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DEGRADATION OF THE FOREST PARKS IN CONDITIONS OF THE DEVELOPMENT OF LVIV AGGLOMERATION

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Received: September 05, 2018 / Revised: October 28, 2018 / Accepted: November 07, 2018

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Abstract. The expansion of urban agglomerations increases the anthropogenic impact on the environment. Forests are more likely to suffer from this pressure. The process of degradation of forested green areas takes place. It is primarily manifested in the change of the spatial structure of forest parks and synanthropy of forest parks flora. We observe phytocenotic degradation, recreational degradation and degradation resulting from improper care of forest parks.

Key words: green area, forest park, phytocenotic degradation, anthropogenic, man-altered territory.

1. Introduction

Contemporary urbanization is characterized by an increasing spatial mobility of the population. Agglomeration belongs to the most important elements of the modern settlement. In Ukraine the agglomerations are formed on the basis of the main regional centers of industry, science, culture, education and transport hubs. Such centres as Kyiv, Kharkiv, Odessa, Lviv are the centres of agglomeration. A significant number of agglomerations were formed in the Prydniprovia (the Dniper River areas). These areas include Zaporizhzhia, Kryvyi Rih and the Dnipro-Kamiansk conurbation. Lviv Metropolitan conurbation is the largest in population agglomeration in the West of Ukraine. Its development has a significant influence on the development not only of the Lviv region but also on the entire macro-region (Rusanova, I., Idak, Y., 2016).

From the time of the founding of the city until the end of the 20th century its area has increased by more than 25 times. A significant increase in the area has occurred over the last 70 years – the territory of the city almost doubled as a result of affiliation of a large number of rural settlements (Kostyuk I., 2007). Due to the development of residential and industrial facilities and transport routes, relative area of vegetative territories has decreased in 1,6 times and has made in 90-ies 37.6 % of the territory compared to 61.2 % of it in 1940, which is below applicable standards (Kurnitska M. P., 2011). To ensure the establishment of favourable environment, the forest ecosystems play an important role in preservation of the biological diversity. Around the city the forest belt is being formed, which unifies the forests adjacent to the urban territory.

The forests included into green zones of the cities complete architectural and spatial perception of the urban landscape, provide a link of urban areas with suburban forests and create favourable conditions for the rehabilitation of the cities. The removal of the forest ecosystems as a result of urbanization processes determines their degradation and deforestation. Green areas of the city are important components of the socio-ecological environment of the city. The dynamics of changes in their size and condition will be an important indicator of changes in ecological situation within the city boundaries and outside it (Nazaruk M., Zhuk Yu., 2013). Taking into account the requirements of regional planning and master plans of the cities to establish a unified urban and rural natural spaces, the suburban green areas connected to the city suburbs start to play an important role. Development of modern ways of ecological comfort zones formation is one of the most significant directions in the urban agglomerations progress.

2. Basic Theory Part

Primary dispersed features of the localization of built up and open areas of the city of Lviv are due to the height differences of the natural skeleton. Development of the valley space of the Poltva river and the gradual urbanization of the territory of the Lviv plateau with the part of the West Podolia and South-East skirt of Roztochchia led to evenly-dense built city centre with a part of open areas. Only 10 % of those areas were more intensively developed.

They were situated along the radial links with the existence of developed local centres between them. Some streets or groups of houses were crowded on the skirts and stripes of hilly and cut terrain and, being limited by natural barriers from two or even three sides, they were originally little fit for the citywide structures (V. V. Didyk, T. M. Maksymyuk, S. P. Tupis, 2010). Embedding of the city into a natural framework characterizes the urban planning of the past centuries. Development process of the city skips the sites inconvenient for the construction works, leaving them in the urban structure unchanged. As the result, the distinctive natural elements divided the city into separate, relatively independent parts (N. S. Sosnova, 2012).

The further process of development of the city of Lviv has undergone several stages. During the first stage (1960–1970) the city center of Lviv was a city concentrating a variety of functions.

