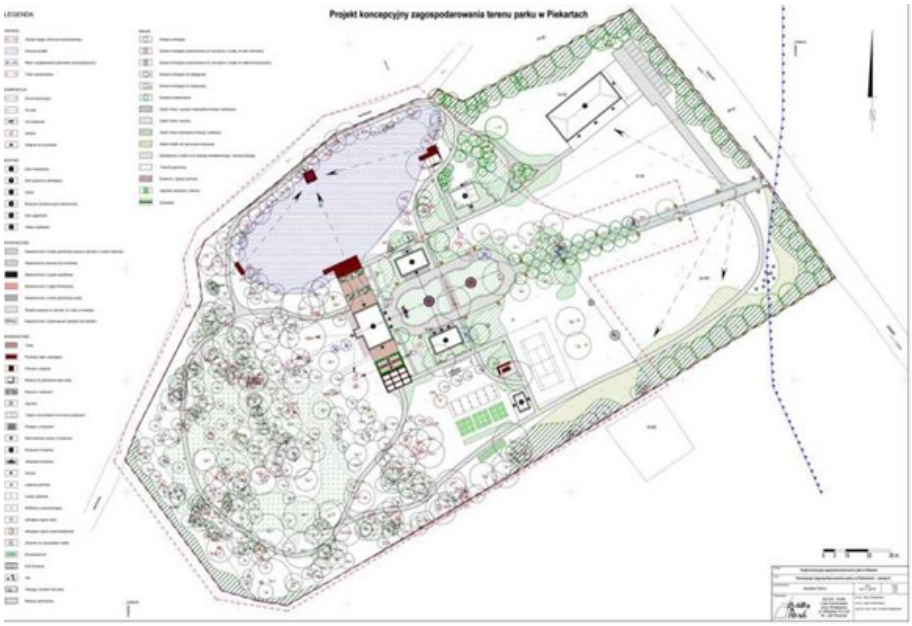

Fig. 3. Design plan featuring a new building on the site of the manor house (aligned with the access avenue), preserved teachers' residence and an additional building to complete the symmetrical design of the access avenue; the former schoolhouse is not preserved
3 pav. *Naujo rūmų pastato (vienoje eilėje su įvažiavimo alėja), išsaugoto mokytojų namo ir papildomo pastato, užbaigiančio įvažiavimo alėjos simetriškumą, projektas; buvusi mokykla neišsaugota*

Design Plan 4: constructing a new building on the site of the manor house (aligned with the access avenue), demolishing the former schoolhouse

Basic features that follow the ordering party's requirements:
- demolishing the existing residential buildings;
- designing a residential building on the site of the old manor house;

- designing new functional buildings (e.g. an outbuilding, an administrative and training centre);
- positioning an outdoor fireplace;
- illuminating the area;
- preserving the course of the access avenue.

In Design Plan 4, the protected part of the premises sees the reconstruction of the access avenue leading up to an oval-shaped driveway with a central flower garden. The building is backed by an elevated terrace with steps to the garden proper. To the north and to the south of the building, along its axis, there are two hedge-lined lawns: one with a flowery arabesque pattern, the other with a carpet of flowers drawing on the style of the park's period of establishment. The loop road runs through the park and ends at the front gate. The park retains its natural system of paths and clearings.

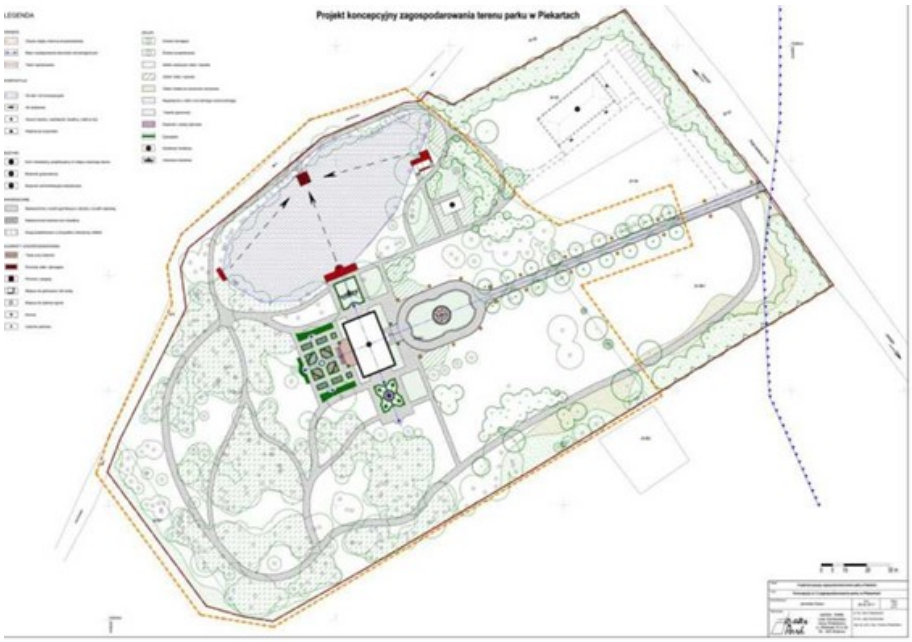

Fig. 4. Design plan featuring a new building on the site of the manor house (aligned with the access avenue); the former schoolhouse is not preserved

4 pav. *Naujo pastato rūmų vietoje (vienoje linijoje su alėja)projektas; buvusi mokykla neišsaugota*

Conclusions

The above-outlined design plans for the park in Piekarty, Poland, bring to the foreground the issues and challenges to be addressed during an adaptation of a historical estate and park complex. They exemplify the procedures and strategies of the landscaping process in today's realities, with investors in historical areas being obliged to seek the Conservator's approval on any changes they wish to introduce to their own landed estate. It would appear that the general character of the conservation guidelines encourages original and creative design ideas. However, it can also be a source of numerous problems and concerns for the landscape designer, whose task is to find the best possible compromise between the conser-

vation law requirements and the ever-changing expectations of the ordering party (the landowner). As a consequence, the design process in such cases may take longer than usual, which should be taken into account during contract negotiations.

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Kai kurie kraštovaizdžio formavimo proceso aspektai istoriniame Lenkijos Piekarty parke

Santrauka

Projekto rengimo darbai siekiant atnaujinti istorinį Lenkijos Piekarty parką atskleidė keletą problemų, į kurias reikia atkreipti dėmesį. Mūsų analizė aiškiai rodo, kad pagrindinė problema yra suderinti esamo savininko interesus su parko išsaugojimo tikslais. Tyrimo apimtis ir metodika atitiko įprastas kraštovaizdžio architektūros procedūras ir praktiką. Projektavimo darbai buvo vykdomi atsižvelgiant į konsultacijas, kurių pagrindu atlikti kai kurie pakeitimai. Šiame straipsnyje aprašomi keturi skirtingi projektai, kurie atitiko savininko lūkesčius.

Raktažodžiai: kraštovaizdžio architektūra, istorinis parkas, projektavimo procesas.

LIETUVOS EGLYNAI IR JŲ AUGIMO PERSPEKTYVOS KLIMATO ŠILTĖJIMO KONTEKSTE

Vytautas Bareika
Kauno miškų ir aplinkos inžinerijos kolegija

Šis darbas skirtas atlikti eglynų sudėties kitimo prognozę, atsižvelgiant į klimato kaitos scenarijus ir išaiškinti jų auginimo Lietuvoje galimybes, remiantis Valstybinės miškų tarnybos turimų duomenų analize bei nustatyti eglynų atkūrimo/įveisimo ir eglynuose vykdomų pagrindinio naudojimo kirtimų įtaką Lietuvos eglynų plotų kaitai.

Lietuvoje paplitusi vienintelė eglės rūšis, tai Paprastoji eglė (*Picea abies* (L) H. Karst.). Ji yra ir viena vertingiausių miško medžių rūšių. Eglei stiebo tiesumu negali prilygti nė vienas lapuotis. Eglynuose eglės gali augti labai tankiai, o mišriuose medynuose su šviesamėgiais lapuočiais ir pušimis formuoja antrąjį ardą. Todėl tiek gryniems, tiek mišriems pirmųjų kartų eglių medynams produktyvumu neprilygo ir šiuo metu neprilygsta net gerai vešantys lapuočiai. Lietuvos miškuose eglynai sudaro 20,9 %, nuo visų medynų ir yra trečioje vietoje pagal užimamą plotą lyginant su kitais medynais.

Manoma, kad atšilus klimatui į šiaurę gali „pasislinkti“ ištisos gamtinės-geografinės zonos. Daugelio autorių sukurtas modelis numato, kad klimato svyravimai turėtų iššaukti vyraujančių rūšių kaitą arba netgi rūšių išnykimą. XXI amžiuje labiausiai tikėtinas sąlyginai šiltamėgių rūšių ir tokių pat genotipų išplitimas šaltamėgių sąskaita. Mokslininkų rezultatai rodo, jog eglės arealo pietvakarinė riba šio amžiaus pabaigoje drieksis apie dabartinę Baltijos ir Rusijos borealinę miškų augalijos zoną (Rimkus ir kt., 2006). Pagal šias prognozes Lietuvos teritorija atsidurtų gerokai piečiau eglės arealo pietinės ribos. Taigi galima būtų teigti, kad XXI a. paprastosios eglės būklė blogės, o pažeidžiamumo tikimybė didės. Tačiau sąlyginai sėkmingas eglės auginimas už natūralaus arealo ribos Vakarų Europoje leidžia manyti, jog paprastoji eglė XXI a. nepasitrauks iš Lietuvos teritorijos ir toliau augs (Augustaitis et al., 2014; Lietuvos miškų ūkio statistika, 2017).

Pagal 2017 m. Lietuvos miškų ūkio statistikos duomenis didžiausi eglynų plotai yra šių miškų urėdijų administracinėse ribose: Telšių – 27697,4 ha; Rietavo – 22897,3 ha; Kretingos – 21185,9 ha; Tauragės – 17873,3 ha; Mažeikių –17844,1 ha; Ukmergės – 17538,5 ha; Panevėžio – 15949,2 ha (4 lentelė). Mažiausi eglynų plotai yra šių miškų urėdijų administracinėse ribose: Druskininkų – 1792,7 ha; Varėnos – 2697,8 ha.

Didžiausi eglynų plotai, atkūrus Lietuvos nepriklausomybę, nustatyti 1998–2004 m. (440,0–447,4 tūkst. ha). Vėliau eglynų plotas mažėjo iki 424,7 tūkst. ha 2007 m., o nuo 2008 m. eglynų plotas palaipsniui, bet neženkliai didėjo. Didesnė eglynų plotų dalis yra valstybinės reikšmės miškuose. Valstybinių miškų eglynų plotai su nežymiu svyravimu didėjo nuo 258,3 tūkst. ha iki 277,5 tūkst. ha. Privačiuose miškuose eglynų plotai buvo ženkliai mažesni ir jie nuolat mažėjo nuo 187,4 tūkst. ha 2001 m. iki 152,0 tūkst. ha 2017 m.

