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Sustainable Development of the Urban Agglomeration through the Creation of an Urban Network of Protected Areas: Case Study of Kyiv City Urban Ecosystem

Abstract. The need for improvement of the environment quality at the territory of cities is directly conditioned by its impact on the health of humans. At the same time humans are not the only residents of urban ecosystems, but they are also inhabited by other organisms, using city as their habitat. The growth of cities is a stable trend of the modern times and it comes into conflict with wildlife living activity and quality of environment. Sustainable development of cities is impossible without environment protection, economic progress and benefits for local communities, therefore the creation of protected areas groups within the city of Kyiv is offered as an instrument for biodiversity support and urban ecosystem stabilization. The most important requirements to the sites to be included into the system of protected areas have been formulated. The first two cores are developed based on small lakes, which are characterized with environmental, recreational and wildlife support potential. The benefits from the creation of the urban network of protected areas have been defined for urban ecosystem and social and economic situation in the city.

Keywords: urban environment, eco-network, protected areas, lacustrine ecosystem

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1. Introduction

The current intensive development of cities and adjoining settlements accelerates the degradation of natural components of urban ecosystem. Eventually it leads to the reduction of living conditions quality and imposes threats to human health due to growing pollution of the atmospheric air, water bodies, soils and intensive electromagnetic and noise pollution. The residuals of natural biocenosis and artificially created green islands are intended for the support of environmental balance at the territory of the city. However, growing population and subsequent construction of new residential areas tread on the nature areas and they gradually vanish, thus living residents without contact with nature, recreation facilities, protection from air and noise pollution, regulation of microclimate parameters, and other living organisms loose their habitats and movement corridors. However, the issues of species conservation at the urban territories are given minor attention in the researches dedicated to the environmental impacts of cities. While green infrastructure of cities is under constant attention due to its obvious importance for the regulation of environment quality, especially atmospheric air pollution mitigation, animals of cities are usually given not much of attention. The major focus in this case is on the biological hazard control, but urban fauna is an important element of biogeocenosis, being a part of biota, which provides the circulation of matter and energy through this ecosystem. Therefore the stability of the urban ecosystem depends also on the viability and quality of both zoo- and phytocenosis, which depends on a range of factors, including quality of abiotic environment and integrity of habitats. So, the aim of this study is to analyze the condition of urban biota and offer the approaches to its support in terms of sustainable development of the city of Kyiv.

2. Biodiversity conservation challenges under urban conditions

While urbanization, agriculture, and introduction of species are all contributing to species endangerment, urbanization seems to be the most intensive impact [Czech et al. 2000]. The essence of the negative influence from the urbanization is the direct destruction of habitats by replacing them with urban facilities and buildings, and the degradation of natural resources quality so that they are not able to provide the needs and living activity of biota. The modeling results of most specialists show that urban areas will grow in the upcoming years: from the

current 55% the proportion of the world's population living in cities is expected to increase to 68% by 2050. Projections show that urbanization combined with the overall growth of the world's population could add another 2.5 billion people to urban areas by 2050, with close to 90% of this increase taking place in Asia and Africa [UN 2018]. In the latter regions the threat is especially serious, as these are mostly areas rich in biodiversity [Lenzen 2014]. As a result by 2030 most population will live under the condition of so called "biological poverty" [Turner et al. 2004]. Biological poverty occurs when urban citizens experience below-average levels of native species diversity on a daily basis [Clergeau et al. 2001; Turner et al. 2004]. Combating poverty and provision of environmental safety to all citizens are among the tasks of sustainable cities. So, the efforts must be invested in the support of the habitat profile of cities to make them really sustainable.

Thus, urban and suburban development leads to huge conservation challenges [McKinney 2002]. As it was already mentioned, urban sprawl increases local extinction rates and the rates of native species loss due to replacement with alien species [Marzluff 2001; Blair 2001]. Scientists note, that the nature of disturbance from urbanization is similar to that from deforestation, but it is more permanent, and the affected lands have no chance to go back to previous conditions [McKinney 2002].

