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EVALUATION OF POTENTIAL OF WOODY SPECIES VEGETATION COMPONENTS IN OBJECTS OF LANDSCAPE ARCHITECTURE

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Abstract

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Potential of woody species vegetation components is defined as the total ability of existing woody species vegetation components (hereinafter referred to as WSVC) of a particular object (or its parts) to ensure the composition stability. The main criteria for evaluation of this potential at all levels are: (a) current (relevant) characteristics of WSVC; (b) expected development of ability of WSVC to preserve, renew and develop its desirable characteristics; (c) expected length of biologically conditioned existence of WSVC (in an acceptable condition); and (d) expected length of desirable existence of WSVC.

Evaluation is based on mutual confrontation and interpretation of especially these woody species characteristics: taxon, age or development stage and landscaping value. These characteristics are surveyed during the evaluation of woody species as standard in the Czech Republic, or at least at a fairly regular basis. It proceeds from the lowest level (individual) to the highest level (the whole object). Especially in case of larger objects and their parts is used as a basis the spatial distribution of the aforementioned characteristics in the evaluated unit (terrain layout) as well as statistical evaluation of these characteristics.

The focuses of this paper are methodological issues of determining and expressing the potential of woody species components.

woody species vegetation components, potential, composition stability, landscape architecture

1 INTRODUCTION

Woody species vegetation components are the most important woody components in landscape architecture which results mainly from their reached height of growth and longevity. These characteristics imply the necessity to look for the answers to the following questions when assessment of woody species: (a) how will they develop their important characteristics in the future; (b) how long will they exist in a desirable or at least acceptable condition.

Indicated predicting the future of existing woody species, thus determining of their potential, is one of the basic and the most difficult evaluation within landscape architecture. Quality of the evaluation depends both on the sufficient knowledge and experience and also the necessary talent.

Methodology of tree inventory for the needs of landscape architecture was first published more than forty years ago in the Czech Republic (Machovec, 1970, 1976, 1982). Thanks to this act is practise in this field relatively uniform. Summary attribute "landscaping value" can then be directly described as field standard (Pejchal and Šimek, 2011). This is at least in Central European rare although in this area was made other quality methodologies such as Jordan (1985).

In the early nineties of the 20th century it begins to use the detailed evaluation of woody species, especially in terms of qualitative indicators such as the development stage of an individual and its vitality (both physiological and biomechanical aspect also known as stability or static). This was related to both social changes and expansion

of natural and forestry sciences; see details in Pejchal and Šimek (2001). Attention focused on new qualitative indicators helped to refine the summary attribute "landscaping value", especially regarding to expression of individual's potential. In accordance with Aristotle's thesis that "the whole is more than the sum of its parts" arose the need at that time to express the potential of collection of individuals – from individual groups and stands of woody species up to the entire object. The authors of this paper an their collaborators carried out the mentioned evaluation in many important objects (e.g. Pejchal and Šimek, 1993, 1996; Šimek, Pejchal and Krejčiřík, 2003; Šimek *et al.*, 2010a,b,c); gained experience has been partly published (Pejchal and Šimek, 1997, 2001, 2012). Similarly oriented method of other authors has not been registered.

The objective of this paper is to present the current methodology of evaluation of woody species vegetation components in objects of landscape architecture.

2 MATERIALS AND METHODS

In the first step was analyzed the development and current state of evaluation of existing woody species (and vegetation components created of them) in landscape architecture objects, namely from the following perspectives: (a) what information is surveyed and needed; (b) what are the methods for obtaining it; (c) how is this information usable for determining the potential of woody species vegetation components. Overview of analyzed sources see Pejchal (2008, p. 139–141, 163–164).

In the second step was formulated: (a) the definition of potential of woody species vegetation components and other related terms; (b) basis and criteria for determining this potential.

The third step consisted of the design of concept of methodology of evaluation of potential of woody species vegetation components.

In the fourth step was this concept of methodology proven in practice, namely from two perspectives: (a) actual determination of potential; (b) use of the obtained data when suggesting tree care and renewal operations. This concept was verified in a number of nationally important and large objects of size from 50 to 250 hectares. Among these objects are foremost castle parks in Lednice, Valtice, Kroměříž, Šilhéřovice and Průhonice.

