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## PROTECTION OF HISTORICAL TREES IN THE CITY AREA USING THE EXAMPLE OF A HISTORICAL MANOR ALLEY IN ZEMBORZYCE

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### OCHRONA ZABYTKOWYCH DRZEW NA TERENIE MIASTA NA PRZYKŁADZIE HISTORYCZNEJ ALEI DWORSKIEJ W ZEMBORZYCACH

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#### Abstract

Alleys are one of the classical elements of open space topography as well as in cultural landscape and city space. These historical plant forms which have survived to our times require special conservatory attention – protective and maintenance works. In this study, one method of evaluating the condition of old trees is presented. The trees are the remains of the alley layout at the former manor house in Zemborzyce. In 2015, an inventory of alley trees was carried out and the internal structures of the examined trees were evaluated using sound tomograph PICUS. The non-invasive method used is especially recommended to evaluate the health condition of valuable, old trees. It allows us to examine each tree extensively and carry out individual procedures according to conservatory rules.

**Keywords:** Lublin, historical alley, evaluation of the trees' condition, sound tomograph PICUS

#### Streszczenie

Do klasycznych elementów ukształtowania i wyposażenia przestrzeni otwartych, jak również krajobrazu kulturowego i przestrzeni miejskiej należą aleje. Te zabytkowe formy roślinne, które przetrwały do naszych czasów, wymagają szczególnej uwagi konserwatorskiej – prac zapobiegawczych i pielęgnacyjnych. W prezentowanej pracy przedstawiono jedną z metod oceny kondycji drzew wiekowych, które są pozostałością układu alejowego przy dawnym dworze w Zemborzycach. W roku 2015 wykonano inwentaryzację drzew alejowych i oceniono wewnętrzne struktury pni badanych drzew za pomocą tomografu dźwiękowego PICUS. Zastosowana bezinwazyjna metoda jest szczególnie polecana przy diagnozowaniu stanu zdrowotnego cennych, starych drzew. Pozwala na staranną ocenę każdego egzemplarza oraz określenie indywidualnych kryteriów postępowania zgodnie z poszanowaniem zasad konserwatorskich.

**Słowa kluczowe:** Lublin, aleja zabytkowa, ocena kondycji drzew, tomograf dźwiękowy PICUS

## 1. Introduction

In Lublin, as in most urban agglomerations, some imbalance between urban space and nature has been observed in the last several years. Urbanization pressure and especially the development of the road transport and building industry, has led to the reduction of green areas and the number of trees. It refers both to the city centers as well as to the suburbs where the population growth is increasing ten times faster than in the city centers [25]. These changes have led to the loss of existing green wedges and their connections with ecological areas surrounding the city. All protective actions connected with the nature preservation of the city which influence the improvement of climatic, health as well as social and economic conditions are of great importance.

Revitalization politics has played an important role in shaping the area of Polish cities for over twenty years. As a part of regional development, the aspect of nature has been taken into consideration within the Lublin voivodeship over the last few years. An example of this is the complex revitalization of Krzna valley in Biała Podlaska and Bystrzyca in Lublin and Wieprz – Krzna canal water system [10]. These actions are also concentrated on the revitalization of historical objects and their surroundings- our regional heritage which should be protected and consciously managed. Alleys are one of the compositional elements of garden art and urbanization. A lot of them have survived to our times in a different condition. These alleys are created by old trees which require thorough evaluation by ascribing special action criteria and further maintenance [24, 18]. Lack of protection of these important, in most cases city-based plant forms, leads to the disappearance of old layouts which are included in the green areas of a given region.

## 2. History and spatial conditions

At present Zemborzyce, one of Lublin districts in the south of the city, consists of open spaces and mostly rural landscape. The landscape axis of Zemborzyce which marks the road system and building development is Bystrzyca valley, 2 km wide and located in this district. For this reason, in 1970-1974 an artificial water reservoir with retentional and relaxation purposes named Zemborzycki Reservoir was localized.

