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ALTERATIONS OF LANDSCAPE CONSTITUENT AND USAGE WITH RESPECT OF ENVIRONMENT INFLUENCES

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Summary: The city of Vác occupies a central place in the Danube Bend Region. The natural advantages values are affected by air pollution due to the increased industrial, commercial, and economic life of the city. Among Vác's attributes, we can find rare and invaluable cultural and historical values. The most significant natural attribute is the Grove of Vác near the Danube bank. The example of the Grove of Vác is of country-wide importance in many aspects – it is part of the Duna-Ipoly National Park – though local protection by the Government of Vác is reasonable regarding the treatment and links because of the pollution of the environment. Nowadays, the research of environmental pollution comes to the front because of the importance of heavy metals in the landscape classification. Even though the heavy metals are a natural component of the environment, we have to look them toxic materials. This paper focuses on the pollution analysis I carried out with various plant samples. It shows the main toxicology pollutants present in different landscape use units.

Introduction

Providing a harmonic relationship between society and environment, while improving the state of health of the population, must include preservation, improvement and restoration of the natural environment also necessary for proper quality of life. This includes providing the conditions of a healthy environment, by reduction and elimination of threatening impacts. Enforcement of environmental criteria in economic development must be maintained and economic growth must lead to increasing population welfare accompanied with decreasing environmental burden. The preconditions are the development and maintenance of a harmonic relationship between society and environment in the course of economic development, through a balance of sustainable natural resources and land use. Use of the environment must not exceed its load-bearing capacity. Prevention, and the mitigation to the smallest possible extent, of environmental damage (Máthé 2005). Natural and semi-natural areas and habitats should not be considered as strictly divided islands or "reserves", but as unified and connecting systems. An ecological network is a coherent, functioning system, in which communication is active between natural habitats. Patches of habitats – with greater than a critical size – are the core areas. Their size is critical because they provide habitat and genetic reserve for the most possible populations among the given conditions. Communication between the core areas is realised by the so-called ecological corridors. Ecological corridors are linear, continuous habitats, or habitat-chains with smaller or greater interruptions (Pallag 2000). Although each species has its own specific requirement for habitat size and mobility, there is often considerable scope for adapting the physical form of a corridor. One must take into account both the needs of the target species and the characteristics of local human activities. For example, corridors need not always be continuous linear pathways. Certain kinds of less intensively used landscape or so-called "stepping stones" of smaller landscape elements - such as ponds, sometimes provide the appropriate degree of interconnectivity. It is also important to recognise that various kinds of land use may be compatible with the function of a corridor and considerable flexibility may be possible in deciding a corridor's route and dimensions (Tardy 2002).

Nowadays the evaluation of heavy metal pollutant levels on the landscape is gaining importance. Although heavy metals are natural components of the environment, we have to consider them potentially toxic materials (Szőke 2005). Heavy metal concentration has increased in the air, soil and waters, especially in the cities and industrial areas. According to predictions based on research monitoring changes in the metal concentrations in the soil and plants, heavy metals will probably become important environmental stress factors over the next decades (Pais1992).

Materials and methods

The protection of the ecosystem, the consideration of the principle of sustainable development, the preservation of vital natural resources (water, land, air) for the future generations, and the implementation of economical and value-protecting management with attention to quantitative and qualitative characteristics in the management of natural resources; furthermore, safeguarding natural systems and natural resources, ensuring their survival, preservation of the diversity of the biosphere, and preservation of information inherent in natural processes (Máthé 2005, Malatinszky 2007).

The ecosystem is the fundamental unit of ecology. Yet the identification and use of appropriate indices to assess the effects of perturbations on "whole" system functioning have been slow to develop. The focus of ecological research has been on the component populations rather than on the system. This fact is particularly evident in the assessment of topic pollutants where a preponderance of effort has been spent to identify individual and population effects which can seldom be extrapolated to describe changes at the ecosystem level (Hammons 1980; NAS 1981). The ecosystem is an integrated system with fundamental characteristics which transcend the simple summation of component processes (Schindler et al. 1980; O'Neill and Reichle 1980). Therefore, analysis of the ecosystem as a unit in ecotoxicology is based upon the premise that the system as a whole possesses characteristics, which not only reflect the integrated response of component populations to perturbation but in addition, provide a more comprehensive picture of ecosystem 'status'. The ecosystem is a viable unit and tends to persist through adverse environmental fluctuations, often reflecting changes in structure and efficiency of function, whereas certain individual populations within the disturbed community do not survive. Although pollutant-caused perturbations have the potential to influence all components of the ecosystem, the impacts on a single species may have negligible effects on system function. Complex internal feedback and controls can minimize overall impact if some form of redundancy exists (O'Neill and Waide 1982). For example, sensitive species may be replaced by competitors without affecting the system, or regulation of trophic functions may be maintained by predator flexibility in prey choice.

