# ДОСЛІДЖЕННЯ АНТРОПОГЕННИХ ЛАНДШАФТІВ

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## ENVIRONMENTAL COMFORT OF URBANIZED LANDSCAPES

The purpose of the study is to establish the degree of compliance of the urbanised landscapes of Kyiv and its administrative districts to the criteria of environmental comfort of a compact and green city. Study methods. The purpose was achieved using the following algorithm: the geospatial data of OpenStreetMap and the QGIS software were used to plot the urban green spaces (UGS) and built-up Kyiv territories a cartographic base. The development of real estate for different purposes and all available UGS were grouped into separate categories using the Union geoprocessing tool. The spatial data layers were reduced to a single cartographic projection using Field calculator to calculate the geometric characteristics of each category. Results. These calculations were used to find the building coverage and the green coverage ratios, and the built-up area-to-UGS ratio within the limits of Kyiv and its ten districts. Since the comfort of an urbanised landscape depends largely on the optimal ratio of UGS and developed territories, its highly non-uniform spatial distribution within Kyiv limits was found: a dense development prevails on the Right Bank, whereas UGS prevails on the outskirts and in some districts of the Left Bank. Based on the calculated green coverage and the building coverage ratios in different Kyiv districts, they were rated by the ratio of built-up and green coverage territories. The maximum green coverage is in the Desnianskyi district, and the most built-up one is in the Solomianskyi district. In general, four city districts are almost devoid of UGS due to absence of free territories for their full-scale development. To establish the degree of compliance of urbanised landscapes to the criteria of environmental comfort in each Kyiv's district, the Environmental Comfort Index (ECI) was calculated. Its principal indicators are the average population density, building coverage and greenery coverage ratios, and emissions into the atmosphere from stationary pollution sources. Each indicator is assigned a certain number of points, enabling to calculate the ECI by the total of points of chosen indicators. The results obtained were used to build a rating of Kyiv's districts according to the degree of their compliance to the criteria of environmental comfort of a compact and green city. The highest ECI are in the Obolonskyi and Desnianskyi districts, and the lowest are in the Solomianskyi, Pecherskyi and Shevchenkivskyi districts. The poor environmental comfort of these districts is largely due to their location in the centre of the city, with an almost dense development and high population density. Due to traffic congestion and concentration of sources of toxic emissions, the atmospheric air is very polluted. Due to displacement of UGS by construction sites, greenery is lacking everywhere, and it is often absent in the sanitary protection zones of industrial plants. The study novelty consists in finding the degree of conformity of Kyiv's urbanised landscapes to the criteria of environmental comfort of a compact and green city. With this in view, the built-up area-to-UGS ratio was found for Kyiv and its ten districts, and corresponding map charts were compiled. ECI was calculated for each district to determine the ratings of Kyiv's districts. The study results can be extrapolated to other cities in Ukraine.

**Keywords:** urban landscape, compact and green city, urban green spaces, environmental comfort, built-up area-to-UGS ratio, Environmental Comfort Index.

**Шищенко П.Г., Гавриленко О.П., Єсипчук Д.В. ГЕОЕКОЛОГІЧНА КОМФОРТНІСТЬ УРБАНІЗОВАНИХ ЛАНДШАФТІВ**

Метою дослідження є встановити ступінь відповідності урбанізованих ландшафтів критеріям геоекологічної комфортності компактного і зеленого міста. Для досягнення мети встановлено коефіцієнти забудови і озеленення та співвідношення забудови і міських зелених зон (МЗЗ) в межах Києва та його десяти районів. Виявлено дуже нерівномірний просторовий розподіл МЗЗ та забудови різних типів у межах міста. Складено рейтинг районів Києва за співвідношенням забудованих і озеленених територій. Найбільш озелененим виявився Деснянський район, а найбільш забудованим – Солом'янський. Для кожного району Києва розраховано Індекс геоекологічної комфортності (ІГК) та визначено відповідний рейтинг. Найвищі ІГК мають Оболонський і Деснянський райони, найнижчі – Солом'янський, Печерський і Шевченківський. Дуже низька геоекологічна комфортність цих районів зумовлена переважно їх розташуванням у центрі міста, майже суцільною забудовою та високою щільністю населення. Через скупчення автотранспорту та інших джерел шкідливих викидів інтенсивно забруднюється атмосферне повітря. Унаслідок витіснення МЗЗ об'єктами забудови всюди бракує озеленення, навіть у санітарно-захисних зонах підприємств. Новизна дослідження полягає у виявленні ступеня відповідності урбанізованих ландшафтів Києва критеріям геоекологічної комфортності компактного і зеленого міста, для чого розраховано Індекс геоекологічної комфортності у кожному районі міста.

**Ключові слова:** урбанізований ландшафт, компактне і зелене місто, міські зелені зони, геоекологічна комфортність, співвідношення забудови і озеленення, Індекс геоекологічної комфортності.

