

What Can We Learn from Monitoring of Monumental Trees – A Case Study of the Jasienica and Jaworze Communes (Silesia, South Poland)

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ABSTRACT

The data of monitoring of natural monuments in the Jasienica and Jaworze communes (Silesian Voivodeship) deriving from 1999, 2008 and 2019 were compared between the periods and communes. The conducted studies involved determining metric data (including tree height and diameter at breast height – DBH) and assessing health condition of monumental trees. A total of 65 trees were included in the research from 2019, dominated by *Quercus robur* (28 specimens) and *Tilia cordata* (9). The health condition of trees was the result of the damage that occurred. Monumental trees in the Jasienica commune were characterized by average (60%) or poor (40%) health condition. In the Jaworze commune, merely 14% of trees have poor state of health. The remaining trees were in average (38%), satisfactory (26%) and good (22%) health condition.

Keywords: nature monuments, monumental trees, biological monitoring, trees health condition.

INTRODUCTION

The beginning of the natural monuments protection can be traced back to religious cults in ancient times, making them one of the oldest form of nature conservation. However, the very notion of natural monument was introduced by a German geographer and naturalist, Alexander von Humbolt in 1816. [Leńkowa 1978, Dubel 1996, Kasprzak 2011]. Currently, in the Polish law system, all the issues related to forms of nature protection are regulated by the Nature Conservation Act [Journal of Laws 2004 No. 92 item 880]. According to the above mentioned law (Article 40(1)), natural monuments are defined as single living and inanimate objects of nature or groups of such objects of unique natural, scientific, cultural, historical or landscape value. They are distinguished from other objects by individual features. Natural monuments are trees of outstanding size, shrubs of native or foreign species, springs, waterfalls, karst springs, rocks, ravines, erratic boulders and caves.

Particular attention is paid to natural monuments, such as aged and magnificent trees. Creations like this often delight and arouse man's admiration for nature, which indicates their aesthetic function. Monumental trees also have cultural, historical and scientific significance. They constitute exceptional research material and are habitat of many organisms, e.g. lichens and bryophytes [Pietrzak 2010, Symonides 2014].

In 2019, the number of natural monuments in Poland was 34 890, out of which as many as 27 636 monuments were trees. Furthermore, 4 462 tree groups and 746 tree-lined avenues were recorded. In total, single trees, tree groups and tree-lined avenues, account for 94% of natural monuments. As the remaining, the following are mentioned: erratic boulders – 1 126, rocks – 293, caves – 41 and others, including shrubs, ravines and waterfalls – 586 [GUS 2020]. Among the various forms of nature conservation, monumental trees have been the subject of many publications [e.g. Antkowiak and Ludian 2016, Salachna et al. 2017, Grzywacz et al. 2018].

As mentioned, the reason for protecting old trees, among others, is their size. The older the protected trees, the worse their sanitary condition can be expected after a specific period of time. If constant monitoring is carried out and new trees are included in the protection, which begin to meet the requirements for protection, the average size of monument trees does not change much.

This work presents the results of evaluation research carried out in 2019 of the natural monuments in the Jasienica and Jaworze communes, in the Silesian Voivodeship. The research consisted in determining basic metric data of the examined tree specimens and assessing their health condition. The results of this study were compared with the data from previous measurements and observations, i.e. from 1999 and 2008. The goal was to specify the efficiency of nature monumental protection in two communes.

If an uneven rate of incorporating subsequent trees into this form of nature protection and insufficient care treatments is assumed, it can be hypothesized that there are differences in the number of monumental trees and health conditions between periods and the communes (i) and that these differences are caused mainly by initial state of monumental trees at the beginning of the study (ii).

STUDY AREA

The Jasienica commune is a rural district with an area of 91.71 km². The Jaworze commune, in turn, has an area of only 21.13 km². The communes are adjacent to each other and located in the Silesian Voivodeship, in the western part of the Bielsko County. The Jasienica commune has greater population (24 419 people) than the Jaworze commune (7 395 people). However, due to its small area, Jaworze is characterized by higher population density (350/km²) than Jasienica (266/km²) [Statystyczne Vademecum Samorządowca 2020].

The Jasienica commune is located at the interface of the Silesian Beskid, the Oświęcim Basin and the Silesian Foothills. The landscape is characterized by the presence of hills, plains and numerous ponds. Jaworze, on the other hand, is located within the Cieszyn Foothills and in the northern part of the Silesian Beskid. The peaks that are featured in the area are: Ostry (659 m a.s.l.), Bucznik (679 m), Borowina (718 m),

Wysokie (756 m) and Błatnia, called Mud Mountain (917 m) [Blarowski et al. 1998, Biesik 2013, Czader 2013].

Jasienica is marked by low forest cover (15.2% of the commune area). Arable lands account for 72.8% and urban area constitute about 10.7% of the commune area. In Jasienica, there are forest communities of the Silesian Beskid, such as beechwood, riparian forests and scrub communities. There are also rush plants, aquatic and wetland vegetation ecosystems as well as meadows alongside water meadows and oak-hornbeam forests, mainly in the Landek, Rudzica, Hłownica and Roztropice villages [Chylak and Kulikowski 2017a]. In Jasienica, there are following forms of nature conservation: Natura 2000 areas: Dolina Górnej Wisły (Special Protection Area – SPA), Pierściec (Special Area of Conservation – SAC), Cieszyńskie Źródła Tufowe (SAC), Beskid Śląski (SAC), nature reserve „Morzyk”, nature reserve „Dolina Łąńskiego Potoku” and 12 natural monuments (including 8 monumental trees and 2 trees groups) [Central Register, 2021].