Didžiausios plynų kirtimų apimtys nustatytos 2013 m. (2439 ha) ir 2014 m. (2584 ha).

Didžiausi atkurtų eglynų plotai valstybiniuose miškuose buvo 1999–2003 m., kuomet atkurtų eglynų plotas vidutiniškai siekė 5513,5 ha.

Miškų urėdijų įveistų eglynų plotas fiksuojamas nuo 2005 m. 2005–2016 m. laikotarpyje jis kito nuo 702 ha iki 159 ha. Nuo 2006 m. stebima įveistų eglynų plotų mažėjimo tendencija, kuri susijusi su vis mažesniais ne miško žemės plotais, perduodamais valdyti valstybinėms miškų urėdijoms.

Raktažodžiai: eglynai, kirtimai, atkūrimas, įveisimas, miško augavietės tipas.

Įvadas

Paprastoji eglė (*Picea abies* (L) H. Karst.) – viena iš pagrindinių ir vertingiausių pagal medienos savybes medžių rūšių, augančių Lietuvos miškuose. Lietuvoje eglynai sudaro daugiau kaip 20 % nuo viso medynais apaugusios miško žemės ploto.

Dėl šiltnamio efektą sukeliančių dujų besikeičiančios klimatinės sąlygos kelia grėsmę Lietuvos eglynams ir jų plotai gali ženkliai sumažėti. Klimato kaita Lietuvoje pasižymi vis stipresnėmis audromis, škvalo protrūkiais, šiltesnėmis žiemomis.

Paprastoji eglė pasižymi paviršine šaknų sistema ir tankia it burė laja. Dėl to labai neatspari vėjų poveikiui – vėjavartoms, ypač drėgnesniuose miško augaviečių tipuose (Lc, Ld).

Dėl šiltų žiemų pagerėjo sąlygos liemenų kenkėjų ir grybinių lygų plitimui eglės medynuose, todėl turi būti skiriamas pakankamai didelis dėmesys eglynų sanitariniai būklei, laiku šalinant pažeistų eglių židinius.

Didelį pavojų eglės jaunuolynams kelia menkai reguliuojamas elninių žvėrių skaičius. Būtina tverti eglės želdinius, naudoti repelentus. Kitu atveju smarkiai yra pažeidžiami eglių viršūniniai ūgliai. Taip pat yra laupoma paaugusių eglių žievė ir susidaro sąlygos per žaizdų vietas plisti kamieno vidinius puvinius sukeliantiems grybams. Dėl šių grybų poveikio patiriami dideli kokybiškos padarinės eglės medienos nuostoliai.

Tik taikant tinkamas ir savalaikęs miško ūkines priemones galima išsaugoti Lietuvos eglynus ir padidinti jų produktyvumą. Kitu atveju klimato kaitos ir prasto ūkininkavimo įtakoje eglynų plotai ir juose augančių medžių tūris mažės.

Valstybinė miškų tarnyba renka informaciją apie visus Lietuvos miškus, tame tarpe ir apie eglynus, ir ją skelbia savo leidinyje - Lietuvos miškų ūkio statistika.

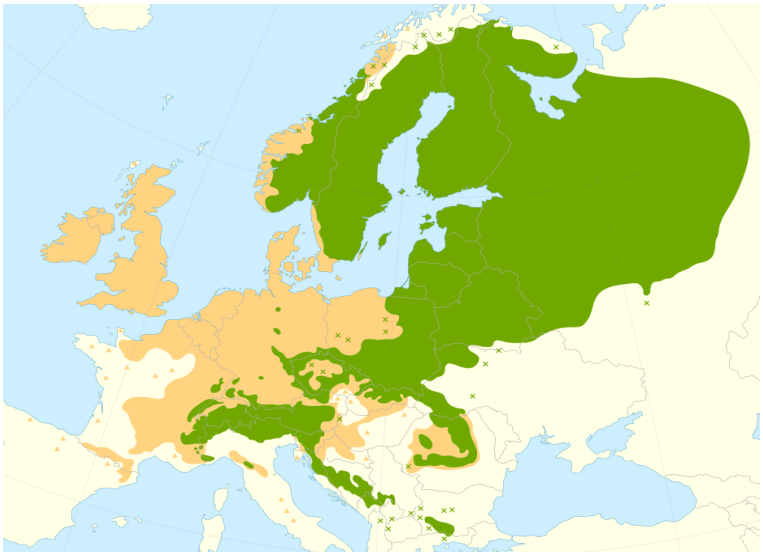
Šio darbo tikslas – atlikti eglynų sudėties kitimo prognozę, atsižvelgiant į klimato kaitos scenarijus ir išaiškinti jų auginimo Lietuvoje galimybes, remiantis Valstybinės miškų tarnybos turimų duomenų analize bei nustatyti eglynų atkūrimo/įveisimo ir eglynuose vykdomų pagrindinio naudojimo kirtimų įtaką Lietuvos eglynų plotų kaitai.

Darbo uždaviniai:

1) atlikti galimus eglynų kaitos pokyčius Lietuvoje, atsižvelgiant į klimato kaitos scenarijus;
2) įvertinti Lietuvos eglynų plotų kaitą;
3) įvertinti eglynų atkūrimo/įveisimo apimtis ir jų įtaką eglynų plotų kaitai;
4) įvertinti pagrindinių miško naudojimo kirtimų apimtis eglynuose ir jų įtaką šalies eglynų plotų kaitai.

Literatūros apžvalga

Spygliuočių miškai Lietuvoje užima 55,6 % miškų ploto: pušynai 713 tūkst. ha (34,6 %), o eglynai – 430 tūkst. ha (20,9 %), jų plotas, palyginti su 2003 m., sumažėjo 15,8 tūkst. ha. (Lietuvos miškų ūkio statistika 2017). Tačiau per pastaruosius keturiolika metų spygliuočių medynų plotas sumažėjo 14,9 tūkst. ha. Kalbant apie medienos produkciją, spygliuočiai vieni produktyviausi Lietuvos miškuose. Spygliuočių medynai ne tik užima daugiau nei 50 % miškų ploto, bet ir juose augančios medienos tūris sudaro net 66, 9 % viso Lietuvos miškų tūrio (Lietuvos miškų ūkio statistika 2017).



1 pav. *Picea abies* (L) H. Karst. paplitimo schema. Žalia: Natūralaus - gamtinio arealo ribos. Oranžinė: sukurtos sritys. (Sykes, Prentice, 1996)

Fig. 1. *Picea abies (L) H. Karst. distribution scheme. Green: boundaries of natural range. Orange: created areas. (Sykes, Prentice, 1996)*

Klimatas – vienas svarbiausių rūšių paplitimą lemiančių veiksnių, o jo kaita bei įvairūs antropogeniniai procesai lemia augalijos būklę, ekosistemų produktyvumą ir biologinės įvairovės pokyčius. Manoma, kad atšilus klimatui į šiaurę gali „pasislinkti“ ištisos gamtinės-geografinės zonos. Tiesiogiai klimato kaita veiks ir skirtingų rūšių arealus, daugelyje Europos regionų jau ir dabar stebimas šiaurinių rūšių nykimas bei pietinių rūšių invazija.

Vadovaujantis Lietuvos klimato kaitos modeliais (Galvonaitė, Valiukas, 2005), prognozuojama, kad pagal B1 scenarijų 2031–2060 metų laikotarpiu vidutinė metų oro temperatūra ($T_{vid.}$) Lietuvoje bus 1 °C aukštesnė, nei 1981–2010 metais; vidutinė vasario mėn. temperatūra pakils 3 °C; vidutinis metinis kritulių kiekis išliks panašus. 2061–2090 metų laikotarpiu $T_{vid.}$ lyginant su 1981–2010 metais pakils apie 2 °C; vidutinė vasario mėn. temperatūra – 3 °C; vidutinis metinis kritulių kiekis išliks beveik nepakitęs.

Pagal A2 scenarijų 2031–2060 metais $T_{vid.}$ Lietuvoje bus 2–2,5 °C, vidutinė vasario mėn. temperatūra – 4 °C aukštesnė; o vidutinis metinis kritulių kiekis – apie 15 % didesnis nei 1981–2010 metais. 2061–2090 metais vidutinė metų temperatūra, pakils vidutiniškai 4 °C; vidutinė vasario mėn. temperatūra – 7 °C; vidutinis metinis kritulių kiekis padidės apie 15 %.

Vadovaujantis klimato kaitos prognozės kriterijais tyrimai parodė, kad jeigu klimato pokyčiai vyks pagal B1 scenarijų, tai Lietuvos klimatas 2061–2090 metais atitiks dabar esantį pietų Danijoje, vakarų Vokietijoje, Olandijoje, šiaurinėje Prancūzijos dalyje. Pagal A2 scenarijų, Lietuvos klimatas 2061–2090 metais atitiks dabar esantį vakarinėje Belgijoje, šiaurinėje ir pietinėje Prancūzijoje.

Modeliuojant paprastosios eglės paplitimą ir arealo kaitą ateityje, akivaizdu, kad tiek pagal B1, tiek pagal A2 klimato kaitos scenarijus, Lietuvos klimatas 2061–2090 metais nebus palankus augti šiai rūšiai. Jei klimatas keisis pagal A2 scenarijų, dėl nepalankaus klimato pušies augimui Lietuvoje sąlygos taip pat nebus optimalios. Kitų Lietuvos miškuose paplitusių medžių rūšių (plaukuotasis ir karpotasis beržai, drebulė, juodalksnis, paprastasis uosis, paprastasis ąžuolas) populiacijų besikeičiantis klimatas neturėtų paveikti neigiamai. Pagal

B1 ir A2 scenarijus klimato sąlygos Lietuvoje bus palankios visoms nemoralinėms rūšims, todėl jos gali natūraliai pakeisti dalį spygliuočių medžių.

Šiuo metu pastarosios rūšies arealo pietinė riba nuo Lietuvos nutolusi apie 200 kilometrų į pietus, o atskiros populiacijų salos išlikusios Europos aukštumų rajonuose – Alpėse, Karpatuose, Dinarų kalnyne. Prognozuojama, kad XXI amžiuje eglės pietinė arealo riba nuo Lietuvos bus nutolusi apie 250 kilometrų į šiaurės rytus (Sykes, Prentice, 1995; Sykes, Prentice, 1996).