Tolerance and effects of heavy metals

Reviews of studies on the genetic basis of metal tolerances in plants have been provided by Macnair (1990, 1993). Early work showing that tolerance appears to vary continuously led to the interpretation that the trait is controlled by many genes, each with small effect (Antonovics et al. 1971). Macnair (1983, 1990) argued, however, that this interpretation is an artifact of using tolerance indices to assess levels of tolerance. Tolerance indices are calculated as the ratio of growth (typically root growth) in some specified metal treatment/growth in a control treatment. Macnair et al. (1992) have pointed out that tolerance indices are subject to high levels of statistical noise because the two component variables each typically have differently skewed distributions. Moreover, rate of root growth (in the absence of metals) is itself variable and may be genetically independent of tolerance (Humphries and Nicholls 1984). Discontinuous variation in tolerance can be obscured by such difficulties in measurement. For these reasons, Macnair (1990) advocates estimating tolerance in terms of absolute root growth in medium supplied with a metal concentration that fully inhibits growth in non-tolerant plants but permits growth in tolerants. Finding such a concentration, however, may be more difficult in some species than in others (Schat and Ten Bookum 1992). It is fundamental premise of all natural selection theories that in the absence of genetic variation for a trait, there can be no response to selection (Fisher 1930). Moreover, it has long been recognized that some plant species evolve tolerance to metals and other do not (Antonovics et al. 1971). In general, for species that occur on metal-contaminated mine tailings, at least a low frequency of tolerant individuals can be detected in normal populations (Bradshaw 1984, 1991; Macnair 1987). Many families of angiosperm include species that evolve metal tolerance, presumably reflecting genetic variance for tolerance, is taxonomically biased (Antonovics et al. 1971).

The unique photosynthetic ability of green plants provides an important physiological measure which can be used to assess pollution stress. Adverse pollutant effects on photosynthesis can be estimated for species in the laboratory and under natural conditions (Bennett and Hill 1974; Jensen 1980). Since the photosynthetic rate is directly related to plant growth, a significant depression or inhibition of photosynthesis will ultimately translate into reduced primary productivity. The important relationship to be established is the degree to which chronic pollutant exposures can repress photosynthetic rates causing a significant retardation in plant growth (Benett and Hill 1974.)

It is difficult, if not too simplistic or even impossible, to generalize as to the precise mechanism by which each specific pollutant affects plants. The overall gross symptoms are distinctive for each pollutant. The precise way in which specific pollutants interfere with normal metabolic processes varies with the pollutant (Treshow and Anderson 1989). The conductance thought the stoma, regulating the passage of ambient air into the cells, is especially critical. Such movement depends on the concentration gradient between the ambient air and the sorptive sites within the leaf. Uptake, also referred to as flux, is a function of the chemical and physical properties along the gas-to-liquid diffusion pathway. Pollutant flow may be restricted by the physical structures of the leaf or scavenging by competing chemical reactions (Guderian et al. 1985). Since these conditions may change during exposure, the ambient dose to which the plant is exposed does not necessarily reflect the actual cellular exposure. The initial flux of gases to the leaf surface is controlled by the boundary layer resistance (Guderian et al. 1985; Tingey and TAYLOR 1982). This is a function of the leaf orientation and morphology, including epidermal characteristics, as well as air movement across the leaf. At slower wind speeds, less than 2 m/s, the boundary layer thickness decreases as wind speed increases (HILL 1971). Thus, more pollutant would enter a leaf when there is some air movement. In chamber studies different in air exchanges can account for much of the variation in result of such investigations. Of the morphological component s influencing uptake, pubescence is important in that the leaf hairs provide a major, yet relatively inert, area of impact (BENNETT et al. 1973). Cuticular waxes also are important in limiting uptake, even through a thin cuticle. Stomatal resistance, on the other hand is critical. Resistance or looking at it conversely the conductance is determined by sotamtal number, size, anatomical characteristics such as the degree to which they may be 'sunken' in the leaf and the size of the stomatal aperture. When close these is little or no uptake. Opening is regulated by internal carbon dioxide content, hydration of the guard cells, temperature, humidity, light, water availability and nutrient status, most notably potassium. It is the osmotic gradient produced by the potassium ions in the guard cells that regulates the guard cell turgor and opening of the stoma (TRESHOW and ANDERSON 1989). Despite the apparent significance of stomatal conductance, results of studies attempting to correlate this with injury have been inconsistent. The genetic sensitivity of individual species and cultivars remains the overriding determinant of injury (GUDERIAN et al. 1985).

