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THE RECREATIONAL POTENTIAL OF URBAN FORESTS – AN APPLICATION OF THE ASSESSMENT METHOD

REKREATIVNI POTENCIJAL URBANIH ŠUMA – PRIMJENA INOVATIVNE METODE OCJENE

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SUMMARY

This paper is devoted to the method of recreational potential assessment of urban forests regarding the functional abilities – a set of indicators measuring of forest stands to recreation as a practical tool for urban forests management, landscape planning and administration authorities. One of the main research tasks presented in this paper was to use indicators which are understandable for ordinary users. This aspect is important, because it enables the method to be utilised for a wide range of participants, administrative collaborators that can assess urban forests in terms of their suitability for recreation. A test of the created methodology (a case study in "Horský park" forest in Bratislava) shows the suitability of evaluation on the recreational purposes of urban forests. The characteristics of each individual indicator designate the ways to enhance the recreational value of urban forests, and they may be used for sustainability of urban forests management.

KEY WORDS: *urban forest; forest recreation; human impact; town greenery*

INTRODUCTION
UVOD

Urban forests are established in original natural forests or planted to support urban life in a positive way (Durkaya *et al.* 2016). The forestry urban dealing with urban forest is represented by the urban forests have been defined as "the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits trees provide society" (Konijnendijk *et al.* 2005; Simpson *et al.* 2008) according to The Dictionary of Forestry by Society of American Foresters edited by Helms (1998). The urban forest has been described as "the sum of all woody and associated vegetation in and around dense human settlements, ranging from small communities in rural settings to metropolitan areas" (Miller 1997) and is located close to agglomerations, as well as on urban lands.

An urban forest provides the city's residents with recreational services, aesthetics, health environment, and psychological wellbeing. It has become a necessary facility for cities because of its economic and ecological contributions (Simpson *et al.* 2008). They have a positive influence on the air quality (Fantozzi *et al.* 2015; Bottalico *et al.* 2016; Jayasooriya *et al.* 2017) and an impact on the climate in cities (Moss *et al.* 2018). Siljeg *et al.* (2018) drew attention to the link between urban green spaces and the quality of inhab-

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itant's life. In many cases, the literature also includes findings of association between the surrounding environment and health (Jackson *et al.* 2013; Dzhambov *et al.* 2014; Nowak *et al.* 2018). In comparison with natural forests, urban forests are probably exposed to the most human impact both directly by recreational activities and indirectly by activities in nearby urbanized spaces.

Recreation in a forest as a specific usage form of a natural biological resource represents a way of use of a forest that is mainly indirect as compared to direct primary use (timber harvesting and collection of other material forest products). Recreational forest use itself has been the subject of numerous investigations in Europe for a few decades (Konijnendijk *et al.* 2005; Miller 1997; Simpson *et al.* 2008; Bell *et al.* 2007; Zeng 2018). The existing literature extensively documents the perception of forests, the recreational needs and demands of the population as well as how these have changed over time (Bell *et al.* 2007). In this context, urban forests are identified as being all the more crucial for the provision of adequate outdoor recreation activities (Konijnendijk *et al.* 2005, Chapter 1). Increased interest in the assessment of recreational functions of forests is due to several significant reasons (Bell *et al.* 2007; Vries and Goossen 2002; Rysin and Levandovská 2018). Under conditions of high density of population and excessive urbanization, urban forests are considered to be vital social valves providing people with rest from intense labour, stress, tension, smoke, noise, and pollution of modern cities (Simpson *et al.* 2008; Eskandari and Ghadikolaei 2013; Cetin *et al.* 2018; Jim and Chen 2006). Arrangement and development of recreational forest areas in towns are the most efficient, and at the same time the least expensive, social measure to ensure proper rest (Cetin *et al.* 2018, Jim and Chen 2006, Eskandari and Ghadikolaei 2013). However, there are contradictions between the needs and wishes of forest visitors on the one hand, and the abilities of forest biotope to fulfil their requests on the other. It follows that there is a social need for high-quality green spaces in cities (Bell *et al.* 2007; Vries and Goossen 2002).

Previous studies on applied assessing methods of the recreational potential differ significantly from each other. The main difference between Vyskot *et al.* (2003) and e.g. Pouwels *et al.* (2008), Eskandari and Ghadikolaei (2013), Cetin *et al.* (2018), Maple *et al.* (2010), Jim and Chen (2006), Vries and Goossen (2002) is in the fundamental approach to the question. Vyskot *et al.* (2003)evaluated the potential functional ability of a forest and the actual functional effectiveness of forest stands using the method of the "Quantification and evaluation of forest functions" based on the non-utilitarian anthropocentric conception of the relationship between man and the forest which has been based on the idea that forests serve exclusively to man according to his topical demands but on systematization and objectification of forest functions in an ecosystem conception.