Palankiausios sąlygos eglynų augimui yra Rusijoje, Vokietijoje, Austrijoje, Pietų Lenkijoje, Baltarusijoje, tačiau ir Lietuvoje esama našių eglynų. Pavyzdžiui, Prienų šile, Punioje, Dubravos ir Ringių sengirėse buvo aptikta eglių 40–45 m aukščio ir apie 1 m skersmens, o Rokiškio, Biržų ir Rietavo miškų urėdijose randama eglynų, sukaupusių 500–600 m^3/ha medienos (Ozolinčius, 1998). Nors didžioji eglynų arealo dalis yra Šiaurės ir Rytų Europoje, tačiau į jį įeina ir visas Lietuvos plotas. Kalnuotomis vietovėmis šis arealas susiaurėdamas ir pertrūkdamas driekiasi dar toliau į pietus ir vakarus, siekdamas Prancūziją ir Italiją (1 pav.). Ir nors Čekijos Baubino kalnų papėdėse eglės užauga iki 58 m aukščio ir iki 2 m skersmens, negalima teigti, kad šiems spygliuočiams ne vieta mūsų miškuose. Susižavėjimą šiais spygliuočiais grindžiamas ir tuo, kad eglės giliai įleido šaknis į mūsų tautos kultūrą, tradicijas ir papročius.

Pasaulio miškų augalijos tyrinėtojo Jano Eniko teigimu, pastarųjų dviejų ar dviejų su puse šimtmečių eglynai – žmogaus veiklos rezultatas. Jau prieš 270 metų Saksonijos miškininkystės mokykla pradėjo propaguoti dirbtinį eglynų želdinimą. XIX a. Vokietijoje eglynams buvo teikiama pirmenybė, palyginti su lapuočiais, nes surinkti sėklas ir želdinti egles buvo kur kas lengviau nei lapuočius. Be to, praeityje buvo sėjama kankorėžiais į įdirbtą ir supurentą dirvožemį.

Intensyvus dirbtinis eglynų želdinimas Lietuvoje prasidėjo XVIII a. pabaigoje, kai karališkųjų valdų aplinkraštyje buvo patariama kankorėžiais apsėti miškų dykvietes. Anksti sukurti spygliuočių želdinimo būdai – vienas iš veiksnių, lėmusių sparčią jų plėtrą. Eglių sėklas taip pat paskleisdavo vėjas, todėl jos savaime plito sparčiau nei kai kurie lapuočiai.

Eglės – monopodinio šakojimosi medžiai. Jų stiebo augimą tęsia kasmet atsinaujinantis viršūninis pumpuras, o palyginti plonos šoninės šakos žiediškai išauga bambliuose. Tarp jų – bešakis tarpubamblis. Stiebo tiesumu negali prilygti nė vienas lapuotis. Eglynuose eglės gali augti labai tankiai, o mišriuose su šviesiniais lapuočiais ir pušimis medynuose formuoja antrąjį ardą. Todėl tiek gryniems, tiek mišriems pirmųjų kartų eglių medynams produktyvumu neprilygo ir šiuo metu neprilygsta net gerai vešantys lapuočiai (1 lentelė) (Ozolinčius, 1998; Ozolinčius ir kt.,1999; Vitas, 2002).

1 lentelė. Eglynų plotai ir vidutiniai tūriai pagal brandumo grupes III ir IV grupių miškuose 2016 m.

Table 1. *Spruce stand areas and average volumes according to maturity groups in the forests of groups III and IV in 2016*

	Brandumo grupės/*Maturity groups*				**Iš viso** *Total*
	Jaunuolynai *Young stands*	***Pusamžiai*** *Middle-aged*	***Bręstantys*** *Pre-mature*	***Brandūs*** *Mature*	
Plotai, 1000 ha *Area, 1000 ha*	202,4	78,7	35,7	75,8	**392,6**
Vid. tūriai, m^3/ha *Mean volume, m^3/ha*	97	295	344	371	**231**

Nuo XX a. vidurio daugelyje Vidurio Europos šalių pastebima intensyvėjanti eglynų nykimo pradžia. Ligų ir kenkėjų sukeltų eglės pažeidimų skaičius per pastaruosius du-tris dešimtmečius stipriai išaugo. XX a. pabaigoje žievėgraužių tipografų antplūdžio metu žuvo trečdalis bręstančių ir brandos amžiaus eglynų. R. Ozolinčiaus ir V. Stakėno (1999) nuomone, esant karštoms ir sausoms vasaroms, eglės gali tapti neatsparios ligoms ir kenkėjams. 1999 m. šie mokslininkai teigė, kad apie penktadalis eglių yra pažeistos vėjo arba vabzdžių. Daugelis Lietuvos miškuose kenkiančių vabzdžių yra šilumamėgės rūšys, kurių vystymosi optimali temperatūra yra tarp 18 ir 32 °C (Gedminas, 2006). Dėl šios priežasties šiltėjantis klimatas gali tapti labai palankus eglės entomofaunos vystymuisi (Bukantis, 1994). O dėl šakninės pinties išplitimo ir abejotinos eglynų ateities dar 1964 m. imtasi priemonių spygliuočių plėtrai riboti. Profesorius A. Vasiliauskas rekomendavo, kad būsimajame medyne eglės sudarytų ne daugiau kaip 50 %. Tačiau klimatui šiltėjant greičiau didėja eglių tūris (2 lentelė).

Mokslininkų rezultatai rodo, jog eglės arealo pietvakarinė riba šio amžiaus pabaigoje drieksis apie dabartinę Baltijos ir Rusijos borealinę miškų augalijos zoną (Rimkus ir kt., 2006). Pagal šias prognozes Lietuvos teritorija atsidurtų gerokai piečiau eglės arealo pietinės ribos. Taigi galima būtų teigti, kad XXI a. paprastosios eglės būklė blogės, o pažeidžiamumo tikimybė didės. Tačiau sąlyginai sėkmingas eglės auginimas už natūralaus arealo ribos Vakarų Europoje leidžia manyti, jog paprastoji eglė XXI a. nepasitrauks iš Lietuvos teritorijos ir toliau augs (Augustaitis et al., 2014; Lietuvos miškų ūkio statistika, 2017).

2 lentelė. Pavienių eglių tūriai, 1000 m^3
Table 2. *Volumes of individual spruce trees, 1000 m^3*

Miškuose *In forests*			**Neapaugusiose mišku žemėse** *On non-forest land*		
2003 01 01	2015 01 01	2016 01 01	2003 01 01	2015 01 01	2016 01 01
152,2	212,7	215,7	29,7	36,7	37,6

Eglių, kaip ir visų kitų medžių augimą įtakoja abiotiniai ir biotiniai veiksniai. Iš abiotinių veiksnių didžiausią įtaką eglių augimui ir jų morfologinei struktūrai turi dirvožemio sąlygos (cheminė sudėtis, granuliometrinė sudėtis, drėgmė bei gruntinio vandens lygis) bei klimato ir meteorologiniai veiksniai (oro temperatūra, krituliai, saulės radiacija, vėjas ir kt.). Eglynai auga derlingesniuose dirvožemiuose nei pušynai, kuriuose yra pakankamai įvairių maisto medžiagų. Dirvožemio specialistai, nagrinėdami ryšius tarp medynų našumo ir kai kurių cheminių elementų kiekio dirvožemyje, teigia, kad maisto medžiagų atsargos dirvožemyje tik iki tam tikros ribos įtakoja medynų našumą: kuo derlingesnis dirvožemis, tuo mažesnę įtaką medynų našumui turi didėjantis maisto medžiagų kiekis (Ozolinčius, 1998). Be to, medžiai prisitaiko prie gruntinio vandens lygio. Jam pakilus, sumažėja medžių augimas. Nežymus (apie 7 cm) gruntinio vandens lygio paaukštėjimas, lyginant su jo optimaliu lygiu, sumažina medynų našumą apytiksliai vienu bonitetu. Tačiau kalbant apie eglės būklę ir pažeidžiamumą dažniausiai kaip neigiamas veiksnys iškeliamas stiprus vėjas. Eglės jautrumą vėjo poveikiui nurodo daugelis autorių (Vasiliauskas, 2009; Žemaitis, 2014). Kai kurie autoriai eglę laiko pačia jautriausia vėjo sukeliamoms vėjavartoms ir vėjalaužoms rūšimi Europoje.

Biotiniai veiksniais vadinama visuma gyvų organizmų „poveikių visuma“. Dažniausiai tokie veiksniai medžio ontogenezės požiūriu yra trumpalaikiai. Nors, antra vertus, šie veiksniai dažnai „įsijungia“ tada, kai medis yra fiziologiškai nusilpęs, ir jie gali tapti medžio

žuvimo priežastimi. Spyglių ir liemenų kenkėjai yra vieni svarbiausių. Lietuvoje nuolat užfiksuojami vabzdžių antplūdžiai. Daugiausiai žalos eglynams padaro Žievėgraužis tipografas (*Ips typographus* L.). Jo populiacijoms išplisti „talkina“ sausros. Literatūroje teigiama, kad tik populiacijos prortūkio metu žievėgraužiai pažeidžia sveikus medžius (Gedminas, 2009). Taip pat eglynams didelės žalos padaro grybinės ligos, o ypač Šakninė pintis (*Heterobasidion annosum* (Fr.) Bref.) (Vasiliauskas, 2009).

Nemažai žalos eglynams padaro elniniai žvėrys. Skiriami du pagrindiniai elninių žvėrių pažeidimų tipai: 1) jaunų medelių pažeidimai skabant ūglius ir laužant liemenis; 2) senesnių medžių pažeidimai laupant kamienų žievę. Sistemingas eglių viršūninių ūglių skabymas bei liemens laužymas suformuoja daugiakamienius, krūmo pavidalo medžius, o kamienuose padarytos žaizdos yra puikus „langas“ plisti medieną pūdantiems grybams (Vasiliauskas, 2006).

Per paskutiniuosius du dešimtmečius pramonės paklausa aukštos kokybės pjautinei medienai kardinaliai auga, atsinešdama stiprią konkurenciją pjautos ir apvalios medienos rinkoje. Tačiau labiau auga kokybiškos, statybų sektoriuje naudojamos medienos kainos. Todėl kyla poreikis užauginti didesnės kokybės medieną ir faktorių įtakojančių medienos kokybę negalima nepaisyti. Šioje srityje jau seniai darbuojasi mokslininkai. Būsimai medienos kokybei gali turėti įtakos pasirinktas miško atkūrimo metodas, aikštelės paruošimas, sodinamosios medžiagos pasirinkimas, pradinis sodinimo tankumas ir sodinimo kokybė. Augimo aplinka t.y. medynų tankumas, dirvožemis bei klimato sąlygos daro įtaką medžių konkurencijai ir būsimiems kokybės požymiams. Pradinis medynų tankumas įtakoja sezoninį medžių augimą bei atskirų jo organų (šakų, ūglių) orientaciją erdvėje. Medynų tankumas ypač didelę įtaką turi ūglių paros prieaugiui laikinosios augimo depresijos metu (Ozolinčius, 1998). Retinimo būdai tiesiogiai ir netiesiogiai veikia medienos kokybę, nes jie veikia medžių vainiko ir šaknų mikro aplinką bei želdinių, turinčių pageidautinas kokybės savybes, atranką. Atrankos operacijos, tokios kaip retinimas (jaunuolynų ugdymo, retinimo ir einamieji kirtimai), daro įtaką miško želdinių tankumui ir yra svarbi miškų ūkio tvarkymo priemonė, kuri po įveisimo daro įtaką augimo ir kokybės parametrams.

