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Cultural Ecosystem Services of historic parks in context of their functionality and spatial organisation by the example of Lublin, Lviv, and London

Abstract

All urban green areas can provide cultural ecosystem services (CES). The spatial structure and equipment of historic urban parks reflect changes since their establishment. These areas are often protected by local laws, limiting modernization. An interesting question is whether the historic value of a park affects the number of CES provided, and if it is possible to preserve this historic value while meeting modern user needs. The goal of this article is to determine the spatial structure of three historical urban parks in Poland, Great Britain, and Ukraine. This work compares the types of CES provided by the studied parks and examines their spatial distribution. All analysed parks provide CES, but the parks in Lublin and Lviv offer fewer CES than Lloyd Park in London, which effectively combines historical value with the growing needs of a modern 21st century city.

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1 Introduction

The discussion regarding the meaning of green areas in modern cities has been ongoing for decades and is interdisciplinary, confirming the multiperspective aspect of this subject (Burgess et al. 1988; Swanwick et al. 2003; Ibes 2014). Urban vegetation is considered in the context of natural systems (Szulczewska et al. 2017; Tzoulas et al. 2017), spatial-compositional settings (Wejchert 1984; Chmielewski 2010), and broadly defined functionality and utility (Chiesura 2004; Qureshi et al. 2010; Ghel 2014; Rabiah 2020). The term "urban green" includes seminatural and synanthropic vegetation, as well as controlled greenery, i.e., purposefully designed (Yilmaz and Mumcu 2016; Taylor and Hochuli 2017; Harasimowicz 2018). Both types of greenery influence the urban ecosystem, fulfilling ecological functions (Vargas-Hernandez et al. 2018; Speak et al. 2015), determining the climate of cities (Skoulika et al. 2014; Wang et al. 2015), and improving citizens' quality of life (Bolund and Hunhammar 1999; Mexia et al. 2017; Maurer et al. 2021). Purposefully planned objects, with perceptible human intent, form the cultural value of cities and determine the character and identity of the urban landscape (Chmielewski 2010; Vargas-Hernandez et al. 2018).

Urban parks play a vital role in balanced cities, considered as complex ecosystems (Chiesura 2004; Loures et al. 2007). They provide ecosystem services with local and global benefits (Bolund and Hunhammar 1999; Zwierzchowska et al. 2018; Priess et al. 2021). According to Tandarić et al. (2020), among ecosystem services provided by public parks in cities, those cultural in character remain invariably underestimated. It is due to the fact, that it is difficult to unequivocally assess their value, and their perception is subjective, depending on the user. Cultural Ecosystem Services (CES) undoubtedly also influence the health and social conditions of citizens' lives, increasing their quality. CES are generated solely by man and nature, depending on three conditions: space, man, and time. Firstly, CES are a result of human interactions within a given, unique space. Secondly, people utilise said space in accordance with the values they uphold. Thirdly, perception of a place can vary, depending on the season, or the time of the day. Therefore, the basic condition of how CES reception is human perception. The greatest problem while analysing CES is their placement in space. In scientific publications spatial analyses most often pertained solely to CES provided in terms of sports and recreation, which are the easiest to measure (Tandarić et al., 2020). However, it is advisable to shift the direction of thought in this regard, so that the starting point would be the assessment of how the surroundings were designed, which will ensure proper space for cultural practices. It is then that such space will be favourable to human interactions with one another, and with nature. Tandarić et al. (2020) state that the spatial scale of urban green areas is irrelevant, since CES are provided by large, multi-functional public areas, as well as small parks, and even roadside vegetation (Tandarić et al., 2020). However, it is a simplification because the range of CES is vast, and not every area can provide all services. Therefore, it is important to carefully consider the scope of distribution of provided services in a given space.

Previously, park assessments focused on spatial structure, visual appeal, accessibility, and safety (Podciborski and Krukowska 2013; Podciborski and Michno 2014). Now, functionality in terms of social, cultural, and health services is more important. Thus, parks should be evaluated for their availability for health-promoting activities, including physical activity, mental health, and social interactions (Lee et al. 2015; Coldwell and Evans 2018; Krzeptowska-Moszkowicz et al., 2023; Trojanowska 2024). Studies of three central parks in Manchester (UK) show that local central parks provide crucial CES to the community by enabling human integration and building social connections (Kaźmierczak 2013). Research shows that both newly designed city parks, as well as those with historic value still play important social and cultural roles (Loughran 2018).

The goal of this work was to determine the scope in which historic urban parks in Lublin, Lviv, and London provide CES to their citizens. The following elements were taken into consideration: access to physical activity, opportunities for intellectual growth, developing mindsets, and having spiritual and existential experiences, which perfectly fit CES (interactions with nature). In this way, we wanted to

obtain answers to the following research questions: whether historic public parks functioning in modern cities can fully address the needs of the citizens. Can the established compositional and functional solutions that result from historic conditioning limit the scope of ecosystem services provided in this day and age in historic objects? Can a wide-ranging functional program pose a threat to historic objects? Does historic value of a park influence the number of provided CES? Is it possible to preserve historic value while satisfying the modern needs of the users? Due to these reasons, we would like to propose a spatial assessment of the potential a given terrain has for providing CES in the case of city parks.

2 Material and methods

Surveys and observations are the most popular method for studying interactions between people and the urban landscape, including ecosystem services. Matsuoka and Kaplan (2008) found that 27% of articles in "Landscape and Urban Planning" were based on surveys, and 24% on interviews, focusing on users' needs and how they are met by the natural environment. Koschke et al. (2014) also highlight that 23% of ecosystem service studies are survey-based, and 22% are interview-based. The main challenge is not data acquisition but understanding and classifying ecosystem services. Surveys identify modern users' growing needs and preferences for park use but often marginalize the spatial structure that influences the functional program and quality of services. GIS tools are useful for defining the distribution of ecosystem services, as shown in studies of the Halle-Leipzig region in Germany, helping in landscape management by highlighting conflict areas and development opportunities (Burkhard et al. 2009).