This study deals with the assessment of recreational resources of common European urban forest. Further mentioned the methodological approach will include ecological and recreational characteristics, and an evaluation of potential recreation classification in the urban forest will be determined. The urban forest "Horský park" in Bratislava was chosen as a basic study area. The used characteristics (indicators) have been chosen in order to be generally applicable and useable in an urban forest. The authors connect the social aspects of visitors and the biological ability of the forest within the total methodological system. Thus, the question of the recreational potential assessment of urban forests is considered not only from the position of a human consumer, but also as the ability of the forest ecosystem to exist under the pressure of recreational loads - it is the degree of direct influence of holiday-makers (tourism, wild harvest, fishing, etc.), their vehicles, the construction of temporary houses and other structures on the ecosystems or recreational areas. It is expressed through the number of people or man-days per unit area or recreational area for a certain period of time (usually a day or a year). The research tasks were defined as follows (1) Determination of individual indicators important for an urban forest condition and recreation possibility of the forest; (2) Development of an evaluation system of these indicators for urban forest, and (3) Testing of the evaluation system in "Horský park" forest.

MATERIAL AND METHODS
MATERIJALI I METODE

The created methodological approach – *Metodološki pristup*

The works of Rysin (2003), Rysin *et al.* (2015a, 2015b) and Ivonin and Samsonov (2011) were the starting point for the development of a methodical approach to assessing the recreational potential of urban forests. The calculation of the coefficients C-forest and C-recreation (coefficient is a quantitative expression of the sum of indicators in comparison with the ideal.) and the determination of limit values for Class recreational volume were evaluated according to these works. Indicators were selected on the basis of literary research of the following works (Kazanskaya *et al.* 1977; Rysin 2003; Gusev 2004; Němeček *et al.* 2011; Pińkovskiy *et al.* 2011; Senov 2006; Schneider *et al.* 2008).

Case study area – *Područje istraživanja*

The urban forest "Horský park" was created in 1868 and is located near the city centre of Bratislava (in the Slovak Republic). The area is predominantly built with granites and

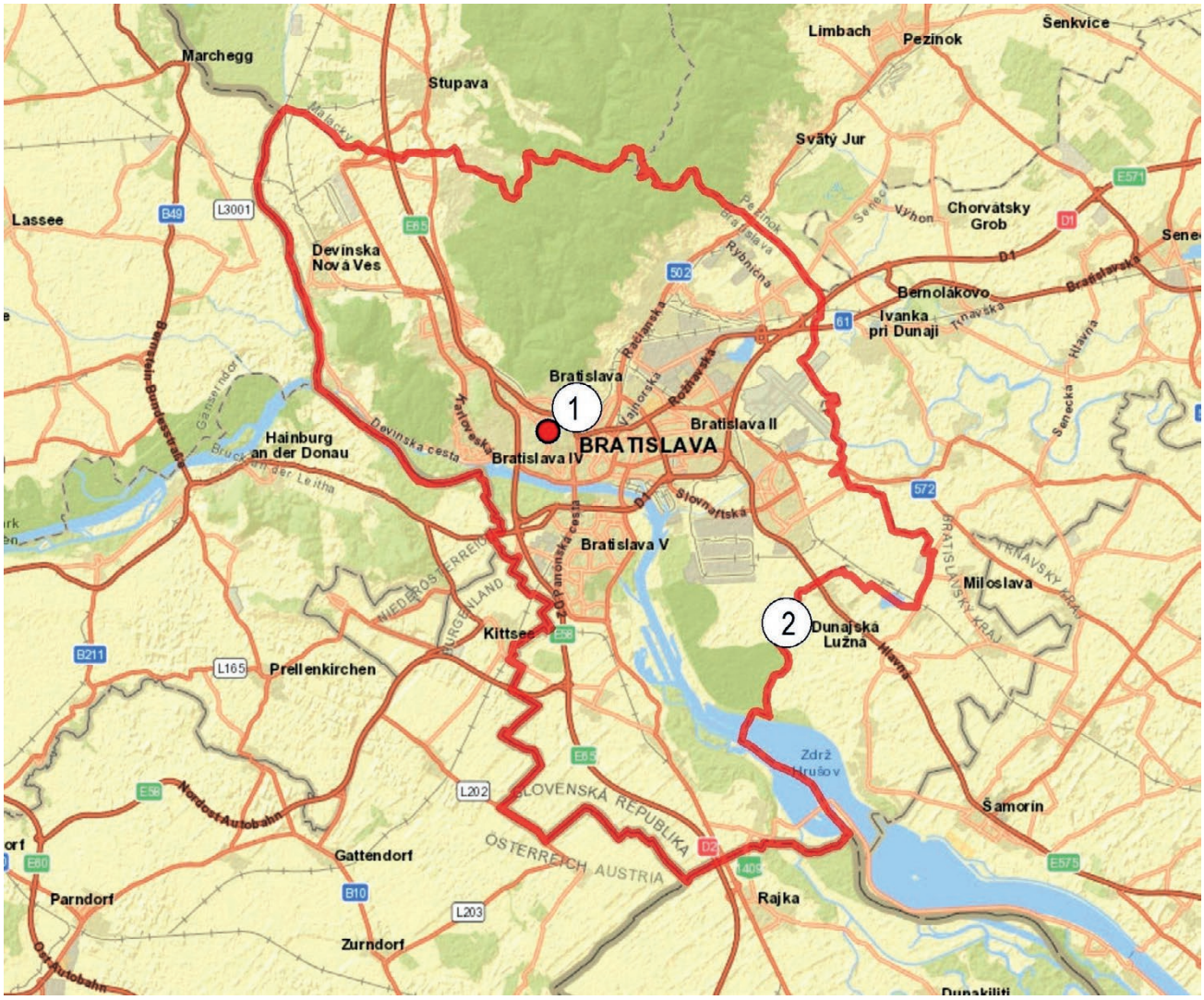

Figure 1. Position of Horský park in the city of Bratislava. 1–Horský park, 2–border of city.
Slika 1. Položaj parka u gradu Bratislavi. 1–Horský park, 2–granica grada.