**Topicality of the study.** In mid-2020, global urbanisation was close to 56%. According to estimates, in 2050 the urban population share will increase to 70% [1]. With such an urbanisation rate, cities will be in the focus of efforts to prevent a global environmental catastrophe. Presently, cities account for 75% of global carbon dioxide gas emission, with a significant impact on climate change by transport and the pattern of development [2]. The huge carbon footprint created by the cities is mostly the result of irrational urban planning [3]. Life in an urbanised environment, especially for the relatively poor segment of the population is usually associated with a high stress level and poor psychic health [4]. Modern cities face a host of problems, including the process of adaptation to climate change [5], significant social and economic inequality and a full-blown degradation of the environment [6]. The spreading and high-density development in compact cities is a serious threat to urban green space (UGS) [7].

This problem is of great relevance to Kyiv, which in the near future must become a compact and green city. Such a perspective is stated in the Kyiv City Development Strategy until 2025 [8] and in the draft of the Master Plan of the City up to 2040 [9]. These documents point to insufficient provision of the population with green public spaces and their non-uniform distribution among the city administrative districts. However, no acceptable strategy of rectifying this drawback is offered. In particular, it is proposed to convert a part of the urban forests to buffer parks that will gain the status of public green spaces [9]. In fact, this will not only increase the actual provision of Kyiv's residents with greenery, but will also lead to destruction of urban forests due to the legalisation of development in adjacent territories.

**The state of studying the problem and principal papers.** Many studies indicate that public access to UGS plays a crucial role in mitigating the stress level and facilitating psychic health [10]. The creation of UGS, which ensure the provision of vital ecosystem services for all demographic groups of consumers, reduces the level of strife and consolidates the social ties in the city residential districts [11]. Apart from ecosystem services, UGS provide the public with social and psychological advantages that bring meaning to human life. Nature in an urbanised environment is a source of positive emotions and valuable services that meet the vital non-consumptive needs of humans [12].

Planning UGI should be based on well-

thought-out principles of improving the condition of the environment and its suitability for living in cities [13]. Besides providing the population with important ecosystem services, UGS create economic values by increasing the urban landscape quality (a scenically attractive sensation, suitability for life, and recreation possibilities). UGS in a compact city compete with other kinds of land use and therefore often they are a contestable space of the urban landscape [14]. The local authorities affect the fragmentation of the urbanised landscape by using different management approaches to manage smaller territorial units. These units often fail to coincide with the boundaries of natural landscapes, and create spatial and functional conflicts [15].

**Purpose of the study** – Based on analysing the ratio of UGS and built-up territories within Kyiv limits and its separate districts, the goal is to assess the degree of their conformity to chosen criteria of environmental comfort of urbanised landscapes in a compact and green city.

**Study methods.** Using the geospatial data of OpenStreetMap (OSM), Google Map and QGIS software, we plotted all the UGS and built-up territories within Kyiv limits and its administrative districts on a cartographic base. For correct calculation of required geometric characteristics, data in the format of polygonal layers were taken from OSM. The buildings with different purposes (offices, residential buildings, dormitories, kindergartens, universities, schools, garages, banks, shops, hotels, industrial facilities, construction sites, petrol filling stations, parking, and hospitals) were loaded into the QGIS environment and grouped into four categories using the Union geoprocessing tool: non-residential buildings, residential buildings, industrial buildings, construction.

Similarly, all available UGS (meadows, grass lawns, cemeteries, bushes, isolated trees, forests, private gardens, open green recreation spaces, natural conservation territories, etc.) were classified into five categories: urban forests, urban protected areas, parks and squares, non-tree vegetation, gardens. For correct display of topographic data and accurate calculation of attributes, all the spatial data levels were reduced to a unique cartographic projection. The result was the creation of polygonal shape files containing the categories of UGS and built-up territories within city limits. Following this, we used Field calculator to calculate the geometric characteristics of each category. These calculations were used for determining the building coverage and the green coverage ratios and the built-up area-to-UGS ratio (Table 1).

To find the built-up area-to-UGS ratio in different Kyiv's administrative districts, all ten districts were cut out from the general city map in the QGIS environment. Using the Clip geoprocessing tool, all the development categories and UGS beyond district limits were clipped. Field calculator was used to calculate the geometric parameters of each category. This allowed finding the building coverage and green coverage ratios and the built-up area-to-UGS ratio for each administrative district of the city.

