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The Ratio of Biologically Vital Areas as a Measure of the Sustainability of Urban Parks Using the Example of Budapest, Hungary

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Abstract: Biologically vital areas (BVAs) indicate regions with ecological functions within cities. Their presence in green spaces helps to counteract the negative impacts of built-up areas and impermeable structures on urban environments and city dwellers. The main objective of this study was to examine the level of sustainability of urban parks based on their real ratio of biologically vital areas (RBVA). The preliminary research was conducted in 2021 on six randomly selected parks in Budapest, Hungary, which are examples either of site rehabilitation or of new designs based on a sustainable approach. The areas of the main types of landcover with ecological functions, such as greenery planted on the ground, green roofs, permeable pavement, and water reservoirs, were measured and compared to the area of hard structures as well as the entire area of each park. The results show that the RBVA was below 50% in four of the six studied cases (ranging from 22.97% in MOM Park to 44.13% in Millenáris Park) and above 50% in two cases (51.52% in Graphisoft Park and 79.31% in Nehru Park). This diversity resulted from the need to reconcile ecological and social functions in urban parks; however, the implementation of sustainable solutions should be increased in further development.

Keywords: urban green spaces; urban parks; biologically vital area (BVA); environmental indicator; green infrastructure (GI); sustainable development (SD); sustainable design (SD); resilient cities

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1. Introduction

The environmental challenges of the past decades, such as global climate change, decreasing urban livability, and the need for responsible water management, have played a key role in the self-definition and acknowledgment of the landscape architecture profession, significantly raising its value and highlighting the role of environmentally sensitive work across various disciplines [1,2]. The social context in European cities has also changed significantly during the past two decades. The issue of environmental quality has become prominent, especially for city dwellers; the need for natural environments, the humanization of open spaces, and more environmentally conscious urban planning have fostered the development of the profession of urban planners and designers [3]. More attention is paid to the conservation and sustainable use of public areas, healthy and green urban environments, the democratic use of green spaces, and environmentally friendly approaches to their creation and/or rebuilding.

1.1. Urban Parks in the Sustainable Development of Cities

Protection and development of green areas currently plays an important role in shaping sustainable cities while posing a challenge to decision makers and designers [3–5]. Urban parks, as the essential components of urban green infrastructure (UGI) [6–9], provide many ecosystem services (ES) and have a positive impact on both the environmental and social functioning of highly urbanized areas, especially metropolitan cities. They can preserve the main ecological functions, counteracting the negative results of climate change and mitigating the effects of urban heat islands (UHIs); at the same time, they offer a large spectrum of features, such as cool ambient temperatures [10,11] and enhanced air quality [12,13], among others. Urban greenery may also support rainwater management in cities through the implementation of diverse, nature-based solutions (NBSs) and the development of systems of blue and green infrastructure (BGI) to maintain natural water cycles and to enhance environmental and urban renewal [14,15]. Urban parks are valuable areas for both maintaining and increasing biodiversity and wildlife in cities [16,17]. A sustainable urban environment has a positive impact on physical and mental health, thus improving the quality of life and well-being of city dwellers [7,16,18–20]. Serving as places for rest and recreation, urban green spaces provide many benefits to people spending their time outdoors by facilitating their contact with nature and many types of social interaction [21–23].

The approach promoted in the new millennium relies on a better understanding of the concept of resilient cities and their implications for sustainability. In view of the rapid increase in the value of urban land and the decrease in its availability, it is crucial not only to reserve space for urban greenery, but also to ensure its quality related to ecological functions. Urban green areas take part in the processes of adaptation to dynamic changes and increasing needs related to the protection and development of nature in highly urbanized areas [4], which are especially important in the struggle against the degradation of urban environments. Both the planning and design of urban parks should, therefore, be directly integrated with activities that make use of this knowledge [24], as well as all available methods and tools to improve the modeling and management of urban ecosystems [25–30]. Modern urban parks contribute to sustainable development as one of the most important strategies to respond to the aforementioned environmental and social challenges [5]. When looking for green solutions and shaping more durable and stable urban areas, an approach featuring sustainable design (SD) is necessary. In the context of urban park creation, it is one of the most successful methods used to address environmental problems. It is also an important approach to meeting sustainable development goals (SDGs), which comprise a large spectrum of issues related to making cities inclusive, resilient, and sustainable [31]. This strategy includes the appropriate creation of urban parks as a valuable component of BGI [32]. SD should also adapt to local conditions and utilize natural processes, and it should be based on long-term monitoring and management of urban green areas related to the maintenance of their diverse ecosystems [33].