granodiorites (Polák *et al.* 2011), on which haplic cambisol is taking place. Near the streams on the alluvial sediments are gleic fluvisols (Deaková 1998). The park is a fragment of the formerly extensive natural forest area of the Little Carpathian Mountains, and is situated in the altitude range of 185 – 260 m. In the area Oak-Hornbeam Carpathian forest dominates. Fundamental species of trees in the park were enriched with introduced species e.g.:

Aesculus hippocastanum L., *Quercus rubra* L., *Quercus palustris* Münch. and coniferous species of the genus *Chamaecyparis* Spach, *Abies grandis* (Douglas ex D. Don) Lindl., *Picea omorika* (Pančić) Purk., *Metasequoia glyptostroboides* Hu et Cheng (Holanská 1998; Reháčková 2009). The park area is 22.96 ha and is delimited by urban roads and dense residential development from all sides. The park is actively used as a recreational forest area for short term rest, such as a walking, playing sports, familiarity with dendrological diversity of the park.

Testing of the methodological approach via the urban forest "Horský park" – *Ispitivanje metodološkog pristupa u urbanoj šumi „Horský park"*

Field works and acquisition of analytical data for the method testing was carried out in the autumn in 2017. Only one assessor was working in the field, because one of the aims methodology is simplify fieldworks. The territory of the park was divided into areas delimited by existing paths (Fig. 2). The georeferencing function in the Arcmap programme allows for specification of they geographic coordinates for a bitmap image. This map (Fig. 2) served as a basis for orientation in the terrain. Each site area was evaluated by all 18 indicators (according to the method). The obtained data was manually filled into an Excel table in the terrain, and then the data was transferred to digital form, where mathematical processing was carried out. An assessment of the Class recreational volume was calculated for each site separately. The generated tabular data from Excel