Urban pollution

Various substances are emitted to the air with traffic. A portion of these substances quickly form deposits on roads and the surrounding ground. Pollution along roads is the highest within the first few metres then becomes relatively low at a distance of 20 metres, although a measurable amount of whirled dust can get as far as 1000 metres from the road. The amount and spread of dust basically depends on the soil type, vegetation, the speed of vehicles, wind and moisture conditions. Large amounts of dust can be deposited on the vegetation along roads (PALLAG 2000).

Biomonitoring with lichens or plants is a very useful and fruitful way to explore urban pollution (KIM and FERGUSSON 1994; RIGA-KARANDINOS and KARANDINOS 1998, BALLACH et al. 2002). Key In identifying good biomonitors (phytomonitors) of the urban pollution is to use the proper plants for the special meteorological conditions of each town or area. For example, drought tolerant for hot and dry seasons which are too long. Then the proper time of sampling must be determined to obtain more accurate information (RIGA-KARANDINOS et al. 2002). Urban and industrial pollution results in the deposit of metals on plants in cities, suburbs and forests. Thus, in biomonitoring procedures, the analyses of the plant leaves allow for the determination of the concentrations of accumulated metals and aid in the indirect assessment of the type of pollution in cities and industrial areas (RIGA-KARANDINOS and SAITANIS 2004).

The scientific investigation and analyses: With current encroachment and arrangement of development, the Danube Bend Region and its areas demonstrates that the fast, regionally uncoordinated, often accidental growth and pollution of settlement areas reduces proportionally the green areas, as well as the proportion of the biologically active surfaces – beside regional and territorial development plans and strategies. Beyond this, it damages the ecological balance and reduces the prospects of the long-term exploitation of the favourable conditions of the particular areas. The decrease of the biologically active forests, plough-lands, meadow-lands, grazing lands, and the spontaneous building up of the territories changes the character of the land, often reducing the development potential of a bigger area. This process leads to the depreciation of the territories. As a result of the environmental pollution arising from the human carelessness and ignorance, the maintenance and restoration of the natural state becomes more difficult, and the demands of the society, especially of the local population, must be taken into consideration during its management (Aradi 1999). The green areas do not appear on the territory of the region in a homogeneous way, and the reduction of the extent of the forests is significant.

The decrease of the biologically active surfaces can be registered especially on the periphery of the settlements, and can be characterized by the increasing proportion of intensive agriculture, new construction in territories or location of territories selected for construction, as the main part of the new build-ups is performed on such territories. Territories under national or local protection are the only exceptions. The reduction of the biologically active surfaces is a result of the territorial tans-ratings or new build-ups arising from the increased demands for settlement areas and green-field projects. The growth of the cultivation territories such as gardens, meadow-lands and plough-lands comes at the price of green surfaces. This can be attributed to change in the structure of the agriculture and the appearance of new proprietary interests (Fogarasi 2001).