1.2. Green Factor Tools for Sustainable Cities

The reason for the weakness of large cities in the face of the unpredictable effects of their own growth is the elimination of the natural mechanisms maintaining the oxygen and water balance from the built-up environment through the excessive elimination of green areas and natural water circulation systems. Intensive urban development is a major threat to both the conservation and maintenance of urban greenery [34]. Despite growing awareness of the benefits of urban parks, natural elements are still heavily limited because functionality and economy in cities are treated as priorities. Increasing the share of natural structures in urban areas requires appropriate legal regulations, including provisions in planning documents. In this context, urban parks are generally assessed through only simple environmental indicators that reflect cities' quality of life and urban comfort [35]. Relevant indicators that are used to assess the environmental performance of the spaces and, thus, contribute to the development of more sustainable and resilient cities need to be conceptually and methodologically well-identified [36]. The simplest indicators, based on basic area measurements and the identification of main landcover structures, are applied to control the intensity of urban development at the early urban planning stage [12,37]. At the same time, designing urban greenery based on urban planning indicators can deliver many of the aforementioned environmental benefits to cities and their inhabitants [38].

The designation of biologically vital areas (BVAs) is one of the environmental and spatial indicators (also called green factor tools [39]) used to express the relationship between built-up and green areas [40,41]. These factors support planners and designers in the achievement of multiple goals related to sustainability [39,42–44]. They appear under varying names and have been adopted by many cities all around the world, including capital cities in Europe (e.g., Berlin [45], Helsinki [46], London [47], Vienna [41], Stockholm [48], Warsaw [49], and Budapest [50–52]) to increase the share and effectiveness of urban greenery [41].

The designation of BVAs is included in the process of establishing the rules of development in cites and is mainly related to the type of greenery and its presence on site [37]. These types of indicators express the ratio of biologically vital areas (RBVA) to the total site area. At the same time, the rationale for this indicator is the implementation of sustainable development for as much space as possible within built-up areas [40,41] to minimize the impact of urbanization on the environment. This indicator is used to both assess the environmental value of urban greenery and, especially, as a planning tool that recommends the minimum BVA value. It is also crucial to increase the RBVA of urban green spaces to make them more stable and to strengthen their resilience—the ability to withstand, resist, and respond positively to pressure or change caused by disadvantageous urban factors [53].

Urban park areas are covered with various structures, usually dominated by those with ecological functions, allowing urban parks to obtain some of the highest RBVAs within cities because of access to the ground and the possibility of introducing many natural elements. Along with vegetation planted in the ground, which is evaluated as the most valuable in the environmental context of urban areas, other natural elements of land cover such as open water reservoirs, permeable pavement, and green roofs participate in biological functions [41]. However, the differentiation of this indicator results from some limitations, such as a high share of other structures apart from those with ecological functions. The ability to satisfy recreational needs of park users depends on the presence of both natural and man-made elements [54–57]. Specifically, components allowing outdoor activities become attributes of urban parks and have a great impact on increasing their usability and accessibility for users [58,59]. However, most of them consist of hard, impermeable structures, e.g., well-developed path systems [60–62] or infrastructure of sports fields and playgrounds [56] that cover much area, thus limiting access to the ground and water retention.