**Table 1.** The built-up area-to-UGS ratio in Kiev

| Area, km$^2$ | Development, km$^2$ | Building coefficient, % | UGS, km$^2$ | Greenness coefficient, % | The ratio of building to UGS, % |
|---|---|---|---|---|---|
| 828 | 193.3 | 23.3 | 452.3 | 54.6 | 42.7 |

**Presentation of the basic material of the study with substantiation of obtained scientific results**. The comfort of living in any urbanised landscape is determined by the

provision of residents with UGS; the availability of advanced technologies in the energy and transport infrastructure; high quality of air and drinking water; appropriate waste disposal level, etc. Almost all Ukrainian cities, irrespective of their size and population, have in common almost the same environmental problems. The majority of these problems are concentrated in the capital. Kyiv's landscape structure is dominated by broadleaved woodland and mixed wood types of landscapes. Accumulative-denudation loessial elevated planes with light-grey, grey and dark-grey wood soil are common for the Right Bank. The mixed wood landscapes are represented by moraine and lake-water-glacial planes with sod-podzolic soil found predominantly in the northern part of the city. Old alluvial sandy plains with sod-podzolic soil formed by dry and fresh pine forests, and herbage and grass family formations are common for Kyiv's Left Bank.

The capital's location on the borderline of the mixed wood zone and the wooded steppe landscape zone defines the favourable conditions for creating a well-developed urban green infrastructure (UGI). Official Kyiv wields powerful financial and administrative resources allowing for an efficient solution of current problems: reduce toxic emissions into the atmosphere; prevent pollution of water basins; stop the random development; resist the destruction of UGS and the overall degradation of valuable urban landscapes. However, in practice this is not the case.

The Kyiv City Development Strategy until 2025 (hereinafter, Strategy), one of the key priorities for city development, stipulates the creation of "the most comfortable city for living in Ukraine, an environmentally clean and green one" [8, p. 16]. However, in the computations of the index of life comfort in Kyiv, the weight coefficient of the sector "Ecopolicy and environmental protection" is only 7%, though actually the environmental sector must be the key one in the process of improving urban life. The principal tool of implementing the Strategy priorities in practice is the Master Plans of development of Kyiv.

Presently, Kyiv is in its second year of going on without a Master Plan because the term of validity of the Master Plan 2020 has expired, and the draft Master Plan for 2040 is nowhere near approval. As to the progress of executing prior tasks, it is worth mentioning that the Master Plan for 2020 planned an increase in urban green public space from 5,289 to 5,986 ha. However, actually the UGS area as of 2020 was 5,313 ha, i.e. less than the planned one by 11.2% [9].

Specifically, Kyiv's green infrastructure, as its integral part, performs several vital functions: facilitates the creation of comfortable conditions for public recreation; protects from strong winds; improves the microclimate; creates shade and coolness in hot weather, etc. The World Health Organisation defines urban green space as an urban space with a green coverage of any kind, including street trees and roadside vegetation; stands inaccessible for public recreation (e.g. green roofs and walls); greenery accessible to the public that provides significant social and recreation functions (parks, squares, urban forests, protected areas) [16].

The draft decisions of the new Master Plan of the Kyiv city, with respect to the planning of green spaces, are confined mostly to converting a part of the urban forests to buffer parks. A buffer park is a developed part of the territory of the urban forest intended for free brief rest. The setup of the park territory provides for combining recreation, landscape-architectural, sanitary-hygiene, educational and forestry activity functions [17]. In total, the plan is to create 17 such parks in Kyiv with an area of 1,598 ha [9]. In principle, this should facilitate the best development of different kinds of recreational activities for all age groups

of the population. At the same time, due to the building of the road and path network and other park infrastructures, the development of buffer parks will result in deterioration of the species composition of the forest flora and fauna, and a reduction of the area of urban forests.

Actually, the real reason of planning buffer parks is the formal increasing of the provision of UGS with public access from 18.2 to 23.2 $m^2$/person [18]. This, in turn, allows for further large-scale construction in the capital because the provision of the residents with green spaces will comply legally with the construction code. The worst thing is the planning of three buffer parks on the territory of the Bilychanskyi forest, which since 2014 is part of the Holosiivskyi National Nature Park. If the project will be put in place, conservation ecosystems will face a recreation digression, a degradation of ecosystem services, and extinction of rare species of plants and animals. Besides, the planning of buffer parks and other UGS with public access exclusively on the city outskirts will make them inaccessible for the majority of Kyiv's residents.

With each year, the building density in the city is increasing. This intensifies heat island effects, impairs the resistance of urban landscapes to climate changes and leads to a reduction of the area of UGS of all kinds. The formation of a comfortable urbanised landscape capable of compensating for the adverse effect of development on the overall environmental situation depends largely on the optimal ratio of UGS and built-up areas. With this in view, we analysed the spatial distribution of UGS and different kinds of development within Kyiv limits.

Since the built-up area-to-UGS ratio is 42.7%, a logical conclusion would be that green areas are predominant in the city. Indeed, as to their geometric parameters they occupy the greater part of Kyiv. However, the map charts of the spatial distribution of UGS and built-up areas clearly show that UGS are distributed across Kyiv very unevenly (Fig. 1). In many city districts, especially on the Right Bank, high-density development is predominant. At the same time, it is almost absent on the outskirts and in some districts of the Left Bank.