The oldest records of Zemborzyce date back to 1364. At this time, on the order of king Casimir the Great, a special document to locate a village near Lublin using Magdeburg Law was prepared and this name was given to it. Zemborzyce is located on the Royal Route leading from Cracow to Lublin and further to Vilnius, which helped its development. Probably in those days, there existed a wooden manor, outbuildings and a garden [1]. A plan from 1823 shows that in Zemborzyce, at the point where the Bystrzyca valley widens, a manor surrounded by a garden marked by the alleys crossing at right angles was built. Next to the manor house there was a pigpen, a hen house, a chamber and a farm house facing north [28]. The manor house building was wooden - the same as the rest of the buildings. After the January Uprising, the owner of the manor became General Major Teodor von Rüdiger, followed by his heirs,

among others, the son-in-law of General Duke Bielajew. During the time of General Rüdzygier and his heirs' management, the manor house was extended and it consisted of 53 buildings, including brick ones and a classicist manor house [16]. Presently, only two buildings have remained – a stable and a historical granary<sup>1</sup> [14] as well as historical trees of different ages represented by alley forms.

The oldest alley in the area of the manor house in Zemborzyce is still a clearly marked lime tree alley formerly localized to the north of the manor and directed from east-west. It probably comes from the 18<sup>th</sup> c. and in those days it marked the northern border of the garden, separating it from the manor farm [8]. Nowadays, it is represented by twenty small-leaved lime trees (*Tilia cordata* Mill.), which in 2017 were declared a natural monument by City Council Resolution [20]. The trunk's circumferences reaches 360 cm. It seems that the oldest trees may be 220-250 years old [27].

Another remaining plant form is a part of a former tree row, which at the turn of the 18<sup>th</sup> and 19<sup>th</sup> c. constituted a closure of the interiors in the west part of the park. Their layout led to the south, opening to the vast manor meadows<sup>2</sup> [12]. The basic species of the tree rows, in the past as well as today, is a small-leaved lime (*Tilia cordata* Mill.) Since 1997, by Resolution nr 4 of the Voivodeship of Lublin, fifty trees shaped in tree rows were classified as natural monuments [13]. After twenty years, forty nine of the remaining trees<sup>3</sup> create a wide, 150 m long lime alley, which in the northern part joins a horse chestnut alley from the west and the oldest lime alley from the east.

To the west of the manor complex there leads the third horse chestnut alley. It is straight and it can be seen on the maps from 1823 and as in the past when it was an alley leading to the manor house, it plays the same role nowadays<sup>4</sup>. The age of the thirty two horse chestnuts (*Aesculus hippocastanum* L.) of this alley is estimated to be about 120-240 years old<sup>5</sup>. Since 2017 they have been protected and classified as natural monuments [20].

The historical alleys in the area of the former manor complex in Zemborzyce are in good condition. All require systematic control and diagnosis of the trees' health condition. The aim of the study is to evaluate chosen trees creating a wide lime alley which comes from the turn of the 18<sup>th</sup> and the 19<sup>th</sup> c. In the research, a non-invasive diagnostic method of sound tomography was used, which allows us to discover the infection and decay of the internal structures of a tree trunk at the height of measure. Such examination is an important addition to the complex diagnosis of the trees and the whole alley. It allows us to predict and plan the range and time of protective and maintenance works [22].

<sup>1</sup> The granary was to the south of the manor, which was destroyed in the sixties of the twentieth century.

<sup>2</sup> At present to the whole reservoir.

<sup>3</sup> Thirty four from the west side and fifteen trees from the east.

<sup>4</sup> Currently it leads from Kreżnicka Street.

<sup>5</sup> The trunks' circumferences reach from 212 to 414 cm.

### 3. Research methods

In the years 2017-2018, research was conducted to evaluate a lime alley preservation in the former manor-park complex in Zemborzyce, which at present is a part of the Marina recreation center at Zemborzyce Reservoir. The manor park complex with a preserved granary and the remains of a park is on the list of the monuments of Lublin under numbers 1713 and 1714 [11]. As part of the research work, a detailed dendrological inventory of a lime alley consisting of trees aged from 150 to over 300 years old was conducted. In 1997 this plant form had fifty trees and it was protected by the law [13]. Nowadays, it plays the role of a two sided, homogenous lime tree alley with an admixture of two trees of the following species: horse chestnut (*Aesculus hippocastanum* L.) and white poplar (*Populus alba* L.) and it consists of forty nine trees. The research conducted covers the measurement of the alley trees: height (m) by the use of a laser distance meter- Nikon Forestry Pro and trunk circumference (at the height of 1.3 m). The estimated age of the plants was defined using age charts by L. Majdecki in 1980-86 [15], a tree age calculator [27] and increment factors defined by the International Society of Arboriculture and published by the Missouri Department of Conservation [26]. Alley trees were localized on the map using GPS, by means of a module in a central unit (tomograph). In 2018 a tomographic diagnosis of six randomly chosen small-leaved limes, which constitute this form of forest cover was made- four trees on the west and two on the east.