Still, urban ecosystems are diverse, and it is impossible to divide them into clearly anthropogenic and natural or habitable and non-habitable. Most cities are rather mosaics of artificial structures and conserved islands of native biocenosis. These elements are now full participants of the urban ecosystem with new interactions within the regional nature complexes of higher levels. So, it is impossible to apply approaches valid for technogenic systems or artificial plantations as agricultural fields to regulate the stability of urban ecosystems for the tasks of habitats protection and biota support. Consequently, research in this field must consider combined framework of various land use patterns and different level of pristine condition. It is also necessary to account that with passing time and economic progressing, the level of human manipulation with the nature increases, especially in cities [Pickett et al. 2001].

With increasing rate of urbanization and consequent loss of wild habitat land, cities are now viewed as potential sites for restoration and conservation of biotic communities and rich diversity [Shochat et al. 2010]. Consequently, urban environments should not be considered as lost wildlife habitat, on the contrary, if certain efforts are invested, these areas could become new habitats for species other than synanthropic. During the last decade urban ecosystems have therefore become a new component of concern for conservation and restoration, covered by a new discipline – reconciliationn ecology [Miller & Hobbs 2002; Rosenzweig 2003].

The sustainable urban ecosystems with high diversity communities must also maintain high quality of abiotic components, such as clean air and water, waste management, and pest control [Sanderson & Huron 2011].

Maintaining ecological function of urban ecosystems can be provided by designing and managing landscapes in an ecologically sensitive mode [Marzluff & Rodewald 2008]. The principles of species conservation in connection with urban planning started to form with the works by Leedy and Adams [1984], Adams and Dove [1989], Soulé [1991], and Shafer [1997]. However, they mostly cover the technical solutions for species conservation in human-dominated habitats. In particular, they argue the perspectives of creating in-city reserves in biodiversity "hotspots," based on native phytocenosis with communities of valuable macro vertebrates, all integrated with human community needs. A more realistic, but general approach offered was to restore shrub layers under urban forests and preserve small wetland complexes [Adams 1994].

Still, ecological studies of urban areas are on the rise now and they start to cover new components, except green plants. It should be noted that efforts aimed at conservation of animal species are of greater complexity as compared with vegetation. Animals are much less controllable due to their mobility and need more specific conditions to provide nutrition bases and behavioral patterns implementation. But really stable ecosystem must give these possibilities. The obvious answer is to concentrate on small animals, but the circulation of matter, which is a system forming process, cannot be provided under reduced scale and simplified hierarchy of interactions between the food chain components. Thus, the work should be done at a full scale for the good result.

From this point the most perspective is the support of the diversity communities at cities as they are in lower competition with the human needs and commodities. Therefore, research concerning birds in cities started to appear during the last quarter of the 20th century and results indicate that as development intensifies, bird communities lose their diversity, but the biomass grows [McKinney 2002; Donnelly & Marzluff 2004; Edgar & Kershaw 1994; Emlen 1974; Lancaster & Rees 1979; Turner et al. 2004]. Birds could also be used as bioindicators as they are active, respond to changes quickly and easily observable. Moreover, trends that work for birds may be good for other species of wildlife as well [Melles 2005]. It is possible to find studies about bird abundance and diversity in relation to ecological attributes, such as tree cover and impervious surface cover, composition, and number of tree species [Melles 2005], relationships between economic status of an urban neighborhood and its bird community [Donnelly & Marzluff 2004]. The research also shows that urban bird diversity is an indicator of human social and economic inequality, which is an important indicator of sustainability.

However, there are still many questions to be answered before the efficient management instruments for bird communities at urban areas will appear. For example, what are the ecological processes and interactions involved in maintaining an urban bird community (i.e., food availability, extinction dynamics, source/sink dynamics, predation, parasitism, disease, dispersal, adaptation); what are preferred mobility pathways under urban conditions (street trees or back yard lanes) and whether birds are ready to cross large open spaces? But even though there is not much information about mortality risks for crossing different land cover types and urban predators, or the relationship between diversity and the amount of impervious surface, or whether species of fragmented urban parks demonstrate population pattern, we can still conclude that the support of continuous habitats and creation of mobility corridors is the solution that will provide the necessary level of biological diversity and final stability of urban ecosystem.