In the fifth step was experience from the previous step used to elaborate the current version of the methodology.

3 RESULTS AND DISCUSSION

3.1 Characteristics of selected terms

Vegetation component (VC) defines Šimek (1998) as a basic space component of the work of landscape architecture. It is defined by: (a) physiognomy (appearance); (b) spatial arrangement of plants; and (c) way of cultivation. The following **primary (basic) VCs** are distinguished:

- **simple VC** – consisting of only one individual (e.g. solitary tree);
- **compound VC** – a collection of several individuals of the same life form (trees and shrubs, perennials, bulbs and tuberous plants, annuals); individuals forming compound vegetation component are referred as to **secondary (derived) VC;**
- **combined VC –** a collection of several different vegetation components (e.g. shrubs combined with perennials).

This paper deals with VC made up with woody species referred as to **woody species vegetation components (WSVC)**.

Potential of WSVC, being in practice established as **dendrological potential**, defined Šimek (1997) for the first time as the total ability of existing WSVCs of specific object (or its parts) to ensure the composition stability.

I: *Development stage – classification scale*

Degree	Degree designation	Characteristics
1	new individual	Distinct signs and symptoms of rooting, without needed care; significant probability of mortality; usually young individual but also just transplanted adult exemplar, too.
2	rooted individual	Rooted, still not stabilized individual; lack of care is usually not an immediate threat to existence; usually young individual but also just transplanted adult exemplar, too, (especially) with young trees is adequate care needed to obtain the required characteristics, particularly architecture.
3	stabilized maturing individual	Young individual, usually of intense growth; completing the characteristics typical for adult individuals and possibly related with tree care goal (especially specific architecture, e.g. of formed WSVP).
4	mature individual	Mature (full-grown) individual; the period of annual increment culmination was exceeded; full capacity of generative reproduction, without significant signs of deterioration, full functionality based on the taxon characteristics and way of cultivation.
5	old to superannuated individual	Old to superannuated individual; at least some dimensions are approaching the maximal limits achievable in a given conditions; growth cessation, visible signs of deterioration up to superannuating.

Development stage (Pejchal and Šimek, 2012) expresses the stage of individual development (ontogeny) of an individual at the time of evaluation, in which growth and development manifestations associated with the increase of the individual's age are combined with symptoms related to its culture. This attribute is routinely determined during the tree assessment in the Czech Republic. The classification scale showed in Tab. I is applied.

Landscaping value (Pejchal and Šimek, 2012) represents total value of an individual in terms of landscape architecture expressing current and potential functionality resulting from its biological characteristics; it is primarily a combination of taxon (including its suitability for a given site), dendrometric measurements, architectural of above-ground part, age and physiological and biomechanical aspect of vitality. The importance of an individual in a composition, given its location in an object of landscape architecture, is not part of the landscaping value. This attribute is standardly used during the evaluation of trees and shrubs in the Czech Republic. The classification scale showed in Tab. II is applied.

3.2 Evaluation of dendrological potential

3.2.1 Bases

This variable has no absolute character because to some extent depends on the specific bases and assumptions (see below). These must therefore be as detailed and accurately defined as possible. Dendrological potential can be evaluated at three levels: (a) simple WSVC, or individual; (b) compound or combined WSVC; (c) the whole object of landscape architecture or its partial compositional unit. With rare exceptions, this evaluation concerns only tree layer.

Dendrological potential of **simple WSVC, or individual,** follows particularly from combination of the following properties (Pejchal, 1996, 1997): taxon, age, development stage, vitality (both physiological and biomechanical aspect), architecture of above-ground or even of below-ground parts, tree care condition.

Dendrological potential of **compound or combined WSVC** is given by: (a) potential of individual exemplars (secondary components) of which it is composed; (b) their importance and localization in this (primary) component.

Dendrological potential of the **whole object of landscape architecture or its partial compositional unit** is based on: (a) the potential of individual WSVC (simple, compound, combined); (b) their importance and localization in this whole.