The air pollution of Vác has increased to such an extent that it also reaches the agricultural and natural territories. Besides the effect on humans, the pernicious effect on plants and animals also appears more and more. The plants are often very responsive to air pollution, therefore the lichens can be used as indicators. The extent of the impairment depends on the concentration of the contaminant, the duration of the effect, as well as the species, type, and age of the plant, which, if taken into consideration, renders the effect acute or lingering. Upon acute impairment, external signs are observable on the surface of the plant, for example, necrosis. External signs cannot be observed in the case of lingering impacts. The number of individuals and species decreases in the natural population. Actual deserts of lichens emerge in the polluted areas. The multiplication of resistant, mostly valueless, species changes the composition of the coenosis. The degenerative disease of the forests has been a growing problem since the 1980s; the air pollution also contributed to its emergence (Bíró 2002). Nevertheless, scientific investigations show that the wildlife and biozoenosis of the region can be rehabilitated up to the functional level, and its functional system can be reconstructed (Bíró 2000). The efforts aimed at the plantation and replacement with new forests in the Region can be considered advantageous from the aspect of the neutralization of the unfavourable processes, although coordination and efficiency are improper from many aspects in the area of plantations. Typically, the plantation of new forests goes on in such territories where the owner of the territory shows his intention concerning it, and the territory is also deemed suitable for this purpose. Arising from this, the regional interests and the interests of land use of the area are emphasized less, and a lack of ideas and accordance characterize the process. The new green surfaces appear mostly in isolated, disintegrated territories, and typically not in those areas where the interests of the Region should require green surfaces. Nonetheless, we cannot deny that the appearance of new forests in the Region is a positive feature, even if the territorial distribution is not always suitable (Fogarasi 2001).

The study area

The examined territory is located in Danube Bend Region in Pest County on the southern boundary of the interior of Vác, partly on the periphery of the town. Phitogeographically, it is a part of the Nógrád flora district within the Great Plain flora region. It is contiguous with the Nógrád flora district of the Hungarian mountains to the east and north. The border of the city includes the main part of Naszály, where conditions are close to natural, and indigenous vegetation appears in some places. The flora of the area is much diversified due to climatic factors. Numerous species of flora characteristic (BÁNHIDI 2001, BÍRÓ 2002) of the area are under protection. The flora of the protected territories is well-known all over the country. Similar to the flora, the fauna of the water, waterside, forest, meadow and highland is diversified. Numerous protected waterside bird species, as well as species of fish, amphibians and reptiles can be found in the protected natural territories, in the Grove of Vác, which is situated on the southern part of Vác (Figure 1).

The Grove of Vác has three owners: the Catholic Church, the local government and the Hungarian State. The maintenance, development and defence of the Grove of Vác are carried out by these three entities. It is significant that in the examined territory one can find different conservationist organisations and networks: the Danube-Ipoly National Park, territories with Natura2000, the Cross-Country Ecological Network, as well as territories declared protected by the local government (VKF 2001, VPHI 2005).

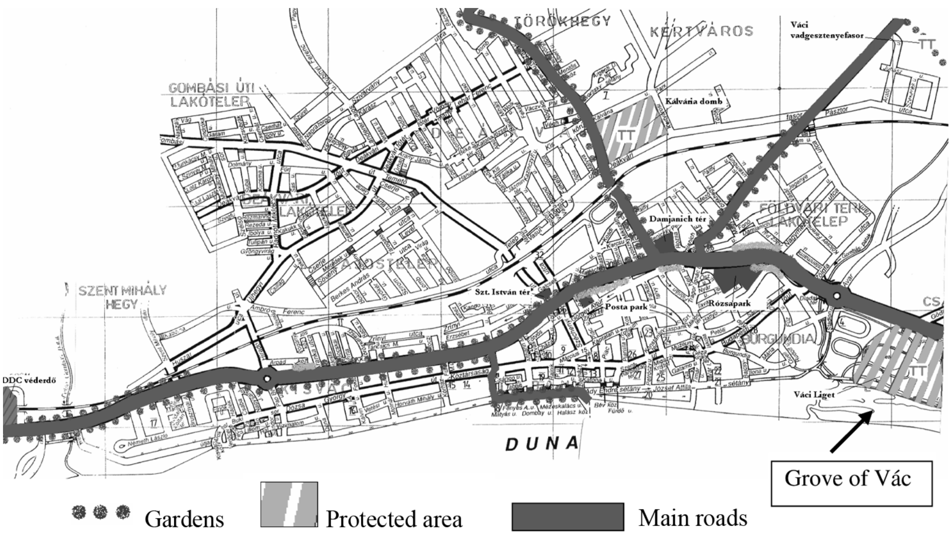

Figure 1. Map of the study area in city of Vác
1. ábra A mintaterület térképe Vácon

The fact is that, in this little region, we meet with a broad spectrum of diverse ecosystems which embraces the significant inland water types: spring, brook, lake, marsh, flood plain and river (HORVÁTH 1998, 1999). Based on the analyses, the problems lie not only in delineating the river-system of Grove of Vác, but also they touch on its other individual aspects (cultural history, land aesthetic) (BÁNHIDI 2001, SÁPI 1983).