3. Protected areas of urban areas

The term "protected area" is very general, covering a variety of names used for natural parks, green areas, reserves, etc. in countries around the world to mark the territory, which has been excluded from direct economic exploitation and is under protection for the purposes of biocenosis conservation. In other words, a protected area can be defined as a precisely delineated area subject to specific legislation aimed primarily at protecting the environment [Girault 2017]. To obtain the status of protected area, the ecosystem must have some environmental value. According to Ukrainian legislation the territory could be a candidate for protected area if it has natural complexes and objects of nature conservation, scientific, aesthetic and other value. Specifically, this territory must also be a habitat for the species under official protection of the state Red Book or any international agreements. Here it is seen that the protected areas are not compulsory those, which had no contact with humans and are really wild, on the contrary they are in many cases a merger between results of anthropogenic influence, which grant cultural and social value, and unique natural complexes of aesthetic and stabilization value for biosphere. If we need as much nature as possible to feel ourselves comfortable in a city, it is worth working on formation of protected areas within a city. Hence as C. Girault states, urbanity can incorporate naturalness and naturalness can incorporate urbanity [Girault 2017]. And the creation of urban protected areas is also the first step in cognition of fundamental principles of natural systems self-regulation and fusion of urban and natural. This process is expected to pave the way to the formation of a "naturbanity" [Rodary 2018].

From the practical point, protected areas in cities also serve utility purposes: some are treated as eco-zones for observation over natural processes, while others are regularly used for physical activities and more contemplative pastimes, the way they would use a public park. Therefore urban protected areas must be provided with public transportation and thereby integrated into the urban fabric. Moreover, in some cities nature areas are protected to improve their integration into the urban system, rather than to save them from the threat of predatory urban development. The diversity of their visitors and the activities for which the reserves are used reflect the diversity of the city [Girault 2017]. However, most cities contain a wide range of small natural islands, not considered real protected areas due to fragmentation; instead they form a sort of "archipelago" [Girault 2017]. The absence of the links levels down the significance of any number of protected areas.

To provide more sustainable and environmentally safe development of Kyiv urban areas it was offered to create a range of minor protected areas within the city, which would be both providers of environmental services (reduction of pollution, regulation of microclimate, recreation) and elements of regional and local eco-network. The core of such protected areas could be water bodies of any kind, and the authors offer to use lakes as the basis for the implementation of the proposal. It is possible to find numerous small water bodies with green areas attached at the territory of almost any city. Due to their small scale they are often disregarded and wiped out in the plans of new construction. Moreover, they are considered attractive elements for future buildings infrastructure and become built around, if not destroyed.

So, to protect these water ecosystems and let them work for good of urban population and wild or synanthrope species, it is necessary to choose the appropriate objects and press for their inclusion into the system of protected areas of any level. The important traits of the candidates, as the authors suggest, are presence of natural of artificial vegetation around the water body, water biocenosis, recreational and cultural value, habitat to any valuable species, sanitary condition. The first line of the plan must be formed of those objects, which posses all the mentioned characteristics, but are under the threat of construction.

The results of lacustrine ecosystems official protection will procure three major components of sustainability – environment, local communities and economic development (Fig. 1). Any new protected area is a stabilizing element for the urban ecosystem as it will be protected from exploitation and pollution. This way, residents will be able to enjoy another spot of safe environment, with reduced human health hazard. The improved tourist attractiveness of these territories will form the economic component of sustainability by providing incomes to the budget from controlled recreation. This will also create some new jobs for local residents and contribute to the improvement of environmental awareness