In contrast, the Jaworze commune is characterized by a high level of forestation. Forests make about 51.2% of commune area, arable lands – 33.4% and urban area – 13.2%. Among forest communities, one can name: *Dentario glandulosae-Fagetum* and *Luzulo luzuloidis-Fagetum*. On the other hand, wet meadows appear as part of non-forest communities. A significant part of forests and the presence of mountain peaks increase the tourist attractiveness of Jaworze [Chylak and Kulikowski, 2017b]. There are also five forms of nature conservation: Beskid Śląski Landscape Park, ecological sites „Uroczysko Jasionka”, Landscape-Nature Protected Complex „Jaworze”, Natura 2000 area Beskid Śląski (SAC) and 28 natural monuments (including 21 monumental trees and 7 trees groups) [Central Register, 2021].

MATERIAL AND METHODS

The field research was conducted in the growing season of 2019. A total of 38 natural monuments were included in the evaluation study, of which 10 are situated in the area of Jasienica and 28 in Jaworze (Figure 1). In the Jasienica commune, monumental trees occur in the form of 8 single trees and 2 groups of trees. On the other hand, in Jaworze, 21 single monumental trees and 7 trees groups appear.

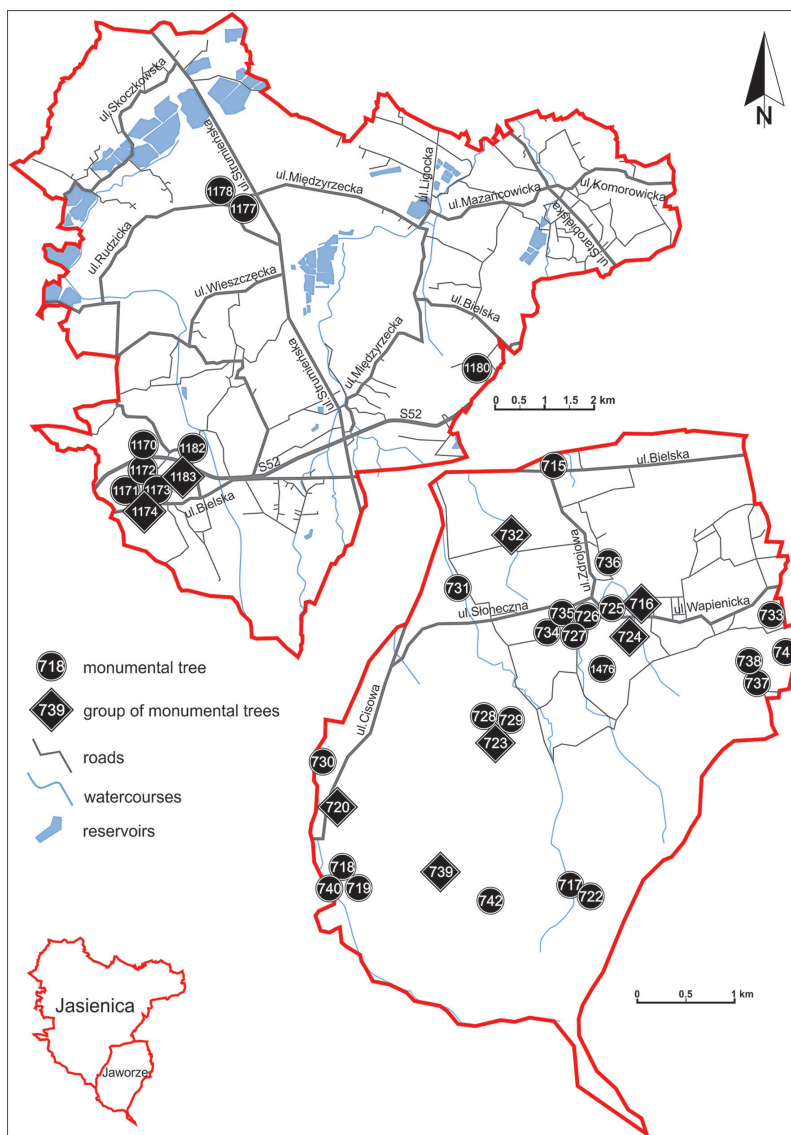


Figure 1. Map of monumental trees in the Jasienica and Jaworze communes

During the research, dendrometric measurements were taken, such as: tree height and diameter at the breast height 1.30 m (DBH). To measure the height, a SUUNTO altimeter was used and caliper for DBH. The obtained data were compared with the dendrometric data collected in 1999 and 2009 [Dziergas 1999, Szafrań 1999, Jarosz 2008, Zalot 2008]. The health condition of boughs (large branches), trunks and

leaves was also evaluated, paying special attention to the damage. The scale of tree health condition was used. The Pacyniak and Smólski scale (1973) was adopted with some modifications to fit the tree condition data. The modified scale has 4 types of health status based on trees damage (Table 1).

In order to compare the statistical difference in mean height of *Quercus robur* among two

Table 1. Tree health condition scale

| Health condition | Characteristics |
|------------------|---|
| Good | No visible damage, no need for conservation treatment |
| Satisfactory | Only dry boughs or branches are present |
| Average | In addition to dry boughs or branches, one other type of damage was found |
| Poor | In addition to dry boughs or branches, other types of damage were found (cracks, bark defects, decay, etc.) |

communes in 1999, non-parametric Wilcoxon sum rank test was performed. The comparison of health condition of protected monumental trees between the Jasienica and Jaworze communes was carried out using contingency tables (Pearson

chi-square test). The accepted level of significance (p-value) was considered at 0.05.

