The health state of street trees in the centre of Opole

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Abstract: The aim of this article was the analysis of health state of street trees growing in south-western part of the Opole town centre (capital of Opole province, south-western part of Poland). The trees growing along 13 streets were subject to research. A scale proposed by J. Duda was used to evaluate the health state of the trees.

As a result of conducted analyses it was found that:

- within the group of examined trees there are 39 identified species. The most often represented were *Acer platanoides*, *Aesculus hippocastanum* and *Taxus baccata* and the least represented were *Juglans regia*, *Malus domestica*, *Populus nigra* and *Rhus typhina*. The great majority represented angiosperms. There are 22 native species and as many as 17 species exotic to our flora. The greatest number of species grew along the streets: Norberta Barlickiego St., Piastowska St. and Strzelców Bytomskich St.;
- the largest share of the examined trees was in good health. The most healthy trees were found in Konsularna St. and Jana Kochanowskiego St. The least healthy of these trees were found along Minorytów St.;
- 23 species were found to be represented exclusively by trees in good health. The least healthy state was found in *Betula pendula*, *Sorbus aucuparia*, *Malus baccata* and *Sambucus nigra*. It's noticeable that the representatives of gymnosperms are found to be in good health; poor health can only be seen in the group *Taxus baccata* where 1.4% share of trees were noted to be in poor condition.

Key Words: tree, street tree, health state, town, Opole.

Introduction

According to ONZ forecasts, after 2025 more than 60% citizens of our globe are going to live in the city. City agglomerations are going to constitute the majority of human living environment. Efforts therefore should be made, to help to improve the quality of living conditions in the city. The greenery is considered essential element of urban environment. Thus, there is a need to raise social awareness about the roles that greenery serves in shaping urban atmosphere, its biological, social and educational, aesthetic and economic roles. Tree plants play a key role in this process (Łukasiewicz 2006).

Greenery with their flora will perform its comprehensive role as a basic environment-forming factor only when it has advantageous conditions for good development (Łukasiewicz 1989).

Notwithstanding climate that results from geographical location, the following factors have essential influence on development and life of plants in urban environment:

- specific microclimate, depending on size and character of agglomeration (temperature, light, moisture, wind);
- soil conditions;
- air pollution (gases, dust, aerosols);
- soil pollution (sole, city gas and natural gas, engine fuels and lubricants and their combustion products, herbicides);
- introduction of artificial turf;
- mechanical damage (above-ground and underground parts) (Łukasiewicz 1989).

Street trees have the least beneficial living conditions. Plant behaviour in such habitat mirrors their level of tolerance to adverse urban conditions. In this respect we can differentiate three groups of species:

- most tolerant (e.g. *Crataegus monogyna*, *Pyrus communis*);
- medium tolerant (e.g. *Acer negundo*, *Betula pendula*);
- least tolerant (e.g. *Acer platanoides*, *Aesculus hippocastanum*) (Łukasiewicz 1989).

There's often a conflict in the cities, between pedestrians and trees. Broken off branches falling on cars, buildings and pedestrians cause damage. When there are strong winds branches of tall trees, growing in the vicinity of overhead power lines may damage the lines. Broken power lines may cause fire hazards and electrical shock. Tall tree roots, are often damaging hardened surface of streets, pavements, squares and buildings and underground infrastructure. The negative influence of trees on their neighbourhood often could be avoided if designers of town green areas planted tree species appropriate to surroundings, soil conditions and moisture. Also people should be responsible for their conservation and timely fulfil their duties (Tylkowski 2006).

Methods

Research area was in the south-western part of Opole town centre (capital of Opole province, south-western part of Poland). Analysis was conducted on all trees (650 objects) growing along 13 streets:

- Żwirki i Wigury St. (25 objects);
- Minorytów St. (7 objects);
- Zamkowa St. (13 objects);
- Piastowska St. (138 objects);

- Norberta Barlickiego St. (165 objects);
- Strzelców Bytomskich St. (112 objects);
- Księcia Jana Dobrego St. (36 objects);
- Mieczysława Niedziałkowskiego St. (34 objects);
- Pasieczna St. (45 objects);
- Konsularna St. (19 objects);
- 11 Listopada St. (28 objects);
- Jana Kropidły St. (18 objects);
- Jana Kochanowskiego St. (10 objects).