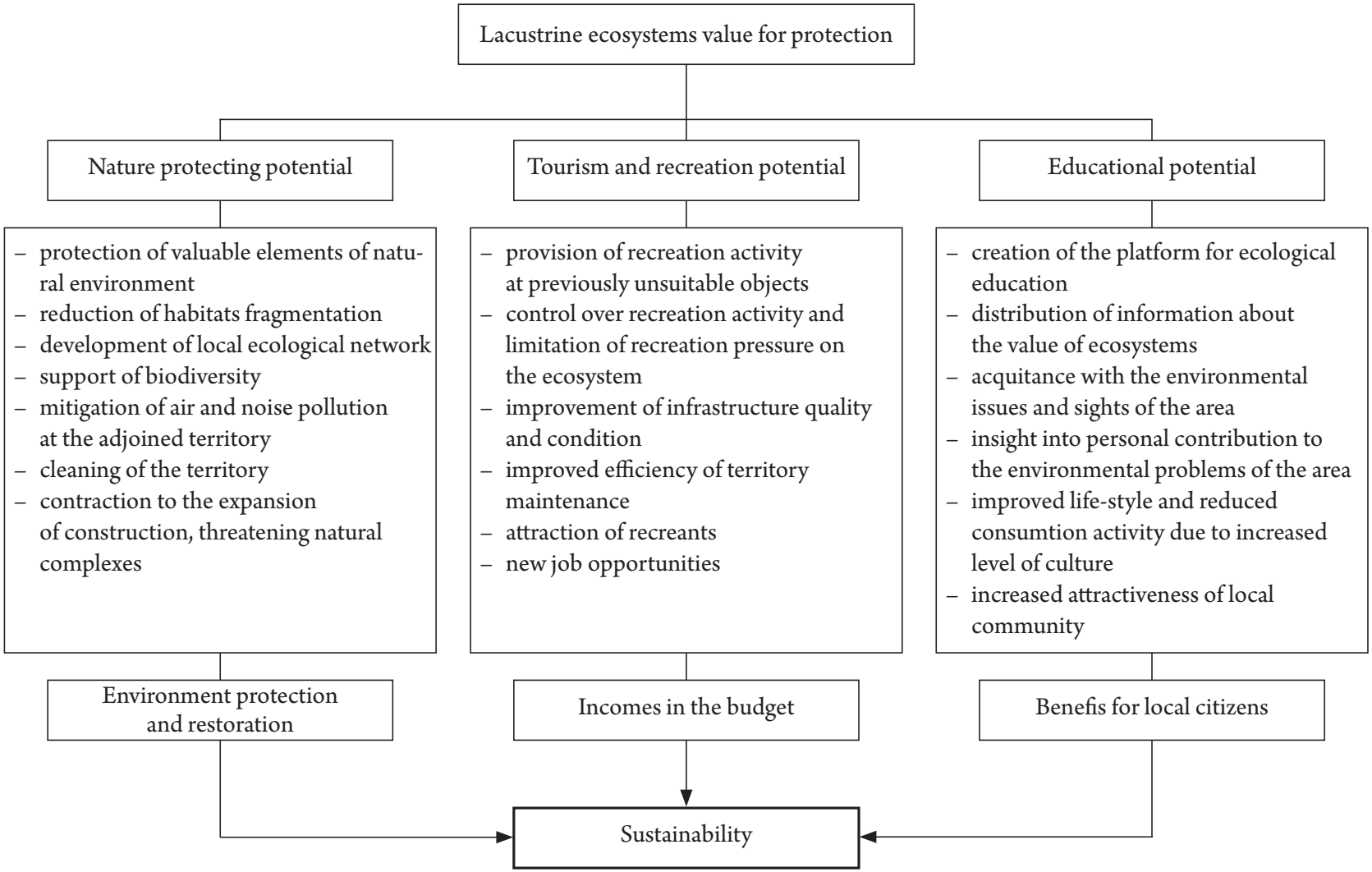

Figure 1. Contribution to cities sustainability from the protection of water bodies ecosystems

Source: own elaboration.

among population. Eventually budget filling, environment quality improvement and ecological education and recreation opportunities will all be valuable for local communities.

From the other point, these ecosystems will also benefit from the acquiring protection status: prohibition of construction; prohibition of waste storage; prohibition of hydrotechnical works; protection of soil cover; protection of phytocenosis; controlled recreation and active information policy, which will contribute to the support of the official nature conservation efforts.

4. Nature protecting potential of Kyiv city

Kiev is the largest city in Ukraine. Taking into account the capital status of the Kiev agglomeration, a significant proportion of both domestic and foreign investments in construction and services are directed here. The processes of land allocation and development also take the fastest rate. Unfortunately, under modern conditions, new land allocation is possible exclusively at the expense of natural areas.

At the same time, Kiev remains the unique European capital, which has preserved significant areas of valuable natural complexes. Kyiv also has a well-developed hydrographic system, including 129 lakes, 102 ponds, 43 small artificial reservoirs, 37 springs, 9 rivers, 27 channels, 28 streams, 2 ducts and 24 bays. Within the boundaries of Kiev, the water area of the Dnieper and its tributaries occupies 5.6% of the city's territory in the form of 430 reservoirs, total area of which is 23.47 km^2 [Batog 2017].