1.3. Urban Parks in the Sustainable Development of Budapest

Together with the economic transformations continued since the end of the 20th century, which had a decisive impact on the rehabilitation of landscapes of many cities, the improvement of urban spatial quality has become the main development aspect of governance in Central and Eastern European countries. SD and the development of green infrastructure make cities more attractive for both visitors and investors, also strengthening their economic position. Many European capital cities, such as Budapest, focus on pro-ecological development [63–66]. The objective of a complex renewal of the spatial and functional structure and greening of spaces has been approved by implementation of the Podmaniczky Program—the Medium-Term Urban Development Program for Budapest in 2005 [50]. Sustainable development was advanced through 'TÉR-KÖZ' projects focused on the renovation of several public spaces, including green areas, initiated in 2013 [67–69]. Accordingly, in the past few years, several green space renovation programs (Imre Steindl Program, Downtown Europe Program, Magdolna Quarter Program, National Hauszmann Program, Modern Cities Program, Corvin–Szigony Project, AngyalZöld Project, Rak–Park Project, etc.), initiated by the central government as well as local city and district authorities, have been successfully realized or are in progress [70–73]. The green approach is also implemented in the Budapest 2030 Long-Term Urban Development Concept—the Integrated Urban Development Strategy [51,74]. Creating a healthy environment for living and enforcing sustainability in urban development has become a fundamental importance. The same approach was promoted in the Thematic Development Programs (TDP) of Budapest in 2014 and 2015 [75] as cooperation between the Municipality of Budapest, including its 23 districts, with authorities and professional organizations. Many open and green areas of Budapest have been deliberately renovated in the last few years, typically with the participation of landscape architects. This accounts for several hundred interventions at the site level in the city, including several urban parks [76,77].

Taking into account all of the aforementioned aspects related to the role of urban parks in Budapest, it is crucial to identify and assess their sustainability based on the quantitative measures of a basic green indicator—the biologically vital area (BVA)—that is approved by decision-makers in urban planning processes and implemented in planning documents. The main objective of the pilot study presented in this paper was, therefore, to determine the real ratio of biologically vital areas (RBVAs) in selected urban parks in Budapest as examples of sustainable design (SD) introduced in recent years. We additionally use a case study as a reference in providing some guidelines to more effectively incorporate urban parks as biologically functioning areas into the modern ecological framework in the future for more sustainable city planning.

2. Materials and Methods

2.1. Case Selection

The pilot study concerns a few typical projects of urban parks created or rebuilt in the 21st century, classified into three main groups of similar geneses and resulting from sustainable changes implemented in Budapest. Based on a literature review [76,77], two typical examples from each group, classified as leading sustainable projects, have been selected for detailed analysis, and they include:

- renovation of existing parks created in the 20th century: Olimpia Park, Nehru Park;
- newly designed parks created as a result of brownfield reuse and development: Millenáris Park, Graphisoft Park;
- newly designed parks created as a result of development of residential areas: MOM Park, Bajor Gizi Park (a complex area including the adjacent K&H Headquarters, the National Theatre, and the Palace of Arts).

All the studied parks are located in the central districts of Budapest and have different sizes. Their main characteristics, including general data related to their creation and aspects related to SD, are presented in Table 1.

Table 1. Main characteristics of urban parks selected for the study (elaborated by authors).

Group of Parks	Name of Park	Location (District)	Creation/Rebuilding Periods	Main Sustainable Approach
Renovation of existing parks	Olimpia Park	V	- 1979—opening in its original form - 2012–2013—redesign - 2014—opening after modernization	- renovation of a green area in a very densely built urban space - preservation of valuable old trees - development of plant structures, increase the number of species to improve biodiversity, increase the quality of social and health conditions, and improvement of economic and tourism potential of the city [78–80]
	Nehru Park	IX	- 1966—opening in its original form as a part of Danube riverside arrangement - 2015–2016—redevelopment - 2016—opening	- renovation of a riverside park as a part of climate resilience activity towards reduction of urban heat island effect, increasing biodiversity, greater habitat connectivity, improvement of climate conditions, and enhance air quality, mitigation of extreme events such as floods or heavy precipitation - development of plant structures, including a garden of biodiversity with perennials [81–83]

Table 1. *Cont.*

Group of Parks	Name of Park	Location (District)	Creation/Rebuilding Periods	Main Sustainable Approach
Newly designed parks created as a result of brownfield reuse and development	**Millenáris Park**	II	- 1999—government decision to create event and exhibition center with park - 2000—design and park construction - 2001—opening	- rehabilitation, including removal of pollution and toxins from the soil and groundwater - transformation of postindustrial site into urban green area - increase of plant diversity, utilitarian plant cultivation - introduction of water reservoirs for microclimate improvement [76,84–87]
	Graphisoft Park	III	- 2004–2006—design - 2007—construction - 2007—opening	- rehabilitation of former gasworks area to urban green spaces - introduction of diversity of plants, including high contribution of green roofs - introduction of water reservoirs for microclimate improvement and ensuring space for aquatic plant development [76,88]
Newly designed parks created as a result of development of residential areas	**MOM Park**	XII	- 2000–2001—planning - 2001–2002—construction - 2002—opening	- rehabilitation of former factory of Hungarian Optical Works to create public green spaces connecting business complex and neighborhood - introduction of plants, including high contribution of green roofs [76]
	Bajor Gizi Park	IX	- Main park area: - 2006–2007—design - 2006–2008—construction - 2008—opening - K&H Headquarters/the National Theatre and the Palace of Arts' surrounding: - 2010—planning - 2011—construction and opening	- renovation of former expo and post-railway areas towards multifunctional public green spaces through organic connection between the neighboring office buildings, the National Theatre, and the Palace of Arts - increase plant diversity, implement green roofs - introduction of water reservoirs for microclimate improvement [76,89]