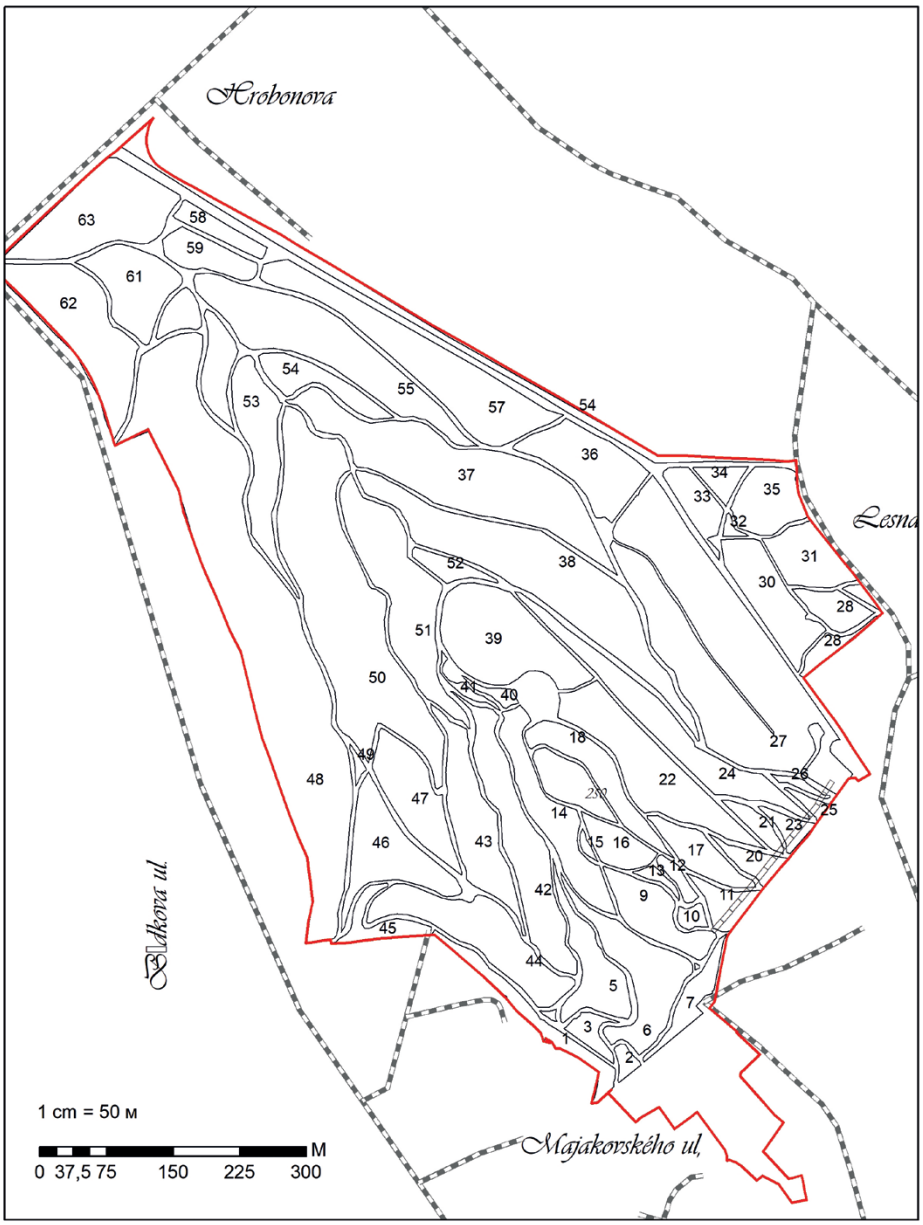

Figure 2. Boundaries of "Horský park".
Slika 2. Granice parka "Horský park".

was transferred to the Arcmap programme where a visual representation and analysis of the situation was made. The maps presented in this paper were created using ArcGIS® software by Esri (2011)

The created methodical approach – *Primijenjen imetodički pristup*

The method assesses the possibility of short-term recreation for a wide range of the population and forests located close to urban development. The assessment system of the method offered contains a set of indicators (18) grouped into 2 domains (Tab. 1). The first domain ***Forest*** contains 6 indicators and assesses forests condition and stability - the ability of forest to maintain their structure and functions with impact of external factors. The domain consists of natural and environmental factors that are more stable in time and space compared to the second domain. The second domain, ***Recreation***, is made up of indicators reflecting appeal and comfort for visitors in urban forests. These are the features reflecting the recreational needs of the population as regards forest areas. The indicators were selected in view of environmental assessment of forests, their aesthetical properties, as well as in view of the social needs of the visitors.

The class recreational volume (CRV) is the value defining forest biotope suitability for recreational use and reflecting the recreational potential of certain forests. Result processing (Rysin 2003) includes a separate calculation of factors

Table 1. System of indicators for assessment of recreational potential of urban forests.
Tablica 1. Sustav pokazatelja za procjenu rekreacijskog potencijala urbanih šuma.

No.	Indicator/*Indikator*	Description/*Opis*	Parameter/*Parametar*	Grade *Oznaka*
		Forest domain/Šumsko područje		
1	Recreational digression/ *Rekreacijska digresija*	Changes in the forest due to recreation impact/*Promjene u šumi zbog utjecaja rekreacije*	Over 50 %/ *Više od 50 %*	0
			Between 11–50 %/ *Između 10–50 %*	1
			Between 0–10 %/ *Između 0–10 %*	2
2	Sanitary condition of the forest/ *Sanitarno stanje šume*	Damages and diseases of various origins, including windthrow/Štete i bolesti različitog *podrijetla, uključujući vjetrove*	Diseased and dry trees over 50 %/*Bolesna i suha stabla više od 50 %*	0
			Diseased and dry trees between 21–50 %/ *Bolesna i suha stabla između 21-50 %*	1
			Diseased and dead standing trees between 0–20 %/ *Bolesna i suha stabla između 0-20 %*	2
3	New regrowth/*Novi rast*	Regrowth – young generation of forest that is able in the future to form an over layer and replace the old growing stock/ *Novi rast - mlada generacija šuma koja u budućnosti može formirati novi sloj i zamijeniti staru šumu*	Lacking or scarce/*Bez rasta ili slabi rast*	0
			Average regrowth/*Prosječni novi rast*	1
			Rich regrowth/*Bogati novi rast*	2
4	Lower layers of vegetation/ Donji slojevi vegetacije	Shrub and herbal layer as a part of the biotope/*Grm i biljni sloj kao dio biotopa.*	Without herb and shrub layers/*Bez slojeva bilja i grmlja*	0
			Only shrub layer or herb layer/*Samo grmlje ili sloj bilja*	1
			Both layers are presented/*Prikazana su oba sloja*	2
5	Road network density/ *Gustoća cestovne mreže*	Calculation of area occupied by roads in the total area of the forest/ *Izračun površine koju zauzimaju ceste u ukupnoj površini šume*	Over 10 %/ *Više od 10 %*	0
			Between 6–10 %/ *Između 6-10 %*	1
			Between 0–5 %/ *Između 0-5 %*	2
6	Soil texture/*Tekstura tla*	Soil texture classification/*Klasifikacija teksture tla*	Mainly clays/*Uglavnom gline*	0
			Mainly silt loam/*Uglavnom ilovača*	1
			Mainly sand/*Uglavnom pijesak*	2
		Recreation domain/*Rekreacijsko područje*		
1	Relief/*Reljef*	Slope and irregularity of land surface/ *Nagib i nepravilnost reljefa*	Slope 21–30°, high irregularity/*Nagib 21–30°, visoka nepravilnost*	0
			Slope 11–20°, medium irregularity/*Nagib 11–20°, srednja nepravilnost*	1
			Slope 0–10°, low irregularity/*Nagib 0–10°, niska nepravilnost*	2
2	Quality/*Kvaliteta* *	A forestry term for forest quality in a certain area. Includes average height and age of trees/ Šumarski izraz za kvalitetu šuma na *određenom području. Uključuje prosječnu visinu i starost stabala*	Class IV.–V.–Va/*Klasa*	0
			Class II.–III. /*Klasa*	1
			Class I–Ia.. /*Klasa*	2
3	Accessibility/ *Pristupačnost*	Distance from public transport and residential buildings/*Udaljenost od javnog prijevoza i stambenih zgrada*	Over 3 km/ *Više od 3 km*	0
			1–3 km/*1-3 km*	1
			Below 1 km/*Manje od 1 km*	2