Natural lakes are commonly found on the left bank. Basically, these are the oxbow lakes of the ancient riverbed of the Dnieper, which gradually migrated from the east to the west. The accumulated alluvial deposits were eventually compacted, which led to the formation of depressions, which later became lakes.

The high plateau of the right bank, dissected with beam and valley depressions, also includes significant number of ponds that were created and used by inhabitants of the city from ancient times. As a result, a range of natural lakes, significantly transformed by man, is located on the right bank of Kiev. The transformations are mainly caused by the extraction of sand for the construction of the residential districts and the creation of embankments for infrastructure (roads, subway, communication lines and power stations, etc) [Anakhov et al. 2018].

The reservoirs on the Right Bank are mostly single and small in size. The lakes of the Left Bank are usually larger, often forming groups; this is a good basis for the implementation of the idea to create continuous protected areas with the reduced level of defragmentation, which equals integrity of potential habitats.

The largest of the lakes in Kiev is Diamond. Its length reaches 3 km. It is located in the northeastern part of the city. The other large lakes are Redkine, Rainbow, Vyrlitsa, Tyagle; slightly smaller are Solar, Verbne, Blue, Telbin, Svyatoshinsky ponds. The smallest water bodies are Central, Glinka, Orikhuvatske, Didorovsky and the system of ponds in the park "Crow grief." The lakes Goloseevsky, Samburk, Feofaniya, Sovki, Syretsky and other small water bodies undergo gradual waterlogging. Most of the lakes in Kiev are eutrophic and dystrophic.

Thus, there are many potential candidates for the official inclusion into the protected areas network. However, to reach the targets set these objects must meet the official criteria: be the habitat of rare species; represent value as a natural complex; have historical or cultural value; be important for research and scientific purposes; be threatened by human activity. The authors have included one more criteria: location – the proposed water bodies must be located close to each other to provide the possibility to form wildlife corridors and continued habitats, as this is the only way to real support of urban fauna.

Kyiv is a habitat of a range of animals and plants listed in the Red Book of Ukraine. The official list of regional rare plants in Kyiv contains 56 types of vascular plants. The list of animal species subject to special protection in the city of Kiev is made of 82 species of animals, including: birds – 10 species, reptile – 3 species, amphibious – 6 species, fish – 3 species, insects – 60 species [Vasylyuk et al. 2012]. It is possible to find ermine, otter, and white-tailed eagle, to see several species of fading orchids here. 12% of Kyiv lands have a protected status. In particular, the territory of Kyiv includes 23 protected areas of the national status, 5 historical and natural parks, 3 regional landscape parks, 20 parks-monuments of the landscape art, 5 botanic gardens, etc. [Ecological passport of Kyiv 2018]. Through the city there passes the Dnieper ecological corridor, which has national and pan-European significance.

5. The project of the urban econetwork

As it was mentioned above the efficient preservation of urban biocenosis depends on the availability of suitable ecotop, which, in turn, is formed by the following factors:

– natural character of vegetation or stable (climax) semi-artificial plantation (the one includes artificially planted vegetation combined with typical species for the region;

– continuous character of habitat (mitigation of barrier effect between protected areas with wildlife corridors and green infrastructure networking);

– low level of noise from adjoining territories;

– reduced level of environment pollution, in particular soil and underground waters (the air pollution is, of course, a crucial factor, but it is hard to control it, and at the same time it will be mitigated by the green plants themselves);

– presence of a water body, which supports the necessary level of humidity without irrigation and increases the diversity of ecological niches, which equals increased diversity of species;

– attractiveness of the territory for the population (picturesque landscape, historical and cultural value) for the purpose of regulated recreation and ecotourism;

– importance of the territory for wider territorial environmental networks (ecological network, margin environmental stripes, networks of valuable wetlands, etc.);

– possibility of organization of research and educational activity.