2.1 Study area

For the purpose of this study, three parks with similar area were selected: Lloyd Park in London, Saxon Garden in Lublin, and Ivan Franko Park in Lviv (Fig. 1). What is more, despite the fact that they were established in different historic periods, today they represent a very similar spatial style, characteristic of European urban parks from the end of the 19th, and the beginning of the 20th centuries. The communication, spatial, and floral settings of all three parks are quite similar. The influence of British models on garden art of Middle-Eastern Europe is additionally important, since English landscape parks were the precursors of other projects. Due to the fact that British parks have a very old tradition and are regarded as model objects, the London park was chosen on purpose, in order to highlight the differences and similarities in the functioning of historic parks. Subsequently, it was compared with parks in Poland and Ukraine. The selection of Lublin and Lviv parks is due to the need to present their differences in functioning despite a relatively small distance (approximately 216 km), similar origins and composition. However, it should be noted, that after the end of II WW, Lviv, which was previously situated within Polish territory, became a part of the Ukrainian People's Republic, belonging to USSR, which could have facilitated the change in its functioning. To sum up, the selection of parks was influenced by: similar size, compositional setting, style, as well as historic character. What is more, they are the most important historic park spaces situated at the closest proximity to the historic centres of the chosen cities (Lublin, Lviv), and the Walthamstow district in London.

The Saxon Garden in Lublin was established in 1837 by an engineer, Feliks Bieczyński, at the contemporary Warsaw Route, behind the fortifications on the town's west side (Niedźwiedź 2007; Przesmycka and Boguszewska 2020). At present, it constitutes a vital element of the greenery system in Lublin, at the same time being the oldest city park. The second studied object is Lloyd Park in Walthamstow, London. Until 1900, this site was a part of a private residence of the Lloyd family, and earlier of the Morris family. It functions as a district park, public in character, since the beginning of the 20th century (Bayliss 2012; Nisbet 2016). The third analysed urban garden complex is what is presently known as Ivan Franko Park in Lviv. This object is the oldest central park in Lviv, and since the 16th century, it had been owned by The Society of Jesus Order. It became a widely available city park at the end of the 18th century. It owes its present compositional setting in an unconstrained landscape style to modernisation in 1855 (Zhuk 2016).

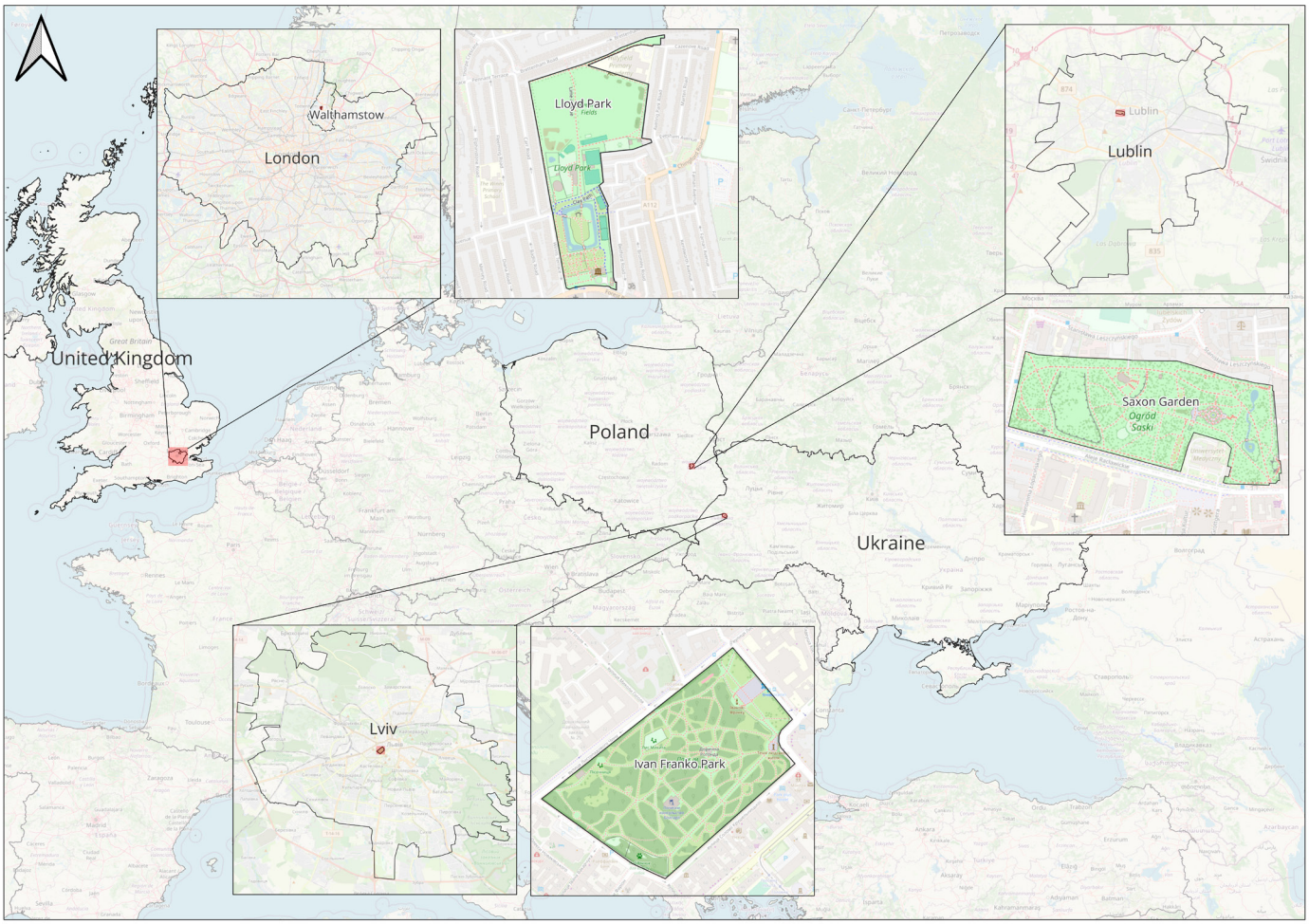

Figure 1. Location of the studied parks (own research, 2023).