The data of monumental trees are shown in Tables 2 and 3. Nomenclature of plants follows Mirek et al. [2002].

Table 2. Monumental trees in the Jasienica commune and their dendrometric data

| No. | ID | Tree species | Year of establishment | Height [m] | | | DBH [cm] | | | Current condition |
|-----|------|--|-----------------------|---|---------------------------------|--|---|------------------------|--------------------------------|--|
| | | | | 1999 | 2008 | 2019 | 1999 | 2008 | 2019 | |
| 1. | 36* | <i>Quercus robur</i> | 1993 | NA | - | - | NA | - | - | - |
| 2. | 110* | <i>Tilia cordata</i> | 1960 | 11.4 | - | - | 102 | - | - | - |
| 3. | 284* | <i>Populus nigra</i> | 1980 | 36.7 | - | - | 189 | - | - | - |
| 4. | 308* | <i>Quercus robur</i> | 1988 | 14.8 | 23.6 | - | 137 | 144 | - | - |
| 5. | 309* | <i>Quercus robur</i> | 1988 | 18.7 | - | - | 140 | - | - | - |
| 6. | 369* | <i>Tilia cordata</i> | 1993 | 23.7 | 22.7 | - | 124 | 125 | - | - |
| 7. | 421* | <i>Aesculus hippocastanum</i> | 1993 | NA | - | - | 42-129 | - | - | - |
| 8. | 1170 | <i>Quercus robur</i> | 2004 | - | 28.6 | 23.7 | - | 190 | 253 | Poor |
| 9. | 1171 | <i>Quercus robur</i> | 1953 | 27.7 | 27.2 | 33.5 | 152 | 150 | 190 | Average |
| 10. | 1172 | <i>Quercus robur</i> | 1953 | 45.7 | 18.6 | 27.5 | 151 | 153 | 186 | Poor |
| 11. | 1173 | <i>Quercus robur</i> | 1953 | 43.7 | 23.6 | 29.8 | 145 | 153 | 167 | Average |
| 12. | 1174 | <i>Quercus robur</i> (currently group of two oaks) | 1953 | 34.7; 25.7; 29.7; 32.7; 36.7; 36.7 | 26.2; 27.6 | 26.7; 22.7 | 147; 108; 134; 135; 133; 136 | 186; 155 | 165; 116 | Poor Average |
| 13. | 1177 | <i>Tilia cordata</i> | 1958 | 26.7 | 32.7 | 27.7 | 137 | 120 | 185 | Average |
| 14. | 1178 | <i>Tilia cordata</i> | 1959 | 22.2 | 23.2 | 24.5 | 163 | 165 | 170 | Poor |
| 15. | 1180 | <i>Tilia cordata</i> | 1960 | 15.7 | 19.0 | 23.0 | 126 | 112 | 189 | Poor |
| 16. | 1182 | <i>Quercus robur</i> | 1993 | 33.8 | 31.6 | 26.5 | 108 | 111 | 120 | Average |
| 17. | 1183 | <i>Tilia cordata</i> (currently group of five lindens) | 1993 | NA | 21.0- 25.0 (mean 23.0) | 18.3; 20.5; 17.9; 30.3; 16.7 | 46-115 (mean 81) | 66-109 (mean 88) | 62; 81; 74; 99; 68 | Average Average Average Average Poor |

Note: ID – identification number; * number of natural monument consistent with the Register of Natural Monuments in the Silesian Voivodeship in 1999, NA – data not available, “-” means that a natural monument did not exist in the given year.

Table 3. Monumental trees in the Jaworze commune and their dendrometric data

| No. | ID | Tree species | Year of establishment | Height [m] | | | DBH [cm] | | | Current condition |
|-----|------|---|-----------------------|--------------------------|---------------|--|-------------------------|-----------------------|---|---|
| | | | | 1999 | 2008 | 2019 | 1999 | 2008 | 2019 | |
| 1. | 328* | <i>Populus nigra</i> | 1992 | 28.2 | 23.9 | - | 184 | 181 | - | - |
| 2. | 332* | <i>Salix alba</i> | 1992 | 23.7 | - | - | 135 | - | - | - |
| 3. | 715 | <i>Quercus robur</i> | 1953 | 25.7 | - | 26.5 | 159 | - | 186 | - |
| 4. | 716 | <i>Quercus robur</i> (group of seven oaks) | 1956 | 28.5-33.7 (mean 31.1) | 23.0-36.0 | 31.3; 26.2; 23.3; 26.7; 32.0; 28.3; 34.8 | 80-167 (mean 124) | 103-172 (mean 132) | 138; 131; 120; 183; 158; 100; 142 | Good Good Average Average Average Poor Satisfactory |
| 5. | 717 | <i>Fagus sylvatica</i> (currently one specimen) | 1990 | 30.7; 31.2 | 27.5; 35.0 | 28.7 | 110; 103 | 104; 111 | 118 | Good |
| 6. | 718 | <i>Taxus baccata</i> | 1963 | 12.7 | 12.3 | 14.5 | 46 | 49 | 61 | Poor |