The main criteria for evaluation of dendrological potential at all levels then are (Pejchal, 1996, 1997):

- current (relevant) characteristics (see above);
- expected development of ability to preserve, renew and develop its desirable characteristics given in particular by: (a) ability of growth and development; (b) ability to regenerate existing or in future very probable damage or repeated damage; (c) ability of self-regeneration – important especially in larger compound and combined nature-near WSVCs; (d) suitability for a given site; (e) stability or expected positive or negative change of site conditions; (f) stability or expected positive or negative change of tree care;
- expected length of biologically conditioned existence of WSVC in an acceptable condition;
- expected length of desirable existence of WSVC: (a) from the current perspective unlimited in time (the most common case); (b) time-limited (e.g. WSVC compounded of old individuals can still have satisfactory potential if it is needed only for short-term existence).

II: *Landscaping value – classification scale*

Degree	Degree designation	Characteristics
1	very valuable individual	Typical or required habitus (neither influenced by canopy nor otherwise), yet full-grown, absolutely healthy and not damaged, full of vitality and long-term perspective (at least about half a century).
2	above-average valuable individual	Compared to the previous degree some weaknesses that do not significantly detract from value, at least half the sizes achievable on site (beginning of full functionality), long-term perspective.
3	average valuable individual	Habitus may strongly deviate from normal (due to canopy etc.), possibly damage or occurrence of diseases and pests does not substantially detract from vitality; medium- to long-term perspective; to this category are classified also young, full of vitality exemplars with typical or required habitus that have not yet reached approximately half the sizes achievable on site or rather at the beginning of the full functionality.
4	below-average valuable individual	Due to old age, diseases and pests or damage is significantly reduced vitality; the probable existence is just a short-term (up to approximately 15 to 20 years) in an acceptable condition.
5	very little valuable individual	Due to old age, diseases and pests or damage is so reduced vitality that prerequisites just of short-term existence are missing; to this category are classified also exemplars to be removed immediately for safety and phytopathological reasons.

3.2.2 Specifying and expressing

Simple WSVC or individual

Dendrological potential is sufficiently accurately expressed by **landscaping value** (see above) for the needs of practice. It is essentially based on the above mentioned assumptions and bases. It is however important to be aware of certain pitfalls arising from the construction of this characteristic: the third degree of classification includes individuals which are too diverse in both expected development of their ability to preserve, renew and develop their desirable characteristics (see above) and expected length of their biologically conditioned existence in an acceptable condition. This disadvantage can be eliminated if the landscaping value is confronted with the **development stage** or vitality.

Compound or combined WSVC, object of landscape architecture or its partial compositional unit

Evaluation is based on the principles mentioned in section 3.2.1. Due to usually large range and difficult structure of WSVC is the evaluation based on the interpretation of "synthetic" attributes commonly applied when evaluating the individuals. Both spatial distribution of these characteristics in the evaluated unit (terrain layouts) and their statistical evaluation are applied as a basis for this evaluation. Correlations exist between:

- landscaping values of individuals, expressing particular degree of stability/perspectivity;
- and development stages of individuals, expressing particular their current importance in the whole of which they are a part (for this purpose can be used also age or age groups of individuals if available).

For easier interpretation has proven to simplify the resulting tables or graphs in a way that both landscaping values and development stages (age groups) are aggregated to a smaller number of widely understood units. For example:

- landscaping values of 1 to 3 (long-term to middle-long-term perspective/stable individuals);
- landscaping values of 4 to 5 (individuals with short-term existence);
- development stage of 1 to 3 (young individuals, playing a less important role in the current composition);
- development stage of 4 to 5 (mature to superannuated individuals, the main elements of existing composition).

The resulting combinations of these units expressing the influence of individuals on dendrological potential are shown in Tab III. It is necessary to re-emphasize that this is the basis for evaluation of which critical part must take place in the field!