2.2 Distribution of CES in the studied parks

The present study was based on a set of ecosystem services compatible with the Common International Classification of Ecosystem Services, following Solon et. al. (2017). As described in the methodology by Kulesza and Lubiarz (2016), functions fulfilled by historic city parks were grouped and assigned to individual sections and classes within the set of ecosystem services CICES. Field analyses and observations were performed in 2018-2020 during the summer months. By means of field observations, elements of equipment of the studied historic parks enabling fulfilment of contemporary CES were assessed. They were also spatially differentiated which allowed for a valorisation of the functional program of individual parks. Also analysed were development opportunities for social actions and organising cultural events. What is more, spatial settings of the studied parks were compared using GIS tools. For that purpose, maps of each park were vectorised, and, basing on polygons, spatial parameters were calculated. All cartographic materials were developed based on Open Street Maps resources. The ratio of park area to the area of the city was determined (and in the case of Lloyd Park it was the ratio of park area to the surrounding district of London). Moreover, it was determined what percentage of the park area was covered with vegetation, and what percentage was left for other types of terrain (paved roads, squares, or playgrounds). Differences in the degree of vegetation coverage in the studied parks, as well as the dominant compositional form of plantings were shown. It was also analysed if there are water elements within park grounds, and what is the ratio of their area to the park area. Therefore, our studies are based on the analysis of the spatial structure of these parks, which influences their functioning and level of provided ecosystem services.

2.3 Accessibility of the studied parks

The next step involved determining the scope of accessibility of the studied parks to inhabitants of the city or district. For this purpose, a distance of 400 m (a quarter of a mile) – i.e. a 5-minute walk to the park from one's place of residence – was established. The distance of 400 m was measured from every park entrance, since in the spatial scale of the analysed parks it was considered that these parks fall into the category of large objects. In order to measure accessibility two methods were used, that is measuring the distance from a given point in a straight line via buffering, as well as on a model of the surrounding road network, using isochrone interpolation. In the first method, the area of influence of a given radius is measured from particular points. Isochrones are based on the communication network and include not only the distance, but also the time of travel (Burdziej 2018). Accessibility of particular service areas of the parks was measured using buffers with a radius of 400 m, beginning with the main park entrances, as well as using isochrones within the time limit of 0 to 5 minutes.

3 Results

All of the analysed parks play the role of modern, public urban green areas. At the same time, they possess heritage and historic value. At present, the Saxon Garden in Lublin and the Ivan Franco Park in Lviv are the oldest central city parks, functioning in the centres of these two cities. Lloyd Park, on the other hand, is the central and main park in Walthamstow – north-eastern district of London. The total area of the parks and their detailed spatial structures are presented in Table 1.

3.1 CES contribution in selected parks

Based on the CES classification, adapted from Solon et al. (2017), in the course of the present research 24 services related to the studied city parks were identified.

Physical interactions The opportunities for sports and recreation in nature are diversified across the parks. Lloyd Park offers a dedicated running track around Aveling Fields, whereas the Saxon Garden and the Ivan Franko Park provide options for running and walking on existing park paths, although they lack dedicated running tracks. For biking, Lloyd Park includes five bike stands and an asphalt bike track, which is transit-oriented in character. The Saxon Garden prohibits biking on paths and pavements due to park regulations, and it lacks bike stands. Similarly, the Ivan Franko Park has signs prohibiting biking and rollerblading. None of the parks provides accommodations for horse riding. Extreme sports facilities are limited; Lloyd Park includes a skate park, but using skateboards, scooters, and rollerblades on paths other than the asphalt bike track is prohibited. The Saxon Garden lacks a skate park, and the Ivan Franko Park only has an illegal bike trial track (Fig 2a-2c).

Regarding group sports, Lloyd Park offers a variety of facilities, including three tennis courts, two bowling tracks (one synthetic and one natural), two basketball courts, two ping-pong tables, and one Pétanque terrain. The Saxon Garden and the Ivan Franko Park lack sports fields and infrastructure. Open spaces for gymnastics such as yoga, tai-chi, or aerobics are available in Lloyd Park, particularly at Aveling Fields, but such spaces are absent in the other parks. Weight-lifting exercise options are provided in Lloyd Park through an outdoor gym (Fig. 2d), which is unavailable in the Saxon Garden and the Ivan Franko Park.

Table 1. Spatial structure of the studied parks (own research 2023).

	Spatial data of the studied parks [ha]		
Park Structure	**Lloyd Park**	**Saxon Garden**	**Ivan Franko Park**
Total park area	**12,6763**	**12,744**	**10,557**
Area of green areas	9,7006	10,042	7,868
Area of roads and paved squares	1,3857	2,364	2,476
Area of bodies of water	0,3177	0,098	0
Area of buildings	0,297	0,053	0,068
Area of sports and recreation objects	0,9753	0,187	0,145
Area of tree crowns	3,194	10,942	9,267