With account of the non-uniform spatial distribution of built-up areas and UGS, we have found their ratios for different Kyiv's administrative districts (Table 2).

Based on the computed indicators, we compiled a rating of Kyiv's districts according to the ratio of built-up and green coverage territories within their limits. Desnianskyi district has the best green coverage, and the most built-up one is the Solomianskyi district. In other words, in spite

**Table 2.** The built-up area-to-UGS ratio in the districts of Kyiv

| Districts of Kyiv | Development, $km^2$ | Building coefficient, % | UGS, $km^2$ | Greenness coefficient, % | The built-up area-to-UGS, % |
|---|---|---|---|---|---|
| Holosiivskyi | 25.6 | 16.4 | 74.3 | 47.6 | 34.4 |
| Darnytskyi | 29.7 | 22.3 | 82.8 | 62.2 | 36.1 |
| Desnianskyi | 17.9 | 12.5 | 98.4 | 69.1 | 18.1 |
| Dniprovskyi | 18.1 | 27.0 | 31.7 | 47.3 | 57.0 |
| Obolonskyi | 21.2 | 19.6 | 72.9 | 67.5 | 29.0 |
| Pecherskyi | 6.2 | 31.7 | 4.1 | 21.0 | 151.2 |
| Podilskyi | 14.9 | 43.5 | 11.3 | 25.9 | 131.8 |
| Sviatoshynskyi | 22.2 | 22.0 | 65.0 | 64.6 | 34.1 |
| Solomianskyi | 24.2 | 59.9 | 6.4 | 15.8 | 378.1 |
| Shevchenkivskyi | 13.3 | 50.1 | 5.4 | 40.6 | 246.0 |