In 1970s, this process covered the area within a radius of 30–35 km around the city. In the late 70s, the densely populated suburban area was built up, which in accordance with the urban planning concepts, should not be built. During the next phase (the 1980s) the interconnections of the city centre with the surrounding settlements within a radius of 40–50 km became stronger. After 1990, the process of building in the suburban areas has acquired a character of dynamism and disorder. The suburban areas of Lviv in Briukhovychi, Vynnyky, Solonka, Obroshyno, Hriada and the like were built-up in chaotic manner. New private buildings, territories for transport connections and public functions squeezed in, grabbed and splitted the surrounding green areas (Rusanova, I., Idak, Y., 2016). Since that time an active attack on the green areas of the city has begun.

In the early 20th century, Lviv was one of the greenest cities in Central Europe. In 1910, the area of green space in Lviv was 8.54 sq.m. per capita, while in Prague, it was 3.96 sq.m., in Graz – 5.32 sq.m., in Bern – 3.67 sq.m., in Vienna – up to 1.09 sq.m (Raciborski M, 1910). Over the long history of the city, the green zone has been formed around it which is characteristic only to Lviv providing optimal living conditions for the residents. It should be noted that today the natural conditions of the existence of green zones within the Lviv agglomeration have changed under the influence of anthropogenic factors. There is a significant fragmentation of the green spaces, simplification of species composition, uneven distribution of tree stands, and decrease of biodiversity in forest ecosystems. The share of forests in suburban areas is 25.05 % (Bila, T., 2013).

The variety of landscapes of Lviv is due to its location at the junction of different geomorphological zones. The green zone of Lviv is situated at the crossroad of five landscape complexes: Roztochchia, Pobuzhzhia range, Vynnyky hills, Holohory, Lviv plateau and Lublin plain. Through the territory of Lviv the Main European watershed runs, part of which is located in the northern part of the Podolian upland of Ukraine. The northern part of suburban forest zone, which lies in the upper reaches of the rivers, belongs to the Baltic sea basin, the southern part of it belongs to the Black sea basin (Fig. 1) (O. Babich, 2010).

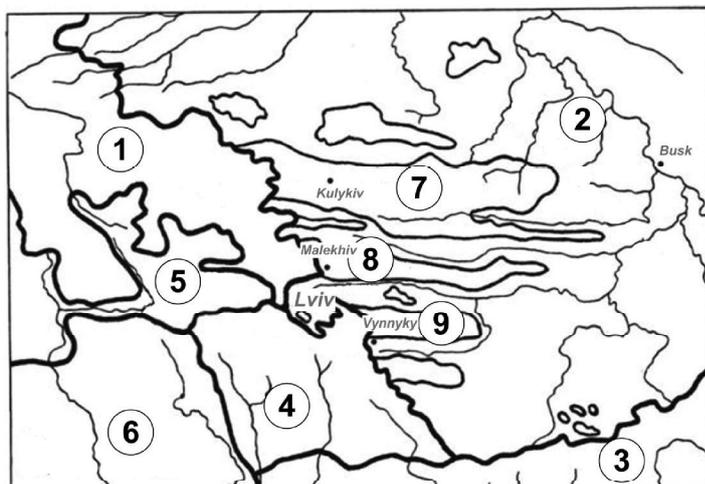


Fig. 1. Geomorphological scheme of the Lviv surroundings (Babich, O., 2010)

- 1 – Roztochchia; 2 – Hriadove Pobuzhzhia;
- 3 – Opillia; 4 – Lviv plateau; 5 – Bilohorsko-Malchytska valley; 6 – Sian-Dnister watershed valley; 7 – Kulykivska Hriada; 8 – Malekhivska Hriada; 9 – Vynnykivska Hriada

Lviv has a pronounced radial-ring system of gardening. The suburban forests are considered as a whole unit with the urban green areas and they form the third green ring (V. P. Kucheryavyy, 2008).

