

## THE STATE OF HEALTH OF STREET TREES IN KŁODZKO

KRYSTYNA BORECKA<sup>1</sup>, ELŻBIETA GOŁĄBEK<sup>1</sup>, AGNIESZKA TROJANOWSKA<sup>2</sup>

<sup>1</sup>Department of Land Protection, University of Opole,  
22 Oleska St., 45-052 Opole, Poland, golabek@uni.opole.pl  
<sup>2</sup>graduate of Biology, University of Opole

**ABSTRACT:** The aim of this article was the analysis of the state of health of street trees growing in the Kłodzko town centre (central point of the Kłodzko Basin, south-western part of Poland). The trees growing along 7 streets were subject to research. A scale proposed by J. Duda was used to evaluate the state of health of the trees.

As a result of conducted analyses it was found that:

- within the group of examined trees there are 23 identified species. The most often represented were *Acer platanoides*, *Fraxinus excelsior*, *Tilia cordata* and the least represented were *Acer campestre*, *Aesculus ×carnea*, *Alnus glutinosa*, *Liriodendron tulipifera*, *Pinus ponderosa*, *Populus alba*, *Sorbus aucuparia*. The great majority represented angiosperms. There are 16 native species and 7 species exotic to our flora. The greatest number of species grew along the streets: I. Daszyńskiego St. and R. Traugutta St.;
- the largest share of the examined trees was in good health. It's worth mentioning that no trees were found to be in very bad health;
- the state of health of the trees in Armii Krajowej St., R. Traugutta St., Zawiszy Czarnego St. and T. Kościuszki St. was very similar. A slightly worse state of health showed the trees growing on F. Szarego St., Nad Kanalem St. and I. Daszyńskiego St.;
- 11 species were found to be represented exclusively by trees in good health. The least healthy state was found in *Aesculus ×carnea* and *Salix ×sepulcralis* 'Chrysocoma';
- the presence of fungi was found on the examined objects: *Ganoderma applanatum*, *Laetiporus sulphureus*, *Meripilus giganteus*, *Phellinus igniarius*, *Polyporus squamosus*, *Schizophyllum commune*;
- as a result of the conducted research it was found that the factors influencing to the greatest degree the state of health of the examined trees were: mechanical damage caused by vehicles parked in the neighbourhood, heavily degraded and parched soil, limited space around the analysed objects and fungi.

**KEY WORDS:** tree, street tree, state of health, town, Kłodzko.

### ***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;
- soil conditions;
- air pollution;
- soil pollution;
- introduction of artificial surface;
- mechanical damage (Łukasiewicz 1989).

Habitat conditions in towns have got worse together with increasing urbanisation and now in many places they make tree growth impossible. Trees vegetate, fight for life and don't fulfil their expected functions (Siewniak 2000). Among city trees, street trees have the least favourable living conditions and are often weakened and prone to attacks from pest and disease (mostly fungi in origin).

The withering of street trees in cities is not only caused by the negative influence of environmental factors, but also by their improper selection. The formerly proposed selection of plants usually hasn't taken into account the superficiality of habitat. The trees planted within the last years, such as lindens or maples in many case haven't been able to withstand the pressure of an urban environment. Therefore, it's vital to create the right selection of trees and seek tree species and subspecies which could successfully grow by streets for the next 20 years (Borowski and Latocha 2006).

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***

The research was conducted along 7 streets in the Kłodzko town centre (central point of the Kłodzko Basin, south-western part of Poland). The choice of the area was due to the fact that this part of the town is rich in valuable and aged tree species and at the same time is composed of streets with heightened traffic levels. The analysis comprised all street trees (160 objects) growing in a belt of up to 5 m from the side of the road.

The research was conducted along the following streets:

- Armii Krajowej St. (24 objects),
- R. Traugutta St. (29 objects),
- F. Szarego St. (24 objects),
- Zawiszy Czarnego St. (12 objects),
- Nad Kanałem St. (13 objects),
- I. Daszyńskiego St. (35 objects),
- T. Kościuszki St. (23 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 axis in a place where right and left edges of callus tissue or injury are most separated (Wika and Włoch 1994).

The research also focused on factors threatening the health of the analysed objects (including the presence of large-fructification fungi) and suggested care and protection treatment.

The research was conducted in 2007.

Table 1. State of health of trees (by J. Duda).