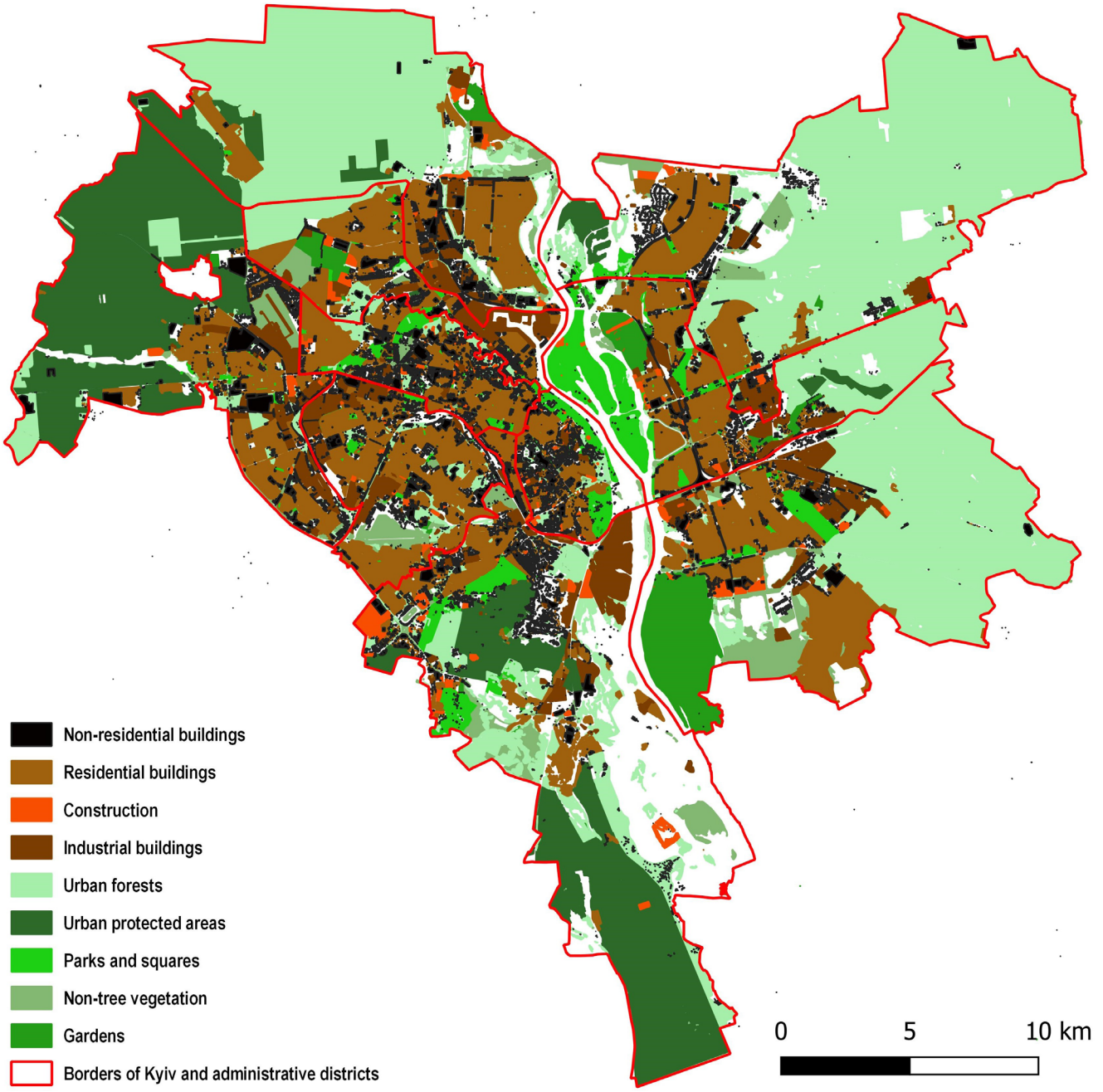


Fig. 1. Spatial distribution of UGS and development in Kyiv

of the rather high overall green coverage ratio, four city districts are almost devoid of UGS (Fig. 2).

The lack of greenery in districts with high-density development is due to the absence of free territories for creating full-fledged UGS. This problem can be solved by introducing green structures (planting greenery on slopes, roofs and walls of buildings) that perform extremely significant social and environmental functions [19]. In particular, they will reduce noise levels, improve air quality and biota migration, and provide additional heat insulation of buildings. An effective way of gardening densely developed micro districts, with prevailing residential and office and commercial building development, is covering the facades and walls of the buildings with greenery. Green walls create deep shadows, prevent their overheating and filter the air from dust and aerosols. Such vertical greening performs an aesthetic function by bedecking the walls and supporting structures of old buildings [20].

UGI can also be expanded by planting trees and making flowerbeds and strips of green lawns along roads and sidewalks. Plants can be planted