Green zones, forest and forest massifs are subordinated to the *Lviv forestry* of Lviv Regional Department of the Forest and Hunting Economy. The forest park part of the green zone of the city (according to the report of 2012) is 28.867 ha (there are 8 forestries – Borshchovychi, Briukhovychi, Zavadiiv, Vynnyky, Krasiv, Lypnyky, Lapajivka and Tovshchiv forestry). The forest park area within the city limits (Vynnyky, Zavadiiv and Brukhovychi forestries) is of 3.447 ha. These forests belong to the first group which does not follow the main deviation. The forest park area is located within a radius of 12 km. It includes Briukhovychi and Vynnyky forest parks, Basiv forest park, and forests in the upper area of the Zubra river being on the landscape of the Lviv plateau geocomplex. They also include the numerous forest tracts on the Bilohorshcha-Malchytzi plain (e.g., the forest park of Bilohorshcha) (Fig. 2). The integrated environmental program for the city of Lviv for the time period of 2012–2016 was developed in accordance with the decision of the Lviv City Council No. 365 dated March 31, 2011.

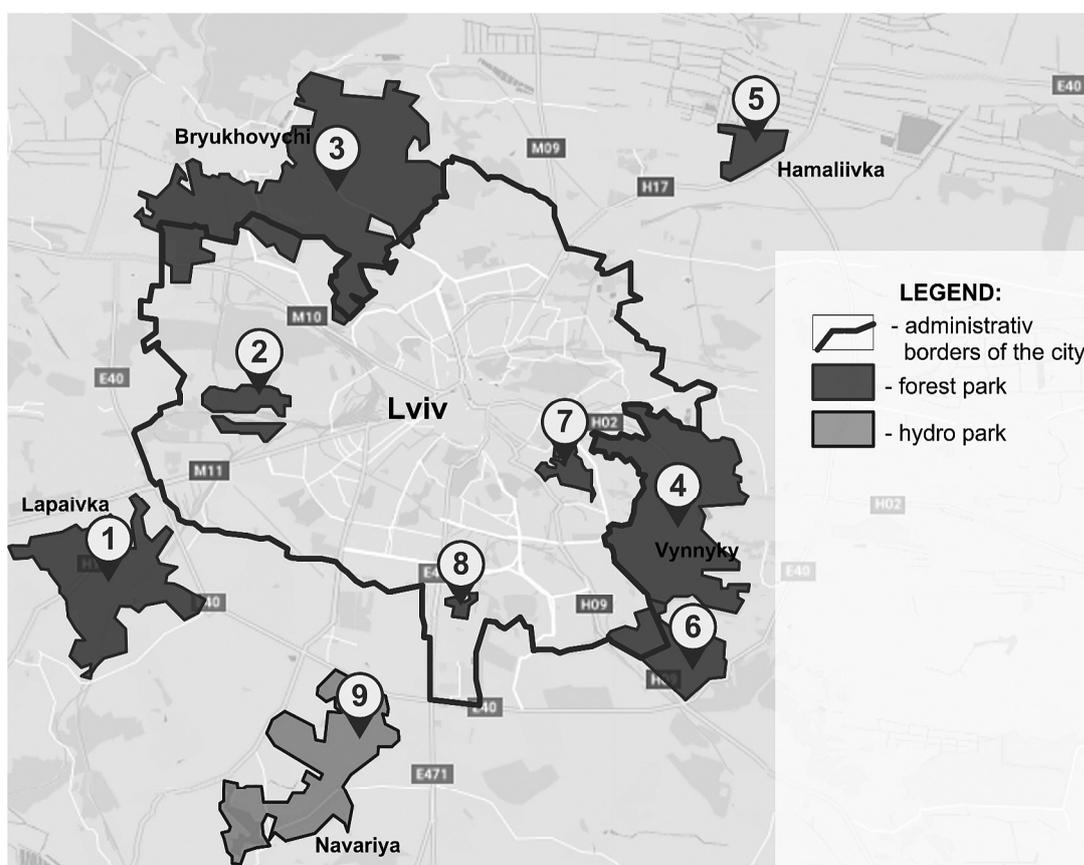


Fig. 2. The scheme of the Lviv forest parks: 1 – the Basiv forest park; 2 – the Bilohorshcha forest park; 3 – the Briukhovychi forest park; 4 – the Vynnyky forest park; 5 – the Hamaliivka forest park; 6 – the Zubra forest park; 7 – the Pohulianka forest park; 8 – the Sykhiv forest park; 9 – the hydro park of Hlynna-Navaria

3. Results and Discussion

The outskirts of Lviv are mainly characterized by broadleaf forests and partly by pine forests. Forest vegetation is most often concentrated in the basins and valleys of streams. River valleys are covered with meadow vegetation; unique meadow-bog and peat groups have survived in the area of the forest park of Bilohorshcha.

