Urban trees management methods and their suitability for creating databases

Marzena Suchocka[*]**, Katarzyna Kostrzewa**

Warsaw University of Life Sciences – SGGW, Nowoursynowska 166 St,
02-787 Warszawa, Poland
[*]e-mail: marzena.suchocka@interia.pl

Abstract. The number of decisions permitting the removal of trees in cities is increasing every year, which suggests long-term negligence, or rather insufficient funds for proper management of urban forests. Lack of appropriate tools causes difficulties in the decision-making process. This problem is especially important in a situation of increased pressure exerted by residents to remove trees, mainly due to the safety reasons. An essential element in maintaining the proper tree management in a city is to improve management systems by applying comprehensive methods and tools. For this reason, many methods are used to support the inventory and identification of dangerous trees. The presented research is a response to the need for unification of management systems based on the most effective and proven methods of defining the resource, health and static condition, value, assessment of tree life expectancy or tree damage. Such a multilateral approach can improve the safety and management of urban forests. The results of the presented analyses led to the formulation of objective guidelines for the urban tree management standards.

Keywords: urban ecosystem, urban forest, public spaces, tree risk assessment, trees management systems, trees valuation methods.

1. Management of urban forest in practice

Society's knowledge and awareness relevant to the topic of operating nature's mechanisms is increasing constantly. Unfortunately it does not translate to the lifespan of trees. It is particularly seen by the example of big cities, where the human impact on the environment is so damaging that newly seeded trees' live only from 7 to 10 years (Dmuchowski & Badurek, 2001; Kosmala et al., 2009b). Moreover, nowadays we are witnessing a loss in Poland's tree stand after changes in Nature Conservation Act in January 2017, wherefore to that the topic of nature protection begins to have a new meaning.

The duty of maintaining trees in a right condition, while ensuring the safety of citizens is not only the public administration authority's responsibility but also the administrator's of private properties. Polish law's regulations and European directives clearly determine entities, which are responsible for the tree stand. But there is a lack of standards, which could simplifies fulfilling this duty in Poland. This situation results in frequent irrational and excessive tree cuttings contributing to a decrease of trees amount in cities. Strategical approach of urban trees' management allows not only for reduction in costs of intervention actions but also eases rational assessment of the situation. Management systems used in common practice aside from our country's borders combines a wide variety of tools and methods allowing for holistic assessment of the situation. This is the main reason why their analysis is essential in the process of implementing and improving of management practices (Gwiżdż, 2014; Suchocka, 2013).

Trees growing in urban environment might be a potential danger for safety of people and their properties. Many factors have impact on current situation, i.e. the lack of control and proven management of urban forest. The additional problem is the knowledge and experience of inspectors, who controls urban trees. Most of their opinions seem to be insufficient, moreover succinct law rules do not provide appropriate support. Hiring the expert's is a costly investment and it translates to limited access to this kind of service for small municipalities. But there also exists such a thing like a big pressure of people who are often not pleased with a presence of trees in the city. In order to optimize the management of urban trees grounded on the assessment of risk many methods and tools used to identify problematic trees were created. It is necessary to implement tools for efficient communication between public administration and local community, to support social participation in decision making process. Such an approach is necessary for protection of the most precious trees in city, specially ancient or veteran trees, in order to protect nature's values connected with them.

Therefore, the attempt of the professional management of urban trees' assessment methods became the target of present examinations' and analysis's. The comparison was conducted and so was the estimation of usefulness and functionality of different tools of urban trees management with the assessment of their capability as the database adaption to Polish conditions.

2. Methodology

In order to estimate all substantive elements, which are relevant to make the urban trees system of management more effective, the analyses of basic methods and tools used to the trees assessment in Poland and worldwide, were conducted. Popular tools and methods used to the trees assessment were examined and divided to six groups, differ in nature. Each of groups were analyzed, their component elements were compared and then the usefulness of individual methods of creating trees management databases in urban areas was measured in scale. Obtained results allowed to formulate objective directions for standards of urban trees management. Therefore, results of analyzes resulted in formulating rules of effective adaptations, expensive and complicated systems.