For localizing possible defects inside the trunks of examined limes, PICUS Sonic Tomograph 3 of the German company Argus Electronic GmbH was used. The device uses the speed of sound waves in the wood which depends on its density and flexibility. The device records the time of acoustic waves by a system of sensors, generated at each measure point. Most defects inside the trunk, especially the presence of decay, lead to a reduction in the density and flexibility of the wood, which results in the reduction of the speed of waves at the point of damage. The results of the conducted research show a tomogram – a graphic picture which presents an actual internal structure of a trunk cross- section at the height of a tree examination in detail and in some cases it allows us to detect the early stages of tree decay [5, 2, 3, 4]. Photographic documentation was made using the camera NIKON D5300. The research covers the library and archive query connected with the village of Zemborzyce. Cartographic materials from the National Archive in Radom with a map of Zemborzyce from 1823 were analyzed.

### 4. Evaluation of the chosen alley trees

Cartographic analysis and measuring the trees' trunk circumferences prove the age diversity of lime trees growing on both sides of the examined alley. From the west there grow small-leaved limes (thirty two plants) which belong to a younger generation in comparison to the trees from the east side (fifteen plants). Their biggest circumferences reach from 250 to 290 cm, while the circumferences of the lime trees from the older generation (fifteen trees) are from 342 to 475 cm. These values as well as the irregular planting of the trees can prove that these plant forms had a different role in the former manor complex than they have nowadays.

The health condition of all forty seven small-leaved lime trees that make up the examined alley is varied. The younger trees are in better condition. At the height between 1.4 and 1.8 m there appear some branch-offs which change into V-shaped branching in some of them. In the tree row of older limes, plenty of dead branches (25-30%) can be seen and a bigger number of suckers and clusters of mistletoe (*Viscum album* L.) are at the bases of the trunks. Besides, in the case of 30% of the trees there is decay extending deep into their internal parts which results in an imbalance of the tree static leading to tilting (inv. no. 40) to the south of the adjacent lime tree. In some lime trees, some loss in the outer part of a trunk extending from 0.8 to 1.5 m was observed. In younger generation lime trees creating the western row, some traces of their maintenance are noticeable. Some trees were operated on which resulted in their being cut down at a high level and damaged branches were removed as a result of breaking or decaying processes. Edges of the wounds are in most cases well healed. On some trees, one can see internal loss of a different size. Small holes are seen (inv. no. 8, 13 and 14), but also damage as a result of atmospheric factors (rain, snow) which cover a large part of the trunk (inv. no. 10 and 11). Some tree crowns are asymmetric with an imbalanced static. Two of the examined trees have their main branches joined with elastic Cobra bonds and steel ropes at the higher parts of the crown (inv. no. 8 and 12) because of dangerous V-shaped branching. In the tree crowns, dead branches only make up 10-15% of the total, which shows the vitality of the trees.

Four trees on the west side of the alley (younger plantings) and two on the east side (older plantings) were randomly chosen to evaluate the internal structures of the tree trunk. On the basis of the tomograms following computer processing it was shown that the younger trees aged 150-180 years are in better health condition than older ones (300 years old). Apart from the easily noticeable processes of internal structure decay of the tree trunks, especially in their heartwood part, presently there is no risk of breaking or blowdown. The destructive processes are still not very advanced so the thickness of the wall guaranteeing the mechanic strength of the tree trunk has a large margin of safety. On the attached tomograms, a safety border marked with a red line beyond which humus decay does not extend is seen. It is only in tree number two (Fig. 1) in the north-west side that the humus center spreads to the outer part of a tree trunk. The area with the most destroyed part of the tree trunk is marked with a blue color and it is in the central part of the tree trunk. The purple color is a sign of a tree with better mechanic strength (less destroyed) and green designates so called 'wood in process' - not yet destroyed, but at the same time not mechanically strong. In case of the examined trees with a smaller trunk circumference (Fig. 2-4) the minimum thickness of the wall seen as a safety border, is from over 9 to almost 14 cm. In the case of the trees with big circumferences and where the decay process is low, this wall has a bigger thickness- over 14 cm (Fig. 5 and 6).