For these reasons in Kyiv the authors have chosen a few small lakes, suitable for the development of protected network and meeting the above mentioned requirements. These are Lake Lisove (Forest), Babyne (Old Lady), Radunka, Veselka (Rainbow), Milen'ke (Shallow), Gnylukha, Bykivnyanske (Table 1). They are located in the eastern part of the city within the major residential areas. There are some valuable species (*Trapa nátans, Rana tarrestris, Salvinia natans*) and they

Table 1. Characteristics of the lakes, chosen for econetwork integration

Group of lakes	Subgroup	Name	Area, ha	Character of shore
Hydrogenic	Natural, partially transformed	Babyne	47	Densely covered with meadow and forest vegetation
	Transformed	Radunka	65	Partially preserved meadow vegetation and groups of trees
		Kyrylivske	18	Arranged for recreation with residuals of natural water plants
		Yordanske	15	Arranged for recreation with residuals of natural semi-water plants
	Ox bow	Gnylusha	9	Partially preserved meadow and forest vegetation
		Verbne	16	Arranged for recreation with residuals of natural semi-water plants
		Milen'ke	8,5	Partially preserved meadow and forest vegetation
Artificial	Quarry	Lisove (Diamond)	162	Dense forest (pine and birch) at the left bank and poor water plants associations at the right bank
		Veselka	41	Partially preserved meadow and forest vegetation

Source: own elaboration.

Figure 2. The candidates for protected areas in the Dniprovsky and Desnyanky districts of Kyiv

Source: own elaboration based on Google Maps.

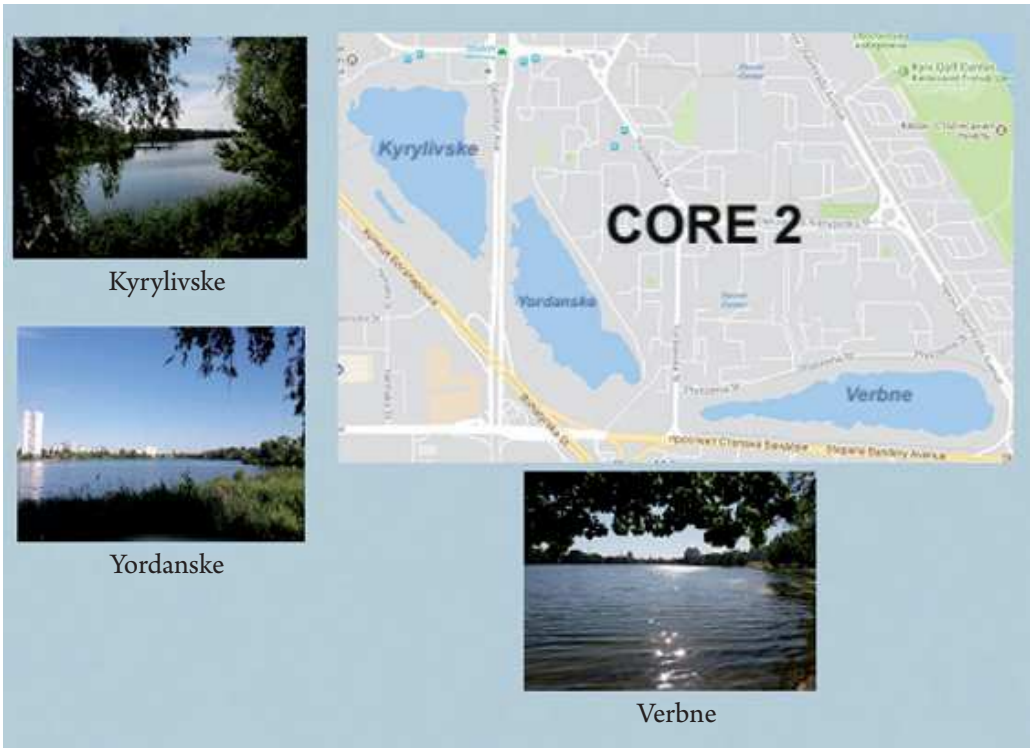

Figure 3. The candidates for protected areas in the Obolon district of Kyiv

Source: own elaboration based on Google Maps.

are well covered with arboreal or bush plantations, mostly natural or semi-artificial. Together they will form two cores, within which the conditions similar to those outside urban areas are created (Fig. 2 and 3).

The Lisove or Diamond Lake is on the left bank of Kiev and is the biggest in the city. It has an artificial origin: earlier it was a peat bog, but in the 80s of the last century the sand was washed here for the construction of a new residential area and subsequently, the area was flooded with water. It is a habitat for European pond turtle, coypu, stoat, weasel, hare, beaver, and the rusty toad (*Rana tarrestris*), which is included in the Red Book of Ukraine. There are wild ducks, grebes, and gulls. The shores are flat, covered with reed vegetation (common reed, narrow-leaved reedmace, broad-leaved reedmace). The lake is home to 10 species of fish, mainly pike, bream, crucian carp, perch, tench, as well as crayfish.