2.1. Characteristics of tools and methods used for trees assessment

The analysis of available methods and systems of trees management allowed to identify six basic types of the attempt at solving this issue:

– traditional methods: the group of test-writing elaborates forming the basic tool of designer's work, being a part of technical documentation but also the basic tool of urban forest management,
– instrumental methods: all methods making use of mechanical or electronic tools are found in this group, they are used for trees and wood structure parameters assessment, which is also called expert methods used by specialists, who carry dendrological expertise out,
– trees valuation methods: used for estimating tree's economical value or the „work" they do,
– statics and risk assessment: group of methods, which defines tree's statics disorders or danger near trees,
– methods of trees health condition assessment: group, which describes methods assessing trees' lifetime based on their branches structure, phase of growth or the length of estimated lifetime,
– methods of damaged trees assessment: this group is estimating damage on trees made, for example during an investment process.

Descriptions and results of analyses received for each group of methods are presented below.

2.1.1. Traditional methods

Tree survey, both general and detailed, are the essential basic starting point needed for all planned actions relevant to tree stand (Witkoś-Gnach & Tyszko-Chmielowiec (ed.) 2014). The management of relevant goods is based on the awareness of what is being managed. In case of attempts to the urban forest assessment, the most important is the management of trees, which is a basic part of analysis. It helps to simplify planning of the scope of work and budget. However, valorization is some kind of elaboration, which is the basic for further work with urban trees and helps to define all priority actions. Furthermore, valorization identifies forms of preservation, for example: the preservation of monumental trees or veteran trees. The limited use in everyday tree management seems to have project of trees preservation during the investment process (Suchocka, 2016). This elaboration is being prepare for specific investment and solves all organizational issues on construction site. The document of tree preservation during building works seems to be indispensable for trees survival, but considering the daily management, this elaboration is non-essential (Table 1).

2.1.2. Instrumental methods

The Table 2 includes the comparison of instrumental methods and shows that 78% from methods are assessed as providing useful or very useful information's about the management of urban trees. The only thing, which was

Table 1. The comparative analysis of traditional methods

Method's name	Period of elaboration currency	Unitary cost for 1m²	Elaboration form	Usefulness of method in management systems*	Notes
General tree survay	1 year	0.80 zł/m²	paper, pdf, dwg, shx	4	----
Detailed tree survay	1 year	1.60 zł/m²	paper, pdf, dwg, shx	4	----
Treestand management	3 years	1.40 zł/m²	paper, pdf, dwg, shx	3	Rarely used alone
Valorization	5 years	1.60 zł/m²	paper, pdf, dwg, shx	2	More useful in parks
The project of trees preservation during investment process	particular investment	3.00 zł/m²	paper, pdf, dwg, shx	1	Limited impact on daily trees management

* Assessment in scale 1- 4, where: 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

Table 2. The comparative analysis of instrumental methods

Method's name	Obtained informations	Usefulness of obtained information*	Usefulness of method in management systems*
Incremental drill	Tree's age, size of annual growth	1	1
Fractometer	Tree's parameters: toughness and stiffness	2	1
Arborist probe	Approximate extend of cavity of roots system or on trunk	4	4
Electronic hammer	Health state of tree's trunk (rotting condition)	3	3
Tomography	Cavity of tree's trunk with location and extent (internal image of trunk)	3	3
Shigometer	Extent of internal cavity of trunk	3	3
Rezystograph	Extent of internal cavity of trunk	4	4
TreeRadar	Internal image of trunk, image of roots system	3	3
SIM	Tree's stability in ground, trunk's resistance to breaking	4	3

* Assessment in scale 1- 4, where 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

considered essential in trees assessment was the arborist probe (Suchocka et al., 2014). This device supports all visual methods and helps to classify trees to detailed statics studies, if needed. Furthermore, one of the best marked devices was rezystograph (Suchocka, 2012), which is able to give to the user reliable information in a short period of time and the method called SIM, because of its received complex information (Siewniak & Bobek, 2010). Considering security reasons, single TreeRadar investigation or by using one layer of tomography does not give us the complete information about tree's health state. Incremental drill and Fraktometr are assessed as not as useful as the rest of devices, specially that their collateral effect on trees is undoubtedly too high. In practice, users are slowly leaving their use these devices (Mattheck et al., 1995; Szewczyk, 2012).