Comparing younger trees with older ones, the bigger resistance to infection of the younger trees is noticeable. In the case of the lime tree with the biggest circumference (474 cm), which is the oldest among the examined trees (inv. no. 39), the fungal infection is more advanced than in the rest of the trees (Fig. 6). In this case it has developed on the east side of the tree trunk covering a bigger area on the cross- section. As a result of ongoing wood decay, there appeared a risk of internal cuts which can lead to a trunk break in future (yellow lines on the tomogram). Trees in the younger tree row are in better health condition than the trees in the



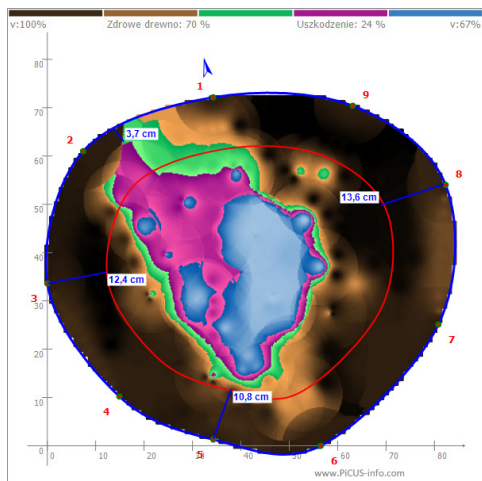


Fig. 1. Tomogram of the interior of the trunk of lime-tree No. 2 (by W. Durlak, 2018)

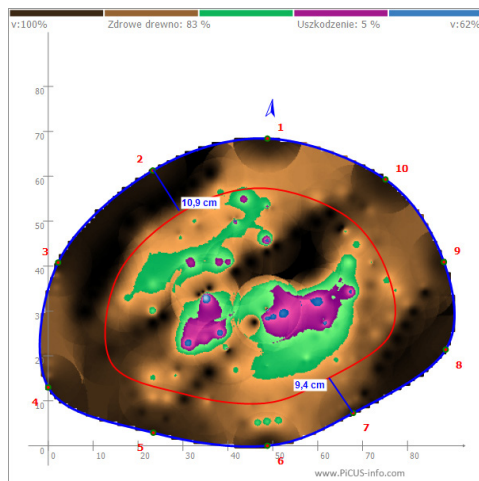


Fig. 2. Tomogram of the interior of the trunk of lime-tree No. 9 (by W. Durlak, 2018)

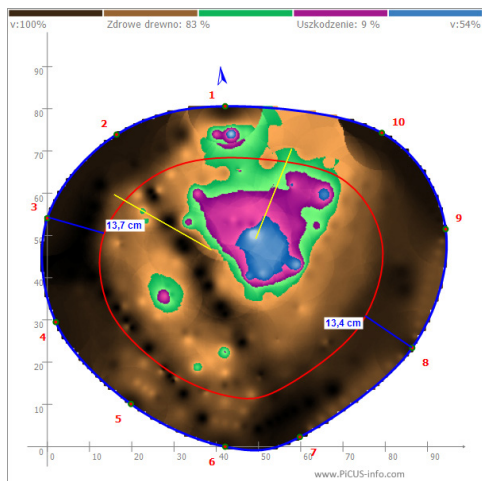


Fig. 3. Tomogram of the interior of the trunk of lime-tree No. 12 (by W. Durlak, 2018)

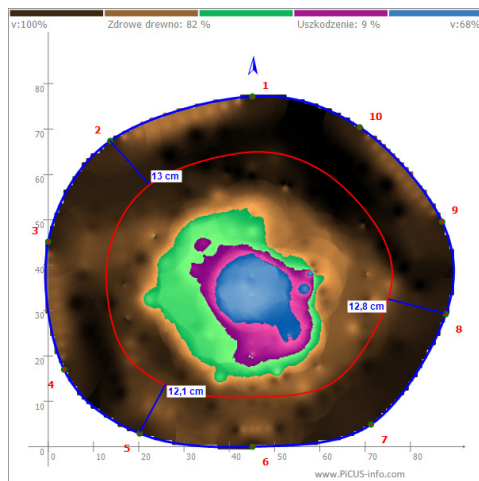


Fig. 4. Tomogram of the interior of the trunk of lime-tree No. 14 (by W. Durlak, 2018)

older one, where the decay processes inside the trunk are more advanced and will probably become stronger with the passage of time.