Tik tinkamas miško ūkinių priemonių (pagrindiniai, tarpiniai, sanitariniai kirtimai, želdinimas, tinkama eglies želdinių apsauga nuo elninių žvėrių, ligų ir vabzdžių kenkėjų) taikymas gali užtikrinti eglynų išsaugojimą Lietuvoje ir padidinti jų produktyvumą.

Darbo objektas, metodai ir apimtis

Darbo objektas: Valstybinės miškų tarnybos kaupiami sklypinės miškų inventorizacijos duomenys apie šalies miškų plotus, medynų rūšinę sudėtį, jų pasiskirstymą pagal nuosavybę, miškų grupes, administracinį suskirstymą, o taip pat, Valstybinei miškų tarnybai pateikti Generalinės miškų urėdijos duomenys apie įvykdytų kirtimų apimtys valstybinės reikšmės miškų eglynuose, eglynų atkūrimą/įveisimą valstybinėse miškų urėdijose.

Darbe taikyti metodai:

1. Sklypinės miškų inventorizacijos duomenų analizė;
2. Generalinės miškų urėdijos duomenų apie įvykdytus miško kirtimus, atkurtus ir įveistus miškus miškų urėdijose analizė;
3. Lietuvos miškų ūkio statistikos leidinių informacijos analizė;
4. Surinktų duomenų apdorojimo, palyginimo ir statistinės analizės metodai.

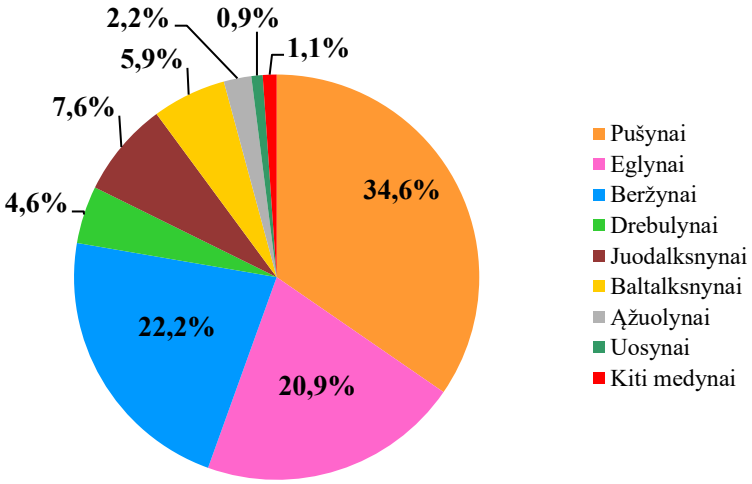
Darbų apimtys: nagrinėjami Lietuvos eglynų plotų ir juose sukauptos medienos tūrio duomenys, valstybinės reikšmės miškų eglynuose vykdytų pagrindinio naudojimo kirtimų ir privačiuose eglynuose vykdytų plynų kirtimų duomenys, eglynų atkūrimo/įveisimo

valstybinėse miškų urėdijose duomenys. Išnagrinėti duomenys apima 1998–2018 m. laikotarpį.

Tyrimų duomenys ir analizė

Miškingumas ir medynų rūšinė sudėtis. Valstybinė miškų tarnyba pateikė duomenis, kad Lietuvoje 2017 m. sausio 1 d. miško žemės plotas buvo 2189,6 tūkst. ha ir užėmė 33,5 % šalies teritorijos. Nuo 2003 m. sausio 1 d. šis plotas padidėjo 144,3 tūkst. ha, o šalies miškingumas – 2,2%. Per tą patį laikotarpį mišku apaugusios žemės (medynų) plotas padidėjo 107,4 tūkst. ha – iki 2058,4 tūkst. ha. Spygliuočių medynai auga 1145,1 tūkst. ha plote. Jie sudaro didžiąją medynų dalį (55,6%). Minkštaisiais lapuočiais apaugę 841,1 tūkst. ha (40,9%), kietaisiais lapuočiais – 72,2 tūkst. ha (3,5 %) (Lietuvos..., 2017).

Pagal 2017 m. Lietuvos miškų ūkio statistikos duomenis medynų plotų pasiskirstymas Lietuvos miškuose pateiktas 2 paveiksle. Lietuvos miškuose vyrauja pušynai, kurie sudaro 34,6 % nuo visų medynų. Beržynai sudaro 22,2%, eglynai – 20,9 %, juodalksnynai – 7,6 %, baltalksnynai – 5,9 %, drebulynai – 4,6 %, ąžuolynai – 2,2 %, uosynai – 0,9 % ir kiti medynai 1,1 %.



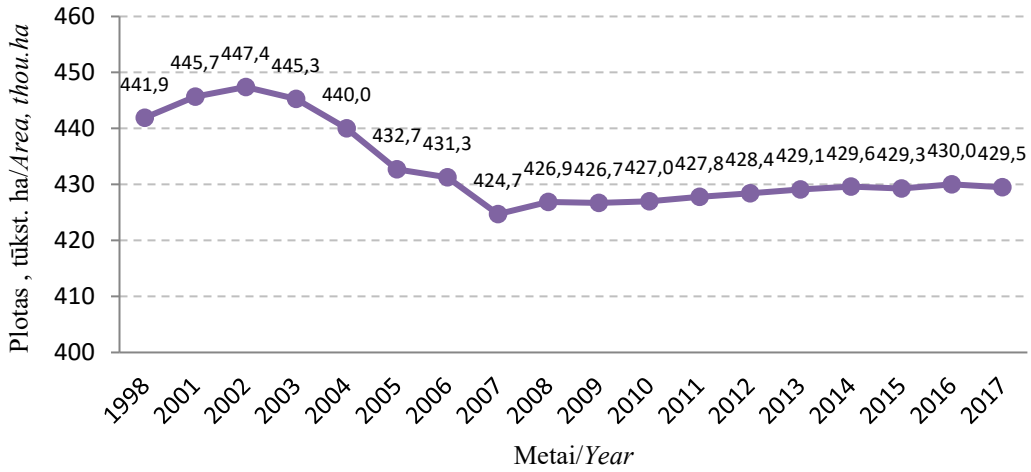
2 pav. Medynų plotai pagal vyraujančią medžių rūšį 2017 m. sausio 1 d.
***Fig. 2**. The area of stands according to the prevailing tree species on the 1st of January 2017*

Eglynų ploto kaita. 2017 m. Lietuvos miškų ūkio statistikoje pateikti duomenys apie medynų rūšinės sudėties kaitą 1923–2017 m. rodo, kad šiame laikotarpyje didžiausia dalį medynuose eglynai sudarė 1923–1936 m. (30,3 %), o mažiausią – 1966–1977 m. (17,9 %). Nuo 1998 m. eglynų dalis Lietuvos medynų rūšinėje sudėtyje laipsniškai mažėjo nuo 23,4 % iki 20,9 % 2016 m. ir 2017 m. (3 lentelė).

3 lentelė. Eglynų ploto dalis Lietuvos medynuose 1923–2017 m. (plotas %)
Table 3. *The portion of spruce stands in Lithuanian forests in 1923-2017 (area %)*

Metai *Year*	**1923-1936**	**1958-1963**	**1966-1977**	**1978-1987**	**1998**	**2001**	**2006**	**2011**	**2016**	**2017**
Eglynai *Spruce stands*	30,3	19,3	17,9	20,7	23,4	23,1	21,4	20,8	20,9	20,9

Nagrinėjant eglynų plotų kaitą absoliutiniais dydžiais, t. y. tūkst. ha, buvo nustatyta, kad 1998–2017 m. laikotarpyje didžiausi eglynų plotai nustatyti 1998–2004 m., kuomet eglynų plotas kito nuo 440,0 tūkst. ha iki 447,4 tūkst. ha (3 pav.). Po to eglynų plotas mažėjo iki 424,7 tūkst. ha 2007 m. Nuo 2008 m. eglynų plotas palaipsniui, bet neženkliai didėjo. 2016 m. eglynų plotas siekė 430,0 tūkst. ha, o 2017 m. – 429,5 tūkst. ha.

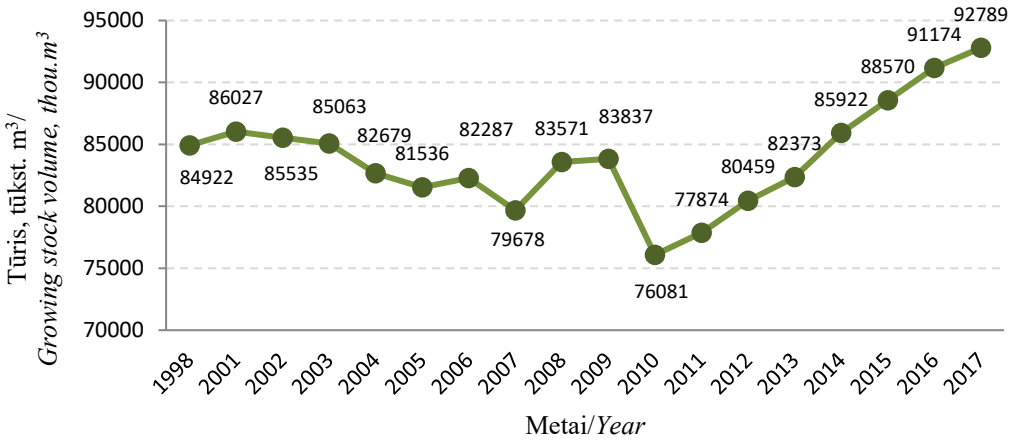


3 pav. Eglynų plotai Lietuvoje 1998–2017 m. (plotas tūkst. ha)
Fig. 3. *Spruce stand areas in Lithuania in 1998-2017 (area, thou. ha)*