2.2. Methods

The six cases selected for the detailed study were discussed following the established common framework consisting of three stages of quantitative studies. In the first stage, documentation of each urban park based mainly on the literature review and supported by the data taken from the design studios' official web pages was completed to define and confirm the sustainable approach implemented in the projects.

In the second stage, the main landcover structures performing biological functions were identified in each urban park selected for the study. The structures were divided into main types and subtypes, such as:

- buildings (B);
- greenery—planted on the ground (GG); green roofs (GR);
- pavement—water-permeable (sand, gravel) (PP); semi water-permeable (bricks or concrete tales overgrown with grass) (PS); water-impermeable (concrete, artificial surface of sport area and playgrounds) (PI);
- water—artificial reservoirs (WA); other water features (water games, fountains, etc.) (WF).

The land cover structures were preliminary identified with the use of remote tools (Google Maps, Google Earth), as well as through verification of park designs based on review of the literature and Internet sources. In order to complete and confirm the obtained information, a general field inventory was carried out during site visits to the parks in September 2021. Basic measurements of the areas with different landcover structures were made. The data were collected in tables prepared for each park, and then the measurements of all structures of the same type and subtype were summed. The results included both the surface area (m^2) and percentage distribution (%) in relation to the whole park area. The layout of each landcover structure has also been presented in a graphic form in the same scale on an aerial photo of each park taken from Google Maps (Figures 1–3).

The third stage consisted in the identification of RBVA in urban parks and the division of their areas into those performing biological functions and other functions. The BVAs included: 100% of the areas covered by vegetation planted on the ground and 50% of vegetation planted on green roofs, permeable pavement supporting the development of vegetation and rainwater retention, and water reservoirs with an area of over 10 m^2. The rules are in line with the guidelines introduced in Hungarian national law [90–92] and with the local regulations implemented by the city of Budapest [74,93]. The results allowed for the indication of RBVA in relation to the whole area of each park individually, as well as to compare its share with other parks selected for the study.