2.1.3. Trees valuation methods

Obtained results indicates the general and highly grounded need of providing the method of tree valuation in city trees management systems (Table 3). Monetary value of the tree's was ranked highly and so was the aesthetic value (Koch, 1997; Helliwell, 2000; Watson, 2002; Neilan, 2010). Differences can be noticed in the time consumption of each method application. Polish method based on replacement costs, called "IGPIM method" is considered to be the least time consuming (Szczepanowska, 2009), application I-Tree and the method developed by CTLA/ISA. Software CITY GREEN (Kosmala et al., 2009a) was deemed to be average time consuming. In general 50% of methods was considered as highly time consuming.

2.1.4. Methods for assessing tree statics and trees risk

In order to define the usefulness of chosen methods' of tree's statics and risk assessment, the comparative analysis of selected criterions and significant elements were conducted with a view to their practicability within the context of trees management (Table 4). Instrumental and SIA methods were taken under consideration (Wessolly & Erb, 1998), and so were visual methods based on the knowledge of rater and the method called IBA – Integrierte Baumkontrolle (Reizartz & Schalag, 1997), AfB – Biostatische Baumkontrolle (Sinn, 2000) or WID method (Wizualna Identyfikacja Drzew – Visual Identification of Trees safety-threatening) proposed by Rosłon-Szeryńska (2006).

Table 3. Summary list of methods and tools for the valuation of trees

Method's name	Parameters of measurement	Parameters of value assessment	Time consumption of method	Usefulness of method in management systems*
Helliwell's method	size, estimated lifetime, value for landscape, habitat conditions, presence of other trees, tree's habit	recreated value	3	4
CAVAT	size, circumference, trunk's diameter, way of use, accessibility for people, condition, life's conditions, estimated lifetime,	recreated value based on monetary value of $1cm^2$ of tree and its functional state	3	4
CTLA/ ISA	species, transversal intersection by inches [2], location, condition,	value based on actual costs of recreating	1	4
I-Tree Eco	data received by environment pollution reading, metrological data, urban forest structure, species composition, density, health status	value based on monetary value of tree's work	1	4
CITY GREEN	location, shape of tree crown, area of roots, visible roots' damage, attributes of trunk, appearance of tree crown, attributes of the trunk collar, diseases	value based on monetary value of tree's work	2	4
Koch's method	circumference of the trunk, size, tree's age, amount of nurseries, tree's function, cost of planting, tree's condition, diseases	value based on actual replacement costs	3	4
STEM method	condition, function, tree's age, valorization, meaning for landscape, historical value, marked-based value, cost of care	value based on actual replacement costs	3	4
IGPIM method	species, condition, location, trunk circumference, tree's growth, diseases, marked value	value based on actual replacement costs	1	4

* Assessment in scale 1-4, where: 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

**Assessment in scale 1-4, where: 1 – low time consuption, 2 – average time consumption, 3 – high time consumption, 4 – very high time consumption.