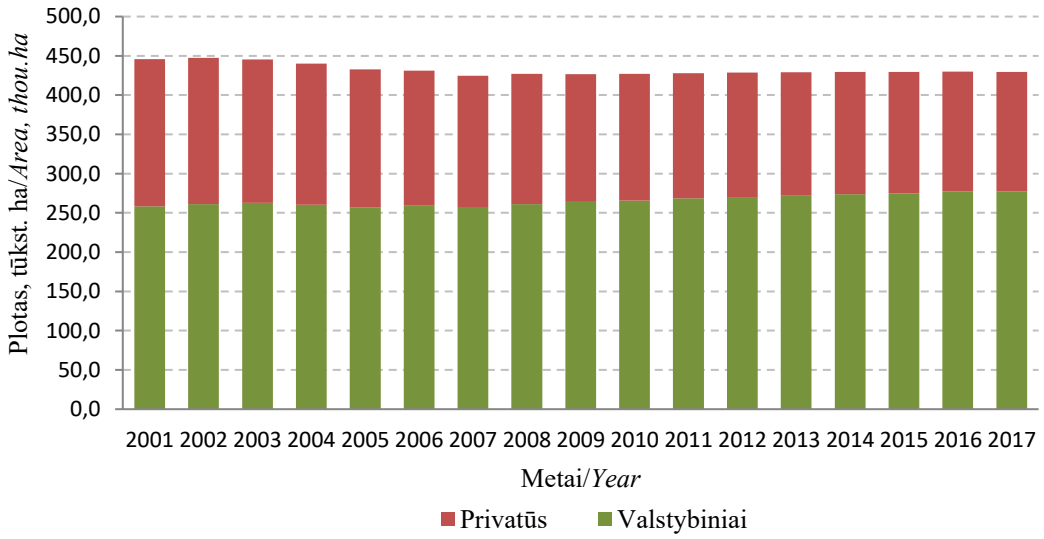
Medienos tūriai eglynuose 1998–2017 m. laikotarpyje kito labai įvairiai (4 pav.). 1998–2004 m., kuomet eglynų plotas buvo didžiausias, juose medienos tūris siekė 82679–86027 tūkst. m^3. Mažiausias medienos tūris buvo nustatytas 2010 m. ir jis sudarė 76081 tūkst. m^3. Nuo 2012 m. iki 2017 m. medienos tūris eglynuose pastoviai didėjo nuo 77874 tūkst. m^3 iki 92789 tūkst. m^3. 2015–2017 m. medienos tūris eglynuose buvo didžiausias 1998–2017 m. laikotarpyje ir viršijo medienos tūrį nustatytą 1998–2004 m., kuomet eglynų plotas buvo didžiausias. Tai rodo, kad augančios medienos tūris eglynuose priklauso ne tik nuo eglynų užimamo ploto, bet ir nuo medynų struktūros ir našumo.

Didesnė eglynų plotų dalis yra valstybinės reikšmės miškuose (5 pav.). Valstybinių miškų eglynų plotai 2001–2017 m. laikotarpyje su nežymiu svyravimu didėjo nuo 258,3 tūkst. ha iki 277,5 tūkst. ha. Privačiuose miškuose eglynų plotai buvo ženkliai mažesni ir jie nuolat mažėjo nuo 187,4 tūkst. ha 2001 m. iki 152,0 tūkst. ha 2017 m. Tikėtina, kad tokiam eglynų plotų pasiskirstymui tarp valstybinių ir privačių miškų turėjo žemės reforma, kuomet po Lietuvos nepriklausomybės atkūrimo privatiems asmenims visumoje buvo gražinami prastesnės rūšinės sudėties buvusių kolūkių miškai. O eglynų plotų mažėjimas privačiuose miškuose labai susijęs su eglynų atkūrimu plynuose kirtavietėse, kuomet iškirtus

brandžius eglynus, šie plotai paliekami savaiminiam žėlimui drėgnose miško augaviečių tipuose arba nepakankamai gerai prižiūrint pasodintus eglės želdinius, juos nusmelkia greitai augančios minkštųjų lapuočių medžių rūšys.



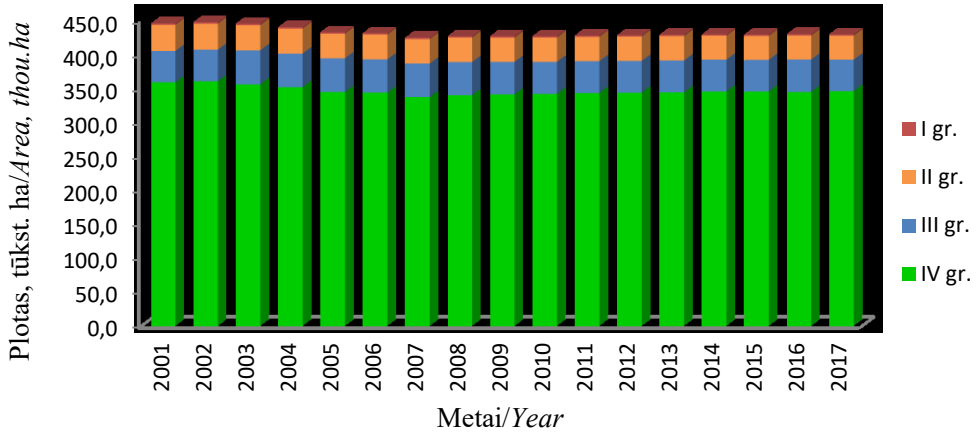
4 pav. Medienos tūriai eglynuose 1998–2017 m. (tūkst. m^3)
Fig. 4*. Growing stock volumes in spruce stands in 1998-2017 (thou. m^3)*



5 pav. Eglynų plotų pasiskirstymas pagal nuosavybę 2001–2017 m. (plotas tūkst. ha)
Fig.5. *Distribution of spruce stand areas by ownership in 2001-2017 (area, thou.ha)*

Analizuojant 2001–2017 m. laikotarpyje eglynų plotų priskyrimą miško grupėms buvo nustatyta, kad didžiausia eglynų ploto dalis yra priskirta IV miškų grupei – ūkiniams miškams (6 pav.). Šioje miškų grupėje eglynų plotai kito nuo 358,9 tūkst. ha 2001 m. iki 345,9 tūkst. ha 2017 m. III miškų grupėje, t.y. apsauginiai miškai, eglynų plotai kito neženk-

liai ir sudarė nuo 46,3 tūkst. ha iki 50,2 tūkst. ha. II miškų grupės (specialios paskirties miškai) eglynai sudarė nuo 35,2 tūkst. ha iki 38,4 tūkst. ha. Rezervatiniams miškams (I miškų grupė) 2001–2017 m. laikotarpyje priskirtų eglynų plotai sudarė 1,9–2,2 tūkst. ha.



6 pav. Eglynų plotų pasiskirstymas pagal miškų grupes 2001–2017 m. (plotas tūkst. ha)
Fig.6. *Distribution of spruce stand areas by forest groups in 2001-2017 (area in thou.ha)*

Pagal 2017 m. Lietuvos miškų ūkio statistikos duomenis didžiausi eglynų plotai yra šių miškų urėdijų administracinėse ribose: Telšių – 27697,4 ha; Rietavo – 22897,3 ha; Kretingos – 21185,9 ha; Tauragės – 17873,3 ha; Mažeikių – 17844,1 ha; Ukmergės – 17538,5 ha; Panevėžio – 15949,2 ha (4 lentelė). Mažiausi eglynų plotai yra šių miškų urėdijų administracinėse ribose: Druskininkų – 1792,7 ha; Varėnos – 2697,8 ha.

Didžiausius valstybinių eglynų plotus valdė Telšių (13963,0 ha), Tauragės (13670,8 ha), Mažeikių (12387,0 ha), Rietavo (12009,2 ha), Kretingos (11507,1 ha) ir Ukmergės (11033,9 ha) valstybinės miškų urėdijos. Didžiausi ne valstybinių miškų urėdijų valdyti eglynų plotai yra šių miškų urėdijų administracinėse ribose: Telšių (13734,4 ha), Rietavo (10888,1 ha), Kretingos (9678,8 ha).

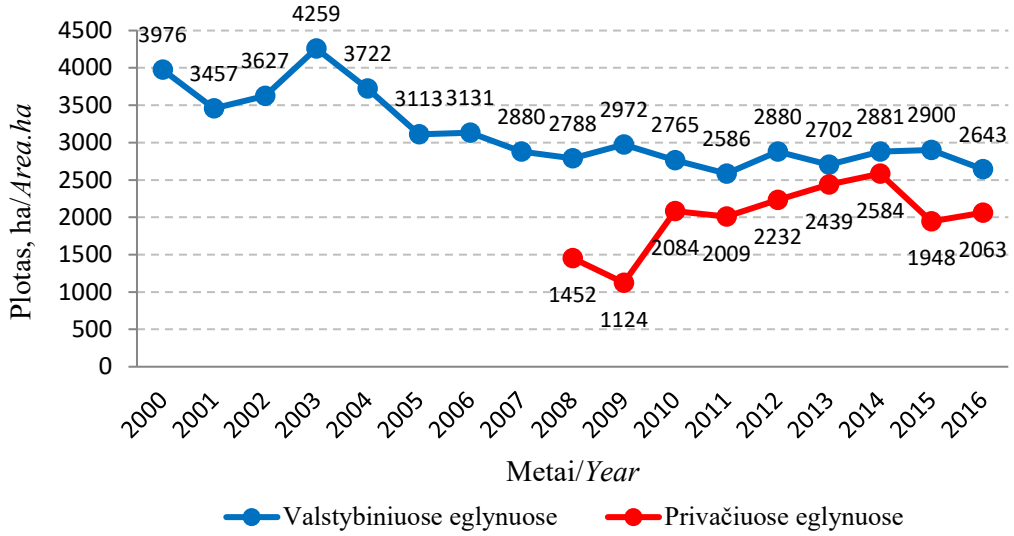
4 lentelė. Eglynų plotų pasiskirstymas pagal miškų urėdijų administracinį suskirstymą (2017 m. duomenys)

Table 4. *Distribution of spruce stand areas by administrative division of forest enterprises (data of 2017)*

Miškų urėdija *Forest enterprise*	**Eglynų plotas, ha** *Spruce stand area, ha*			**Miškų urėdija** *Forest enterprise*	**Eglynų plotas, ha** *Spruce stand area, ha*		
	Urėdijų valdomi *Enterprise-owned*	**Ne urėdijų valdomi** *Non-enterprise-owned*	**Viso** *Total*		**Urėdijų valdomi** *Enterprise-owned*	**Ne urėdijų valdomi** *Non-enterprise-owned*	**Viso** *Total*
Alytaus	4675,3	1712,2	6387,5	Prienų	4923,1	1675,8	6598,9
Anykščių	5244,8	4709,1	9953,9	Radviliškio	8529,1	3505,6	12034,7
Biržų	7621,2	3808,6	11429,8	Raseinių	6419,3	4431,0	10850,3
Druskininkų	1030,3	762,4	1792,7	Rietavo	12009,2	10888,1	22897,3
Dubravos	3648,0	827,2	4475,2	Rokiškio	7031,2	4809,7	11840,9
Ignalinos	5045,5	4147,8	9193,3	Šakių	5373,6	1457,2	6830,8
Jonavos	5298,6	2135,6	7434,2	Šalčininkų	5778,0	3616,6	9394,6
Joniškio	6393,9	983,1	7377,0	Šiaulių	8487,7	2986,8	11474,5
Jurbarko	5838,6	2871,1	8709,7	Šilutės	9312,5	3292,5	12605,0
Kaišiadorių	7239,1	2919,1	10158,2	Švenčionėlių	3693,5	2664,4	6357,9
Kauno	4604,4	1251,2	5855,6	Tauragės	13670,8	4202,5	17873,3
Kazlų Rūdos	5353,8	1137,4	6491,2	Telšių	13963,0	13734,4	27697,4
Kėdainių	4178,7	2770,7	6949,4	Tytuvėnų	6392,0	5666,5	12058,5
Kretingos	11507,1	9678,8	21185,9	Trakų	7721,9	3576,7	11298,6
Kupiškio	4233,4	3199,7	7433,1	Ukmergės	11033,9	6504,6	17538,5
Kuršėnų	10285,8	3455,6	13741,4	Utenos	4162,7	5609,2	9771,9
Marijampolės	5991,7	1080,6	7072,3	Valkininkų	3447,3	1183,3	4630,6
Mažeikių	12387,0	5457,1	17844,1	Varėnos	1817,6	880,2	2697,8
Nemenčinės	2625,3	2555,8	5181,1	Veisiejų	2482,3	1938,9	4421,2
Pakruojo	4770,2	1279,8	6050,0	Vilniaus	7773,6	4765,0	12538,6
Panevėžio	10644,7	5304,5	15949,2	Zarasų	2807,2	3227,1	6034,3
Kiti valdytojai	-	1380,4	1380,4	-	-	-	-