To assess the trees health a scale proposed by Duda (table 1) was applied. According to the scale, the health of each tree is assessed in a 12-grade scale (good, if sum of points for trunk and crown does not exceed 3, poor if it is between 4 and 7 and very poor if it exceeds 7). A tree injury is defined as mechanical damage of a tree trunk in the form of bark and phloem stripping that reaches cambium and even deeper. Its width is measured perpendicularly to tree trunk axe in a place where right and left edges of callous tissue or injury are most separated (Wika and Włoch 1994).

The research was conducted in August, September and October 2006.

Table 1. Health state of trees (by J. Duda).

Degree of damage	Damage size		Note
	tree-stem (S)	tree-crown (K)	
0	Not damaged cambium and phellogen	No damage	Growth of a new wood grain and phloem in a whole girth of tree
1	Single injury or several injuries together up to 10 cm of girth	Up to 15% of tree crown, withered 1-2 branches or boughs, girth at base exceeding 5cm	Frost cracks, mechanical injuries, unscarred cork in a trunk up to10cm
2	Injuries of 10-25% of trunk girth	15-25%, more than 2 injured boughs	At least ¾ of trunk girth function as a conductor in wood and phloem
3	Injuries of 25-50% of trunk girth	25-50%	Cambium functions preserved in at least ½ of trunk girth
4	Injuries of 50-75% of trunk girth	50-75%	At least ¼ of trunk girth function as a conductor
5	Injuries more than 75% of trunk girth	More than 75%	Less than ¼ of trunk girth functions as a conductor

Source: S. Wika, W. Włoch (ed.), *Aleja Husarii Polskiej z alejami bocznymi na tle rezerwatu Łężczak w Kotlinie Raciborskiej*, Rudy Wielkie 1994, p. 44.

Results

In the group of examined trees there was found occurrence of 39 species. These were the following: *Abies koreana* (1.1%), *Acer campestre* (0.5%), *Acer negundo* (0.5%), *Acer platanoides* (14.8%), *Acer saccharinum* (1.1%), *Aesculus hippocastanum* (10.9%), *Betula pendula* (0.6%), *Carpinus betulus* (0.8%), *Catalpa speciosa* (4.0%), *Corylus avellana* (0.3%), *Corylus colurna* (0.5%), *Crataegus monogyna* (4.4%), *Fagus sylvatica*

(0.3%), *Fraxinus excelsior* (4.0%), *Juglans regia* (0.2%), *Larix decidua* (0.5%), *Malus baccata* (0.6%), *Malus domestica* (0.2%), *Picea abies* (2.4%), *Picea pungens* (0.3%), *Pinus sylvestris* (0.9%), *Platanus ×hispanica* 'Acerifolia' (0.3%), *Populus alba* (0.6%), *Populus nigra* (0.2%), *Prunus domestica* (1.1%), *Pyrus communis* (0.3%), *Quercus petraea* (1.8%), *Quercus robur* (0.3%), *Quercus rubra* (0.3%), *Rhus typhina* (0.2%), *Robinia pseudoacacia* (7.4%), *Salix ×sepulcralis* 'Chrysocoma' (1.5%), *Sambucus nigra* (4.9%), *Sorbus aucuparia* (4.6%), *Sorbus intermedia* (6.1%), *Taxus baccata* (10.6%), *Thuja occidentalis* (1.1%), *Tilia cordata* (8.6%), *Tilia platyphyllos* (1.2%).

The most represented species were *Acer platanoides* - 14.8%, *Aesculus hippocastanum* - 10.9% and *Taxus baccata* - 10.6% and the least represented were *Juglans regia*, *Malus domestica*, *Populus nigra* and *Rhus typhina* - each 0.2%.