Table 4. Comprehensive analysis of tree risk assessment methods

Method's name	Necessity of training	Comprehensiveness of assessment	Analysed parameters	Final assessment/ recomentations	Usefulness of method in management systems*	Notes
VTA	Yes	static's assessment, evaluation of breaking	vitality, body of fungus, anatomical features, shape of the crown, area of tree canopy „sail", annual growth, investigation with manual hammer and rezystograph	Yes	4	reliable method recommended by ISA
SIA	Yes	evaluation of trunk and roots breaking risk	trunk, height, location, species, shape of brunches of the tree, branch thickness, alley's gauge	Yes	3	used as supporting method
IBA	Yes	static's assessment	wood's rottenness, phase of fungus growth	No data	3	----
AfB Biostatic Method of Trees Control	No	evaluation of trunk and roots breaking risk	fungus's fruits, bark dining, annual growth, assessment of cavity, dry branches, bark included, abandoned tree hollows, wood necrosis, cracks in soil	Yes	3	----
WID	No	evaluation of branches, trunk and roots breaking risk	use of surrounding, bark included, trunk, site condition changes, species, root collar, roots area, area and size of crown, trunk diameter, height of the tree	Yes	3	lack of reference to fungus presence
Tree Analyzer	No	evaluation of branches, trunk and roots breaking risk	use of surrounding, bark included, trunk, site condition changes, species, root collar, roots area, area and size of crown, trunk diameter, height	Yes	3	more comfortable and faster than WID method
General diagnostics – Drogi dla Natury (Roads for Nature)	No	evaluation of trunk and roots breaking risk	species, location, size, value, way of use, roots area, site condition changes, exposition on the wind, vitality, roots, root collar, trunk, crown collar, crown, branches, shoots, leaves, risk of failure	Yes /No	3	assessment done on the form, method might be insufficient (special investigation needs to be done)
Report of Tree Failure	No	risk of fall, braking branch	size, condition, reason of damage or accident, range of loss, kind of defect	No	3	assessment made after tree accident for statistical reasons
Hazard Tree Rating Method	No	risk in the surrounding of trees	trees' valorization in 4 groups of risk	No	3	lack of statistics assessment trees division by location

Method's name	Necessity of training	Comprehensiveness of assessment	Analysed parameters	Final assessment/ recomentations	Usefulness of method in management systems*	Notes
QTRA	Yes	risk in the surrounding of trees	value of object, size of falling part, possibility of accident, size of tree, frequency of terrain use	Yes	3	----
Tree Safety Managment System	Yes	risk in the surrounding of trees	value of object, impact of the accident on surrounding, possibility of accident, size of tree, frequency of the terrain use	Yes	3	faster alternative to QTRA
MORZD	Yes	risk identification, lowering of accident risk	size, health state, statistic, vitality, surroundings' sensitivity, phase of risk, resistance to fractures, stability in the ground, frequency of use, kind of surrounding use	No	4	takes into account using methods such as: AFB, SIA, VTA, Verhangen method

* Assessment in scale 1-4, where: 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

All above-mentioned methods were marked as very useful or essential in case of urban trees' management. To essential methods, as the most comprehensive and combining a couple of trees assessment methods have been included: VTA (Kosmala et al., 2009b), Application form of general risk assessment from Droga dla Natury (Suchocka et al., 2014) and MORZD (Bobek, 2013). Therefore, each of these methods differ from each other. VTA formulates recommendations on statics assessment and takes into account instrumental investigation. Application form of general risk assessment combines elements from VTA with QTRA, apart from specialist studies (Ellison, 2005; Matheny & Clark, 1994). However, MORZD method is some kind of urban trees management system, because of being expanded on planning elements, which supports budged planning and operation priorities. All remaining methods are useful to a great extend but used individually do not allow for complete problem diagnosis. They need to be fulfilled with another expert method. Such an easy and possible to direct use in Poland method is Hazard Tree Rating Method, which can be used without equipping employees in additional devices or specialistic programs.

2.1.5. Methods of trees condition assessment

Obtained results of condition analysis shows, that only 29% of vitality assessment were approved as very useful

(Table 5). These methods are: SULE method (Safe Useful Life Expectancy, 2009) and Green's method (Green, 1984). Both methods, apart from classification allowing to determine health state, includes recommendations or indications of further trees lifespan assessment. Remaining methods allow for trees' lifespan assessment but results depends on competence and knowledge of person, who uses these methods and they can often be subjective in a high extend.