Table 3. Cont. Monumental trees in the Jaworze commune and their dendrometric data

| | | | | | | | | | | |
|-----|------|--|------|--|--|--|---|--|--|--|
| 7. | 719 | <i>Taxus baccata</i> | 1963 | 6.7 | 8.1 | 10.0 | 30 | NA | 47 | Good |
| 8. | 720 | <i>Taxus baccata</i> (group of two yews) | 1963 | 12.7; 12.7 | 12.1; 11.5 | 14.7; 14.7 | 49; 33 | 50; 33 | 33; 37; 40 | Average Good |
| 9. | 722 | <i>Abies alba</i> | 1990 | 40.7 | 36.0 | 37.3 | 88 | 95 | 113 | Satisfactory |
| 10. | 723 | <i>Quercus robur</i> (two oaks) | 1990 | 27.7; 34.2 | 22.0; 30.5 | 24.7; 28.7 | 103; 131 | 101; 137 | 114; 129 | Satisfactory Average |
| 11. | 724 | <i>Fagus sylvatica</i> (two specimens), <i>Larix decidua</i> (one), <i>Aesculus hippocastanum</i> (one) | 1990 | 26.5-33.4 (beeches) 25.7 (chestnut) 28.7 (larch) | 29.5-37.1 | 35.2; 37.2; 37.8; 28.2 | 102-116 (beeches, mean 110); 116; 89 | 89-116 (mean 105) | 116; 123; 92; 119 | Average Average Average Good |
| 12. | 725 | <i>Quercus robur</i> (currently one specimen) | 1990 | 25.6; 25.2 | 32.6; 36.5 | 33.3 | 145; 131 | 124; 144 | 177 | Average |
| 13. | 726 | <i>Liriodendron tulipifera</i> | 1990 | 27.7 | 26.6 | 23.0 | 79 | 82 | 87 | Good |
| 14. | 727 | <i>Populus nigra</i> | 1990 | 35.7 | 38.0 | 28.5 | 143 | 150 | 121; 159 | Good Average |
| 15. | 728 | <i>Acer pseudoplatanus</i> | 1992 | 26.2 | 25.0 | 16.7 | 116 | 112 | 121 | Poor |
| 16. | 729 | <i>Fagus sylvatica</i> | 1992 | 21.7 | 11.5 | 19.5 | 82 | 84 | 90 | Average |
| 17. | 730 | <i>Tilia platyphyllos</i> | 1992 | 21.2 | 24.9 | 21.7 | 134 | 132 | 142 | Poor |
| 18. | 731 | <i>Populus nigra</i> | 1992 | 27.7 | 26.2 | 33.3 | 166 | 172 | 188 | Poor |
| 19. | 732 | <i>Quercus robur</i> (group of seven oaks) | 1992 | 22.2-25.5 (mean 23.8) | 19.6-26.4 (4 specimen) | 26.6; 25.0; 24.5; 23.5; 31.6; 26.6; 22.6 | 99-131 (mean 113) | 99-119 (mean 107) | 119; 146; 112; 103; 151; 112; 74 | Average Poor Average Average Average Average Good |
| 20. | 733 | <i>Quercus robur</i> | 1992 | 26.7 | NA | 32.8 | 132 | NA | 152 | Satisfactory |
| 21. | 734 | <i>Populus nigra</i> | 1992 | 33.7 | 37.6 | 40.8 | 143 | 136 | 164 | Satisfactory |
| 22. | 735 | <i>Populus nigra</i> | 1992 | 33.7 | 34.6 | 40.8 | 133 | 137 | 158 | Satisfactory |
| 23. | 736 | <i>Quercus robur</i> | 1992 | 31.5 | 31.6 | 32.5 | 113 | 103 | 99 | Good |
| 24. | 737 | <i>Quercus robur</i> | 1992 | 22.0 | 27.0 | 26.7 | 139 | 85 | 93 | Satisfactory |
| 25. | 738 | <i>Carpinus betulus</i> | 1992 | 22.0 | 25.0 | 26.7 | 139 | 82 | 86 | Average |
| 26. | 739 | <i>Fagus sylvatica</i> (one specimen), <i>Abies alba</i> (two), <i>Ulmus glabra</i> (one), <i>Acer pseudoplatanus</i> (two) | 1992 | 34.7; 33.5 (beeches); 39.2 (elm); 38.0; 35.2 (fir); 28.7; 27.9 (sycamore); 39.7 (spruce) | 26.5; 34.0; 32.5; 38.0; 37.0; 26.0; 29.0; 28.0 | 32.2 (beech); 32.6; 35.3 (fir); 35.0 (elm); 30.3; 28.8 (sycamore) | 123; 124; 102; 79; 76; 67; 97; 79 | 122; 113; 117; 81; 81; 101; 68; 77 | 153; 88; 124; 134; 122; 74 | Poor Satisfactory Satisfactory Satisfactory Satisfactory Satisfactory |
| 27. | 740 | <i>Tilia cordata</i> | 1995 | 25.7 | 20.6 | 17.7 | 104 | 105 | 110 | Average |
| 28. | 741 | <i>Aesculus hippocastanum</i> | 1995 | 20.7 | 22.0 | 20.6 | 106 | 117 | 134 | Good |
| 29. | 742 | <i>Acer pseudoplatanus</i> | 1997 | 29.7 | 29.6 | 26.2 | 96 | 93 | 109 | Satisfactory |
| 30. | 1476 | <i>Fraxinus excelsior</i> | 2013 | - | - | 28.3 | - | - | 99 | Average |

Note: ID – identification number; * number of natural monument consistent with the Register of Natural Monuments in Silesian Voivodeship in 1999, NA – data not available, “–” means that a natural monument did not exist in the given year.