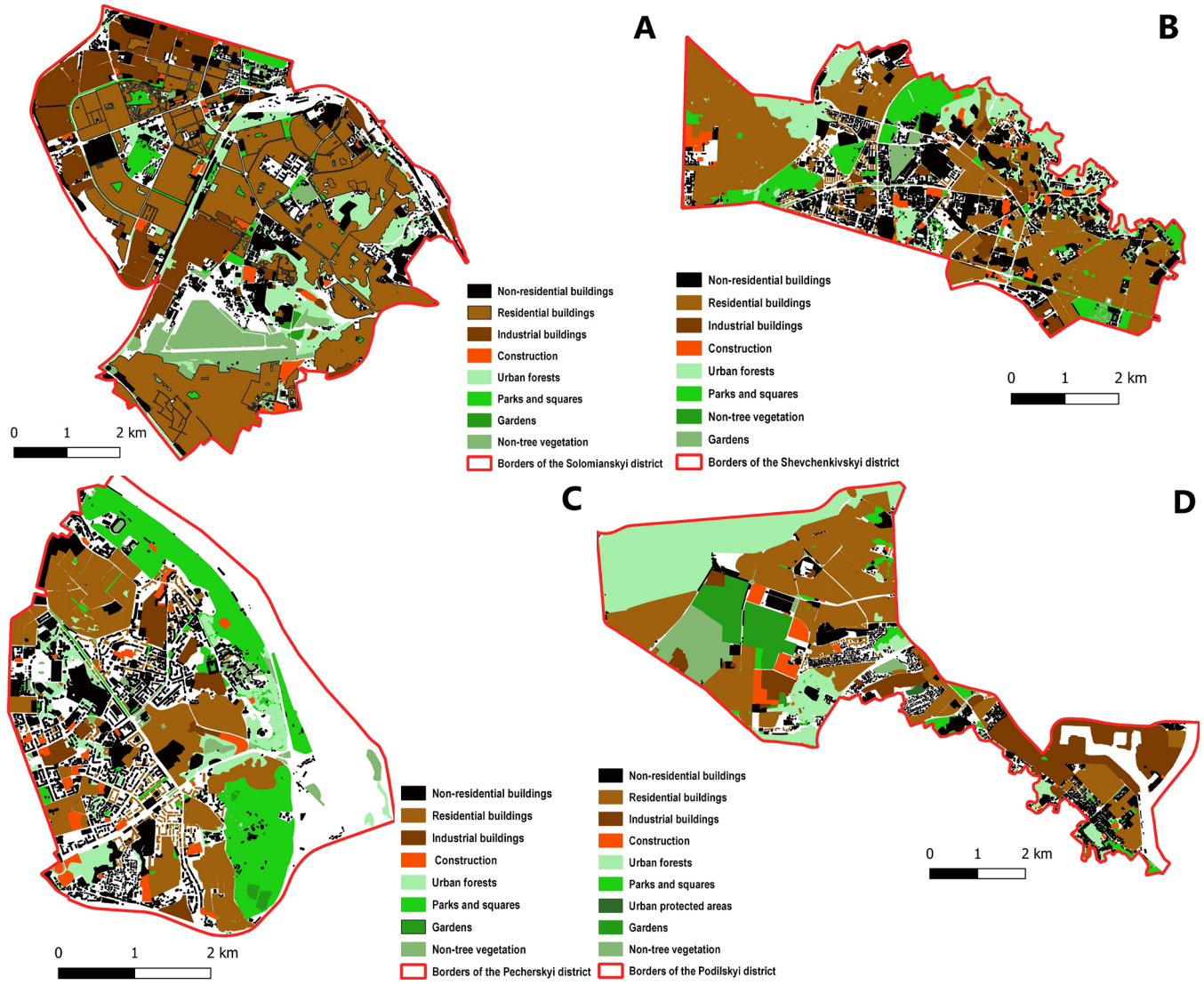


Fig. 2. Districts of Kyiv almost devoid of UGS: Solomianskyi (A), Shevchenkivskyi (B), Pecherskyi (C), Podilskyi (D)

in flowerpots on residential building terraces and balconies, and next to public and commercial buildings. Dense development increases the risk of accidents in areas with a rugged topography. For instance, in Kyiv's Pecherskyi district a high-rise residential building is being built on the bank of the Hlynka lake on a landslide-hazardous slope, with the resulting destruction of trees and subsidence. Actually, it is firmly prohibited to build on such sites. Alternately, it is necessary to reinforce the slopes with green structures to increase public safety.

Yet another way of optimising UGI is building Eco Parking – special lawns for automobile parking, which are protected from external influences with a net filled with fertile soil with grass over. A latticework prevents damage to the root system of plants by automobile tyres. Because the majority of pollutants from the atmosphere are deposited on the roofs of buildings, this adverse impact can be mitigated by building green roofs. Greenery on rooftops reduces the urban heat island effect and traps precipitation to reduce the risks of street flooding during downpours. The space of these roofs can be used for recreation activities. Flat roofs in any city can be used for developing UGS. If the roofs are covered with black decking, this will enable to build rooftop mini greenhouses on them. As distinct from common greenhouses, the rooftop

ones consume much less energy due to passive heat accumulation from the building below.

The principal criteria of comfortable living in a compact and green city are the presence of UGS, clean air and a not dense development [14]. Increasing the comfort of living in Kyiv was pronounced the strategic goal of development of the city up to 2025. The updated Comfort Index includes about 50 indicators from nine life-activity sectors. In particular, the environment control sector is calculated only by four indicators: pollutants emission into the atmosphere, waste disposal share, urban protected areas (UPA), and UGS provision for residents [8]. Since these parameters differ significantly in different Kyiv districts and fail to represent in full the level of environmental comfort, we developed an Environmental Comfort Index (ECI) and calculated it for each city district.

The basic indicators of compliance of Kyiv's districts to the criteria of environmental comfort of a compact and green city were chosen as follows: average population density, building coverage ratio, green coverage ratio, emissions into the atmosphere from stationary pollution sources (Table 3). The average population density in each district was calculated by dividing the number of permanent residents by the district area. Population data were taken from the official website of the General Statistics Office in Kyiv [21]. Atmospheric pollution was evaluated using statistical information for 2020 [22].

As shown in Table 3, Kyiv districts differ significantly by population numbers and density. The highest average population density is in the Pecherskyi, Solomianskyi and Shevchenkivskyi districts. They all are located mostly in the central part of the city where the majority of the population typically resides. Accordingly, within the peripheral districts, the population density is much lower. The compliance of calculated indicators with the criteria of environmental comfort of a compact and green city was assessed by assigning each indicator a certain number of points by using estimation scales (Table 4).

The estimation scales were processed to calculate the received points and, hence, determine the compliance of each Kyiv district to the criteria of environmental comfort of a compact and green city (Table 5). Environmental Comfort Index was calculated by the sum of points of chosen indicators. The higher the ECI of any city district the more comfortable and environmentally safe it is for living.

Based on the results obtained, we compiled a rating of Kyiv's districts by the degree of their compliance to the criteria of environmental comfort of a compact and green city (Fig. 3). Obo-

**Table 3.** Indicators of the Kyiv districts' compliance with the environmental comfort criteria

| Kyiv districts | Average population density, persons per km$^2$ | Building coefficient, % | Greenness coefficient, % | Emissions into the atmosphere, t |
|---|---|---|---|---|
| Holosiivskyi | 1,619 | 16.4 | 47.6 | 3895,14 |
| Darnytskyi | 2,674 | 22.3 | 62.2 | 907,56 |
| Desnianskyi | 2,585 | 12.5 | 69.1 | 2689,42 |
| Dniprovskyi | 5,187 | 27.0 | 47.3 | 8000,99 |
| Obolonskyi | 2,912 | 19.6 | 67.5 | 370,19 |
| Pecherskyi | 8,040 | 31.7 | 21.02 | 7387,33 |
| Podilskyi | 5,953 | 43.5 | 25.9 | 294,15 |
| Sviatoshynskyi | 3,279 | 22.0 | 64.6 | 240,11 |
| Solomianskyi | 9,445 | 59.9 | 15.8 | 359,28 |
| Shevchenkivskyi | 7,920 | 50.1 | 40.6 | 1361,01 |