Degree of damage	Damage size		Notes
	tree-stem (S)	tree-crown (K)	
0	Not damaged cambium and phellogen	No damages	Growth of new wood and phloem rings 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 to 10cm
2	Injuries of 10-25% of trunk girth	15-25%, more than 2 injured boughs	At least $\frac{3}{4}$ of trunk girth functions as a conductor in wood and phloem
3	Injuries of 25-50% of trunk girth	25-50%	Cambium functions preserved in at least $\frac{1}{2}$ of trunk girth
4	Injuries of 50-75% of trunk girth	50-75%	At least $\frac{1}{4}$ of trunk girth functions as a conductor
5	Injuries more than 75% of trunk girth	More than 75%	Less than $\frac{1}{4}$ of trunk girth functions as a conductor

Source: W i k a S., W ł o c h W. (eds.). 1994. Aleja Husarii Polskiej z alejami bocznymi na tle rezerwatu Łęczzak w Kotlinie Raciborskiej. Dyrekcja Parku Krajobrazowego „Cysterskie Kompozycje Krajobrazowe Rud Wielkich”, Rudy Wielkie: 44.

## Results

In the group of examined trees there was found occurrence of 23 species. These were the following: *Acer campestre* (0.6%), *Acer platanoides* (24.5%), *Acer pseudoplatanus* (1.2%), *Aesculus ×carnea* (0.6%), *Aesculus hippocastanum* (8.7%), *Alnus glutinosa* (0.6%), *Betula pendula* (4.5%), *Carpinus betulus* (1.9%), *Fagus sylvatica* (1.9%), *Fraxinus excelsior* (18.2%), *Liriodendron tulipifera* (0.6%), *Pinus ponderosa* (0.6%),

*Populus alba* (0.6%), *Populus nigra* (8.7%), *Quercus robur* (1.2%), *Quercus rubra* (2.5%), *Robinia pseudoacacia* (2.5%), *Salix fragilis* (1.9%), *Salix ×sepulcralis* ‘Chrysocoma’ (1.2%), *Sorbus aucuparia* (0.6%), *Thuja occidentalis* (1.2%), *Tilia cordata* (10.7%), *Tilia platyphyllos* (5.0%).

The most represented species were *Acer platanoides* - 24.5%, *Fraxinus excelsior* - 18.2%, *Tilia cordata* - 10.7% and the least represented were *Acer campestre*, *Aesculus ×carnea*, *Alnus glutinosa*, *Liriodendron tulipifera*, *Pinus ponderosa*, *Populus alba*, *Sorbus aucuparia* - each 0.6%.

The substantial majority constitute trees representing angiosperms (98.2%) - 21 species. Other trees (gymnosperms) constitute 1.8% - 2 species. There have been identified 16 native species and 7 species exotic to our flora (tree share respectively 83.3% and 16.7%).

Most species grew along the following streets: I. Daszyńskiego St. and R. Traugutta St.

Among the examined objects the greatest share - 76.2% (figure 1) showed trees in good health. Objects identified to be in a poor state were respectively 23.8%. It's worth mentioning that no trees were found to be in very bad health.

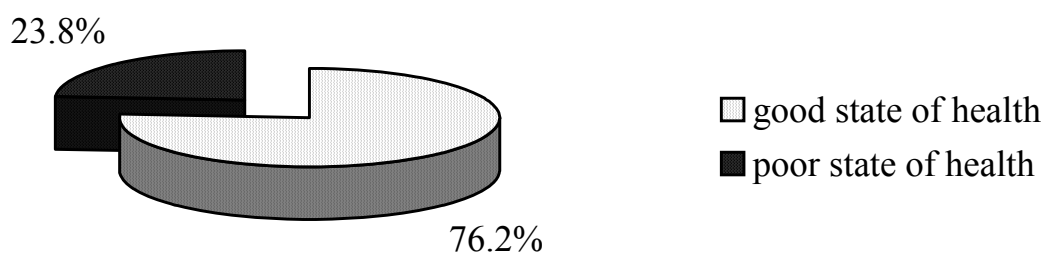


Figure 1. Street trees state of health in the Kłodzko town centre.

While determining the state of health of the given trees, the size of damage of trunk and crown were separately assessed.

The research proved that within 67.7% of the objects damage to the trunk was not noted (damage degree 0), 6.2% showed single injury or few injuries together up to 10cm girth (damage degree 1), 20.5% showed injuries of 10 - 25% of girth (damage degree 2) and 5.6% showed injuries of 25 - 50% of girth (damage degree 3). There haven't been noted tree injuries over half of a trunk girth (damage degree 4 and 5).

The observation of crowns showed that 32.5% of trees haven't been damaged (damage degree 0), 25.0% showed up to 15% of damage (damage degree 1), 22.5% showed 15 - 25% of damage (damage degree 2), 11.9% showed 25 - 50% of damage (damage degree 3), however 6.9% showed 50 - 75% of damage (damage degree 4). There were 1.2% of objects in which more than 75% of crown damage was noted (damage degree 5).