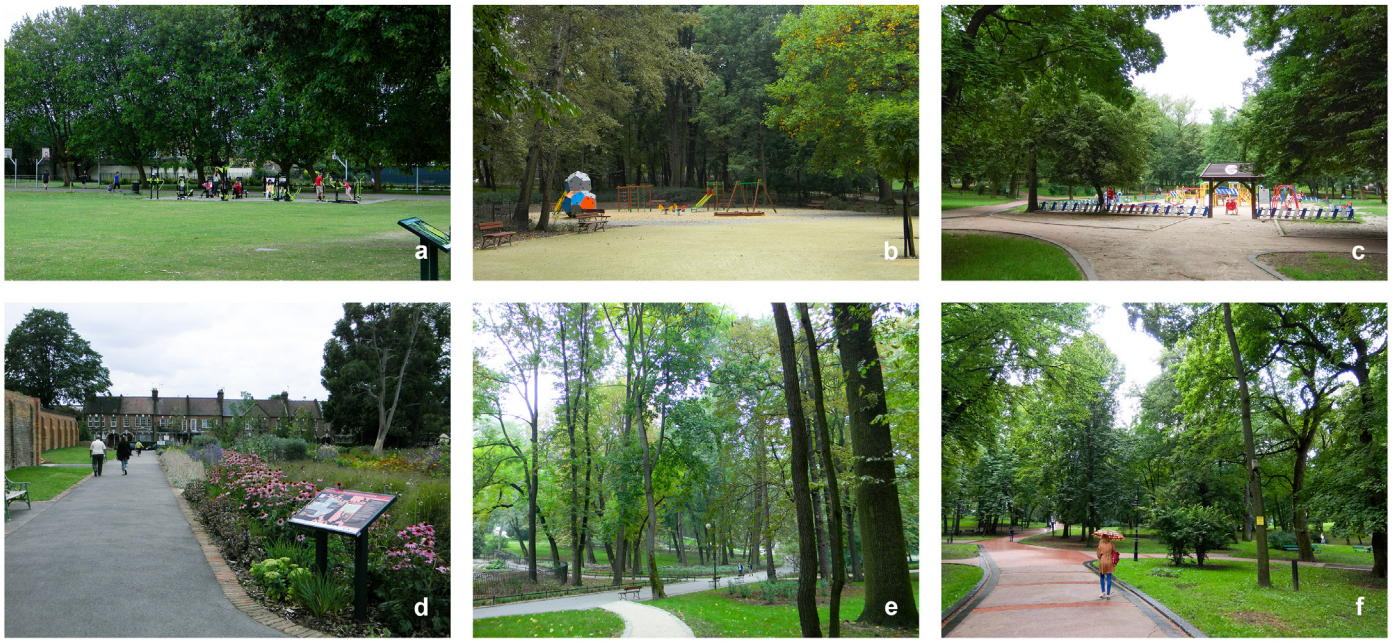

Figure 2. Communication structure (**a-c**) and elements of sports and recreational infrastructure (**d-f**) of the studied parks: **ad**. Lloyd Park in London, **be**. Saxon Garden in Lublin, **cf**. Ivan Franko Park in Lviv (own research, 2018-2020).

Pet owners benefit differently depending on the park. Lloyd Park includes free-range zones for dogs, areas requiring leashes, and zones where pets are prohibited. The Saxon Garden provides opportunities for pet walking but lacks dog parks. The Ivan Franko Park features one dog park with an off-leash area and agility equipment. Outdoor board games are not accommodated in any of the parks.

For children, Lloyd Park features a multifunctional playground, a natural playground (comprised of logs and tree stumps), and a Grow Wild playground. The Saxon Garden and the Ivan Franko Park each provide one multifunctional playground (Fig. 2e, 2f). The Ivan Franko Park also includes a sandpit unconnected to the playground. Cultural attractions vary; Lloyd Park offers open spaces suitable for concerts, exhibitions, and contests. The Saxon Garden features a wooden garden pavilion on an island, while the Ivan Franko Park includes an amphitheatre, an octagonal gazebo, and a Doric rotunda.

Water sports are not supported in any of the parks. Lloyd Park's moat has a naturalistic character unsuitable for water recreation. The Saxon Garden's two fenced-in ponds and the Ivan Franko Park's lack of water elements further highlight this limitation. Gardening opportunities exist only in Lloyd Park, which houses the William Morris Garden, a thematic garden. The other parks lack gardening accommodations.

Observations of nature The parks offer different opportunities for observing flora and fauna. Lloyd Park enables observation of various fauna, including invertebrates, fish, amphibians, reptiles, birds, and mammals, within its enclosed nature area. The Saxon Garden's moat and island provide similar opportunities, although it lacks an enclosed nature area. The Ivan Franko Park features ponds, an aviary, and individual bird nesting boxes on trees, yet it does not have an enclosed nature area. Observations of flora are facilitated in Lloyd Park's enclosed nature area and William Morris Garden, whereas the Saxon Garden and the Ivan Franko Park encourage flora observation throughout the entire park.

Intellectual interactions Scientific studies are supported in different capacities. Lloyd Park emphasizes urban ecosystem studies, particularly focusing on habitats and foreign species within park grounds. The entire area of the Saxon Garden and the Ivan Franko Park serve as venues for such studies. Microclimate studies, however, lack accommodations across all three parks. Educational activities vary; Lloyd Park provides classes for children and adults and features numerous information boards and didactic boards. The Saxon Garden and a terraced gar-

den at the W. Morris Gallery offer educational opportunities, while the Ivan Franko Park includes one large information-didactic board addressing nature protection, fauna, and flora.

Creative work such as painting, writing, photography, and land art is supported differently. Lloyd Park hosts a community hall but lacks outdoor elements. The Saxon Garden and the Ivan Franko Park do not provide accommodations for creative work.

Creating mindsets and identities Formation of local identities is facilitated through various landmarks. Lloyd Park's W. Morris Gallery fosters local identity, as do monuments such as the burial mound and chapel in the Saxon Garden and the Ivan Franko Park's Ivan Franco monument, Cast-iron Vase, and Doric Rotunda. Pro-environment mindsets are cultivated in Lloyd Park through activities like green gym voluntary work and campaigns such as "Social Dog Walk." The Lloyd Park features the "Friends of Lloyd Park" Association and free fitness classes under the "Our Parks" program. However, the Ivan Franko Park and the Saxon Garden lack organizations or events encouraging community participation or park identification. Recently the situation has begun to change, due to the fact that since the autumn of 2022 the Saxon Garden serves as a venue for the Nature Festival, which facilitates promoting pro-environment actions.

Spiritual and existential experiences Spiritual experiences are promoted through spaces for prayer and meditation. Lloyd Park provides numerous benches and open spaces, while the Saxon Garden offers a burial mound and chapel. The Ivan Franko Park lacks such accommodations. Existential experiences include connecting with nature and understanding its importance for health. Lloyd Park's William Morris Garden supports such experiences, as do the moat and island in the Saxon Garden and the enclosed nature area and numerous benches in the Ivan Franko Park. Additionally, the history of each park contributes to these experiences. Lloyd Park's W. Morris Gallery and the Saxon Garden's Bastion and burial mound with chapel showcase historical significance. The Ivan Franko Park is notable as the oldest public garden in Lviv and Ukraine. Detailed CES in relation to the studied city parks are presented in Table 5, which is available in the supplementary materials.