1.2.6. Methods of mechanical damage assessment

Obtained results shows, that the most useful method for assessing the tree's mechanical damage is VSSG method, because it relates damage to civil responsibility and contains the proposition of care treatment. On the same basis was build the IGPIM method, which additionally was adapted to polish legal conditions. Methods, which determine the range of damage on the point basis were assessed as the least attractive for trees management.

Table 5. Summary of methods for assessing vitality and health condition of trees

Method's name	Assessed factors	Marks scale	Usefulness of methods in management systems[*]
Roloff's method (Rollof, 2001)	classification – phases of crown's growth	0-3	2
Green's method (Green, 1984)	tree's condition as potential lifetime	1-9	3
Braun's method (Braun, 1990)	classification based on crown's condition	1-5	2
Scale of wholesomeness according to Pacyniak and Smólski	assessed over ground part of tree – health state	1-5	2
SULE (2009)	approximate lifetime	1-4	3
Urban Forestry Service (2001)	trunk's mechanical resistance, crown's structure, crown's vitality	0-4 0-4 0-4	2
Guidebook to decorative trees' vitality assessment (ISA, 2007)	assessment of roots and trunk's state, of main branches, buds and leaves	1-4	2

[*] Assessment in scale 1-4, where: 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

Table 6. Comparison of selected mechanical damage assessment methods

Method's name	Assessed elements of tree	Assessed elements of site condition	Marks scale	Usefulness of method in management systems[*]	Notes
Construction Damage Assessment (Coder, 1996)	trunk, roots system, tree's bottom, root collars, crown's collar, branches, bark	a cut of the topsoil, filling the layer of soil, compaction, contamination within the root zone	point, impassable (critical) threshords, allowed amount of dead brnaches,	2	----
Best Managment Practises (Coder, 1995)	trunk, roots system, bark, wood	factors deforming the shape of roots system	clases of damage compatible with its meaning	2	----
VSSG (Szczepanowska et al., 2009)	trunk, crown, roots system, branches	--------------------	in percentage/ factors	4	----
Damage Exvaluation (ISA, 2007)	trunk, roots system, branches, bark,	--------------------	in percentage/ factors	3	----
Bernatzky's Metod (1978)	trunk, crown	--------------------	in percentage/ factors	3	----
Koch's method (1997)	entire tree	--------------------	factors	3	divides damage into total or partial damage
IGPIM method (Szczepanowska, 2009)	crown, trunk, roots system	--------------------	in percentage/ factors	3	divides damage into total or partial damage

[*] Assessment in scale 1-4, where: 1 – low usefulness, 2 – useful, 3 – very useful, 4 – essential.

3. Conclusion and guidelines resulted from analyzed methods

The ground of trees inspector's work, for rational management of urban trees, should be a detailed survey of trees. It is commonly used practice in both, Europe and United States of America. Tree survey methods are more advanced in time, nowadays they are also shown as 3D models. Unfortunately polish cities struggle with a lack of surveys of trees, and often of the project of trees management or valorization as well. Changes in urban trees stand are so dynamic, that durability of tree survey is defined just for a year. The best solution to that situation is elaborating the tree survey in electronic form with the option of easy modifying all trees data.

Each of described instrumental methods completes specialist's knowledge with current investigation of trees state. The only difference between methods is the type of gained information. In majority, these methods are called expert methods and are used to assess the tree, which value is significant. The alternative solution is arborist probe. This device is not only cheaper but also allows to gain initial estimating of rottenness extent. It is important to underline the fact that correct diagnosis is related to inspector's experience. This is the reason why education of inspectors is a priority.

Results of trees valuation methods comparisons and analysis points at the need of using this kind of devices in trees management process. This improves making decisions process about the trees live spam predictions, e.g. in situation when the costs of care will exceed the value of the tree. Application i-Tree was positively assessed in analyses because of the fact, that it allows for valuation of annual benefits provided by trees. Polish method IGPIM, which was developed in 2009 on base of foreign methods, was considered as the least time consuming. Both mentioned methods are compatible and provides arguments to the discussion e.g. about the budged intended for trees preservation.