Lake Radunka is 1,4 km long, divided with the artificial pre-wall embankment and bridge into uneven parts. The reservoir is surrounded with a reed. There are 5 species of fish, wild ducks, martini, water chickens, common moorhen, muskrat. Vegetation of water body includes 20 species of plants, which is quite rich diversity for Kiev reservoirs. The most important plant species such as *Salvinia natans* and *Trapa natans*, which are listed in the Red Data Book of Ukraine, and Salvinia natans has the international protection status of the Berne Convention. This territory is under the threat of destruction due to planned expansion of residential construction.

Lake Babyne is of natural origin and was heavily exploited at the end of the nineteenth century when the workshops of the Dnieper Shipping Company worked there. Now it is rewilded area out of active touristic use, but there is a problem of overfishing. In the coastal zone there is a number of rare and endangered species requiring protection: Becketter's Festuca (*Festuca beckeri (Hack.) Trautv.*), which is listed on the European Red List, *Salvinia natans L.*, and early marsh-orchid (*Dactylorhiza incarnata (L.) Soo*), listed in the Red Book of Ukraine.

Lake Hnylusha is considered one of the most dangerous water reservoirs in Kiev, because it does not meet sanitary norms due to building of private houses and household waste dumped in. There is an open question about cleaning and arrangement of the territory around. There is a memorial sign next to the lake, in which it is noted, that on this place Yaroslav the Wise concluded a peace agreement with his brother, which contributed to the unification of Kyiv Rus into a single state in 1020. The historical park "Horodets knyazhy" works here. The biocenosis of this area is marsh meadow. It is represented with groups of sedge, more rarely Glyceria, also known as mannagrass in the United States, or sweet-grass in the UK. The floral nucleus is formed of hydrophilic species, including Siberian horns, listed in the Red Book of Ukraine. In the open landscapes, there are many big isolated white willows, which have significant age and must be preserved. The

water protection zone of the lake is included into the landscape reserve of local significance "Desniansky meadows," but it has no established zoning, protected plan and marking on the land, therefore the conservation efficiency is not high and the lake should be included into separate protected area.

The lakes Veselka and Milen'ke are hydrologically similar and located in close proximity, but Veselka is artificial, formed in 1950 by deepening and expansion of the Darnytsa River. Still the Veselka Lake experience lower human influence and higher water quality as a result. By the characteristic of the water plantation they are both poor, but they have big amount of fish, and there dwells the moor frog, protected by the Red Book of Ukraine and the Red Book of vertebrates of the International Union for Conservation of Nature (IUCN).

The lakes Yordanske and Kyrylivske are created on the place of the riverbed of the Yordanska River, which is a historical landmark as it was the place of Kyiv population first baptizing in 998. The lakes are polluted due to the discharge of storm waters from residential areas. The value of these objects is due to the fact that their shores include the preserved remains of the typical biotopes of the region, which were destructed for the construction of residential area. In particular, there are fragments of sand dunes overgrown with psamophytic (peptic) groups, including willow acorns or shellfish (*Salix acutifolia Willd.*). Overgrown inaccessible shores of lakes have also become a protected biotope for many coastal and water birds and valuable fish species (crucians, pikes and carps). The presence of fish attracts birds – in particular, river martins. Well-developed coastal and aquatic vegetation, such as canopy walls and broad-leaved hornbeam, is common in the site. In the vicinity of the lake of Jordan there are creeping roes (*Iris pseudacorus L.*) protected by the decision of the Kyiv city council.

Lake Verbne is an ichthyological-botanical nature reserve of local importance and is offered as the basis for the creation of the Core 2. Economic activity, leading to damage to natural complexes, is prohibited in the reserve. There are information signs, but the territory of the reserve is not fenced. It is a place for local recreation. The southern shore of the lake is shallow with the beach, the northern - elevated. On the banks willow fragile grows, as well as black poplar, willow shrubs and ashen. The grassy tier is represented by typical meadow and meadow-bog cereals and grasses. Coastal aquatic vegetation is represented by species of common reed and rare rice cutgrass and salvinia. The lake water has high phytoplankton biomass, which is the basis for the development of the animal world: there are more than 20 species of fish, such as bream, tench, white bream, silver and gold carp, perch.