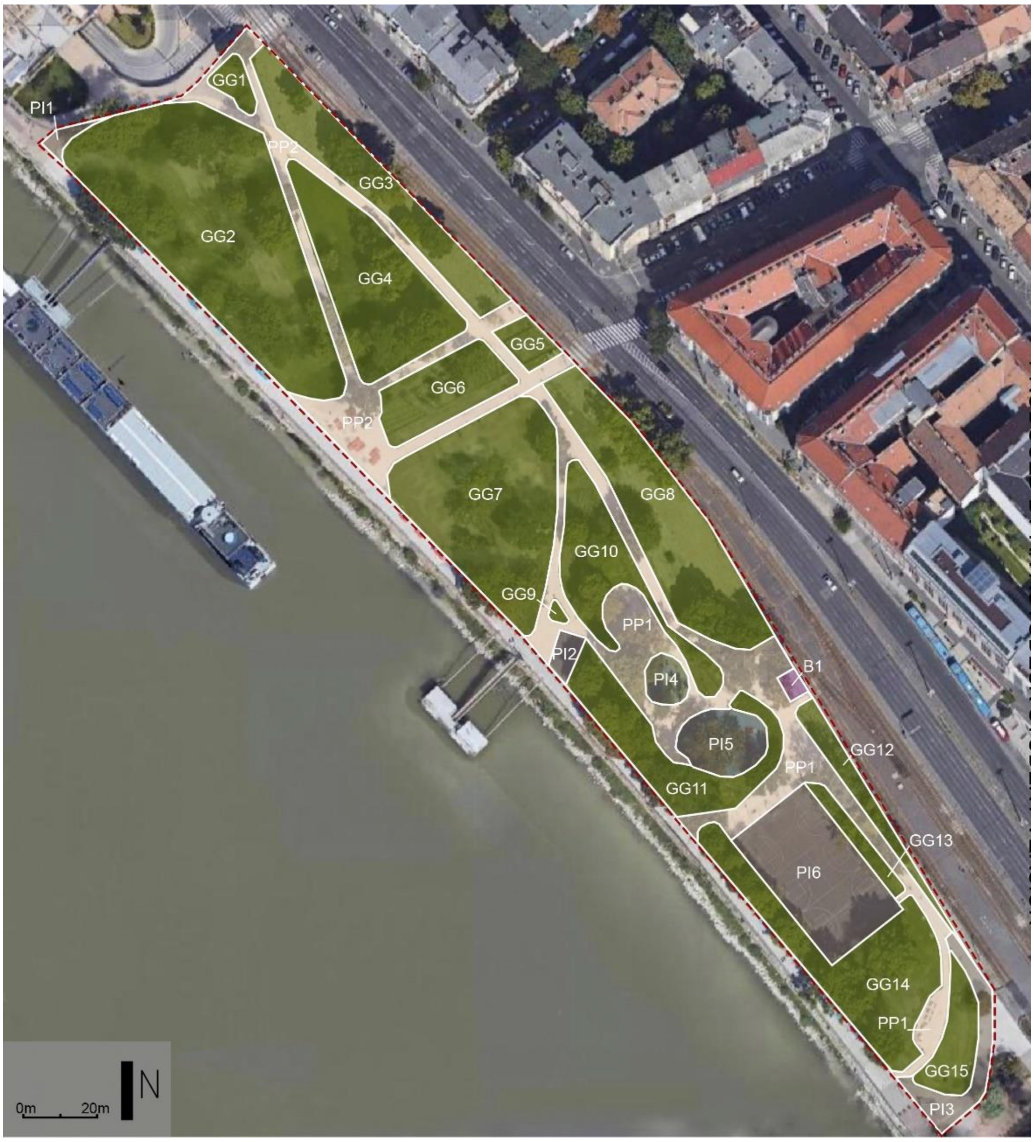

Figure 1. The main landcover structures identified in Nehru Park (B—buildings; GG—greenery on the ground; PP—water-permeable pavement; PI—water-impermeable pavement); an example of the park with the RBVA of 79.31%.

Figure 2. The main landcover structures identified in Olimpia Park (B—buildings; GG—greenery on the ground; PP—water-permeable pavement; PI—water-impermeable pavement; WA—artificial reservoirs); an example of the park with the RBVA of 43.72%.

Figure 3. The main landcover structures identified in MOM Park (B—buildings; GG—greenery on the ground; GR—green roofs; PP—water-permeable pavement; PI—water-impermeable pavement; WA—artificial reservoir); an example of the park with the RBVA of 22.97%.

3. Results

The landcover structures divided into the four main types identified in all three groups of the studied urban parks in Budapest are presented in Table 2. The relationships between those structures are also visualized in graphic form on the plan of selected parks and presented in Figures 1–3.

Table 2. The characteristics of landcover structures identified in all types of urban parks (elaborated by authors).