Pagrindinio naudojimo kirtimų apimtys eglynuose. Generalinės miškų urėdijos duomenimis, valstybiniuose eglynuose pagrindinių kirtimų apimtys buvo ženklesnės 2000 - 2004 m. laikotarpyje, kuomet kirtimų plotas siekė nuo 3457 ha iki 4259 ha (7 pav.). Nuo 2004 m. pagrindinių kirtimų apimtys mažėjo ir 2007–2016 m. laikotarpyje nesiekė 3000 ha. Mažiausios pagrindinių kirtimų apimtys valstybiniuose eglynuose buvo 2011 m. (2586 ha) ir 2016 m. (2643 ha).

Valstybinės miškų tarnybos duomenimis, nustatytais pagal išduotus kirtimo leidimus, privačiuose eglynuose 2008–2016 m. laikotarpyje plynų (kartu su plynais sanitariniais kirtimais) kirtimų plotas sudarė nuo 1124 ha iki 2584 ha. Ženkliausios plynų kirtimų apimtys nustatytos 2013 m. (2439 ha) ir 2014 m. (2584 ha). Pažymėtina, kad 2010–2016 m. laikotarpyje plynų kirtimų apimtys privačiuose eglynuose palyginti ne ženkliai skyrėsi nuo pagrindinio naudojimo kirtimų apimčių valstybiniuose eglynuose, nors privačių eglynų plotai yra ženkliai mažesni nei valstybinių eglynų plotai.

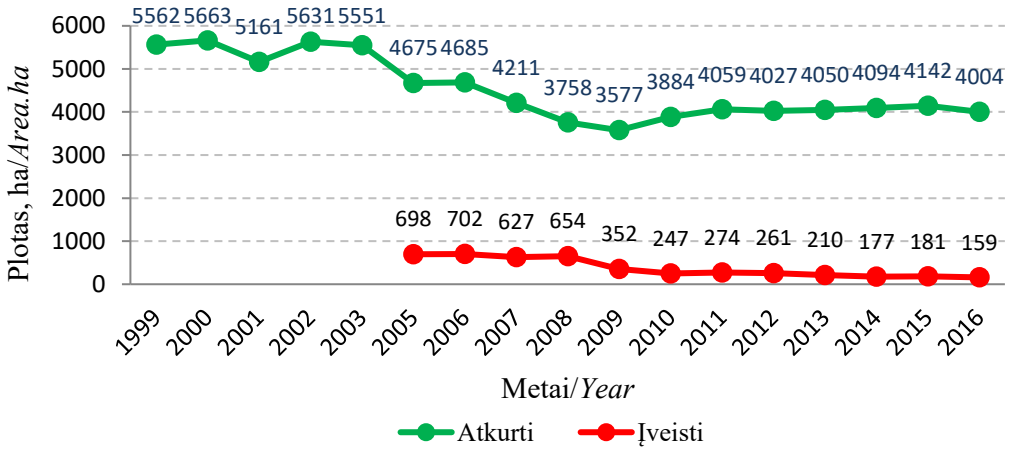


7 pav. Pagrindinio naudojimo kirtimų apimtys valstybiniuose eglynuose ir plynų kirtimų apimtys privačiuose eglynuose 2000–2016 m.

Fig. 7. *The volume of final cuttings in state spruce stands and clear-cutting volumes in private spruce stands in 2000-2016*

Eglynų atkūrimas ir įveisimas. Eglynų atkūrimo ir įveisimo analizei galima naudoti duomenis tik apie valstybinių miškų urėdijų atkurtų ir įveistų eglynų plotus. Išsamių ir oficialių duomenų apie privačiose žemės valdose atkurtus ir įveistus eglynus šiai dienai nėra (8 pav.). Lietuvos Respublikos Vyriausybės nutarimais miškų urėdijoms perduotuose valdyti laisvos valstybinės žemės fondo žemės, sklypuose ne miško žemėje įveistų eglynų plotų, duomenys Lietuvos miškų ūkio statistikoje yra pateikiami tik nuo 2005 m. Anksčiau ne miško žemėje įveistų eglynų plotai buvo priskiriami prie eglynais atkurtų miško žemės plotų.

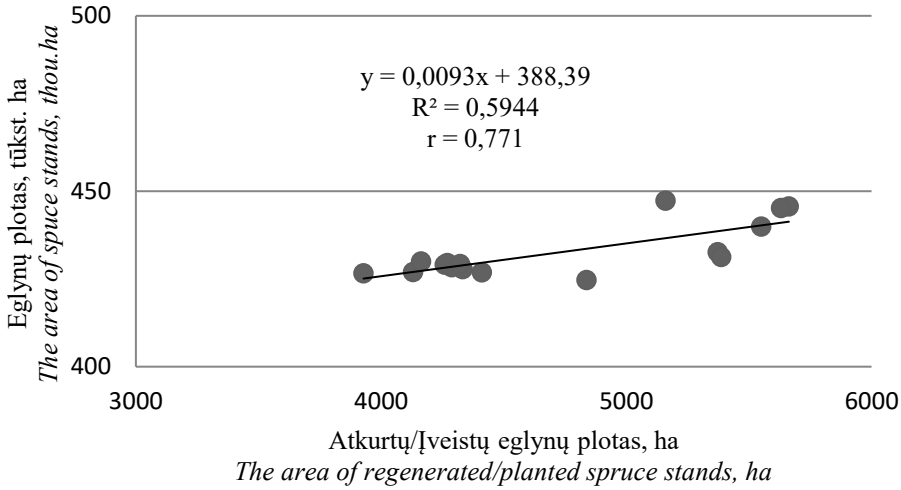
Nagrinėjant 1999–2016 m. laikotarpio duomenis apie atkurtų eglynų plotus galima matyti, kad didžiausi atkurtų eglynų plotai buvo 1999–2003 m., kuomet atkurtų eglynų plotas vidutiniškai siekė 5513,5 ha ir kito 5161–5663 ha ribose. Vėlesniu laikotarpiu atkuriamų eglynų plotas mažėjo, tačiau reikia atkreipti dėmesį į tai, kad 1999–2003 m. į atkurtų eglynų plotų statistiką galėjo būti įtraukiami ir įveistų ne miško žemėje eglynų plotai. 2005–2016 m. laikotarpyje atkurtų eglynų plotas kito nuo 3577 ha iki 4675 ha. 2011–2016 m. eglynų atkūrimas valstybiniuose miškuose stabilizavosi ir siekė apie 4000 ha per metus.



8 pav. Atkurtų ir įveistų eglynų plotas miškų urėdijose 1999–2016 m.
Fig. 8. *The area of regenerated and planted spruce stands in forest enterprises in 1999-2016*

Įveistų eglynų plotas fiksuojamas nuo 2005 m. 2005–2016 m. laikotarpyje įveistų eglynų plotai kito nuo 702 ha iki 159 ha ribose. Nuo 2006 m. stebima įveistų eglynų plotų mažėjimo tendencija, kuri susijusi su vis mažesniais ne miško žemės plotais, perduodamais valdyti valstybinėms miškų urėdijoms. 2016 m. įveistų eglynų plotas sudarė vos 159 ha.

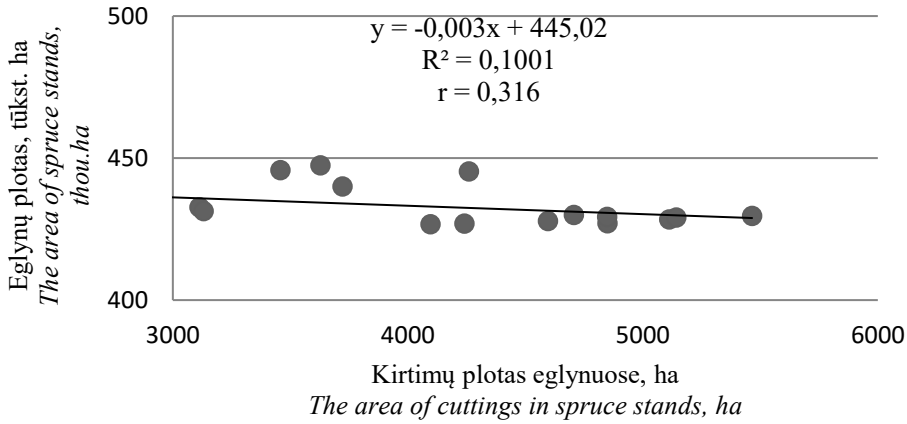
Eglynų atkūrimo/įveisimo ir pagrindinio naudojimo kirtimų įtaka eglynų plotų kaitai. Nagrinėjant valstybiniuose miškuose atkurtų/įveistų eglynų plotų įtaką Lietuvos eglynų plotų kaitai 2000–2016 m. laikotarpyje, buvo nustatytas reikšmingas tiesinis ryšys (R^2=0,6; r = 0,771) tarp eglynų atkūrimo bei įveisimo ir eglynų plotų kaitos (9 pav.). Ženklus eglynų atkūrimas valstybiniuose miškuose turi stabilizuojantį poveikį visų šalies eglynų plotų kaitai.



9 pav. Tiesinis priklausomumas tarp eglynų plotų ir atkurtų/įveistų valstybiniuose miškuose eglynų plotų (2000 – 2016 m.)