**Table 4.** Scales for assessing the compliance of selected indicators with the criteria of environmental comfort of a compact and green city

| **Scale of assessment of built-up and green areas** | | | | |
|---|---|---|---|---|
| Points | | | | |
| 1 | 2 | 3 | 4 | 5 |
| Degree of compliance | | | | |
| bad | unsatisfactory | satisfactory | good | perfect |
| *Building coefficient, %* | | | | |
| >50 | 50-41 | 40-31 | 30-20 | <20 |
| *Greenness coefficient, %* | | | | |
| <20 | 20-30 | 31-40 | 41-50 | >50 |
| **Scale for estimating the average population density** | | | | |
| Points | | | | |
| 1 | 2 | 3 | 4 | |
| Degree of compliance | | | | |
| very high | high | medium | low | |
| *Average population density, persons per km²* | | | | |
| >6000 | 6000-4501 | 4500-3001 | 3000-1500 | |
| **Air pollution assessment scale** | | | | |
| Points | | | | |
| 1 | 2 | 3 | 4 | |
| Degree of compliance | | | | |
| very high | high | medium | low | |
| *Emissions of pollutants into the atmosphere, t* | | | | |
| >4000 | 4000-1001 | 1000-401 | 400-240 | |

**Table 5.** Levels of environmental comfort in the Kyiv's districts (in points)

| Kyiv's districts | Population density | Development | Greenness | Air pollution | ECI |
|---|---|---|---|---|---|
| Holosiivskyi | 4.3 | 5.1 | 4.1 | 2.0 | 15.5 |
| Darnytskyi | 4.1 | 4.1 | 5.0 | 3.0 | 16.2 |
| Desnianskyi | 4.2 | 5.2 | 5.3 | 2.1 | 16.7 |
| Dniprovskyi | 2.1 | 4.0 | 4.0 | 1.0 | 11.1 |
| Obolonskyi | 4.0 | 5.0 | 5.2 | 4.0 | 18.2 |
| Pecherskyi | 1.1 | 3.0 | 2.0 | 1.1 | 7.2 |
| Podilskyi | 2.0 | 2.0 | 2.1 | 4.2 | 10.3 |
| Sviatoshynskyi | 3.0 | 4.2 | 5.1 | 4.3 | 16.6 |
| Solomianskyi | 1.0 | 1.0 | 1.0 | 4.1 | 7.1 |
| Shevchenkivskyi | 1.2 | 1.1 | 3.0 | 2.2 | 7.5 |

lonskyi district was the leader of the rating, with the Desnianskyi district also demonstrating high environmental comfort indicators. The least comfortable was the Solomianskyi district. Besides this district, the Pecherskyi and Shevchenkivskyi districts, located in the city centre, demonstrated a very low environmental comfort indicator. The lowest ECI of these districts is due mainly to their completely built-up area and high population density. Transport congestion and the concentration of other sources of toxic emissions intensely pollute the atmosphere. Due to displacement of UGS by buildings, greenery is very scarce.

According to the ECI rating, three administrative districts in Kyiv (Solomianskyi, Pecherskyi and Shevchenkivskyi) demonstrate very poor environmental comfort. Being somewhat higher, this indicator is nonetheless poor in the Podilskyi and Dniprovskyi districts. The leading indicator that has a significant impact on the poor living comfort of people in these districts is the low green coverage ratio. This worsens the envi-