The substantial majority constitute trees representing angiosperms (83.1%) - 32 species. Other trees (gymnosperms) constitute 16.9% - 7 species. There have been identified 22 native species and as many as 17 species exotic to our flora (tree share respectively 68.6% and 31.4%).

Most species grew along the following streets: Norberta Barlickiego St., Piastowska St. and Strzelców Bytomskich St.

Among the examined objects the greatest share - 90.9% (figure 1) showed trees in good health. Objects identified to be in a poor and very poor state were respectively 8.2% and 0.9%.
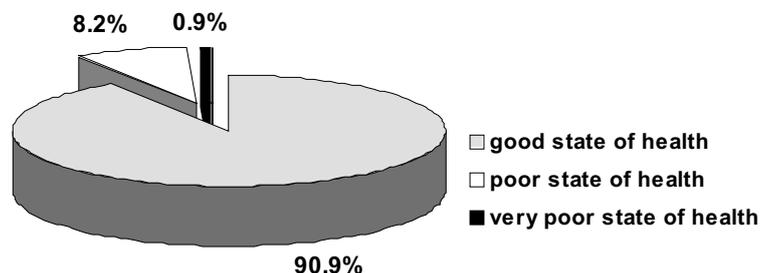

Figure 1. Street trees state of health in south-western part of Opole town centre.

Table 2. Health of trees of particular streets in south-western part of Opole town centre.

Street	Health state (by J. Duda)		
	good	poor	very poor
Żwirki i Wigury St.	76.0%	20.0%	4.0%
Minorytów St.	57.1%	28.6%	14.3%
Zamkowa St.	84.6%	15.4%	-
Piastowska St.	89.1%	10.2%	0.7%
Norberta Barlickiego St.	95.8%	3.6%	0.6%
Strzelców Bytomskich St.	92.9%	6.2%	0.9%
Księcia Jana Dobrego St.	86.1%	11.1%	2.8%
Mieczysława Niedziałkowskiego St.	91.2%	8.8%	-
Pasieczna St.	91.1%	8.9%	-
Konsularna St.	100.0%	-	-
11 Listopada St.	92.9%	7.1%	-
Jana Kropidły St.	77.8%	22.2%	-
Jana Kochanowskiego St.	100.0%	-	-

Data found in table 2 shows that trees growing in Konsularna St. and Jana Kochanowskiego St. were in the best state of health (all in good condition). Objects located in Minorytów St. were in the worst health of state (57.1% trees in good state of health, 28.6% in poor state of health and 14.3% in a very poor state of health).

Table 3. Street trees state of health in south-western part of Opole town centre according to species.

Species	Health state (by J. Duda)		
	good	poor	very poor
Abies koreana	100.0%	-	-
Acer campestre	100.0%	-	-
Acer negundo	100.0%	-	-
Acer platanoides	91.7%	7.3%	1.0%
Acer saccharinum	100.0%	-	-
Aesculus hippocastanum	87.3%	11.3%	1.4%
Betula pendula	50.0%	25.0%	25.0%
Carpinus betulus	100.0%	-	-
Catalpa speciosa	92.3%	7.7%	-
Corylus avellana	100.0%	-	-
Corylus colurna	100.0%	-	-
Crataegus monogyna	93.1%	6.9%	-
Fagus sylvatica	100.0%	-	-
Fraxinus excelsior	96.2%	3.8%	-
Juglans regia	One object in good health		
Larix decidua	100.0%	-	-
Malus baccata	75.0%	25.0%	-
Malus domestica	One object in good health		
Picea abies	100.0%	-	-
Picea pungens	100.0%	-	-
Pinus sylvestris	100.0%	-	-
Platanus ×hispanica 'Acerifolia'	100.0%	-	-
Populus alba	100.0%	-	-
Populus nigra	One object in good health		
Prunus domestica	100.0%	-	-
Pyrus communis	100.0%	-	-
Quercus petraea	91.7%	8.3%	-
Quercus robur	100.0%	-	-
Quercus rubra	100.0%	-	-
Rhus typhina	One object in good health		
Robinia pseudoacacia	91.7%	8.3%	-
Salix ×sepulcralis 'Chrysocoma'	90.0%	10.0%	-
Sambucus nigra	75.0%	25.0%	-
Sorbus aucuparia	73.3%	20.0%	6.7%
Sorbus intermedia	97.5%	2.5%	-
Taxus baccata	98.6%	1.4%	-
Thuja occidentalis	100.0%	-	-
Tilia cordata	83.9%	14.3%	1.8%
Tilia platyphyllos	87.5%	12.5%	-