Fig. 9. *Linear dependence between the area of spruce stands and regenerated/planted spruce areas in state forests (2000-2016)*

Nagrinėjant pagrindinio naudojimo kirtimų valstybiniuose eglynuose ir plynų (su plynais sanitariniais) kirtimų privačiuose miškuose apimčių įtaką šalies eglynų plotų kaitai 2001–2016 m. reikšmingo tiesinio ryšio nebuvo nustatyta (R^2=0,1; r = 0,316) (10 pav.). Tai rodo, kad pagrindinio naudojimo kirtimais, esant aukščiau nagrinėtam eglynų atkūrimo mastui, eglynų plotai iš esmės nėra mažinami.



10 pav. Tiesinis priklausomumas tarp eglynų plotų ir eglynų plotų, kuriuose buvo vykdyti pagrindinio naudojimo kirtimai (2001–2016 m.)

Fig.10. *Linear dependence between the area of spruce stands and spruce areas where final cuttings were conducted (2001-2016)*

Įvertinus atkurtų/įveistų eglynų plotų ir eglynų plotų, kuriuose buvo vykdyti pagrindinio naudojimo kirtimai, skirtumus, buvo nustatyta, kad 2001–2008 m. atkurtų/įveistų eglynų plotai buvo didesni nei kertamų eglynų plotai, o 2009–2016 m. kirtimų plotai buvo didesni nei atkurtų/įveistų eglynų plotai (5 lentelė).

5 lentelė. Atkurtų/įveistų eglynų ir kertamų eglynų plotų skirtumai
Table 5. *Differences in the area of regenerated/planted and felled spruce stands*

Metai *Year*	**Atkuriamas/įveisiamas plotas, ha** *Regenerated/planted area, ha*	**Kertamas plotas, ha** *Felled area, ha*	**Plotų skirtumas, ha** *Difference in areas, ha*
2001	5160,7	3457,0	1703,7
2002	5631,4	3627,0	2004,4
2003	5550,9	4259,0	1291,9
2004	-*	3722,0	-
2005	5373,0	3113,0	2260,0
2006	5386,6	3131,0	2255,6
2007	4837,7	2880,0	1957,7
2008	4411,7	4240,0	171,7
2009	3928,2	4096,0	-167,8
2010	4130,3	4849,0	-718,7
2011	4333,3	4595,0	-261,7
2012	4288,0	5112,0	-824,0
2013	4260,0	5141,0	-881,0
2014	4270,3	5465,0	-1194,7
2015	4322,4	4847,5	-525,1
2016	4162,7	4705,5	-542,8

Pastaba:*- nėra duomenų
Note:* - no data available

Išvados

1. Modeliuojant paprastosios eglės paplitimą ir arealo kaitą dėl klimato šiltėjimo, ateityje, akivaizdu, kad tiek pagal B1, tiek pagal A2 klimato kaitos scenarijus, Lietuvos klimatas 2061–2090 metais nebus palankus augti ypač šiai rūšiai.
2. Lietuvos miškuose eglynai sudaro 20,9 %, nuo visų medynų ir yra trečioje vietoje pagal užimamą plotą lyginant su kitais medynais.
3. 1998–2017 m. laikotarpyje didžiausi eglynų plotai nustatyti 1998–2004 m., kuomet eglynų plotas kito nuo 440,0 tūkst. ha iki 447,4 tūkst. ha. Vėliau eglynų plotas mažėjo iki 424,7 tūkst. ha 2007 m., o nuo 2008 m. eglynų plotas palaipsniui, bet neženkliai didėjo. 2016 m. eglynų plotas siekė 430,0 tūkst. ha, o 2017 m. – 429,5 tūkst. ha.
4. Didesnė eglynų plotų dalis yra valstybinės reikšmės miškuose. Valstybinių miškų eglynų plotai 2001–2017 m. laikotarpyje su nežymiu svyravimu didėjo nuo 258,3 tūkst. ha iki 277,5 tūkst. ha. Privačiuose miškuose eglynų plotai buvo ženkliai mažesni ir jie nuolat mažėjo nuo 187,4 tūkst. ha 2001 m. iki 152,0 tūkst. ha 2017 m.
5. 2001–2017 m. laikotarpyje didžiausia eglynų ploto dalis buvo priskirta IV miškų grupei – ūkiniams miškams. Šioje miškų grupėje eglynų plotai kito nuo 358,9 tūkst. ha 2001 m. iki 345,9 tūkst. ha 2017 m.

6. Valstybinių miškų eglynuose pagrindinių kirtimų apimtys buvo ženkliausios 2000–2004 m., kada kirtimų plotas siekė nuo 3457 ha iki 4259 ha. Nuo 2004 m. pagrindinių kirtimų apimtys mažėjo ir 2007–2016 m. laikotarpyje nesiekė 3000 ha. Privačiuose eglynuose 2008–2016 m. laikotarpyje plynų kirtimų plotas sudarė nuo 1124 ha iki 2584 ha. Didžiausios plynų kirtimų apimtys nustatytos 2013 m. (2439 ha) ir 2014 m. (2584 ha).

7. Didžiausi atkurtų eglynų plotai valstybiniuose miškuose buvo 1999–2003 m., kuomet atkurtų eglynų plotas vidutiniškai siekė 5513,5 ha ir kito 5161–5663 ha ribose. 2005–2016 m. laikotarpyje atkurtų eglynų plotas kito nuo 3577 ha iki 4675 ha. 2011–2016 m. eglynų atkūrimas valstybiniuose miškuose stabilizavosi ir siekė apie 4000 ha per metus.

8. Miškų urėdijų įveistų eglynų plotas fiksuojamas nuo 2005 m. 2005–2016 m. laikotarpyje jis kito nuo 702 ha iki 159 ha. Nuo 2006 m. stebima įveistų eglynų plotų mažėjimo tendencija, kuri susijusi su vis mažesniais ne miško žemės plotais, perduodamais valdyti valstybinėms miškų urėdijoms.

9. Nagrinėjant valstybiniuose miškuose atkurtų/įveistų eglynų plotų įtaką Lietuvos eglynų plotų kaitai 2000–2016 m. laikotarpyje, buvo nustatytas reikšmingas tiesinis ryšys (R^2=0,6) tarp eglynų atkūrimo bei įveisimo ir eglynų plotų kaitos. Ženklus eglynų atkūrimas valstybiniuose miškuose turi stabilizuojantį poveikį visų šalies eglynų plotų kaitai.

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Internetiniai puslapiai: https://en.wikipedia.org/wiki/Picea_abies

Vytautas Bareika

Lithuanian Spruce Stands and Their Growth Perspectives in the Context of Climate Warming

Summary

The objective of this study was to assess the influence of forest management for the dynamics of Norway spruce stand areas in Lithuania.

Picea abies (L) H.Karst. is the only spruce species spread in Lithuania and one of the most valuable forest stands forming species. None of the deciduous trees cannot compete with spruce for straightness. Spruce in stands can grow very densely, and in many stands spruce can grow in the second storey with light-demanding deciduous trees or pines. Therefore, spruce stands, both pure and mixed, overtake well-growing deciduous stands by productivity. In Lithuanian forests spruce stands comprise 20.9% from all stands and take the third place by the area occupied by other stands.

It is believed that due to climate warming entire natural-geographical areas can be "shifted" to the north. A model developed by many authors suggests that climate fluctuations should trigger changes in prevailing species or even species extinction. In the 21st century, the most probable is the spreading of relatively warmth-preferring species and the same genotypes at the expense of cold-preferring ones. The results of research indicate that the south-western boundary of the natural range of spruce at the end of this century will be close to the current boreal forest vegetation zone in the Baltic and Russia (Rimkus et al., 2006). According to these forecasts, the territory of Lithuania would find itself far below the southern boundary of spruce range. Thus, it could be stated that in the 21st century the condition of spruce will deteriorate, and the likelihood of its vulnerability will increase. However, the relatively successful cultivation of spruce behind the boundaries of its natural range in the western Europe suggests that spruce in the 21st century will not abandon the territory of Lithuania and will continue to grow (Augustaitis et al., 2014; Lithuanian Forestry Statistics, 2017).

In the future, by simulating the prevalence and spatial changes of spruce due to climate warming, it is clear that the climate of Lithuania in the years 2061-2090 will not be favourable for this species in both climate change scenarios: B1 and A2.

According to 2017 statistics, the largest Norway spruce areas were singled out in the following state forest enterprises: Telšiai (27697,4 ha), Rietavas (22897,3 ha), Kretinga (21185,9 ha), Tauragė (17873,3 ha), Mažeikiai (17844,1 ha), Ukmergė (17538,5 ha), Panevėžys (15949,2 ha), the least - Druskininkai (1792,7 ha), Varėna (2697,8 ha).

After Lithuania regained Independence, the largest Norway spruce areas were recorded in 1998-2004 (440-447.4 thous. ha). Later on spruce areas decreased to 424.7 thous.

ha in 2007, thereafter the area gradually augmented. A larger part of spruce stands is found in the state forests. Spruce areas of the state forest with a slight fluctuation increased from 258.3 thou. ha up to 277.5 thou. ha. In private forests, the area of spruce was significantly smaller and decreased steadily from 187.4 thou. ha 2001 up to 152.0 thou. ha in 2017.

Study results revealed that the maximum felling volumes were set in 2013 (2439 ha) and 2014 (2584 ha). The largest spruce areas for reforestation in the state forests were in 1999-2003, when the regenerated spruce area on average amounted to 5513.5 ha.

The area of spruce afforestation has been registered since 2005. During the period from 2005 to 2016, it ranged from 702 ha to 159 ha. Since 2006, the tendency of decrease in spruce afforestation areas has been observed, which is related to ever smaller non-forest land areas transferred to the state forest enterprises.

Keywords: Norway spruce, felling, afforestation, reforestation, forest site type.

REIKALAVIMAI MOKSLINIAMS STRAIPSNIAMS RENGTI

1. Bendrieji reikalavimai

1. Moksliniai straipsniai turi būti tokios struktūros:

- straipsnio pavadinimas;
- autoriaus vardas, pavardė;
- autoriaus reprezentuojama institucija;
- straipsnio anotacija originalo kalba (ne daugiau kaip 200 žodžių), jos pabaigoje - ne daugiau kaip 5 straipsnio turinio esmę nusakantys prasminiai žodžiai;
- įvadas (nurodant tyrimų objektą ir tikslą);
- tyrimų metodika (metodai);
- rezultatai;
- aptarimas;
- išvados;
- literatūra;
- santrauka – jeigu straipsnis rašomas lietuvių kalba, santrauka turi būti anglų kalba;

2. Mokslinio straipsnio apimtis – 3-4 puslapiai. Paskutinis puslapis turi būti užpildytas ne mažiau kaip dviem trečdaliais puslapio.

2. Reikalavimai straipsniui rengti kompiuteriu

Šie reikalavimai parengti laikantis Lietuvos mokslo tarybos kolegijos 2000 m. vasario 23 d. nutarimo Nr. V-3 priedo, papildant jame išdėstytus reikalavimus straipsnio teksto tvarkymo nuorodomis (>xx pt – tarpo tarp pastraipų dydis)

Reikalavimai programinei įrangai

Straipsniai turi būti parengti Microsoft Word programine įranga.