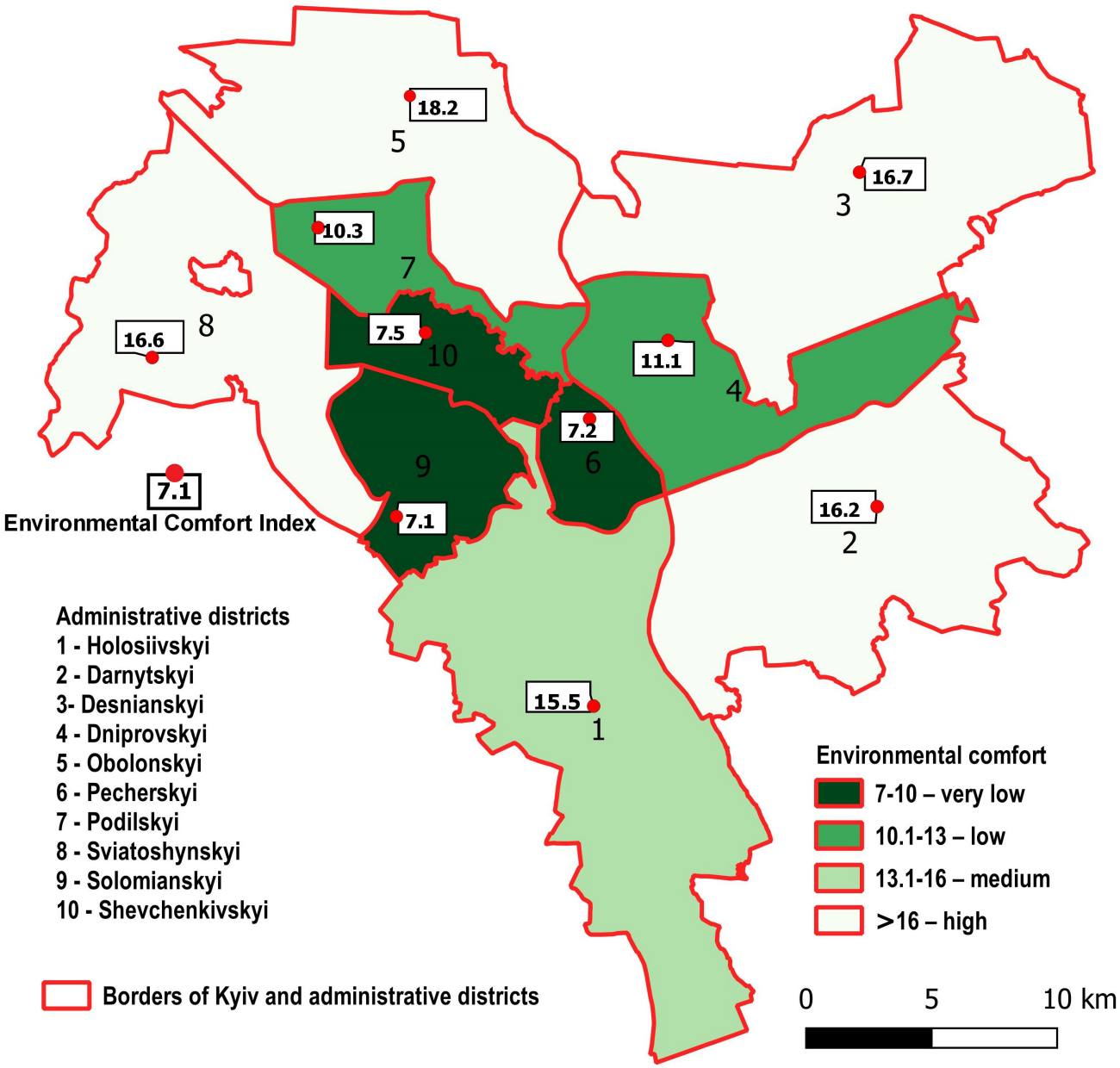


Fig. 3. Rating of Kyiv's districts according to the Environmental Comfort Index

ronmental safety and leads to persistent degradation of urbanised landscapes. The major part of these districts is congested with residential and non-residential buildings, and even greenery is often absent along roads and amid buildings. The most critical situation is in the Solomianskyi district due to the highest population density and the lowest provision of UGS. In addition, it concentrates so-called "grey" zones, i.e. industrial enterprises, which are virtually lacking any sanitary protection greenery.

**Conclusions.** UGS provide the city community with vital ecosystem services: absorb industrial and transport emissions, reduce noise effects, form a favourable microclimate, and perform recreation and revitalising functions. The higher the green coverage ratio the more comfortable is the district for living. In half of Kyiv's districts, with poor and very low environmental comfort, the risk of lung, cardiovascular, infection and other diseases can increase. A consequence of random urban development is also the destruction of existing UGS. The result of this is intense air pollution, formation of new heat islands, and a substantial public demand for recreational and cultural services. Hence, the lower the building

coverage ratio the more comfortable for life is the district.

The priority tasks of Kyiv's administration in terms of increasing the environmental comfort of urbanised landscapes are as follows: the establishment of clear UGS and UPA boundaries; the development of recreational sites, roadside greenery and the sanitary protection zones of enterprises; the prohibition of improper use of UGS with public access; holding annual inventory and monitoring of the sanitary and environmental condition of UGS of all kinds; all-round introduction of green structures that need no additional free areas. All these activities must be carried out in strict compliance with the State Construction Code, particularly as related to developing residential blocks with pedestrian access to parks and miniparks.

**The novelty of the study** consists in identifying the degree of compliance of Kyiv's urbanised landscapes to the criteria of environmental comfort of a compact and green city. With this in view, the built-up areas-to-UGS ratio was found for Kyiv and its ten districts, and relevant map charts were compiled. Environmental Comfort Index was calculated for each district and used for compiling a rating of Kyiv's districts. The study findings can be extrapolated to other Ukrainian cities.

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