No.	Indicator/*Indikator*	Description/*Opis*	Parameter/*Parametar*	Grade *Oznaka*
4	Soil moisture/*Vlaga tla*	Degree of soil moisture/*Stupanj vlage u tlu*	Swamps/*Močvare*	0
			Wet forests/*Mokre šume*	1
			Fresh and dry forests/*Svježe i suhe šume*	2
5	Water sources/*Izvori vode*	Distance from water sources of recreational importance/*Udaljenost od izvora vode rekreativne važnosti*	1–3 km/*1-3 km*	0
			Under 1 km/ *Manje od 1 km*	1
			Nearby/*U blizini*	2
6	Diversity of tree species/ *Raznolikost vrsta drveća*	Species variability of trees in the forest/ *Varijabilnost vrsta u šumi*	1 species/*1 vrsta*	0
			2 species/*2 vrste*	1
			More than *2 species/Više od 2 vrste*	2
7	Objects of interest/ *Objekti od interesa*	□aves, Waterfalls, Rocks, natural or architectural monuments/*Spilje, slapovi, stijene, prirodni ili arhitektonski spomenici*	Summary 0/*Sažetak 0*	0
			Summary 1/*Sažetak 1*	1
			Summary 2 or more/*Sažetak 2 ili više*	2
8	Vertical structure/ *Vertikalna struktura*	Vertical differentiation of the trees depending on the height/*Vertikalna diferencijacija stabala ovisno o visini*	1-story forest/*1. kat šume*	0
			2-story forest with new staddle-shrubs/*2. kat šume s novim slojem grmolike vegetacije*	1
			multistory forest with the staddle-shrubs / *višekatna šuma s grmolikom vegetacijom*	2
9	Stand density/*Gustoća sastojine*	Density of trees/*Gustoća stabala*	Dense forest (0.8–1.0) or scarce (0.1–0.2)/*Gusta šuma (0.8–1.0) ili rijetka (0.1–0.2)/*	0
			Average density (0.3–0.7) and even individual distribution/*Prosječna gustoća (0.3–0.7) i pojedinačna distribucija*	1
			Average density (0.3–0.7) and cluster tree distribution/*Prosječna gustoća (0.3–0.7) i distribucija stabala klastera*	2
10	Waste/*Otpad*	Both man-made (industrial and domestic waste), and natural, biological waste (tree stems, branches)/*I umjetni (industrijski i kućni otpad) i prirodni, biološki otpad (stabljike, grane)*	Large amount, 2 or more cases in each area/*Velika količina, 2 ili više slučajeva u svakom području*	0
			Medium amount, at least 1 case in each area/*Srednja količina, najmanje 1 slučaj u svakom području*	1
			Almost lacking/*Gotovo bez pojave*	2
11	Noise/*Buka*	Man-caused noises from roads, industrial facilities, etc./*Prouzrokovane bukom od cesta, industrijskih objekata itd.*	Significant loud/*Značajno glasno*	0
			Low/*Nizak*	1
			Lacking/*Nedostaje*	2
12	Development level/ *Razina razvoja*	Benches, summerhouses, dustbins, washrooms, playgrounds and sports grounds/*Klupe, ljetnikovci, kante za smeće, umivaonici, igrališta i sportski tereni*	Zero/*Nula*	0
			On average at least 1 object in the study area/ *U prosjeku najmanje jedan objekt na istraživanom području*	1
			High in the study area - 2 or more objects/*Visoka razina u području istraživanja - 2 ili više objekata*	2

*See Table 2/ *Vidi tablicu 2*

for each domain for each area in question, which enables subsequent CRV determination of certain parts of the forest. The values of the relevant coefficient (C) are calculated according to this formula:

$$C = \frac{SP}{SM}$$

SP is the sum of points of the forest assessed for a group of indicators and SM is the maximum possible sum of points for a group of indicators in the formula. The point grades for all indicators are presented in Table 1. We have used three grades for assessment each indicator, where 0 is bad, 1 is average, and 2 is excellent. There are two possible relevant coefficients as result: C–forest (Cf, including domain Forest) and C–recreation (Cr, including domain Recreation). We have took value for the grade perfectly – 1(one). Hence is the subsequent gradation.

For the purpose of general assessment of recreational potential, forests are divided into 3 CRVs:

– if the value of each factor (Cf and Cr) ≥ 0.67, the forest belongs to the 1st CRV, and is suitable for recreational use
– if the value of 1 of the factors calculated is from 0.34 to 0.66, and that of the other factor is > 0.33, the forest belongs to the 2nd CRV, which enables limited recreational use of the forest;
– if the value of at least one of the factors calculated is ≤ 0.33, the forest belongs to the 3rd CRV, and its recreational use is not recommended before implementation of a set of measures aimed at improvement of its quality by improving indicators with low values.