RESULTS

According to the data from 2019, in total, there were 65 monumental trees, which belong to 14 species in both communes. Selected specimens are shown in Figure 2. In the area of Jasienica,

among examined monumental trees, only 2 species were noticed: *Tilia cordata* (8 specimens) and *Quercus robur* (7). However, in the area of Jaworze commune, 14 tree species were observed. The most numerous were *Quercus robur* (21) and *Fagus sylvatica* (5). Trees of such

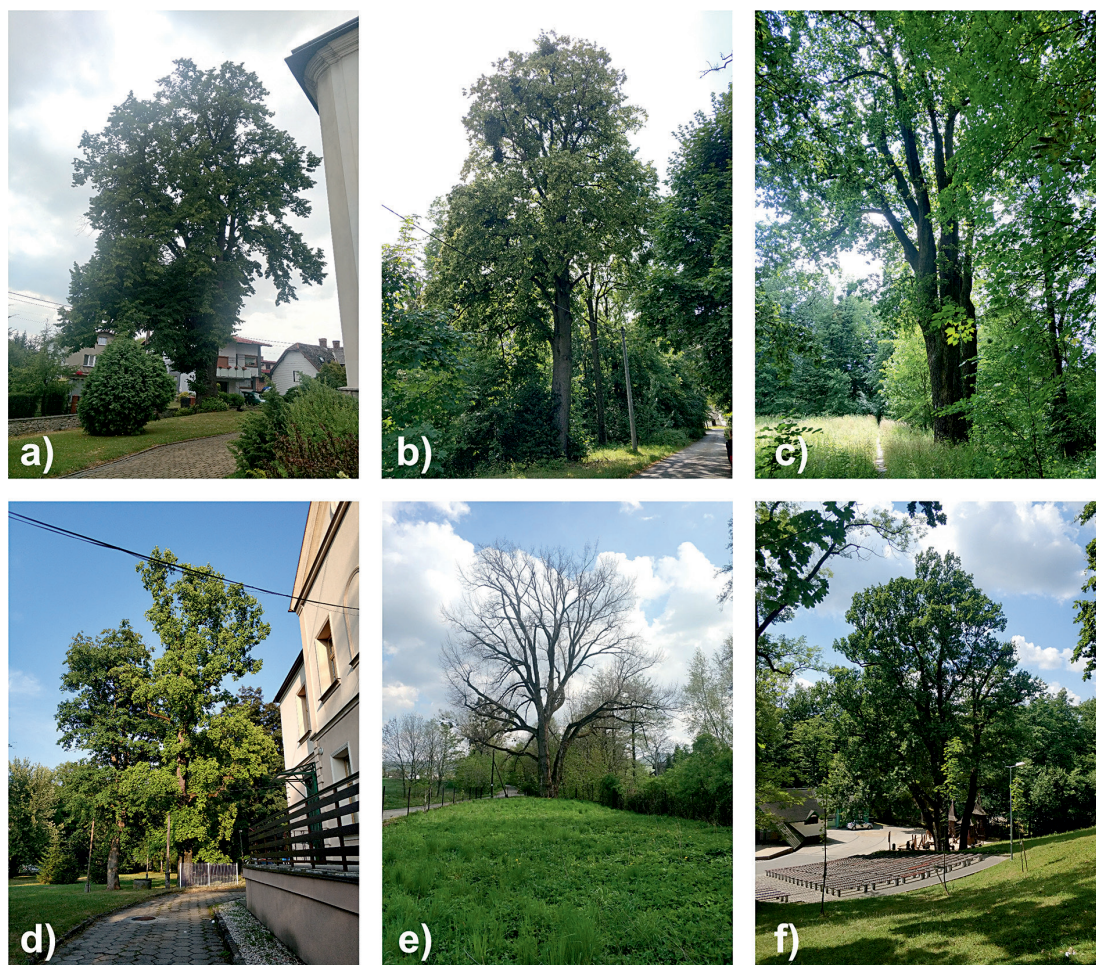


Figure 2. Selected monumental trees. The Jasienica commune: a) small-leaved linden *Tilia cordata* (1177), b) one of the small-leaved lindens *Tilia cordata* from group 1183, c) one of the pedunculate oaks *Quercus robur* from group 1174. The Jaworze commune: d) American tulip tree *Liriodendron tulipifera* (726), e) black poplar *Populus nigra* (731), f) one of the pedunculate oaks *Quercus robur* from group 716

species as: *Carpinus betulus*, *Fraxinus excelsior*, *Tilia cordata*, *Tilia platyphyllos*, *Larix decidua*, *Liriodendron tulipifera* and *Ulmus glabra* were represented by single specimens.

Considering the 2019 data and results of inventories carried out earlier [Dziergas 1999, Szafrań 1999, Jarosz 2008, Zalot 2008], it was noted that the number of monumental trees has changed over the years. In the Jasienica commune, in 1999, the number of monumental trees (single trees and group of trees) was 16, in 2008 – 11 and in 2019 – 10. In the period of 20 years, the number of natural monuments in Jasienica decreased by 6. It was revealed that since 1999, the protection on 7 natural monuments (numbered 36, 110, 284, 308, 309, 369 and 421) were abolished and in 2004 a new monument (number 1170) was established [Register of Natural ... 2019]. However, in Jaworze, in 1999 were 29 natural monuments, in 2008 – 27 and in 2019 – 28. In the period of 20 years, the

number of nature monuments decreased by 1. In 2013, the monument protection was extended to the ash called “Zośka” (ID 1476). The data indicate that the protection was repealed from the monuments with the numbers 328 and 332 [Register of Natural ... 2019].