Among the three studied parks, the greatest number of aforementioned services in the cultural section were provided by Lloyd Park in London. Within its grounds, 20 out of 24 identified services were noted. Not found were spatial accommodations for 4 services. In the Saxon Garden in Lublin 14 out of 24 CES from 7 classes were provided. Two classes – creative work and building mindsets – were not noted. 10 services were not observed, especially opportunities to use accommodations for horse riding, group and water sports, gymnastics and weight exercises, or outdoor board games. The Lublin park does not offer its users the opportunity for gardening, microclimate studies, creative work, or forming ecological mindsets. The Ivan Franco Park in Lviv is characterised by the smallest number of provided CES (12 services in 6 classes were noted). In this park, there are no accommodations for active recreation in the form of biking, or gardening. There is also no infrastructure necessary to carry out microclimate studies, developing creative work, or associations and social activities promoting ecological mindsets. Not noted were also spaces facilitating personal prayer or meditation.

None of the analysed urban garden compositions provides spatial accommodations for any of the four services: horse riding, outdoor board games, water sports and games, or microclimate studies. Nonetheless, all of them provide the same 12 CES. Due to a well-developed network of paved paths and squares, they facilitate walking, nordic walking, and jogging. They enable extreme sports training in the form of riding scooters, rollerblades, and skateboards. However, it should be noted that only Lloyd Park in London is equipped with a professional and safe skate park. In the Saxon Garden, riding skateboards and rollerblades is allowed only on a single asphalt road assigned for this purpose. In turn, in the Ukrainian park a spontaneously and probably illegally constructed and used bike trial track was observed. All of the analysed parks possess complex, multi-functional playgrounds for children. They are the most diverse in the London object, since it has three spaces where the young citizens can play: a traditional playground with a broad array of equipment, a Grow Wild playground, which helps to develop creativity, as well as a natural playground in the form of an irregular setting of rootstocks and

tree stumps. All of the studied parks also have equipment, which facilitates organising local exhibitions, meetings, and outdoor events. As terrains of high natural value and diverse structure of vegetation they are also places to observe flora and fauna. Their spatial and compositional setting, as well as complex species composition allow carrying out empirical scientific studies in terms of functioning of urban ecosystems. They are also perfect places for education, with the most numerous and complex facilities in this regard situated in Lloyd Park. Within its grounds is the William Morris Gallery with a terraced garden and a thematic garden. This institution provides space for workshops and training courses, and the gardens are enriched with numerous didactic and information boards. In all three parks, one can observe historic spatial structures, which help form local identity. They are an important element of districts and entire cities, and as valuable historic monuments, they are proof of spatial development of London, Lublin, and Lviv. Additionally, all of them provide opportunities to maintain contact with nature and to draw physical and psychological benefits from its proximity.

3.2 Intensity of occurrence and spatial distribution of CES in the studied parks

The park areas were divided using a grid of squares with 30-metre sides within the local system of coordinates (using QGIS 3.18 software) to determine the degree of intensity of occurrence of individual ecosystem services and their spatial distribution. Lloyd

Figure 3. Distribution of CES within the area of the studied parks: a. Lloyd Park in London, b. Saxon Garden in Lublin, c. Ivan Franko Park in Lviv (own research, 2023).

Park yielded 185 such squares, the Saxon Garden – 174, and the Ivan Franco Park – 148. The dissimilarities stem not from different areas of the studied parks, as from the layout of their boundaries (Fig. 3a-3c).

The following step involved assessing the terrain of the parks, as well as their spatial and functional capabilities for providing 24 CES. That is how it was determined what kind and number of services was provided in individual squares of the grid. The minimal and maximal number of services observed in the studied parks per one square is as follows (Tab. 2.).

Table 2. Maximal and minimal number of CES per 1 grid square of the studied parks (own research 2023)

Studied object	Minimal number of services in 1 square	Maximal number of services in 1 square
Lloyd Park in London	1	12
Saxon Garden in Lublin	5	9
Ivan Franko Park in Lviv	5	7

Significant differences between the studied objects were found while analysing the spatial distribution of CES. In Lloyd Park these services were concentrated mainly in its southern section, i.e. in the William Morris thematic garden and terraced garden. In this area, the park provides from 10 to 12 services (10 grid squares). A similar result can be observed in one square, in the northern fragment of the park, where one can find basketball courts, and an outdoor gym. Equally attractive in terms of offered services are two sections of the London park, namely the open spaces of Aveling Field in the North (42 grid squares), and an island surrounded with a moat in the South (11 grid squares). Both terrains presented between 7 and 9 CES. What is more, in the central section of the park, the same value was assigned to one square, which fits in with the Lloyd Park central building, and its immediate, multifunctional surroundings (playgrounds, catering services, toilets). What is interesting, these areas are substantially different in terms of vegetation and spatial structure. The North is dominated by large, open lawns, without a clearly defined usable area arrangement, and with poor amounts of vegetation. Owing to the aforementioned facts, these areas are characterised with high functional freedom, dedicated predominantly to sports and recreation. The character of the island in the South is more intimate and closed. Dense vegetation, which frames the moat, gives it a naturalistic appearance. Its usable area arrangement is focused on passive leisure, intellectual interactions, contemplation of nature, and existential experiences. The central section has meagre vegetation, and an architectonic form with numerous paved surfaces. The lowest values of ecosystem services in the cultural aspect are presented by the park peripheries, especially a narrow strip of land in the North. In the grid squares with the highest numbers of provided services, Lloyd Park facilitates a total number of 17 services.