In this way, it is easy to determine the CRV and to express the assessed forest quality.

RESULTS
REZULTATI

Testing of the methodical approach via the urban forest "Horský park" – *Ispitivanje metodičkog pristupa u urbanoj šumi „Horský park"*

As a result of field works, the indicators were defined specifically for each domain in the urban forests. The following indicators reflect the forest condition and most influence the assessment of the Forest domain: *Recreational digression*, *Sanitary condition of the forest*, *New regrowth* and *Lower layers of vegetation*. The *road network density* indicator turned out to be important too.

During the long history of park being used as a recreation facility, an entire network of paths running along main park roads has appeared. As a result, the degraded area increased significantly. The quantitative value C-forest is shown in Figure 3.

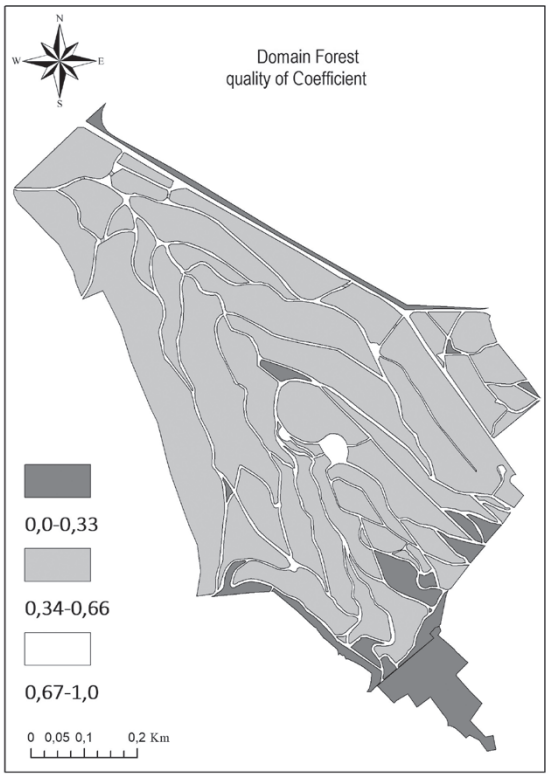

Figure 3 Figure The Evaluation of domain Forest coefficient: low 0.0–0.33 score, medium 0.34–0.66 score, high 0.67–1.0 score.
Slika 4. Evaluacija domene Šuma koeficijenta: nizak rezultat 0,0–0,33, srednja ocjena 0,34–0,66, visok rezultat 0,67–1,0.

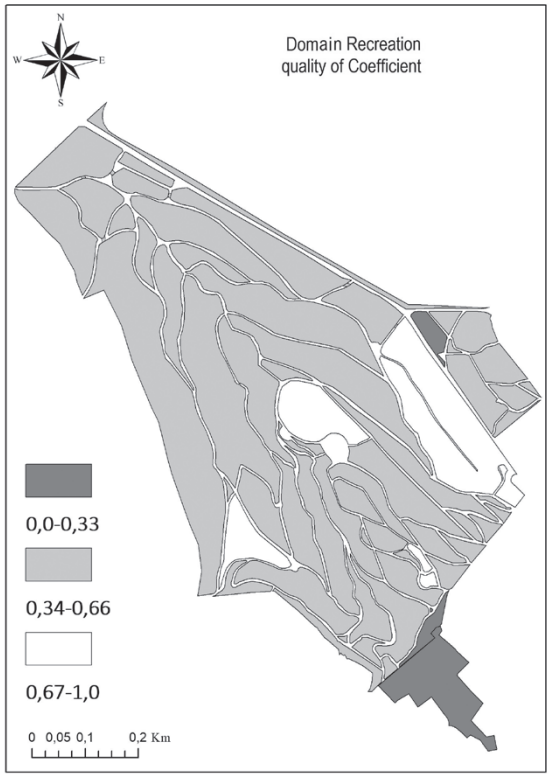

Figure 4. The Evaluation of domain Recreation coefficient: low 0.0–0.33 score, medium 0.34–0.66 score, high 0.67–1.0 score.
Slika 4. Evaluacija domene Koeficijent rekreacije: nizak rezultat 0,0–0,33, srednja ocjena 0,34–0,66, visok rezultat 0,67–1,0.