The number of trees in some monumental trees groups decreased since results of valorization in 1999. It concerned the groups numbered 724 (from 6 to 4 trees), 725 (from 2 to 1) and 739 (from 8 to 6) in Jaworze, and in the Jasienica commune, groups – 1174 (from 6 to 2 trees) and 1183 (from 15 to 5).

While analyzing the metric data together, it can be observed that in Jaworze, the average height of monumental trees in 1999 (27.6 m), 2008 (27.1 m) and 2019 (27.7 m) was on similar level and fluctuated around 0.6 m. In the same years, the average height of trees in Jasienica (28.7 m, 25.4 m, 24.6 m, respectively) was more varied

and fluctuated within 3.3 m. In the studied period, on average the highest heights were recorded in Jasienica in 1999. In turn, according to 2019 data, the tallest monumental trees were *Populus nigra* (734 and 735, Jaworze). They reached a height of 40.8 m. On the other hand, the lowest was *Taxus baccata* (719, Jaworze) and height of 10.0 m.

Considering the average DBH of monumental trees, the highest value was 142 cm in Jasienica in 2008 and 2019. In 1999, the average DBH was 132 cm. In the Jaworze commune, average DBH were, 109 cm in 1999, 106 cm in 2008 and 119 cm in 2019, respectively. According to the data from 2019, the highest value of DBH (253 cm) was reached by *Quercus robur* (1170, Jasienica),

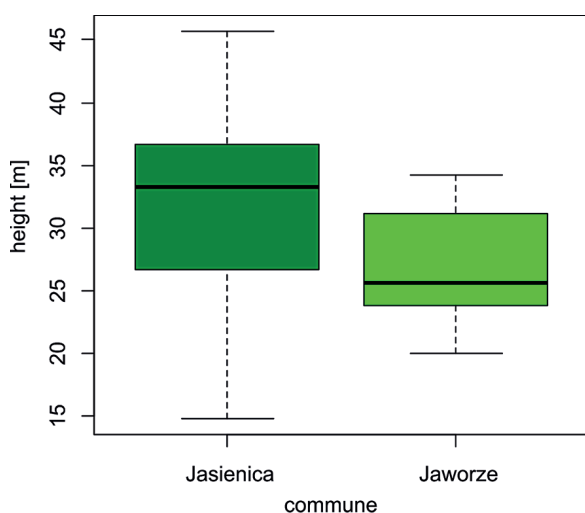


Figure 3. The comparison of height of *Quercus robur* in 1999 between the Jasienica and Jaworze communes ($W = 181.5$, p -value = 0.03953, Wilcoxon sum rank test)

and the lowest (33 cm) by one of the *Taxus baccata* in group 720 (Jaworze).

Taking into account trees of most common species – *Quercus robur* the mean height in Jasienica was significantly higher than in Jaworze (Figure 3).

In order to determine the health condition, a scale based on presence of trunk and crown damage was used (Table 1.). Exemplary damage is shown in the Figure 4.

There are significant differences between Jaworze and Jasienica in health conditions (Figure 5). In Jaworze, there are trees of good and satisfactory condition, while in Jasienica only at average and poor conditions trees were recorded. The most common damage were dry boughs (on 42 trees), bark defects (27) and cracks (13). Less common (up to 5 cases) were decay, growths and thickening or exposed roots.

DISCUSSION AND CONCLUSIONS

The most numerous monumental trees species in Jasienica and Jaworze were *Quercus robur* (28 specimens) and *Tilia cordata* (9 specimens). A similar result was indicated by Antkowiak et al. [2014]. Deciduous monumental trees (57) dominate over conifers (8).

On the basis of the data collected between 1999 and 2019, it can be observed that the characteristic metric data of trees (height and DBH) mostly increased or were at a similar level as the years passed. In certain cases, trees decreased size over time. These changes may have been caused

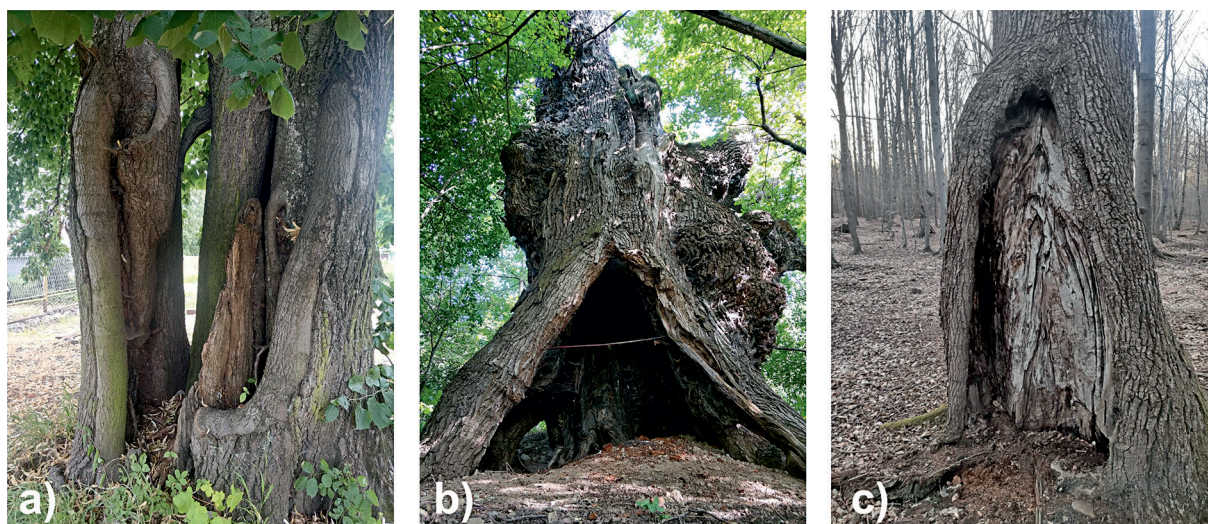


Figure 4. Damaged monumental trees: a) small-leaved linden *Tilia cordata* (1178), b) pedunculate oak *Quercus robur* (1170), c) pedunculate oak *Quercus robur* (723)