Table 2. Health of trees of particular streets in the Kłodzko town centre.

Street	State of health (by J. Duda)		
	good	poor	very poor
Armii Krajowej St.	83.3%	16.7%	-
R. Traugutta St.	82.7%	17.3%	-
F. Szarego St.	70.8%	29.2%	-
Zawiszy Czarnego St.	83.4%	16.6%	-
Nad Kanałem St.	69.2%	30.8%	-
I. Daszyńskiego St.	68.6%	31.4%	-
T. Kościuszki St.	78.3%	21.7%	-

The data placed in table 2 show that the state of the health of trees in Armii Krajowej St., R. Traugutta St., Zawiszy Czarnego St. and T. Kościuszki St. was very similar (about 80% of objects in a good state and 20% in poor state). A slightly worse state of health showed the trees on F. Szarego St., Nad Kanałem St. and I. Daszyńskiego St. (about 70% of objects were in good health and 30% in poor health).

Table 3. Street trees state of health in the Kłodzko town centre according to species.

Species	State of health (by J. Duda)		
	good	poor	very poor
<i>Acer campestre</i>	100.0%	-	-
<i>Acer platanoides</i>	69.2%	30.8%	-
<i>Acer pseudoplatanus</i>	50.0%	50.0%	-
<i>Aesculus ×carnea</i>	-	100.0%	-
<i>Aesculus hippocastanum</i>	50.0%	50.0%	-
<i>Alnus glutinosa</i>	100.0%	-	-
<i>Betula pendula</i>	42.9%	57.1%	-
<i>Carpinus betulus</i>	100.0%	-	-
<i>Fagus sylvatica</i>	33.3%	66.7%	-
<i>Fraxinus excelsior</i>	86.2%	13.8%	-
<i>Liriodendron tulipifera</i>	100.0%	-	-
<i>Pinus ponderosa</i>	100.0%	-	-
<i>Populus alba</i>	100.0%	-	-
<i>Populus nigra</i>	100.0%	-	-
<i>Quercus robur</i>	100.0%	-	-
<i>Quercus rubra</i>	100.0%	-	-
<i>Robinia pseudoacacia</i>	50.0%	50.0%	-
<i>Salix fragilis</i>	100.0%	-	-
<i>Salix ×sepulcralis</i> ‘Chrysocoma’	-	100.0%	-
<i>Sorbus aucuparia</i>	100.0%	-	-
<i>Thuja occidentalis</i>	50.0%	50.0%	-
<i>Tilia cordata</i>	93.8%	6.2%	-
<i>Tilia platyphyllos</i>	87.5%	12.5%	-

Data in table 3 show that 11 species were represented exclusively by trees in good health. The worst health represented *Aesculus ×carnea* and *Salix ×sepulcralis* ‘Chrysocoma’. According to Łukasiewicz (1989) these are respectively: little and medium immune to city conditions.

On the examined objects the presence of fungi was observed. These were:

- *Ganoderma applanatum*,
- *Laetiporus sulphureus*,
- *Meripilus giganteus*,
- *Phellinus igniarius*,
- *Polyporus squamosus*,
- *Schizophyllum commune*.

#### *Ganoderma applanatum*

Location: *Fraxinus excelsior*, Zawiszy Czarnego St.

Harmfulness: initially causes rot of hardwood, later of sapwood. In an advanced stadium of rot the wood whitens, softens, becomes spongy and divided by black zonal lines. A very common species (Kwaśna and Łakomy 2007).

#### *Laetiporus sulphureus*

Location: *Fagus sylvatica*, R. Traugutta St.

Harmfulness: really maliciously attacks hardwood, less maliciously attacks sapwood. Between brown lumps of the attacked wood there forms white layers of mycelia. Causes the emergence of hollows. Kills the attacked tree within a few years. A very common species (Kwaśna and Łakomy 2007).

#### *Meripilus giganteus*

Location: *Fagus sylvatica*, Nad Kanałem St.

Harmfulness: paralyses roots, which wood goes brown and then there appear white spots of mycelia. These spots grow with time and consequently hollows appear (Młynik 1990). A species under strict protection in Poland.

#### *Phellinus igniarius*

Location: two specimens of *Salix ×sepulcralis* ‘Chrysocoma’, I. Daszyńskiego St.

Harmfulness: paralyses mainly hardwood, causing very strong rot. In its initial stadium wood goes slightly light, then softens heavily and whitens. Most often rot is concentrated inside the trunk. A species is ordinary (Kwaśna and Łakomy 2007).

#### *Polyporus squamosus*

Location: *Fraxinus excelsior*, I. Daszyńskiego St.