Forest park arrays are unevenly located around the city, and mainly adjacent to the urban quarters from the east (the Vynnyky forest park) and the west (the Briukhovychi forest park) and partly from the southwest – Basivka forest park. The southern and northern outskirts of the city are forestless. From the southwest side near the river of Shchiryk, the hydro park of Hlynna-Navaria lies having an area of 400 ha (Fig. 2).

Our surveys were conducted in 2016–2017² and their results have revealed that the existing green arrays have recede under the onslaught of the construction, which is carried out both along the perimeter of the territory and from the inside.

The process of dissection of the forest massifs into isolated island areas together with the air pollution and increase of soil density due to the increase of the number of visitors leads to a change in the spatial structure of forest parks, changes in its species variety of the woody and grassy tiers. This, in turn, leads to their degradation.

The Vynnyky forest park, which is located within the hills and partly in the Pobuzhzhya range, is characterized by the indigenous type of forest. The main forest species are *Fagus sylvatica* L. with an admixture of *Carpinus betulus* L., *Acer platanoides* L. Over the past few years, massive felling of the forest beech has occurred in this area, which has caused the formation of new groups partially different from indigenous species. *Betula pendula* Roth., *Acer pseudoplatanus* L., *A. platanoides* began to enter the first tier in the tree tier. *Sambucus nigra* L has spread to the undergrowth. Along with the decrease in the projective cover of the typical forest grasses with mosaic placement in the grass cover in the luminaries and along the paths, the meadow and meadow forest species of grasses penetrate there. These are *Agrostis tenuis* Sibth., *Veronica chamaedrys* L., *Trifolium repens* L. The involvement of ruderal species comprises *Carex hirta* L., *Capsella bursa pastoris* (L.). Some species increase in the glades as well as those of “forest weeds”: *Geum urbanum* L., (3–5 %), *Urtica dioica* L. (2–10 %), *Geranium robertianum* L., *Galeopsis pubescens* Bess, *Lamium maculatum* (L.) L. (1–5 %), *Alliaria petiolata* (Bieb.) Cavara et Grande, *Aegopodium podagraria* L. Distribution of these species depends on the composition of the plantings. Expansion of the network of forest roads led to the bogging of the territory of the forest park.

It is worth mentioning that the collection areas that are laid down on the territory of the Vynnyky forest park are currently in abandoned state. In 1895, in the western part of Vynnyky (not far from Zhupan hill), the director of the Forestry school S. Sokolovsky created an extremely interesting arboretum in terms of the organization of the territory: the introduced species were planted on the areas of 10*10 m. In 1913, fifty six species of wood were acclimatized: *Betula lenta* L., *Carya alba* (L.) S. Koch, *Quercus austriaca* Willd., *Thuja plicata* Lamb., *Pseudotsuga glauca* Mayr, *Abies nordmanniana* (Stev.) Spach (A. Baysar, 2012). At present, most species are lost. Some individual species such as *Pseudotsuga menziesii* Mirb., *Pinus nigra* Arn., *Larix leptolepis* (Sieb, et Zuce) Gord., *Quercus rubra* L. are the only species preserved.

The pine butchers characteristic of the Briukhovychi forest park are a new natural succession planted in the early 19th century on the local sand fields (V. P. Kucheryavyy, K. S. Brunets, 2010). The species structure on the territory of the former park is represented by *Pinus sylvestris* L., *Quercus petraea* Liebl., *Q. robur* L., *Acer platanoides*, *Carpinus betulus*, *Betula pendula*, occasionally by *Picea abies* (L.) Karst and *Fagus sylvatica*. The specimens of the rock oak and the common pine are old and are over the age of more than 150 years.

The ordinary pine stands out in the first tier and forms an array with an admixture of a spiky maple. In these areas, the formation of sublime sinusia with the participation of *Sambucus nigra*, *Corylus avellana* L., *Euonymus verrucosa* Scop. and *E. europaea* L., species of the genus *Rubus* L. is observed.