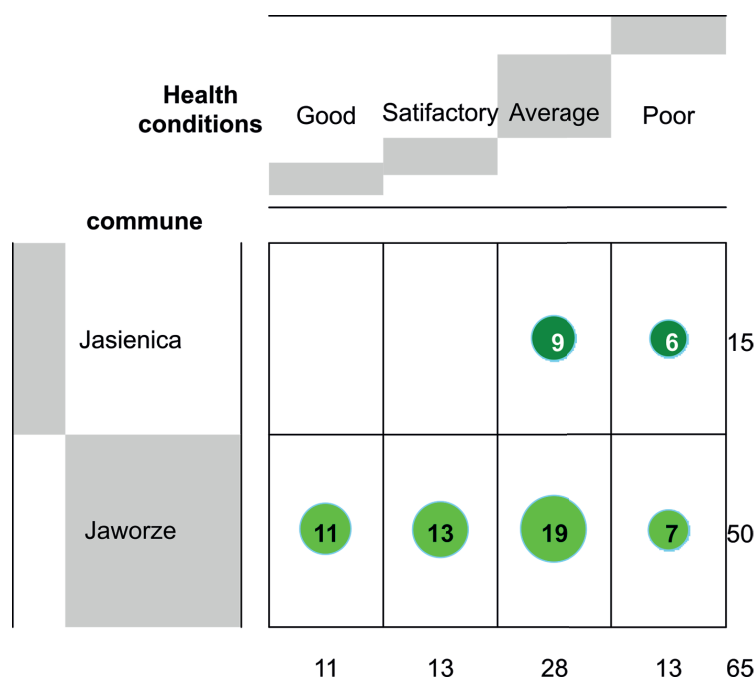


Figure 5. The comparison of health condition of protected monumental trees between the Jasienica and Jaworze communes (p-value = 0.006141, chi-square test)

by reduction of branches, breakage of the top part of the tree crown due to lightning strikes, poor health condition or other damage. In addition, some significant deviation may have resulted from measurement errors or rounding assumed.

The collected data indicate that the number of natural monuments in both communes has been decreasing over the past 20 years. The reasons for the abolition of monumental protection are the deteriorating health of some specimens and the loss of their natural and landscape values. This emphasizes the key role of monitoring and evaluation studies in the protection of monumental trees. Other grounds for the abolition of a natural monument are set out in Article 44 (4) of the Nature Conservation Act [Journal of Laws 2004 No. 92 item 880]. However, according to the above mentioned Act, if monumental trees do not cause danger to people or their property, they remain under protection until decay. In the both communes, only two new nature monuments were established in the period 1999–2019.

The health condition of monumental trees was the result of damage that occurred. Each of the examined monumental trees in Jasienica required conservation treatment, while in Jaworze, as many as 11 trees did not require any of those actions. The recommended treatment for the most common damage, which was dry boughs, is to remove them. In case of other damage, appropriate

conservation and care procedures need to be applied. Some of them are presented by Chachulski and Rodek [2014].

It is worth mentioning that the monumental trees should be marked with a standard information plaque in according to the Appendix No. 2 to the Ordinance of the Minister of the Environment of 10 December 2004 on specimen plaques [Journal of Laws 2004 No. 268 item 2665]. Lack of marking concerned 9 monumental trees in Jasienica and 16 in Jaworze.

In order to determine the efficiency of monumental protection in the study area, the data of the most numerous species that can be considered as representative for both communes, were analyzed. As noted earlier, this species was pedunculate oak. Oaks can reach the height of up to 50 m and diameter of 2–3 m. They have wide crown with thick branches. Oaks grow on fertile and fresh soils and poorly tolerate unfavorable soil conditions. They are long living trees, from several hundred to over 1000 years old [Seneta and Dolatowski 2008]. On the basis of the data collected for the oaks, several relationships related to the efficiency of monument protection can be noted.

The data from 1999 and 2019 for both communes show that the number of oaks decreased from 35 to 27 specimens in total. In Jasienica, 6 oaks under protection have been removed from the Register of Natural Monuments since

1999. Jaworze, on the other hand, lost 1 specimen. The progressive reduction in the number of monumental oak trees in Jasienica indicates low quality or lack of proper conservation actions. This corresponds to a poor or average health condition of the trees. Moreover, the discussed oaks in Jasienica are older than in Jaworze. It is indicated by the average year of establishment (oaks in Jasienica 1975 on average and 1982 in Jaworze). That also can be correlated with the health condition of the trees.

Monumental trees are an essential aesthetic element of commune's landscape. The results of this research have shown that regular damage reduction activities are necessary to maintain these exceptional forms of nature protection, and preserve their good health. An important action is also to ensure the marking of nature monuments, which will allow distinguishing these unique creations of nature from others and will contribute to increased awareness of their existence among the residents of the commune and tourists.