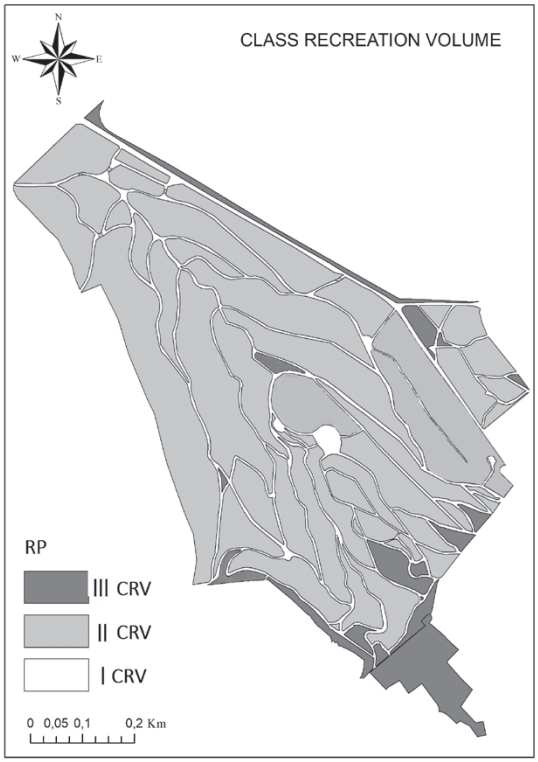

Figure 5. The Evaluation of class recreation volume: low III score, medium II score, high I score.

Slika 5. Evaluacija razrednog volumena rekreacije: niska ocjena III, srednja ocjena II, visoka ocjena I.

In the Recreation domain, the great impact was from indicators: *Diversity of tree species* – aesthetic point of view, *Noise* – the object is located in the centre of an urbanized space, and *Development level* – availability of equipment for active and quiet leisure. Indicators of low impact to the final result included: *Waste*, *Accessibility*, *Quality*, and *Water sources*. The quantitative value of C-recreation is shown in Figure 4.

In general, the state of the urban forest "Horský park" according to the assessment system, has recreational value of I (1%), II (75.9%) and III (23.1%) classes. (Fig. 5)

DISCUSSION
RASPRAVA

Urban forests and other parts of the green infrastructures are the most popular outdoor recreation environments for residents and visitors of city agglomerations in Europe (Konijnendijk 2003).

The fundamental forest recreation related research in Russia is mainly based on the study of the biological stability (tolerance) of forest ecosystems and their components. Recreation in urban forests of Moscow city is discussed in detail by Rysin (2003). The author has identified 29 indicators divided into three domains: Attractiveness of the area, Comfort for recreation and Resistance (stability) to the influence of recreation. Similar indicators were used by Lepeshkin (2007), which included "Visibility" to attractiveness, increasing the total number of indicators to 30. Rysin *et al.* (2015a) published a revised methodological approach. The original concept of the three domains of indicators was regrouped and the total number of indicators decreased to 19. The number of indicators was reduced in order to simplify the practical use of the methodological approach. In contrast to Rysin *et al.* (2015a), our method contains two domains of indicators (Forest and Recreation). We merged the Attractiveness and Comfort domains, which include the interests and requirements of recreation, into the Recreation domain. Now, the Forest domain contains forest environment status indicators only. Additionally, we adapted the content of the indicators. We blended "Age of trees" and "Height of trees" into the *Quality* indicator, which is a measure of the production capacity of the tree in the assessed area (the basic quality indicator is the average height and age of trees). We replaced the indicators of "Walk trail" and "Roads density" (including bicycle paths), due to the often high number of walkways and roads in the urban forest. The indicator no longer evaluates only the existence or absence of a road network but it determines by the share of the area of the road network the total assessed area. In order to simplify the methodological approach, we dropped the indicators of "Stability of lower layers of vegetation" and "Species representation" (Rysin *et al.* 2015a) because they require botanical knowledge. These indicators are partially replaced by the *Diversity of tree species* and *Vertical structure* indicators of vegetation. For the first time the *Objects of interest* and *Development level* indicators are used in the proposed methodological approach. The *Objects of interest* includes a natural object (caves, waterfalls, etc.), and *Development level* includes places equipped with benches, playgrounds, dustbins, etc. The list of domains and indicators is shown in Table 1.

A higher number of indicators have the potential to increase the objectivity of the evaluation results, but it cannot make the proposed methodological approach simpler and more versatile.

The number of indicators is also dependent on the surface area. According to Rysin *et al.* (2015b), it is necessary to reduce the number of indicators in areas with a surface area of more than 1 000 ha, due to the high demand and hence the high fieldwork costs. This reducing approach was tested by Kutilin (2014) in the Losi Island National Park (an area in the north-eastern part of Moscow). The reduction in the number of indicators did not have an appreciable negative impact on the accuracy of the evaluation of the recreational potential of a forest. Eskandari and Ghadikolaei (2013) pointed out that not only ecological parameters are very important, but also socio-economic factors, with an emphasis on visitors' recreational requirements. This data has key importance in terms of influencing both the species and spatial structures of urban forests, as well as their manage-

ment and infrastructure development (Roovers *et al.* 2002). This group of factors in our methodology design is included in the domain Recreation (*Water sources*, *Objects of interest*, and *Development level*). The Ivonin and Samsonov method (2011) addresses an extraordinarily wide range of issues for assessing the recreational potential of forests. It is not designed for urban forests, but is intended for national parks and natural reserves. Ivonin and Samsonov (2011) takes environmental factors into account– climate, soil, water bodies, and weather comfort.

The new method uses the analytical data obtained from the field survey. Rysin *et al.* (2015b) used data from forest planning, satellite imagery and Open Street Maps to assess the recreational potential of quite large areas. A similar data approach was used by Bertini *et al.* (2016) for assessing the urban greenery and environmental quality of life in São Carlos, Brazil. Their primary data sources were satellite imagery and topographic maps. The combination of high-resolution WorldView-2 multi-spectral satellite imagery and airborne laser scanning (LiDAR) data tested for classification of different tree species was also technically demanding (Verlic *et al.* 2014).