Landcover Structures			Renovation of Already Existing Parks				Newly Designed Parks Created as a Result of Brownfield Reuse and Development				Newly Designed Parks Created as a Result of Development of Residential Areas			
			Olimpia Park		Nehru Park		Millenáris Park		Graphisoft Park		MOM Park		Bajor Gizi Park	
			m^2	%	m^2	%	m^2	%	m^2	%	m^2	%	m^2	%
Architecture	buildings (B)		118.91	1.09	40.09	0.21	13,232.12	29.70	5136.72	23.45	11,487.71	40.63	22,398.00	35.57
Greenery	planted on the ground (GG)		4262.76	39.13	13,114.11	69.67	16,991.89	38.13	8073.38	36.86	4279.24	15.13	15,085.02	23.95
	green roofs (GR)		-	-	-	-	-	-	3396.14	15.50	3262.76	11.54	3633.40	5.77
Pavement	water-permeable (PP)	gravel	1079.68	9.18	3626.24	19.27	2926.71	6.57	1205.63	6.71	36.97	0.13	2080.70	3.30
		sand	-		-		-		263.57		-		-	
	semi water-permeable (PS)	bricks or concrete tales overgrown with grass	-	-	-	-	-	-	71.07	0.33	-	-	1294.04	2.06
	water-impermeable (PI)	concrete	4159.40	50.24	459.63	10.85	8998.09	20.19	3099.84	14.15	9180.10	32.46	16,685.74	26.99
		artificial surface on sport fields and playgrounds	1314.12		1582.53		-		-		-		309.13	
Water	artificial reservoirs (WA)		39.42	0.36	-	-	2411.20	5.41	558.80	3.0	31.72	0.11	1470.28	2.36
	other water features (WF)		-		-		-		98.54		-		17.82	
Total park area			10,894.29	100	18,822.60	100	44,560.02	100	21,903.69	100	28,278.50	100	62,974.13	100

The results show that in all urban parks in Budapest selected for the study the RBVA mostly results from those landcover structures which have the most ecological functions (a factor of 100% for the RBVA). These structures are greenery planted on the ground, and the average RBVA for all six parks is 37.15%, while their share is much different in individual parks. Natural elements cover only 15.13% of the MOM Park area, in which many office buildings and hard structures such as impermeable pavement have been introduced. The situation is much different in Nehru Park—greenery planted on the ground covers the largest area of all six parks and amounts to 69.67%. A very low share of impermeable surfaces and other hard structures, especially buildings, in the area of this park makes it much more sustainable than others.

Structures such as green roofs have been identified in three of the six parks, but at the same time their share in total RBVA is also generally low. Greenery planted on architectural surfaces accounts only for 16.22% of buildings in Bajor Gizi Park, which is at the same time only 5.77% of the park area. There are more green roofs in MOM Park—they cover 28.40% of buildings (11.54% of the park area). The highest share of those components was identified in Graphisoft Park—green roofs cover 66.11% of buildings, which is equivalent to 15.50% of the park area. A large area of green roofs results from the preservation of a high number of postindustrial buildings adapted to ecological functions in this park. Some deficiencies in this approach have been observed, in particular in Millenáris Park, in which the potential for the introduction of greenery on the roofs of both historic and new buildings has not been taken into account in the adaptation and design process.

Water elements included in the RBVA with a minimum size of 10 m^2 were identified in half of the studied urban green areas and are represented by large artificial water reservoirs. Their share in the RBVA is very low. In the case of Bajor Gizi Park, water reservoirs cover only 2.36% of the total area, while in Graphisoft Park the share is 3.0%, and in Millenáris Park it amounts to 5.41%. In two parks, water elements function together with vegetation. This relationship, which is valuable for the urban environment, is, however, low in Millenáris Park due to the fact that water plants occupy only a small area by the water, while in Graphisoft Park the reservoir was designed with a variety of plants, and thus this system contributes much better to ecological function.

Pavement is one of the most important elements of parks. This type of structure does not ensure the presence of vegetation, but can indirectly support its development by water supply from surface runoff or infiltration as part of rainwater retention. Regardless of possible limitations, the implementation of water-permeable or pervious pavement is necessary to improve the ecological functions of urban parks. The results show that water-permeable pavement, such as gravel, was identified in all six parks. However, as only 50% of those types of surfaces are included in the RBVA, their share in the total park area is assessed as very low and ranges between only 0.13% in MOM Park and 19.27% in Nehru Park. The potential to supply vegetation with surface runoff water is, therefore, poorly or at least insufficiently used in all cases, especially while water-impermeable pavement dominates in all parks, with their general coverage varying between 10.85% in Nehru Park and 50.24% in Olimpia Park. The area of paved surfaces is generally high (between 21.19% in Graphisoft Park and 59.42 in Olimpia Park) due to the need to ensure users access to all elements of recreational infrastructure.

The RBVA of the six studied urban parks, resulting from the quantity of biologically functioning landcover structures included in this factor in relation to the whole park area, is presented in division into four main types in Table 3.