REFERENCES

1. Antkowiak W., Ludian J. 2016. Natural monuments and monumental trees in the Oborniki and Ryczywól communes (Wielkopolska Voivodeship). *Steciana*, 20(4), 219–231.
2. Antkowiak W., Wiśniewski G., Wachowiak D. 2014. Natural monument in Śrem County (Wielkopolska Voivodeship, Poland). *Steciana*, 18(4), 213–232.
3. Biesik T. 2013. Mountain shelters past and present. *Little Beskid and Silesian Beskid*. Logos, Bielsko-Biała. [in Polish]
4. Blarowski A., Bernacki L., Wilczek Z. 1998. Peculiarities of the flora of the Bielsko-Biała Voivodeship. *Colgraf-Press*, Poznań. [in Polish]
5. Central Register of Nature Conservation Forms. 2021. <http://crfop.gdos.gov.pl/CRFOP/search.jsf>, access: 30.07.2021.
6. Chachulski Z., Rodek L. 2014. Care and protection of trees with quality standards. *Polskie Towarzystwo Chirurgów Drzew – NOT*, Łódź. [in Polish]
7. Chylak A., Kulikowski S. 2017a. Environmental protection program for Jasienica commune for 2017–2020 with an outlook until 2025. [in Polish]
8. Chylak A., Kulikowski S. 2017b. Environmental protection program for Jaworze commune. [in Polish]
9. Czader M. 2013. *Bielsko-Biała - guide to mountain trails in Little Beskid and Silesian Beskid*. Urząd Miejski w Bielsku-Białej, Bielsko-Biała. [in Polish]
10. Dubel K. 1996. Protection and management of the environment. *Oficyna Wydawnicza Makago*, Bytom. [in Polish]
11. Dziergas G. 1999. Preservation status of natural monuments in the Jasienica commune. Engineering Thesis prepared under the direction of J. Żarnowiec. Wydział Inżynierii Włókienniczej i Ochrony Środowiska. Politechnika Łódzka filia w Bielsku-Białej, typescript. [in Polish]
12. Główny Urząd Statystyczny, Departament Badań Przestrzennych i Środowiska. Environment Protection 2020. Warszawa. <https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/srodowisko/ochrona-srodowiska-2020,1,21.html>. [in Polish]
13. Grzywacz A., Keczyński A., Szczepkowski A., Bielak K., Bolibok L., Buraczyk W., Drozdowski S., Gawron L., Szeligowski H., Zajęzkowski J., Brzeziecki B. 2018. Monumental trees in the Strict Nature Reserve of Białowieża National Park. *Sylvan*, 162(11), 915–926. [in Polish]
14. Jarosz P. 2008. Assessment of the conservation status of natural monuments in the Jasienica and Skoczów communes. Master's Thesis prepared under the direction of J. Żarnowiec. Wydział Nauk o Materiałach i Środowisku. Akademia Techniczno-Humanistyczna w Bielsku-Białej, typescript. [in Polish]
15. Kasprzak K. 2011. Trees - natural and cultural monuments. *Turystyka kulturowa*, 4(2011), 17–38. [in Polish]
16. Leńkowa A. 1978. The outline of environmental protection history (W:) Michajłow W., Zabierowski K. Protection and management of natural environment. *Państwowe Wydawnictwo Naukowe Warszawa-Kraków*, 137–186. [in Polish]
17. Mirek Z., Piękoś-Mirkowa H., Zając A., Zając M. 2002. Flowering plants and pteridophytes of Poland. A checklist. *Biodiversity of Poland*. Vol. 1. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.
18. Pacyniak C., Smólski S. 1973. Trees worthy of being regarded as nature monuments and the current status of the protection of monumental trees in Poland. *Roczniki Akademii Rolniczej w Poznaniu*. Wydział Leśny, 57, 41–66. [in Polish]
19. Pietrzak J. 2010. Problems of protection of monumental trees and shrubs in Poland. *Szkoła Główna Gospodarstwa Wiejskiego w Warszawie*, 283–300. [in Polish]
20. Register of Natural Monuments in Silesia Voivodeship in 2019, <http://bip.katowice.rdos.gov.pl/wojewodzki-rejestr-form-ochrony-przyrody>, access: 14.02.2020.
21. Salachna A., Czech A., Matlakiewicz A., Żarnowiec J. 2017. Monitoring of natural monuments in the Żywiec Park. *Ecological Engineering*, 18(2), 136–141. [in Polish]

22. Seneta W., Dolatowski J. 2008. *Dendrology*. Wydawnictwo Naukowe PWN, Warszawa. [in Polish]
23. *Statystyczne Vademecum Samorządowca*. 2020, Urząd Statystyczny w Katowicach, <https://katowice.stat.gov.pl/statystyczne-vademecum-samorzadowca/>, access: 08.07.2021.
24. Symonides E. 2014. *Environmental protection*. Wydawnictwa Uniwersytetu Warszawskiego, Warszawa. [in Polish]
25. Szafran S. 1999. *Valorization of natural monuments in Jaworze commune*. Engineering Thesis prepared under the direction of J. Żarnowiec. Wydział Inżynierii Włókienniczej i Ochrony Środowiska. Politechnika Łódzka filia w Bielsku-Białej, typescript. [in Polish]
26. The Nature Conservation Act of 16 April 2004 (Journal of Laws 2004, No. 92, item 880).
27. The Ordinance of the Minister of the Environment of 10 December 2004 on specimen plaques (Journal of Laws 2004 No. 268 item 2665).
28. Zalot T. 2008. *Assessment of the conservation status of monumental trees in Jaworze commune*. Master's Thesis prepared under the direction of J. Żarnowiec. Wydział Nauk o Materiałach i Środowisku. Akademia Techniczno-Humanistyczna w Bielsku-Białej, typescript. [in Polish]