When it comes to statics or risk assessment, the most comprehensive methods is VTA, Form of general risk assessment and MORZD. The analysis shows that the VTA method approved by the International Society of Arboriculture (ISA) is one of the most versatile methods of risk assessment. It encompasses not only the visual assessment. The full analysis demands using professional devices (tomograph, rezystograph). In this case, the effectiveness of assessment depends on inspector's experience in a large extend. All these methods include by the parameter of risk assessment and the possibility of accident. This attitude simplifies the appropriate risk prioritization with taking into account surrounding usage, which provides the rational approach for urban forest management.

The knowledge of health assessment methods increases inspector's competence. Methods, which includes the element of recommendation for further investigation or assessment of predictable lifespan are more desired. For example Green's method, which predicts the lifespan of tree, allows for planning further plantings. The SULE's method allows for tree management during investment process.

Methods, which are enable to assess tree's mechanical damage create the last group. They are crucial because of numerous situations when greenery is devastated in cities because of construction activities, incompetent care treatment or vandalism. Inspectors are often eyewitnesses of devastation, their awareness and knowledge of the appropriate tools allows better protection of the trees they care for. According to comparison (Table 6), the VSSG method is the most congeneric, because it includes recommendation of damage mitigation. But for experienced inspector, who owns this knowledge, the IGPIM method would be as good as VSSG.

Because of its difficult site condition for grow and the need of ensuring human safety, urban forest will be always in need of comprehensive assessment and increased financial support. What is the most important, urban trees assessment conducted by inspectors should be objective and comprehensive. Comparison of most effective methods from different countries presented in this article may determine the base of the data bases, which should allow for responsible urban trees management. Whereas, all conclusions resulted from conducted comparisons are the base for urban trees management guidelines development. What is more, they determine potentially desired directions to ensure highest effectiveness, also taking into account the costs range of using management systems built-in data bases.

References

Bernatzky A., 1978, Evaluation of trees. Tree ecology and preservation. Elsevier Scientific Publishing Comp., Amsterdam -Oxford -New York: 313-323.

Bobek W., 2013, Wyniki badań statyki drzew w mieście jako podstawa wyznaczania stref ryzyka. Wyd. Politechnika Krakowska, Kraków.

Coder K.D., 1995, Best Managment Practises. University of Georgia, Athens, Georgia.

Coder K.D., 1996, Construction Damage Assessmen Trees and Sites. University of Georgia, Athens, Georgia.

Dmuchowski W. & Badurek M., 2001, Stan zieleni przyulicznej w Warszawie na podstawie wieloletnich obserwacji i doświadczeń Ogrodu Botanicznego – CZRB PAN, Materiały z konferencji „Zieleń Warszawy, problemy i nadzieje – 5 lat później. Ogród Botaniczny – CZRB PAN, Warszawa: 62-74.

Green T.L., 1984, Maintaing and preserving wooded parks. Jurnal of Arbiculture 10: 193-197.

Gwiżdż A., 2014, Zieleń w mieście na wagę złota. Przegląd Komunalny 2: 63-64.

Helliwell D.R., 2000, Amenity Valuation of Trees and Woodlands (revised.). The Arboricultural Association, Romsey, Hants, United Kingdom.

ISA, 2007, Damage Evaluation, International Society of Arboriculture. (http://www.treesafterthestorm.org/damage_evaluation.html), [Accessed on: 02.05.2008].

Koch W., 1997, Aktualisierte Geholtzwerttaballen, 3 Auflage. Verlag Versicherungswirtschaft, Karlsruhe.

Kosmala M., Rosłon-Szeryńska E. & Suchocka M., 2009a, Influence of Mechanical Damage on the Condition of Trees. Annals of Warsaw University of Life Sciences – SGGW, Warszawa, 29: 137-144.