The presented methodical approach unifies and resolves the possibility of a uniform assessment of the recreational potential of urban forests. The selected indicators are easily identifiable, measurable and generally usable. Thus, the simplicity of the methodological approach for assessing the recreational potential of urban forests allows the method to be used by a wide range of users. The most promising is its use for administrative workers of city management to be able to use green areas of the city. The method can be used by scientists, environmentalists and students of environmental faculties to analyse the dynamics of changes in the forest environment under the influence of anthropogenic pressures. In addition, indicators included in the evaluating system are probably useable for targeted management of urban forests (Miller 1997) for monitoring of forest stand and future planning of economic activities.

The technique gives a clear understanding of the biological state of the urban forest, and the possibility of using it for recreational purposes. In cases of low scores, an analysis of each individual indicator will make it possible to understand the reason for its low level. Then the necessary economic measures to increase the recreational potential of the territory can be determined. As mentioned above the degraded area in the park has increased significantly by whole network of track appeared. In this case we would suggest limited guests to main roads and carry out activities to restore the soil and cover. All used indicators are probably comprehensible for common users. According to the case study (Figures 1–3), it seems that all used indicators are reliable.

The method described above in comparison with previous studies (Rysin 2003; Lepeshkin 2007; Rysin *et al.* 2015a, 2015b) in these fields has six advantages:

- it contains a small amount of indicators required for forest assessment;
- to understand the essence of the indicator, you do not need to be a specialist in environmental science;
- an assessment of the forest can be carried out by one person not just a group;
- the process of work you do not need special tools and devices;
- the evaluation process is quick, as most indicators are visual;
- the calculation of results is simple and does not require deep mathematical knowledge.

Table 2. Indicator of Quality
Tablica 2. Pokazatelj kvalitete

Age / *Starost*	Quality – *Kvaliteta*						
	Ia	I	II	III	IV	V	Va
	Height (m) – *Visina (m)*						
10	6–5	5–4	4–3	3–2	2–1		
20	12–10	9–8	7–6	6–5	5–4	2	1
30	16–14	13–12	11–10	9–8	7–6	5–4	3–2
40	20–18	17–15	14–13	12–10	9–8	7–5	4–3
50	24–21	20–18	17–15	14–12	11–9	8–6	5–4
60	28–24	23–20	19–17	16–14	13–11	10–8	7–5
70	30–26	25–22	21–19	18–16	15–12	11–9	8–6
80	32–28	27–24	23–21	20–17	16–14	13–11	10–7
90	34–30	29–26	25–23	22–19	18–15	14–12	11–8
100	35–31	30–27	26–24	23–20	19–16	15–13	12–10
110	36–32	31–29	28–25	24–21	20–17	16–13	12–10
120	38–34	33–30	29–26	25–22	21–18	17–14	13–10

Vorob'yev *et al.* (1985).
Old quality stands and associated concepts such as a productivity can be understood in terms of more resistant to recreational impacts than the new regrowth for instance.

It should be noted that the disadvantage of the methodology is the complexity of assessing

such indicators as the *Quality* and *Soil moisture*. The *Quality* indicator requires additional Tab. 2. measurements, the *Soil moisture* can be assessed subjectively, which will affect the final result. The next step in our research will be to compare the recreational potential of several urban forests from different geographical areas.

CONCLUSION
ZAKLJUČAK

The method of assessment for recreational potential urban forests was developed in view of easy, simple and common available indicators and useable by one assessor. The authors selected and tested 18 indicators grouped in two domains (visitors' activities – Recreation, ecological characteristics – Forest) in a case study of "Horský park" forest in Bratislava. The case study in Horsky park tested this new methodology and confirmed the importance of the selected indicators, which enable unbiased assessment of an area in terms of suitability for recreational use. We intend to reaffirm the relevance of methodology by questionnaires in the future.

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SAŽETAK

U radu je prikazana metoda procjene rekreacijskog potencijala urbanih šuma u odnosu na funkcionalne sposobnosti šumskih sastojina za rekreaciju kao praktičnog alata za upravljanje urbanim šumama i uređenju krajobraza. Jedan od glavnih zadataka ovog istraživanja bio je primijeniti razumljive pokazatelje običnim korisnicima. Ovaj aspekt je važan, jer omogućava primjenu metode širokom krugu korisnika. Na primjer, upravitelji mogu procijeniti urbanu šumu u smislu njezine pogodnosti za rekreaciju. Test izrađene metodologije (studija slučaja u šumi „Horský park", Bratislava, Slovačka) pokazuje pogodnost vrednovanja rekreacijskih namjena urbanih šuma. Obilježja svakog pojedinog indikatora određuju načine za povećanje rekreacijske vrijednosti urbanih šuma, a mogu se koristiti i u svrhu njihovog održivog upravljanja.

KLJUČNE RIJEČI: *urbana šuma; šumska rekreacija; ljudski utjecaj; gradsko zelenilo*