Regardless of the area covered by individual structures participating in ecological functions and the proportions observed between them, the results show that generally the RBVA is low or very low in as many as four of the six parks. The ratio is higher than 50% only in two studied green areas—this ceiling has been slightly exceeded in Graphisoft Park at 51.52%, while it is highest in Nehru Park at 79.31%. The research results show that in the case of the remaining four parks, the RBVA is, unfortunately, below 50%. The ratios of 22.97% in MOM Park and 29.66% in Bajor Gizi Park are very low and result mainly from buildings and hard surfaces (pavement) covering much area. In two other parks, the RBVA is slightly over 40%: 43.72% in Olimpia Park and 44.13% in Millenáris Park. This ratio is still relatively low for urban green areas, which must counteract many negative effects of climate change characteristic for central city districts of the city. The unfavorable proportions of ecologically functioning areas to those covered by hard structures show that a sustainable approach to the creation of these parks may be also assessed as rather limited.

Table 3. The real ratio of biologically vital areas (RBVA) in urban parks (%)—the park with the highest RBVA (marked in green); the park with the lowest RBVA (marked in grey) (elaborated by authors).

Landcover Structures		Landcover Included in the RBVA	Renovation of Already Existing Parks		Newly Designed Parks Created as a Result of Brownfield Reuse and Development		Newly Designed Parks Created as a Result of Development of Residential Areas	
			Olimpia Park	Nehru Park	Millenáris Park	Graphisoft Park	MOM Park	Bajor Gizi Park
Greenery (G)	on the ground (GG)	100%	39.13%	**69.67%**	38.13%	36.86%	**15.13%**	23.95%
	green roofs (GR)	50%	-	**-**	-	7.75%	**5.77%**	2.89%
Pavement (P)	water-permeable (PP)	50%	4.59%	**9.64%**	3.29%	3.36%	**0.07%**	1.65%
Water (W)	artificial reservoirs (WA)	min. 10 m^2	-	-	2.71%	1.28%	-	1.17%
	Total RBVA:		43.72%	**79.31%**	44.13%	51.52%	**22.97%**	29.66%

4. Discussion

The maintenance and restoration of urban green areas to increase their sustainable functioning has become more and more important in recent years [34]. This approach results from the continuous processes of rapid urbanization related to densification of cities and their huge spatial expansion, which has a negative impact on green areas and transforms many urban spaces into impervious landscapes [94]. The use of urban parks to counteract those negative phenomena [6–9] consists in introducing a large number of natural elements that compensate for the negative impact of hard components. Therefore, the role of landcover structures included in urban environmental indicators [40,41], such as the most comprehensive ecological functioning greenery planted on the ground, is especially increasing and appreciated, but others, such as green roofs, water-permeable surfaces, and water reservoirs, which support environmental functions of the site are also welcomed.

The method for identification of the RBVA introduced in the study conducted in urban parks in Budapest is generally easy to apply. The use of online tools such as Google Maps and Google Earth may essentially support the initial identification of landcover structures in urban parks, which then need to be verified during observations and supported by in situ measurements. This kind of identification method is one of the landcover metrics that can be successfully used for the purposes of a preliminary study of sustainable structures in urban green areas, and is consistent with the scope required for the implementation in urban planning (documents of local law). The RBVA is one of the eco-indicators based on quantitative data resulting from identification of the main types of landcover components, in this case biologically functioning soft structures and hard structures without those functions. At the same time, by comparing the collected data, this method makes it possible to define the basic characteristics of the main landcover structures, such as size, spatial configuration, fragmentation of area, diversity, etc. [95], as well as the basic quantitative relations between them. It allows for the monitoring of parks and other areas of the urbanized environment in terms of BVAs [96] and transformation of park landscape over time [97,98]. It also can support the monitoring of sustainable growth in urban areas [99,100] and identification of both positive and negative changes [95,97,101]. Therefore, the RBVA as a spatial and temporal metric is useful for classifying different urbanization trends in cities [102].