I conducted the data collection for toxicological pollution in three units in the Grove of Vác, which is a mosaic ecosystem. After our study these will be evaluated against the function of land use types, ecosystem facilities and conflicts between the different landscape uses. The first ecosystem unit was the natural ecosystem along the Danube River bank. The second unit was a planted band (verge) adjacent to the No. 2 motorway. The third unit was a transition field between the areas of the natural plants and the disturbed plants by the motorway. I made the data collection for plant toxicological pollution in these areas and I compared these with sample plants from the Duna-Ipoly National Park as controls.

I analysed the following elements in the sample leaves: Ni, Cu, Zn, Mn, Pb, Cd, Co, Fe. Plant samples were collected in two periods: the first in early May and the second at the end of October. Among the analysed plant pieces, I can find more trees, for example *Fraxinus excelsior,* *Salix alba* and bushes *Buddleia davidii, Ligustrum ovalifolium, Pyracantha coccinea, Syringa vulgaris*, *Spiraea vanhouttei* and in the herb *Plantago major.* All plant samples were cut into small pieces, dried at 70 ^{o}C and ground to a fine powder in order to pass a 0,5 mm aperture screen. The destruction of organic matter was accomplished by dry ashing 0,5 g of plant material in a muffle furnace at 500 ^{o} C for 8 hours. The ash was dissolved in dilute HNO_3 filtered and diluted with deionized water to a final volume of 25 ml. All metal concentrations were determined by atomic absorption spectrophotometry, using Varian-spectra AA300 located at the Agricultural University of Athens. The calibration standards were prepared in the same matrix used for the plant samples. At all stages of sample preparation and analysis, stringent precautions were taken to minimize contamination from air, glassware, etc and analytical grade reagents were used. A control sample was analyzed for every 10 samples and reproducibility was tested by reanalyzing 30% of the samples. The analytical precision, measured as relative standard deviation, was less than 5%. Concentrations of the metals in plant material were expressed as mg kg^{-1} dry plant weight.

Results

Based on our analytical outcomes, it is concluded that, on the Danube bank and the band along No. 2 motorway, an exceptional toxicology level has evolved in the vegetation. In some tree species, like *Salix alba,* near the band of No. 2 motorway – appearing in all spring and autumn samples – we observed multiple values as compared with samples from the Duna-Ipoly National Park (Figure 2). These values occasionally could be as much as 5–8 times as concentrated. Furthermore, the content of nearly all kinds of heavy metals was elevated in *Plantago major*, in the autumn samples from the areas along No. 2 motorway and the Danube bank (Figure 3). This suggests that the heavy metals have a very important function in the life of the Grove of Vác (Figure 4). In the life of the ecosystem, the primary source of heavy metals is the No. 2 motorway and the secondary is the pollution of the Danube bank.

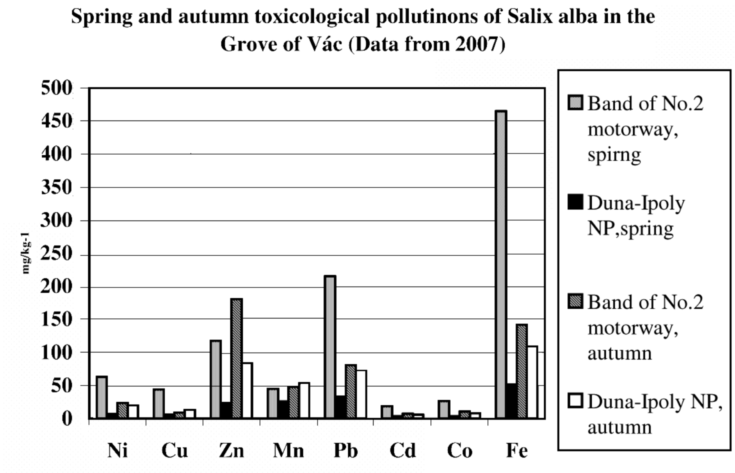

Figure 2. Spring and autumn toxicological pollution of *Salix alba* in the Grove of Vác
2. ábra Salix alba tavaszi és őszi toxikus szennyezettsége a Váci-ligetben