In the grass cover, *Anemone nemorosa* L., *Lathyrus vernus* (L.) Bernh., *Galeobdolon luteum* Huds can be seen. A rock oak is a part of the alley and acts as a powerful solitaire. In the thickened part of the park under the old specimens, there is an abundant renewal of the rock oak. The distribution of deciduous tree-shrub species indicates an improvement of soil condition. On raised areas, hornbeam and beech plantings dominate. The territory of the forest park is anthropogenically disturbed. This is especially true for areas that are directly adjacent to the transport routes. It is possible to note the formation of a peculiar structure of trampled paths and unstoppable places. Under the influence of trampling, cereals start to grow on the sites. On the separate sites of the forest, park herbal cover is completely destroyed.

For the Bilohorshcha forest park dominating plants in the first tier are: *Quercus robur* and *Alnus glutinosa*. On separate sites *Salix fragilis* L. joins these species. Undergrowth is formed with *Padus avium* Mill.,

² H. Lukashchuk.

Rhamnus cathartica L., *Corylus avellana*, *Euonymus europaea* and *Frangula alnus* Mill. In the wet areas, a large number of species of the genus *Salix* L. are found. Typical forest types of grass are covered with weeds.

It is worth mentioning that the forest park is practically not adapted for recreational activities, there is no net of tracks, although it is situated close to urban areas. On many sites, a fertile layer of soil (peat) is excavated. The meadow-boggy complexes of Bilohorshcha are of a significant zoological value.

The Pobuzhzhia range landscape is practically not reforested. At this researched area the forest park of the array of the tract of Hamaliivka is to be discussed (Fig. 2). The old oak forest forms the basis of the phytocenoses of this tract. Underbrushes are formed with *Padus avium*, *Rhamnus cathartica*, *Corylus avellana*. Novoyarychiv forests are represented by oak and beech phytocenoses.

The forest park area includes the Sykhiv forest park, the Basiv forest, as well as the Zubra forest area (Fig. 2). The oak and oak-beech cenosis of these forest parks have been significantly altered by man for mixed broadleaf cenosis. On wet areas the species of *Alnus glutinosa* survived. There is the seizure of large areas by the non-abiotic species (*Acer negundo* L., *Impatiens parviflora* DC.), the synantropy of flora takes place. The Basiv forest park includes the Basiv arboretum – a park-monument of landscape and landscape art of the local significance. The arboretum is located among the forest massif in the 35 quarter, sections 6–7, which lies between the villages of Lapajivka, Obroshyno and Basivka, belonging to the Lapajivka forestry. Its area comprises 15.4 hectares; and was approved by the decision of the Lviv Regional Council on October 10, 1984. The purpose of its foundation is to preserve more than 100 wood-shrub species of plants. These are, as a rule, introduced from the North America, Japan, and China. Today, the arboretum is in an abandoned state. There is no maintenance of exotic species of plants there.

However, despite the significant transformation of the territories of the forest parks, species of vascular plants that are included in the *Red Data Book of Ukraine* are preserved in their territories. In most cases they are spring ephemerals. The prevalence of the forest species and the presence of rare species is evidence of a high level of sustainability of natural forest ecosystems. At the same time, the formation of specific groups of spontaneous vegetation within the forest parks on the outskirts of Lviv depends on the intensity and nature of the use of the territory. The vitality of phytocenoses of forest parks is negatively affected by soil redevelopment. Excessive attendance leads to a violation of the links between the components of the forest, the loss of resistance to the forest planting, and in some cases – to its complete disorder (H. B. Lukashchuk, T. A. Fedorchuk, 2015). Typical vertical structure has survived in plantations, which by origin and composition are indigenous (Vynnyky forest park, Pohulianka forest park). Differentiation of the first and second wood tiers, brushwood, undergrowth and grassy tiers is observed as well.



Fig. 3. The degradation of the Bryukhovitsky Forest Park: a – erosion processes in the forest park area; b – the unauthorized arrival of vehicles in the forest park area (H. Lukashchuk, 2016)

A significant problem in practically all of the forest-park part of the city is its pollution with solid household waste, in particular, construction debris, arrival of vehicles into suburban forests, their parking and unauthorized arrangement of residents' places of recreation (incendiary of foci) (Fig. 3). The erosive processes are observed along the transport routes. The sanitary condition of the forests is estimated as satisfactory.