Spatial distribution of CES in the Saxon Garden in Lublin is less diversified than in the London park. It is visible in the number of squares, which provide the same number of services. Within 77 grid squares the number of offered CES falls between 4 and 6. The second group consists of squares with the number of provided services ranging from 7 to 9; there are 97 such squares. Concentration of squares with the highest number of facilitated services in terms of culture can be found in the central-eastern section of the park, and alongside its boundaries. This overlaps the distribution of the main traffic routes, especially with a clearly visible, and historically valuable, road in the form of a park promenade. It is also in accordance with the present functional-spatial sectioning of the Saxon Garden. According to the current plans, the shared communication zone, connecting the main park entrance at a neo-gothic porter's house with a gate in the north-western corner of the site, enables rollerblading, riding scooters and bikes. It is also the main transitional traffic route of the park, with the highest pedestrian and bike traffic. The remaining squares with a higher level of facilitating CES fit in with places of the highest historic and aesthetic values. They are situated at the location of historic elements, such as: a tumulus with a chapel, monument commemorating the park establishment, central garden lounge with formal composition, sundial, fountain, and a rose garden. What is more, squares with a higher number of provided ecosystem services are situated also in the location of the playground and amphitheatre.

The spatial structure of the park is very homogenous and does not influence the number of offered servic-

es. Lack of open spaces, high concentration of trees and shrubs, as well as small amount of infrastructure conducive for active leisure makes the level of provided CES quite limited across the entire object. In the Saxon Garden the grid squares with the highest number of offered CES fit in with those park sections, where the total number of provided services equals 14.

The Ivan Franco Park in Lviv is characterised by an even lower level of spatial differentiation of provided CES. In this case, only 27 grid squares presented a higher number of offered services, which equalled from 7 to 9. The remaining grid squares provide between 4 and 6 services. Squares with the highest number of provided services are visibly grouped together in three localisations. The first group is situated in the northern part of the park, where its form is formal, with a monumental statue of Ivan Franco, and a historic cast-iron vase (9 squares). The second group is concentrated in the southern section, where an enclosed dog park with agility equipment is situated (9 squares). The third group is comprised of 6 squares in the western part of the park, which fit in with equipment dedicated for children to play with (separate sandpit, and a multifunctional playground). The two remaining squares with a higher number of provided CES are more scattered spatially. The first one is situated in the centre of the park, where one can find a historic Doric rotunda. The second one is located in the eastern section of the site, where educational boards were placed. The total number of services in the squares with their highest concentration equals 11. Such spatial diversity of the offered CES in the park confirms its infrastructural and organisational maladjustment to provide modern CES. Its spatial structure is almost completely devoid of open terrains, which, in combination with a lack of sports equipment, makes this park mostly useless in terms of sports and recreation activities. The only forms of sports activity can be walking, running, or nordic walking, facilitated by a dense, spatially fragmented path network. Evidently, the main function of this object is representative, therefore only decorative, with a deliberately limited functional-spatial program in terms of physical activity. The Ivan Franco Park in Lviv and Saxon Garden in Lublin are examples of a historic park, which are not adjusted for contemporary needs of the citizens. They realise a conservative program of protection, the primary goal of which is to maintain the historic object in a condition as similar to the original one as possible, without including adaptation processes.

3.3 Assessment of accessibility of the studied parks

The study evaluated the accessibility of parks to city or district inhabitants. Each park has nine labelled entrances for easy access from all directions. The Saxon Garden in Lublin and the Ivan Franco Park in Lviv have a symmetrical spatial distribution of entrances. Lloyd Park, however, has a concentration of four entrances in its southern section near the William Morris Gallery. Using a 400-meter distance and buffering method, the London park influences the most private residences and sacral objects, dominated by single-family terraced housing. The Lublin park's influence includes multi-family housing, schools, and universities, while the Lviv park covers multi-family housing and cultural objects (Tab. 3). Similar results

Table 3. Scope of influence of the studied parks on selected functional groups of their terrain, within the distance of 400 m, using the buffer method, measured from the main park entrances (own research, 2023).

Functional group of the terrain	Lloyd Park	Saxon Garden	Ivan Franko Park
Offices and bureaus	2	25	3
Schools	9	17	8
Sacral objects	9	3	4
Commercial objects	3	4	0
Housing development	4328	689	756
Cultural objects	5	4	7
Healthcare objects	3	5	5
Universities	0	11	6

Table 4. Scope of influence of the studied parks on selected functional groups of their terrain in temporal division from 0 to 5 minutes, using the isochrone method, measured from the main park entrances (own research, 2023).

Functional group of the terrain	Lloyd Park	Saxon Garden	Ivan Franko Park
Offices and bureaus	1	19	2
Schools	7	15	5
Sacral objects	6	3	4
Commercial objects	3	3	0
Housing development	3352	509	549
Cultural objects	3	3	4
Healthcare objects	3	4	4
Universities	0	10	5

were obtained using the isochrone method, with one difference – all of these parks influence a smaller number of selected functional groups of their terrain, especially housing development (Tab. 4).

4 Discussion

The importance of CES in urban areas is often underestimated due to assessment difficulties. Additionally, cultural criteria are insufficiently used in urban planning because CES are not uniformly defined, and their classification varies widely. They are based on psychological and sociological processes rather than measurable ecological functions (Tandarić et al. 2020). CES are considered in terms of services, benefits, and values that affect human well-being, and they are measured by subjective indices. This connection is usually local, making it hard to generalize results to a national level due to social and cultural differences (Wangai et al. 2017). Burkhard et al. (2009) note that the difficulty in evaluating CES often limits their assessment to recreational and aesthetic values and biological diversity. The first parameter is based on the number of visitors and accessibility of infrastructure, while the second one on species diversity.