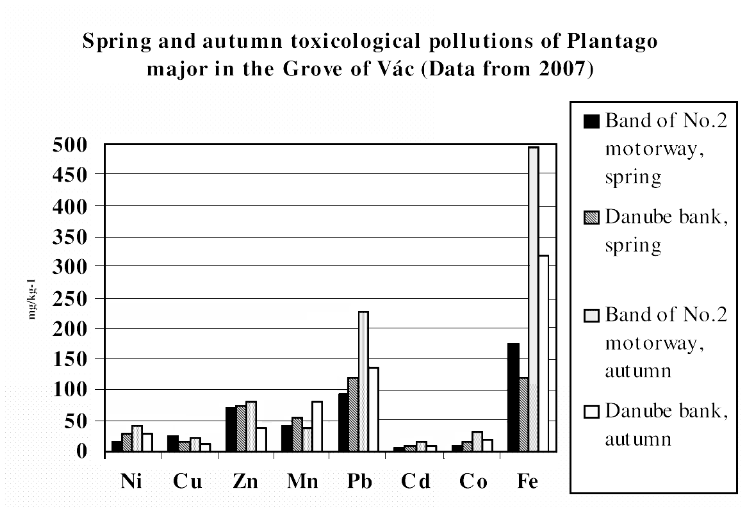

Figure 3. Spring and autumn toxicological pollution of *Plantago major* in the Grove of Vác
3. ábra Plantago major tavaszi és őszi szennyezettsége a Váci-ligetben

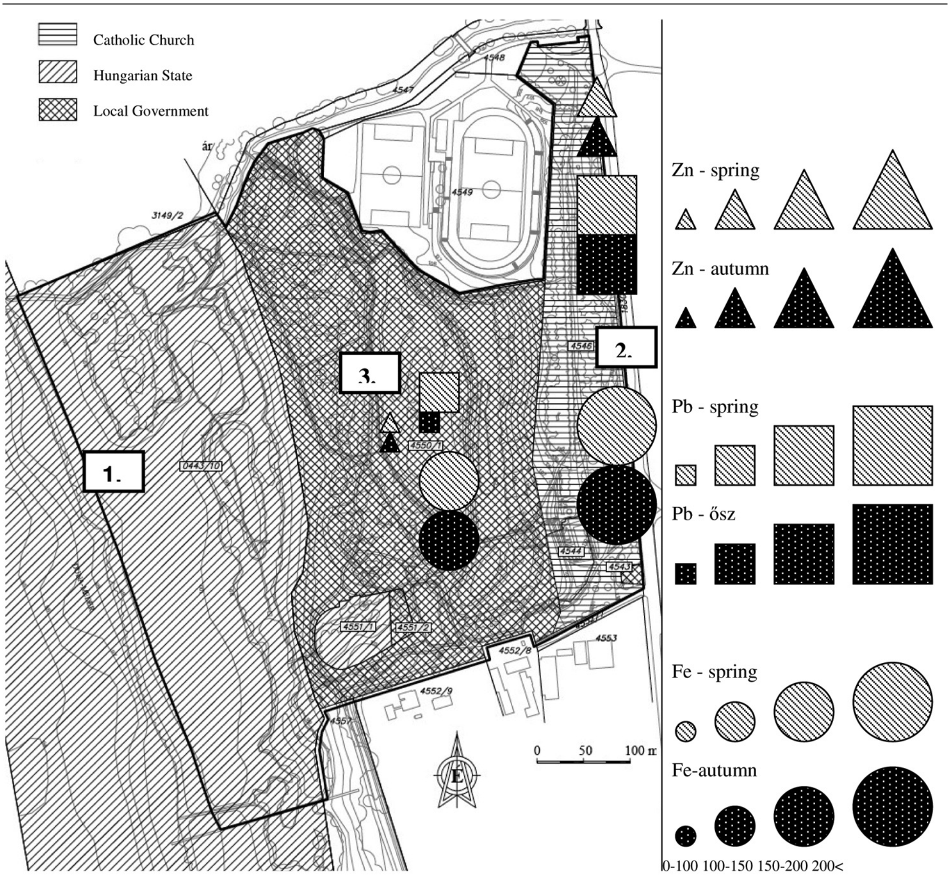

Figure 4. The concentration of zinc, lead and iron in the leaves samples in the three types ecosystem (mg/kg^{-1})
4. ábra A levélminták cink, ólom és vas tartalmak összesítése a három területi egységben (mg/kg^{-1})