STRAIPSNIO PAVADINIMAS (Cambria, 11 pt, Bold)

>11pt

Autoriaus (-ų) Vardas Pavardė (Cambria, 11 pt, Bold)

Autoriaus reprezentuojama institucija (Cambria, 11 pt, Italic)

>10 pt

Anotacijos tekstas per visą puslapio plotį (Times New Roman, 10 pt, Normal, First line 1,2 cm)

Raktažodžiai (Times New Roman, 10 pt, Italic, First line 1,2 cm)

>5 pt

Įvadas (11 pt, Bold, lygiuojama kairėje puslapio pusėje)

>5 pt

Puslapio formatas

Straipsnis (tekstas, formulės, lentelės, paveikslai) maketuojamas B5 JIS (182 x 257 mm) formato lapuose su tokiomis paraštėmis: viršuje – 20 mm; apačioje – 20 mm; kairėje ir dešinėje – 20 mm.

Straipsnio informacijos išdėstymas ir tvarkymas

Straipsnio pradžioje atskiromis pastraipomis pateikiami: pavadinimas; straipsnių autorių nesutrumpinti vardai ir pavardės; darbovietė ir anotacija. Straipsnio pagrindinis tekstas 1 intervalo eilėtarpiu spausdinamas Times New Roman, 11 pt, Normal šriftu ir išdėstomas viena skiltimi, Pirma eilutė atitraukiama 1,2 cm.

Visų struktūrinių dalių (skyrių) pavadinimai (išskyrus"*Summary"*) rašomi 11 pt, Bold. Lygiuojama prie kairiojo skilties krašto. Skyrių pavadinimai nuo teksto atskiriami 1 eilutės intervalu. Poskyrių pavadinimai rašomi iš naujos eilutės 11 pt, Italic, Bold tekstą tęsiant toje pačioje eilutėje. Formulių pagrindiniai simboliai rašomi 11 pt, Italic, o jų indeksai – 11 pt. Formulės centruojamos ir numeruojamos arabiškais skaitmenimis lenktiniuose skliaustuose dešinėje kraštinėje skilties dalyje. Parašius formulę rašomas taškas, jei joje naudojami dydžiai neaiškinami, jei aiškinami, – kablelis ir naujoje eilutėje be įtraukos rašomas žodelis "čia", kiekvienas dydis paaiškinamas.

Lentelės ir paveikslai turi būti įterpti tekste po nuorodų į juos, pasibaigus pastraipai, tačiau negali būti spausdinami po išvadų. Didesnio formato paveikslai ir lentelės gali būti spausdinami per visą puslapio plotį. Grafikai ir brėžiniai braižomi kompiuteriu. Nuotraukos turi būti tik geros kokybės, tinkamos reprodukuoti. Parašai po paveikslais, lentelių pavadinimai ir pastabos po jų rašomi centruotai 11 pt šriftu lietuviškai ir santraukos kalba. Lentelėse lietuviškas tekstas rašomas – 11 pt, Bold ir santraukos kalba 11 pt, Italic. Paveikslai ir lentelės nuo teksto atskiriami 1 eilutės intervalu.

Šaltinių nuorodos tekste pateikiamos skliausteliuose nurodant autoriaus pavardę (be vardo raidės) ar šaltinio pavadinimo pirmą žodį (kai autorius – institucija) ir šaltinio publikavimo metus, pvz., (Petraitis, 2001), (Peterson, 1988), (Valstybės…, 2004, (Кресникова, 2005). Jei literatūros šaltinis parašytas daugiau kaip vieno autoriaus, nurodoma tik pirmojo autoriaus pavardė, o po jos rašoma tekste lietuvių kalba "ir kt.", o anglų kalba "et al", pvz., (Jonaitis ir kt., 1999), (Johanson et al., 2003). Skliausteliuose galima nurodyti tik publikavimo metus; naudojamos citatos rašomos su kabutėmis papildomai nurodant šaltinio, iš kurio paimta citata, puslapio numerį, pvz., Kadangi Peterson (1988) įrodė, kad …, "tai atitiko vėliau gautus rezultatus" (Kramer, 2003, p.15).

Literatūros sąrašas sudaromas abėcėlės seka – pagal autorių pavardes ar šaltinio pavadinimo pirmą žodį. Pirmiausiai dėstomi bibliografiniai aprašai lotyniškais rašmenimis, po to kitais (pvz., kirilica).

Keletas to paties autoriaus darbų surašomi chronologiškai. Kai vieno autoriaus leidiniai išleisti tais pačiais metais, rašoma taip: 2003a, 2003b ir t.t.

Sąraše sutrumpinimai nenaudojami – čia pateikiamos visų šaltinio bendraautorių pavardės ir visas pavadinimas. Visi įrašai sužymimi arabiškais skaitmenimis ir numeruojami iš eilės.

Po literatūros sąrašo per visą puslapio plotį spausdinama santrauka, duomenys apie autorių originalo ir anglų kalbomis (žr. pavyzdį).

>5 pt

Literatūra (11pt, Bold)

> 5 pt

1. Čekanavičius A. Pastatų išorės sienų, apšiltintų iš vidaus, drėgminė būsena. Daktaro disertacijos santrauka. KTU, 2003.
2. Čekanavičius A., Stankevičius V., Montvilas E. Pastatų išorinių sienų, apšiltintų iš vidaus, drėgminė būklė. Kaunas, Technologija, 2004.
3. Rapcevičienė D. Daugiabučių namų renovacijos efektyvumo vertinimas. Mokslas – Lietuvos ateitis, 2010, 2 tomas, Nr. 2.

>10 pt

[Santrauka anglų kalba:]

Autoriaus (-ų) vardas (-i), pavardė (-s) (11 pt, Bold)

>5pt

Straipsnio pavadinimas anglų kalba (11 pt , Bold)

>5pt

Summary (11 pt, Italic)

>5pt

Santraukos tekstas (11 pt, Normal, First line 1,2 cm)

Keywords: (11 pt, Italic, First line 1,2 cm)

INSTRUCTIONS FOR AUTHORS

1. General requirements for manuscript preparation

1. Manuscript structure:

• title;
• full author first name(-s) and surname(-s);
• affiliation;
• annotation (no more than 200 words) with up to five keywords at its end;
• Introduction (including brief presentation of a study object and main aim);
• Materials and Methods;
• Results;
• Discussion;
• Conclusions;
• References;

2. The paper normally should not exceed 4–5 printed pages. At least two thirds of the last page should be filled with text.

2. Text formatting requirements

Requirements for computer software

Manuscripts should be prepared using Microsoft Word.

Text formatting (example):

MANUSCRIPT TITLE (ALL CAPS, Cambria, 11 pt, Bold)
>11 pt (>xx pt – font size of an empty space between lines)
Author name (-s) surname (-s) (Cambria, 11 pt, Bold)
Affiliation (Cambria, 11 pt, Italic)
>10 pt
Abstract (Times New Roman, 10 pt, Normal, First line 1,2 cm)
Keywords (Times New Roman, 10 pt, Italic, First line 1,2 cm)
>5 pt
Section Heading (Introduction, Materials and Methods, Results, Discussion, Conclusions or References - 11 pt, Bold, justified to the left)
>5 pt
Text

Page formatting

The page (including text, equations, tables, figures) should be formatted using B5 JIS (182 x 257 mm) standard with a 20 mm top and bottom margins; and 20 mm left and right margins.

Manuscript design (page layout)

The following information should be provided on the first page of the manuscript: manuscript title; full (unabbreviated) author name(-s); author affiliation(-s) and a brief annotation of the presented manuscript. The main body text of the manuscript should be in Times New Roman 11 pt Normal font using line spacing 1.0. The first line of each paragraph should be indented by 1.2 cm.

Section headings should be in 11 pt **Bold** font, and aligned to the left margin of a page. Section headings should be separated from the body text by a blank line (5 pt font). Subsection headings start from a new line and should be in 11 pt ***Italic Bold*** font followed by the body text on the same line (11 pt Normal). The main symbols in equations should be in 11 pt *Italic* font, while indices – in 11 pt Normal font. The equations should be center-aligned and numbered using Arabic numbers in parentheses on the right-hand side of the page. A full stop is put after the equation when the variables are not explained. If the variables are explained, a comma sign is put after the equation and a word „here“ is placed below the equation starting from a new line without indentation, followed by explanation of each relevant variable.

Figures and tables are to be inserted into text below the paragraph where they are mentioned for the first time in text, although figures and tables should not be placed after Conclusions section. Figures and tables of a larger format may occupy an entire page. Graphs and drawings should be produced using computer software. Photographs should be of good resolution, suitable for reproduction. Captions for figures should be placed below the figures, and table titles – above the tables. Figure captions, table titles and table footnotes should be typed using 11 pt font and centered. Text in tables should be in 11 pt font. Figures and tables are separated from the main body text with an interval of one blank line.

Citations in text are to be given in parentheses, e.g. (Peterson, 1988); if the author is an institution, given is the first word of its name followed by three dots, e.g. (State…, 2004). Citations of sources in Russian are given using Cyrillic script, e.g. (Кресникова, 2005). For citations of a source written by multiple authors only the first author‘s name is given followed by „et al.”, e.g. (Johanson et al., 2003).

References are listed fully in alphabetical order according to the last name of the first author (or institution name) and numbered. Sources in Latin script are listed first followed by sources in Cyrillic script.

Papers with one author only are listed first in chronological order, beginning with the earliest paper. Papers with dual authorship follow and are listed in alphabetical order by the last name of the second author. Papers with three or more authors appear after the dual-authored papers and are arranged chronologically.

Names of all authors of a respective source should be listed. Journal titles should not be abbreviated.

A summary of the presented study is prepared in Lithuanian by editor‘s office and placed below the reference list. Below presented is an example of a reference list:

>5 pt

References (11 pt, Bold)

> 5 pt

4. Cotte J., Ratneshwar S. Choosing leisure services: the effect of consumer timestyle. Journal of Services Marketing, 2003. 17 (6), 558-572.

5. Mallen C., Adam, L. Sport, Recreation and Tourism Event Management. Theoretical and Practical Dimensions, Brock University, USA, 2008.

6. Jackson E. L., Scott D. Constraints to leisure. In E. L. Jackson & T. L. Burton (Eds.), Leisure Studies: Prospects for the Twenty-First Century (pp. 299-332). State College, PA: Venture Publishing, Inc., 1999.

7. Выдрин В. М, Джумаев А. Д. Физическая рекреация – вид физической культуры. Теория и практика практической физической культуры, 1989. Nr. 3, с. 2-3.

>10 pt

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FORESTRY AND LANSDCAPE MANAGEMENT

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