Harmfulness: initially attacks hardwood and then sapwood. In the paralysed tree there are visible black zonal lines. A species is ordinary (Kwaśna and Łakomy 2007).

#### *Schizophyllum commune*

Location: *Fagus sylvatica*, Nad Kanałem St.

Harmfulness: causes a shallow rot of sapwood. A very common species (Kwaśna and Łakomy 2007). Shows strong xerothermic properties, therefore is common in city areas, in sunny places (Młynik 1990).

As a result of the conducted research it was found that the factors influencing to the greatest degree the state of health of the examined trees were: mechanical damage caused by vehicles parked in the neighbourhood, heavily degraded and parched soil, limited space around the analysed objects and fungi.



Picture 1. *Fagus sylvatica* in R. Traugutta St. attacked by *Laetiporus sulphureus*.

### **Conclusions**

In the group of examined trees there was found existence of 23 species. The most numerous were *Acer platanoides*, *Fraxinus excelsior*, *Tilia cordata* and the least numerous were *Acer campestre*, *Aesculus ×carnea*, *Alnus glutinosa*, *Liriodendron tulipifera*, *Pinus ponderosa*, *Populus alba*, *Sorbus aucuparia*. The substantial majority were objects representing angiosperms. There have been identified 16 native species and 7 species exotic to our flora (tree share respectively 83.3% and 16.7%). The biggest number of species grew along the streets: I. Daszyńskiego St. and R. Traugutta St.

Among examined objects the biggest share (76.2%) was of trees in good health. It's worth mentioning that no trees were found to be in very bad health.

The state of health of the trees in Armii Krajowej St., R. Traugutta St., Zawiszy Czarnego St. and T. Kościuszki St. was very similar (about 80% of objects in good state and 20% in poor state). A slightly worse state of health showed the trees on F. Szarego St., Nad Kanalem St. and I. Daszyńskiego St. (about 70% of objects in a good state and 30% in a poor state).

11 species were represented only by trees in a good state of health. The worst state of health showed the following species: *Aesculus ×carnea*, *Salix ×sepulcralis* 'Chrysocoma'.

On the examined objects the presence of fungi was noted: *Ganoderma applanatum*, *Laetiporus sulphureus*, *Meripilus giganteus*, *Phellinus igniarius*, *Polyporus squamosus*, *Schizophyllum commune*.

As a result of the conducted research it was found that factors influencing the greatest degree the state of health of the examined trees were: mechanical damage caused by vehicles parked in the neighbourhood, heavily degraded and parched soil, limited space around the analysed objects and fungi.

### **Bibliography**

- Borowski J., Latocha P. 2006. Dobór drzew i krzewów do warunków przyulicznych Warszawy i miast centralnej Polski. Rocznik Dendrologiczny 54: 83-93.
- Kwaśna H., Łakomy P. 2007. Grzyby rozkładające drewno ze szczególnym uwzględnieniem obiektów zieleni miejskiej. Uprawa i Ochrona Drzew 17: 5-26.
- Łukasiewicz A. 1989. Drzewa w środowisku miejsko-przemysłowym. In: S. Białobok (eds.), Życie drzew w skażonym środowisku. PWN, Warszawa - Poznań: 49-86.
- Łukasiewicz A. 2006. Rola i kształtowanie zieleni miejskiej. Wydawnictwo Naukowe UAM, Poznań. 127 pp.
- Młynik A. 1990. Grzyby niszczące stare drzewa - sprawcy zgnilizn drewna. Komunikaty Dendrologiczne 15: 3-35.
- Seneta W., Dolatowski J. 2003. Dendrologia. Wydawnictwo Naukowe PWN, Warszawa. 592 pp.
- Siewniak M., Siewniak M. 2000. Dobór drzew do nasadzeń w mieście. Uprawa i Ochrona Drzew 6: 5-31.
- Szczepanowska H.B. 2001. Drzewa w mieście. Hortpress Sp.z o.o., Warszawa. 262 pp.
- Tylkowski T. 2006. Drzewa dla terenów zieleni. Przegląd Komunalny 8(179): 40-42.
- W i k a S., W ł o c h W. (eds.). 1994. Aleja Husarii Polskiej z alejami bocznymi na tle rezerwatu Łęczzak w Kotlinie Raciborskiej. Dyrekcja Parku Krajobrazowego „Cysterskie Kompozycje Krajobrazowe Rud Wielkich”, Rudy Wielkie. 68 pp.
- Zimny H. 2005. Ekologia miasta. Agencja Reklamowo - Wydawnicza A. Grzegorzcyk, Stare Babice. 233 pp.