Data in table 3 shows that 23 species were represented exclusively by trees in good health. Objects in a very poor health state existed only among *Betula pendula* (25.0%), *Sorbus aucuparia* (6.7%), *Tilia cordata* (1.8%), *Aesculus hippocastanum* (1.4%) and *Acer platanoides* (1.0%). According to Łukasiewicz (1989) these are species with lower immunity to urban conditions. The worst health represented *Betula pendula*, *Sorbus aucuparia*, *Malus baccata* and *Sambucus nigra*. Good health is noticeable in representatives of gymnosperms - only in the group *Taxus baccata* it has been noted 1.4% share of trees in poor health.

Conclusions

In the group of examined trees there was found existence of 39 species. The most numerous were *Acer platanoides*, *Aesculus hippocastanum* and *Taxus baccata* and the least numerous were *Juglans regia*, *Malus domestica*, *Populus nigra* and *Rhus typhina*. The substantial majority were objects representing angiosperms. There have been identified 22 native species and as many as 17 species exotic to our flora. The biggest number of species grew along the streets: Norberta Barlickiego St., Piastowska St. and Strzelców Bytomskich St.

Among examined objects the biggest share was of trees in good health. The trees in Konsularna St. and Jana Kochanowskiego St. were found in best state of health. In the worst state of health were trees located in Minorytów St.

23 species were represented only by trees in a good health state. The worst state of health showed the following species: *Betula pendula*, *Sorbus aucuparia*, *Malus baccata* and *Sambucus nigra*. Good health state of representatives of gymnosperms is noticeable - only in group *Taxus baccata* there noted 1.4% tree share in a poor state of health.

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Streszczenie

Stan zdrowotny drzew przyulicznych w centrum miasta Opola

Artykuł przedstawia analizę stanu zdrowotnego drzew przyulicznych rosnących na terenie południowo-zachodniej części centrum miasta Opola (stolica województwa opolskiego, południowo-zachodnia część Polski). Badaniami objęto drzewa rosnące wzdłuż 13 ulic. Do oceny zdrowotności wykorzystano skalę zaproponowaną przez J. Dudę.

W efekcie przeprowadzonych analiz stwierdzono, iż:

- w grupie badanych drzew występowało 39 gatunków. Najliczniej reprezentowane były *Acer platanoides*, *Aesculus hippocastanum* i *Taxus baccata* a najmniej *Juglans regia*, *Malus domestica*, *Populus nigra* oraz *Rhus typhina*. Zdecydowaną większość stanowiły drzewa reprezentujące gromadę okrytozalążkowe. Wyróżniono 22 gatunki rodzime oraz aż 17 obcych naszej florze. Najwięcej gatunków występowało wzdłuż ulic: Norberta Barlickiego, Piastowskiej i Strzelców Bytomskich;

- wśród badanych obiektów zdecydowanie największy udział miały drzewa w dobrej kondycji zdrowotnej. W najlepszym stanie zdrowotnym były egzemplarze rosnące przy ulicach Konsularnej i Jana Kochanowskiego. Najgorszą zdrowotnością charakteryzowały się drzewa zlokalizowane przy ulicy Minorytów;

- 23 gatunki reprezentowane były wyłącznie przez drzewa w dobrym stanie zdrowotnym. Najgorszą zdrowotnością charakteryzowały się *Betula pendula*, *Sorbus aucuparia*, *Malus baccata* oraz *Sambucus nigra*. Uwagę zwraca dobry stan zdrowotny przedstawicieli gromady nagozalążkowe - tylko w grupie *Taxus baccata* odnotowano 1.4% udział drzew w złej kondycji.