Due to the clarity is useful to summarize the above mentioned evaluation – especially for large objects – to easily expressible classification. The following scale can be applied:

1. Units with very high dendrological potential.
   The vast majority of trees (in terms of both number and space they occupied) are long-term perspective and of very high or at least above-average value.
2. Units with high dendrological potential.
   The vast majority of trees are long-term perspective and of above-average value or are a high probability of an increase in the value of currently average exemplars.
3. Units with middle dendrological potential.
   The vast majority or at least a substantial number of trees are at least middle-term perspective but only of average value, without greater assumption of its increase. Alternatively occurring only short-term perspective individuals are thus located and in such numbers that smaller-area mosaic restoration of tree layer is possible and is relatively easily decomposable to a larger number of stages. During this restoration can be avoided a reduction or significant change of function unless a change is desirable.
4. Units with low dendrological potential.
   The vast majority of trees (in terms of both number and space they occupied) are only short-term perspective, that is expected duration of their still acceptable condition will not exceed probably 15 to 20 years. The area still contains not inconsiderable number of trees with at least middle-term perspective. Tree layer requires the total renewal for which is not the use of existing tree substantial but it is still practically significant.
5. Units with very low dendrological potential.

III: *Evaluation of dendrological potential – percentage distribution of selected values*

Development stage	**Landscaping value**					
	1	**2**	**3**	**4**	**5**	**Total**
1	High dendrological potential, without a decisive influence on the current composition.			Low dendrological potential, shortcomings in tree care.		
2						
3						
4	High dendrological potential, direct decisive influence on the current composition.			Low dendrological potential, current disintegration of composition.		
5						
Total						

The vast majority of trees (in terms of both number and space they occupied) are not short-term perspective either. Tree layer requires total renewal for which is not the use of existing exemplars practically of great importance.

Any methodological instructions can be likened to musical instruments one has to learn to play on first to make desired tones. In this case, it is necessary to combine a lot of knowledge, especially woody species biology, function of woody species components in objects of landscape architecture and last but not least also ways of their cultivation and renewal. The result of evaluation may be valuable data on material substance of the work of landscape architecture that is – together with an understanding of its ideological substance – necessary especially for strategic deciding.

SUMMARY

In any assessment of woody species, especially trees, in objects of landscape architecture is necessary to know their potential, which means to estimate: (a) how they will develop their important characteristics in the future; (b) how long will they exist in a desirable or at least acceptable condition. Potential of individual specimens of woody species sufficiently accurately reflects so called landscaping value. This attribute is during the tree inventory expressed as standard in the Czech Republic. But for evaluation and expressing the potential of groups and stands of woody species, cohesive composition units of objects and the whole objects still lacked a suitable tool. Therefore the methodology of evaluation of potential of woody species vegetation components has been developed and in practice proven. This potential is defined as the total ability of existing woody species vegetation components (referred to as WSVC) of a particular object (or its parts) to ensure the composition stability. With rare exceptions, this evaluation covers only the tree layer.

The main criteria for evaluation of this potential at all levels are: (a) current (relevant) characteristics of WSVC; (b) expected development of ability of WSVC to preserve, renew and develop its desirable characteristics; (c) expected length of biologically conditioned existence of WSVC (in an acceptable condition); and (d) expected length of desirable existence of WSVC.

Due to usually large range and difficult structure of WSVC is the evaluation of collection of individuals based on the interpretation of "synthetic" attributes commonly applied when evaluating the individuals. Both spatial distribution of these characteristics in the evaluated unit (terrain layouts) and their statistical evaluation are applied as a basis for this evaluation. Correlations exist between: (a) landscaping value of individuals (see above), expressing particular degree of stability (perspectivity); and (b) development stage of individuals (attribute is characterized in detail), expressing particular their current importance in the whole of which they are a part (for this purpose can be used also age or age groups of individuals if available).

Mutual combinations of these characteristics indicate the influence of individuals on potential of evaluated units and serves "only" as a basis for evaluation itself that must take place in the field and take into account: (a) woody species biology; (b) function of woody species vegetation components in objects of landscape architecture; and (c) ways of their cultivation and renewal. The results of evaluation are expressed by means of five-degrees classification.

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