Despite the listed difficulties, CES play a vital role in creating balanced cities. By influencing the health and social conditions of citizens, they take part in improving their quality of life (Tandarić et al. 2020). The method offered by us is an attempt to view CES in the aspect of urban space and of the terrains of city parks. It is quite important, since CES are the outcome of interactions between man and nature, which are anchored in time and space (Tandarić et al. 2020). This study shows that an analysis of the space of urban parks in terms of their equipment and spatial organisation may indicate their capability for providing CES. What is more, park accessibility determines how their space can be used by citizens. The main indicator of park accessibility is distance. Distance and size of a park are more important than its functional and spatial attractiveness (Giles-Corti et al., 2005). Studies show that the farther a park is from a residence, the less it is frequented. Balanced cities should have small estate parks and larger parks with broader influence (Ibes 2014). The key issue is to determine the degree of accessibility of parks to citizens. The lower the accessibility, the lower the level of use of public space (Krzywnicka and Jankowska, 2021). Key factors for park accessibility include distance, distribution, travel time, and the condition of communication routes (Pasaogullari and Doratli 2004). In the USA, the National Recreation and Parks Association recommends 10 acres (4.1 ha) of public open terrain per 1,000 citizens, while the UK's National Playing Fields Association recommends 6 acres (2.4 ha) for the same population size. The radius method assesses accessibility by the desired maximum distance between parks and users (Nicholls 2001). Boone et al. (2009) argue for a standard buffer of 400 meters (a 5-minute walk) from residence. Park accessibility assessments should also consider actual entrances (Maroko et al. 2009) Studies of urban parks in Santa Cruz, Bolivia also confirm that distance is the factor determining their accessibility, but also limiting the users, since a commute to the park is linked to the cost of public transport (Wright Wendel et al., 2012).

Equal and fair access to city parks is another issue. Studies in American cities show that downtown residents, often poorer and from black and Latino populations, have easier access to smaller parks, while affluent, white suburban residents have larger park areas per person, often located more than 400 meters away (Maroko et al. 2009; Boone et al. 2009). In Lublin, we observed that visitors often commute from the suburbs to use city parks. Unlike the USA, ethnic diversity in Poland and Ukraine is less pronounced; for example, although Lublin has a large Ukrainian population, they share the same culture. In both countries, the material status of park neighbours varies widely, with rich and poor citizens living close to each other. Housing development is the dominant land cover near the studied parks, except in Lublin, where universities, schools, and offices are more prevalent. Thus, park in Lublin serves local residents, students, and office workers. Similar findings were noted in the Athens National Garden, used more by nearby office employees than families. Occupation influences park use: public office employees spend about half an hour in the park, while others may spend up to three hours (Paraskevopoulou et al., 2020). Research in Chile, Spain, and Germany confirm that residents of socially challenged districts

value urban green areas for their economic benefits, treating them as investments with higher financial returns than maintenance costs (Priego et al. 2008). Regardless of material status, citizens show a high need to use urban green areas, with affluent citizens more likely to use parks farther from their homes (Priego et al. 2008).

Research by Zwierzchowska et al. (2018) shows that the structural setting and equipment of parks can enhance the quality of ecosystem services. Understanding park users' expectations is crucial. However, the design of city parks reflects more than just new user needs, ecological awareness, climate adaptation, and urban planning trends. It also incorporates historical aspects and traditions of public green spaces, aligning with the spatial potential of each area. Historic parks play a foundational role in modern urban planning, creating cultural bonds with citizens (Woudstra, 2000) and serving as vital urban green spaces (Conway, 2000). Studies of four historic parks in Alexandria, Egypt, revealed that only one park's size was reduced by 19% due to urban changes, while the others retained their original areas. It confirms the high historic importance of parks in the structure of modern cities as well as social awareness of the importance and influence of historic parks on city identity, regardless of changing user needs (Abdel-Rahman, 2017).

Historic urban parks serve as aesthetic models for future urban planners and help establish new functional norms, adapting to current social needs (Loughran 2018). Despite their different spatial and functional structures, they can offer numerous ecosystem benefits. Therefore, historic parks should be integrated with new urban green areas to maintain landscape recognizability and integrity (Rodriguez Romero et al. 2018). However, adapting historic parks to modern demands risks degrading their historical value (Obad Šćitaroci et al. 2019). Studies of the historic Athens National Garden revealed that, despite frequent use, it retains its historic value and provides social and environmental benefits. Visitors use it for sports, walking with children, and socializing, although there is insufficient sports equipment and benches (Paraskevopoulou et al. 2020). Similar results were obtained for the Saxon Garden in Lublin, and the Ivan Franco Park in Lviv. Sports infrastructure is limited to the playground for children. The remaining spatial elements refer to the historic ones, for example the sundial, or the fountain (Przesmycka and Boguszewska 2020). On the other hand, the analysis conducted by Trzaskowska and Adamiec (2014) showed, that the Saxon Garden is the most valuable park in Lublin, not only from the historic or functional, but predominantly from the natural point of view. This is beneficial for observations of nature, educational and scientific goals, as well as enables realising CES.

City parks in Great Britain adapt more successfully to new social needs and offer a more diverse spatial program than those in Poland, likely due to cultural differences and traditions in creating and using urban green spaces (Kulesza and Lubiarz 2016). In the 19th century, British city parks had broad functional programs for various social and age groups. In contrast, Middle Eastern European urban parks diversified into representative city parks and people's parks with sports and recreation programs. After WWII, Communist Bloc countries transformed these into parks of culture and leisure, focusing on everyday recreation. This differentiation is evident in Lublin and Lviv, where parks like the Saxon Garden and Ivan Franco Park were primarily representative and pedestrian sites, and not recreational ones, which significantly limits their modern role in the life of the local communities. Thus, modernizing historic green areas in Middle Eastern Europe should prioritize both historical and functional aspects.

5 Conclusion

Studies have shown that historic urban parks play a vital role in the structure of modern European cities; however, in order to meet the increasing social needs, they must adjust to new functions. How they are utilised depends greatly on the spatial structure, including the accessibility of open spaces, as well as the diversity of equipment such as benches, arbours, paths, football fields, or playgrounds. Open spaces, such as lawns, offer more opportunities for physical activities, especially in terms of sports and recreation in contact with nature. The park sections with greater historic and aesthetic values provide

the highest number of ecosystem services regarding culture.