Based on the aforementioned functions, the RBVA is one of the most important planning and urban design tools and measures, helpful in the creation of sustainable urban areas. It supports urban managers and decision makers related to urban landscape planning and design prevent environmental consequences [40,103]. This indicator may be also recommended for the modernization or revitalization of both existing and newly designed green areas to make them more sustainable. It is important to use all possible methods and tools to shape sustainable urban greenery, especially those which are at the first stage of inexpensive data collection, and use the results for fast response to the expansion of built-up areas [98,100]. However, at the same time, it must be also understood that the scope of data used for the RBVA indicator may be deemed insufficient nowadays. The lack of qualitative data required in planning decisions related to the diversity of landcover structures resulting in their diverse ecological functioning may be considered a limitation. This observation is important in the context of increasing threats, such as those caused by climate change, that need intensive preventive actions. Further research on the RBVA should be also combined with other measures, e.g., major needs of city dwellers related to the use of urban parks. Therefore, in order to recognize how sustainable urban green areas are, research should be developed towards the coexistence of qualitative and quantitative indicators due to the complexity of the urban landscape [40,104].

This paper focuses on the review of characteristic public park renovation and design projects from Budapest. The case studies are used to present the directions of development and values of the contemporary design of urban green spaces based on pro-ecological approaches and solutions. The results for six urban parks in Budapest selected for the study as those created in line with the sustainable approach and as examples of SD show that their identified RBVA is, in most cases, at the level of 50% or lower, which may be assessed as inadequate for urban green areas. They present the real situation and prove that a sustainable approach was or could be only partially introduced in the contemporary designs of studied urban parks. The reasons for this are associated with several aspects. The main design methodology of urban green areas has already changed in the new millennium. On the one hand, the legal background for planning has become more rigid, complex, and focused on increasing requirements towards the implementation of costly and technically demanding sustainable solutions. On the other hand, the planning process is more developed and based on the contribution of multiple actors: local governments and other relevant authorities and the users of urban parks. The role of urban planners and designers has become more complex. The final result, then, must be accepted by all participants, which requires comprehensive coordination based on a comprehensive approach from the landscape architect as the general planner [3,105,106].

The results show the real RBVA in the studied urban parks in Budapest. Their relatively low levels may indicate some deficiencies in terms of their SD. Therefore, the data presented in this study have an important practical dimension by directly indicating that those parks especially require the implementation of more-ecological solutions that should compensate for the negative impact of hard structures on the urban environment. Taking action to improve this situation to increase BVA is very important for the maintenance and development of urban green areas located in central and densely populated districts, which must counteract many negative effects of climate change and meet the expectations of inhabitants related to the use of urban parks. This is a considerable challenge, but, at the same time, the driving paradigm for urban planners and designers, whose role in shaping sustainable cities is increasing nowadays. A positive perception of urban parks and their components by users is an important factor in planning and managing urban green spaces [107]. Successful activities in urban parks which meet those objectives may therefore create a balance between a variety of landcover structures in the city landscape [108].

5. Conclusions

Contemporary cities operate as organisms consisting of a rich patchwork of soft and hard structures, with the tendency to degrade natural features. Due to the need to increase the adaptive capacity of urbanized areas to counteract an increasing number of threats, there is a growing interest in developing sustainability evaluation frameworks at different scales. In that context, it is purposeful to develop research on BVA in urban areas, and especially to appreciate the role of parks in this regard. The RBVA is one of the indicators used to assess the environmental value of urban greenery, as well as a planning tool used to recommend its minimum level. The key concepts of sustainable parks should focus on increasing this value to enhance the role of those areas within the city.

The data presented in the study on six parks in Budapest confirm that the implementation of a high RBVA may be difficult; however, it needs to be introduced to increase the ecological role of urban green areas. The renovation and design of urban parks is an important part of the medium-term and long-term Integrated Urban Development Strategy for Budapest. It significantly expands the function of public parks, contributing to the overall development of the city. Therefore, the experiences of Budapest show the potential for older or newly designed public parks to shape an approach to and/or a catalyst for urban regeneration.

The study on urban parks in Budapest also contributes to increase knowledge and has significant value in understanding how much activity is still needed to improve their sustainability. Therefore, the research on the RBVA presented in this paper has important implications for public debate on the possibility of maintaining and increasing the ecological functioning of urban green areas. The renovation and design of urban parks should also be carried out under direction towards their multifunctional recreational use. Taking into account the aforementioned aspects, it is needed to emphasize the importance of further research on spatial morphology and landcover structures in urban green areas to create more-detailed data and use it as a tool to build more urban resilience. In that context, raising the awareness of decision makers, planners, and designers about the importance of such approach, as well as the implementation of their knowledge and experience, is crucial for promoting the SD of urban parks.

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