Kosmala M., Rosłon-Szeryńska E. & Suchocka M., 2000b, Metoda oceny kondycji drzew z uwzględnieniem bezpieczeństwa i uszkodzeń mechanicznych. Instytut Gospodarki Przestrzennej i Mieszkalnictwa, Warszawa.

Mattheck C.G., Breloer H., Bethge K.A., Albrecht W.A. & Zipce A.W., 1995, Use of the fractometer to determine the strength of wood with incipient decay. Jurnal of Arbiculture 21(3): 105-112.

Neilan Ch., 2010, CAVAT (Capital Asset for Amenity Trees). Full Method: User's Guide. The London Tree Officers Association, London.

Reinartz H. & Schlag M., 1997, Integrierte Baumkontrolle (IBA). Stadt und Grün 10/97: 696-696.

Roloff A., 2001, Baumkronen. Verständnis und praktische Bedeutung eines komplexen Neturphänomens. Verlag Eugen Ulmer GmbH & Co, Stuttgart.

Rosłon-Szeryńska E., 2006, Opracowanie metody oceny zagrożenia powodowanego przez drzewa o osłabionej statyce, Praca doktorska. Wydział Ogrodnictwa i Architektury Krajobrazu. SGGW w Warszawie, Warszawa.

Siewniak M. & Bobek W., 2010, Zagrożenie ludzi i mienia parkach, metody określania stanu statycznego drzew. Kurier Konserwatorski 8: 13-17.

Sinn T., 2000, Biostatische Baumkontrolle fachgerecht, schnell und sicher. Stadt und Grün 7/2000: 702-708.

Suchocka M., 2013, Zarządzanie drzewostanem – sposób na bezpieczne i zdrowe drzewa. Jak dbać o drzewa – dobre praktyki ochrony zadrzewień, [in:] J. Ziętek-Warga (ed.), Jak dbać o drzewa. Dobre praktyki ochrony zadrzewień. Fundacja EkoRozwoju, Wrocław: 36-54.

Suchocka M., 2014, Wprowadzenie do podstawowej diagnostyki drzew, [in:] K. Witkoś-Gmach, P. Tyszko-Chmielowiec (eds), Drzewa w krajobrazie. Podręcznik praktyka. Fundacja EkoRozwoju, Wrocław., Wrocław. [ISBN: 978-83-63573-09-6].

Suchocka M., 2012, Zalety i ograniczenia stosowania wizualnej metody oceny drzew (VTA) jako odpowiedź na problemy związane z zagrożeniami powodowanymi przez drzewa miejskie [Advantages and limitations of Visual Tree Assessment (VTA) method application as a response to the hazard related problems caused by trees]. Człowiek i Środowisko 36(1-2): 97-110.

Suchocka M., 2016, Projekt ochrony drzew w procesie inwestycyjnym. Instytut Gospodarki Przestrzennej i Mieszkalnictwa, Warszawa.

Szczepanowska H.B., Sitarski M., Suchocka M., Kosmala M., Rosłon- Szerzyńska E., Borowski J., Olizar J., Pstrągowska M., Dmuchowski W., Latos A. & Białecka-Kornatowska B., 2009, Metoda wyceny wartości drzew na terenach zurbanizowanych dla warunków polskich. Instytut Gospodarki Przestrzennej i Mieszkalnictwa, Warszawa.

Szewczyk G., 2012, Arborystyka. Wybrane zagadnienia pielęgnacji drzew. Wydawnictwo Uniwersytet Rolniczy, Kraków.

Watson G., 2002, Comparing Formula Methods of Tree Appraisal. Jurnal of Arbiculture 28(1): 11-18.

Wessolly L. & Erb M., 1998, Handbuch der Baumstatik und Baumkontrolle. Patzer-Verlag, Berlin-Hannover.

Witkoś-Gnach K. & Tyszko-Chmielowiec P. (eds), 2014, Drzewa w krajobrazie. Podręcznik praktyka. Fundacja EkoRozwoju, Wrocław.