Having analyzed the forest parks in the vicinity of Lviv, we can state that the level of their degradation depends upon the depth of the territory's entry into the urban environment, the nature and intensity of their usage. It is worth mentioning that present recreational stability of the forest areas of the green zone is not sufficiently studied. In the territories of forest parks in the vicinity of Lviv, the areas of forest parks that correspond to different stages of forest degression are revealed.

Conclusions

Urbanization causes the suppression of the natural environment as a quantitative – spontaneous seizure of large areas of land – and qualitatively: the deterioration of the natural environment in general. The reasons for the deterioration of forest conditions and the reduction of forest ecosystems are due to the complex activity of natural and man-made factors.

In the forest park plantings, the degradation processes are caused by the onslaught of the urban environment on the natural surroundings. We can distinguish between degradation caused by recreational pressure, degradation due to inadequate forest park maintenance, degradation associated with changing the landscape of the forest parks, and phytocenic degradation (a change in the composition of indigenous phytocenoses of the forest parks). The end of the 20th – the beginning of the 21st century is marked by the creation of collections of land in the territories of the forest parks, on which exotic plants are concentrated. Today, the task is to restore these collection areas and to preserve the existing species composition of plants.

As all forest parks undergo significant anthropogenic influences, it would be advisable to take measures for the restoration of indigenous forest stands, to organize recreation areas, that would reduce unauthorized recreational pressure on these areas.

Due to the modern development of the urban areas, a special urbogenous environment was formed, the ecological state of which requires constant monitoring (environmental monitoring). Plants react very sensitively to changed conditions, so they can serve as indicators of the state of the environment.

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Галина Лукашук

ДЕГРАДАЦІЯ ЛІСОПАРКІВ В УМОВАХ РОЗВИТКУ ЛЬВІВСЬКОЇ АГЛОМЕРАЦІЇ

Анотація. Розширення міських агломерацій посилює антропогенну дію на середовище. Лісові масиви найбільше потерпають від цього навантаження. Лісопаркові масиви розміщені навколо міста нерівномірно, прилягаючи до міської забудови переважно зі сходу (Винниківський лісопарк) і заходу (Брюховицький лісопарк), частково з південного заходу – Басівський лісопарк. Південна і північна околиці міста безлісі. З південно-західної сторони на р. Щирек лежить гідропарк Глинна-Наварія, площею 400 га. Існуючі зелені масиви відступають під натиском забудови, яка здійснюється не тільки по периметру території, але і зсередини. Процес розчленування лісових масивів на окремі острівні ділянки, загазованість повітря, збільшення щільності ґрунтів через зростання кількості відвідувачів веде до зміни просторової структури лісопарків, зміни видового складу деревного та трав'яного ярусу. Дубові та дубово-буккові ценози лісопарків суттєво змінені людиною на змішані широколистяні ценози. За останні кілька років у лісопаркових зонах відбулися масові рубання бука лісового, що спричинило утворення нових угруповань, частково відмінних від корінних У деревному ярусі почали виходити у перший ярус такі види як *Acer pseudoplatanus L.*, *A. platanoides*, *Betula pendula Roth.* Спостерігається захоплення неаборигенними видами (*Acer negundo L.*, *Impatiens parviflora DC.*) значних площ. У підліску поширилася *Sambucus nigra L.* Поряд зі зменшенням проективного вкриття типових лісових трав із мозаїчним розміщенням у трав'яне вкриття у провітах та вздовж мережі стежок проникають лучні та лучно-лісові види. На галявинах збільшується участь рудеральних видів. Проходить деградація лісопаркових зелених зон. Вона проявляється передусім у зміні просторової структури лісопарків, синантропізації флори лісопарків. Ми спостерігаємо фітоценотичну деградацію, рекреаційну деградацію та деградацію, зумовлену неналежним доглядом лісопарків.

Ключові слова: зелена зона, лісопарк, фітоценотична деградація, антропогенно порушена територія.