It is tough task to apply to the authorities, but the active group of students of the National Aviation University managed to prepare and submit the application to the Kyiv City municipal authority and the Ministry of Environment protection about the Lake Radunka, which was finally approved and implemented: the local

landscape reserve was created in 2017. Lake Verbne is already a nature reserve, as well as Lake Hnylusha, so, the next stage is obtaining protected status for the Lake Lisove and Babyne – corresponding applications has already been prepared and are currently under consideration.

A good support of 'wildlife island" image of these territories would be a dense population and variety of birds, which could be an ideal entry point for families and school groups, who can learn about the avifauna through the information materials and excursions, contributing to ecological education and understanding the importance and vulnerability of nature at their neighborhood. To achieve this it is necessary to invest efforts into creation of continuous habitat, which will be provided when all the offered territories acquire the necessary status. Simultaneously, such an independent and massive biocenosis will support the stability of urban ecosystem by mitigating the levels of environment pollution and supporting careful attitude to the nature from the local population, benefitting from such neighborhood through the reduced health risks and improved living standards.

6. Conclusions

The issues of environmental safety support are quite topical for urban areas, as the most of prognosis prove that the number and density of urban population is going to grow in the upcoming years. The various approaches to tackling this problem must also consider cities as an ecosystem with components other than buildings and people and with certain flow of energy and information through the food chains and communication between living organisms. Here comes the need to develop cities as habitats for local and regional species of animals and plants. But the success of this work depends on the availability of areas with reduced anthropogenic pressure, including that from industry, transport and recreation. The outcomes of the study on the problem are as follows:

1. Kyiv possess a rich and diverse nature protection potential due to conservation of a range of natural biogeocenosis and presence of dense hydrological network. The main threats to the natural areas are growing residential construction and overexploitation of recreational resources.

2. The possible solution to the outlined problem is the creation of small protected areas around the lakes within the urban territory. They should be chosen to be located as close as possible so that they form continuous habitat and overcome fragmentation problems by providing passages for wildlife.

3. The authors offer to create two core areas of wildlife habitats maintenance and communication in Kyiv. 9 lacustrine ecosystems have been chosen to be included into these cores. These lakes have landscape, biocenotic and cultural value,

and their potential for granting the status of protected area is supported by the presence of rare and valuable species, included into national and pan-European lists.

4. The process of the protected status acquisition is a time-consuming factor, which limits the process of the protected cores formation. Currently 3 objects have already received their protection, and two others are on their way.

5. The urban protected areas are still usual elements of cities, which follow the rhythm of urban life, with peak visitor periods in the evenings and at weekends, as at many other urban facilities such as stations and shops. Still, they will have much more important positive impact for the quality of life of citizens.

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Zrównoważony rozwój aglomeracji miejskiej poprzez stworzenie sieci miejskiej obszarów chronionych. Studium przypadku miejskiego ekosystemu Kijowa

Streszczenie. Potrzeba poprawy jakości środowiska na terytorium miast wynika z jego wpływu na zdrowie ludzi. Jednak ludzie nie są jedynymi mieszkańcami ekosystemów miejskich, zamieszkują je także inne organizmy, wykorzystując miasto jako swoje siedlisko. Rozwój miast jest współcześnie stałym trendem i wchodzi w konflikt z dziką przyrodą i jakością środowiska. Zrównoważony rozwój miast jest niemożliwy bez ochrony środowiska, postępu gospodarczego i korzyści dla społeczności lokalnych, dlatego tworzenie obszarów chronionych w Kijowie może stanowić narzędzie wspierania różnorodności biologicznej i stabilizacji ekosystemów miejskich. W artykule przedstawiono najważniejsze wymagania dotyczące obiektów, które mają zostać włączone do systemu obszarów chronionych. Pierwsze dwa dotyczą małych jezior, które mogą służyć ochronie środowiska, rekreacji i przyrodzie. Korzyści wynikające z utworzenia miejskiej sieci obszarów chronionych zostały określone dla ekosystemu miejskiego oraz społeczno-gospodarczej sytuacji miasta.

Słowa kluczowe: środowisko miejskie, ekosieć, obszary chronione, ekosystem jeziorny