Presence of elaborate sports and recreation infrastructure increases the park's functionality, without decreasing its historic value; however, such solutions are not sufficiently implemented in Lublin and Lviv. Less formal park areas, characterised by more loosely arranged vegetation, as well as the presence of water elements, significantly broaden the spectrum of ecosystem services. They facilitate contact with nature, which benefits observations of nature, conducting scientific studies, education, forming pro-environment mindsets, and improving physical and mental health. However, the vast network of park pathways, by fragmenting the space, limits the options of using the terrain, enforcing particular forms of activity and, therefore, narrows the scope of offered ecosystem services.

The cultural and historic aspects influence the range of CES offered by the studied urban parks. History has substantially influenced the directions of modernising the studied parks, which is especially visible in Lublin and Lviv. The London park serves as a model for how to ensure realisation of diverse CES due to informed spatial organisation.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary material

Table 5. Classification of CES (interaction with nature), in relation to the studied city parks (own research 2023).

Group	Class	CES	Lloyd Park	Saxon Garden	Ivan Franko Park
Physical interactions	Sports and recreation (in nature)	Walking, nordic walking, jogging	Track dedicated for running – around Aveling Fields Options for running and walking on existing park paths	Opportunities for running, and walking on existing park paths, but no dedicated running tracks	Opportunities for running, and walking on existing park paths, but no dedicated running tracks
		Biking	5 bike stands	1 asphalt bike track, only transit in character Lack of opportunities for bike riding on the remaining paths and pavements (prohibited by park regulations)	No bike stands Signs prohibiting riding bikes and rollerblades
		Horse riding	Lack of accommodations	Lack of accommodations	Lack of accommodations
		Extreme sports (skateboard, bike trial track, rollerblades, roller skates, scooters, climbing, etc.)	Skate park	Using skateboards, scooters, and rollerblades on paths other than the asphalt one dedicated for biking is prohibited by park regulations. No skatep ark	Lack of accommodations Illegal bike trial track
		Group sports (basketball, volleyball, football, bowling, tennis, ping-pong, etc.)	3 tennis courts 2 bowling tracks (synthetic surface, and a natural, grass surface) 2 basketball courts 2 ping-pong tables 1 Pétanque terrain	Lack of sports fields and infrastructure Lack of open spaces	Lack of accommodations
		Gymnastics (yoga, tai-chi, aerobics, etc.)	Open space (Aveling Fields)	Lack of flat open spaces	Lack of open spaces
		Weight exercises	1 outdoor gym	No outdoor gym	No outdoor gym
		Opportunities for pet owners to use the park with their pets, or opportunities for interactions with household animals (dogs, cats, ferrets, etc.)	Free-range zones for dogs, zones for dogs on leashes, and zones where pets are not allowed Lack of dog parks	Opportunities for pet walking Lack of dog parks	1 dog park with an off-leash area and elements of agility equipment
		Outdoor board games	Lack of accommodations	Lack of accommodations	Lack of accommodations
		Games for children	1 multifunctional playground 1 natural playground (logs and tree stumps) 1 Grow Wild playground	1 multifunctional playground	1 multifunctional playground 1 sandpit not connected with the playground
		Cultural attractions within the park area (concerts, workshops, outdoor events, etc.)	Open space (possibility to organise concerts, exhibitions, contests, competitions, etc.) Wooden garden pavillion on the island	Amphitheatre Octagonal gazebo	Doric rotunda (open garden pavillion)
		Water sports (kayaking, swimming, RC models racing, etc.)	The moat has a naturalistic character, and is not suitable for water recreation activities	2 fenced-in ponds, not for water recreation activities	Lack of water elements
		Gardening	William Morris Garden (thematic garden)	Lack of accommodations	Lack of accommodations

	Observations of nature	Observation of fauna (invertebrates, fish, amphibia, reptiles, birds, mammals)	Enclosed nature area Moat and island	Lack of an enclosed nature area Aviary ponds	Lack of an enclosed natural area Individual nesting boxes for birds on trees
		Observations of flora	Enclosed nature area William Morris Garden (thematic garden)	Entire park	Entire park
Intellectual interactions	Scientific studies	Studies of urban ecosystems, habitats, foreign species seen within park grounds	Entire park, especially boat and island William Morris Garden (thematic garden)	Entire park	Entire park Lack of flower boxes, thematic gardens
		Microclimate studies	Lack of accommodations	Lack of accommodations	Lack of accommodations
	Education	Educational classes for children and adults within park grounds	Numerous information boards and didactic boards William Morris Garden (thematic garden) Terraced garden at the W. Morris Gallery	Lack of accommodations	1 large information-didactic board regarding nature protection, fauna and flora of the park
	Creative work	Painting, writing, photography, land art	Community hall, lack of outdoor elements	Lack of accommodations	Lack of accommodations
Creating mindsets and identities	Forming identities	Forming a local identity	W. Morris Gallery	Monument of Feliks Bieczyński - park creator Burial mound and chapel	Ivan Franco monument Cast-iron Vase Doric Rotunda
	Creating mindsets	Creating pro-environment mindsets, and avoiding so-called ecological alienation, active participation in pro-environment associations, voluntary work for the park	Green Gym voluntary work (green gym) (protecting nature in the park) „Social Dog Walk" campaign for pet owners in need of forming social connections Free-of-charge fitness classes in the „Our Parks" program „Friends of Lloyd Park" Association Club 5 for children less than 5 years old	Lack of an organisation bringing together „friends of the park" Lack of park and garden events addressed to the local community Lack of identifying oneself with the park	Lack of an organisation bringing together „friends of the park" Lack of park and garden events addressed to the local community Lack of identifying oneself with the park
Spiritual and existentional experiences	Spiritual experiences	Opportunities for prayer and meditation within park grounds	Numerous benches Open space	Burial mound and chapel	Lack of accommodations
	Existentional experiences	Familiarising oneself with nature, and thus, understanding the need for human contact with nature in the context of health	William Morris Garden (thematic garden) Moat and island Enclosed nature area	Very numerous benches	Very numerous benches
		Learning the history of the place and the city	William Morris Gallery	Bastion Burial mound with chapel	Entire park is the oldest public garden in Lviv and in Ukraine.