The predominance of sound tomography over other research methods is primarily determined by its non-invasive nature. For many years, the only available instrument for the detailed evaluation of the internal structure of the growing tree was the Pressler borer. However, this method requires interference in the internal tissues of the tree. In the case of particularly valuable ancient trees, its use is controversial [2, 23].



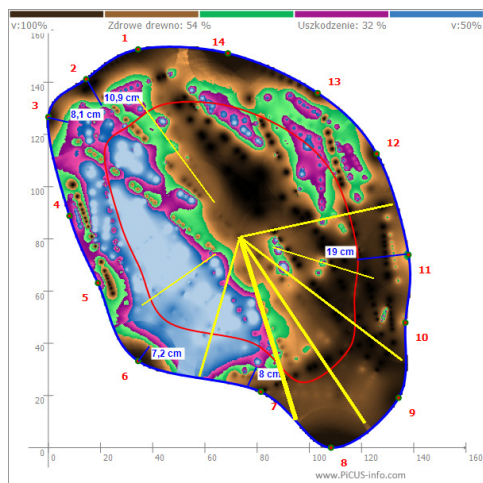


Fig. 5. Tomogram of the interior of the trunk of lime-tree No. 37 (by W. Durlak, 2018)

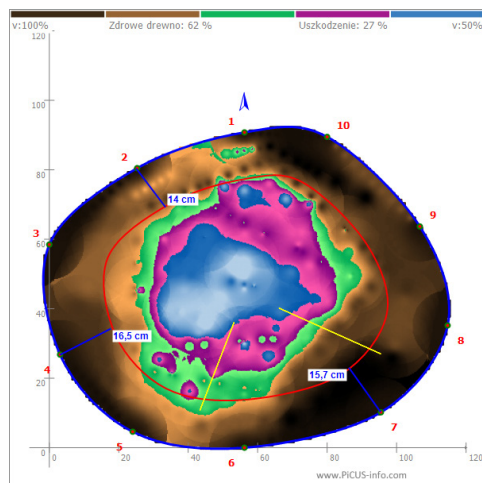


Fig. 6. Tomogram of the interior of the trunk of lime-tree No. 39 (by W. Durlak, 2018)

## 5. Summary

Poland is one of very few countries in Europe with a large number of old trees [17, 9]. They appear in urban green spaces, especially in historical gardens, in cemeteries and open areas. These are single trees, clusters or alleys with native species such as petiolate oak, common beech, small-leaved limes, and some foreign species (e.g. silver maple, tuliptree, ginkgo) [6, 19]. In Poland in 2016 (according to the GUS data), the following number of trees were under protection: 30 063 single trees, 3734 clusters of trees and 770 alleys including the Lublin voivodeship of: 1165 trees, 180 clusters of trees and 57 of alleys [7]. These forms are of great educational value, influence the quality of the environment and the evaluation of landscape esthetic, as well as improving its diversity and attraction. This role has been played by historical alleys in Zemborzyce, one of Lublin's districts, which in the 70s of the 20<sup>th</sup> c. was the place of recreation for the inhabitants of the city. Today, two lime alleys and one chestnut alley are the main cultural, natural and esthetic value of the recreational Marina area increasing its attractiveness. Conducted tomographic studies showed that decay processes inside the older lime trees trunks are more advanced and will increase with the passage of time in comparison to younger trees. Fungal infection is more advanced and covers a bigger area of the trees' cross-section (Fig. 6). As a result of an ongoing wood decay, a risk of internal cuts appeared, which could lead to a trunk break in the future (yellow lines on a tomogram).

Lime trees, often seen in historical and modern manors and park complexes, have soft wood, easily influenced by biocorrosion. The decay processes begin in a core part of a tree trunk spreading along its circuit with different speeds or they appear as a result of destruction localized in its peripheral structures. It results in fast infection spreading into the trunk. This process is much faster in older trees in which natural protection methods (creating a compartmentalization barrier, are not as strong as in younger trees [21]. That is why the permanent control of the health condition of trees making up the alley on the area of the

former object is advised. These valuable remains of culture, which many tourists can admire and learn about their history, require constant monitoring, systematic actions undertaken by specialists and the authorities of a Member State as well as by territorial and local authorities.

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