Discussion and conclusion

It is not so much the atmospheric concentration of a pollutant that should concern us but the amount that gets into the plant. Thus, pollutant uptake becomes critical. Uptake of any air pollutant from the atmosphere depends on move than ambient concentrations. It is important to emphasize that it is the pollutant concentration within the leaf, more than the ambient concentration that is most critical to plant health. The leaf is the principal photosynthetic organ of the plant and organ most subject to the influence of air pollutants. When fully developed the tissues of the stem merge with those of the leaf. The leaf therefore has basically the same tissue as the stem; epidermis forms the outer layer, vascular tissue is arranged in veins and photosynthetic tissue occupies the same region as does cortex tissue in the stem. The damage is often dramatically visible in the form of white to coloured makings on leaves and fruit, or burnt, dry necrotic lesions that eventually drop out of living plant tissues, leaving ragged-edged or shot-holed leaves.

These are obvious symptoms of severe or acute exposure by aggressive air pollutants. Stomata normally open in daylight and close at night during drought or when excessively disturbed as in a wind storm. But their behaviour is complex: water relations, extremes of light intensity and other factors such as the presence of air pollutants can affect them. The epidermis – except at the stomata – is covered by a waxy layer that makes it fairly resistant to the passage of both liquids and gases. Stomata are important factors in the sensitivity of a plant to air pollution because most of the gases entering or leaving a plant must pass through them.

Human health is essentially influenced by air quality. Atmospheric air in residential areas contains many pollutants. It follows that changes in species composition in the natural and transition bands could change the composition throughout the Grove of Vác, with impact on landscape use methods and potential influence on the microclimate, too. These are just preliminary results and provide information about the actual stage. It is absolutely necessary to continue the investigation of the plant pieces. This examination could be a part of a complex research which aims to analyse the heavy metal pollution of Grove of Vác (plants, soil, and water-systems: springs, lake, stream, river). If the pollution of the plants, soil, and the water-system prove to be interrelated, it outlines a future environmental protection duty for landscape management. The monitoring and the plain publishing of the measured values are important both for the authorities and the public.

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TÁJALKOTÓK ÉS TÁJHASZNÁLAT VÁLTOZÁSA A KÖRNYEZETI HATÁSOK FIGYELEMBE VÉTELÉVEL

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Kulcsszavak: természetvédelem, területhasználat, toxikus szennyezés

Összefoglalás: Vác városa centrális helyet foglal el a Dunakanyar Régiójában. Természeti értékeit jelentős mértékben befolyásolja a levegő szennyezettsége a város fokokozott ipari-, kereskedelmi-, gazdasági élete. Vác város kiemelkedő természeti értékei között fellelhetjük azokat a természeti ritkaságokat, amelynek természeti- és kultúrtörténeti értéke felbecsülhetetlen. Ezek közül a legjelentősebb képviselője a Duna-part mellett található Váci-Liget. A Váci-Liget példája sok tekintetben országos jelentőségű, – mint a Duna-Ipoly Nemzeti Park része – azonban a környezetvédelmi szennyezés kezelése és kötődése szempontjából, mégis célszerűbbé vált helyi szinten is – a Vác Városi Önkormányzat által – természetvédelmi oltalom alatt tartani. Napjainkban a környezetszennyezések vizsgálata során egyre gyakrabban előtérbe kerül a nehézfém terhelések értékelése. Annak ellenére, hogy a nehézfémek környezetünk természetes alkotóelemei közé sorolhatóak, potenciálisan toxikus anyagoknak tekintjük azokat. A cikk bemutatja azokat szennyezési méréseket, amelyeket különböző növénymintákban készítettem el. Ez szemlélteti a legjelentősebb toxikus szennyezési állapotot a különböző területi egységek alapján.