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From the heap to the park – reclamation and adaptation of degraded urban areas for recreational functions in Poland

Key words: Chorzów, Łódź, parks, recreation, urban landscape reclamation

Introduction

Wherever they lived, humans for centuries have contributed to a dramatic transformation of the environment and landscape, frequently resulting in biological devastation of many areas (Simpson, Dugmore, Thomson & Vésteinsson, 2001; Holm, Cridland & Roderick, 2003; Bell & Treshow, 2004; Bobál, Šír, Richnavský & Unucka, 2010; Čech & Krokusová, 2017). In the second half of the 20th century, eco-awareness was raised sufficiently to highlight the problem of degraded areas and concerted (often large-scale) efforts aimed at restoring the 'lost' space were initiated (Gasidło, 1998; Jiasheng et al., 2011; Chen, Wong, Leung & Wong, 2017). In Poland as early as in the 1950s considerable re-vegetation plans have been implemented, especially in industrial areas, but also country-wide, albeit on a local scale, e.g. through intensive tree planting (such efforts peaking in the 1960s and 1970s) in areas such as wastelands and any lands difficult to restore (Strzelecki & Sobczak, 1972; Siuta, 1978; Koda, Pachuta & Wojarska, 1999; Bell & Treshow, 2004; Pancewicz, 2007; Pluta, 2014). At various times and to a varying extent soil restoration was initiated in multiple locations, mostly by using suitably selected vegetation. Silesia Park is a good example of such effective operations. Located in Silesia, until recently a heavily polluted region, this huge, about 600 ha

recreation ground is a perfect example of degraded land transformed into a sports and leisure area of enormous significance for the entire region, i.e. the Upper Silesian metropolitan area (Pełka-Gościniak, 2006; Kicińska, 2016).

Meanwhile, new degraded locations/ /areas have kept appearing (e.g. closed municipal landfills, defunct industrial facilities, mines with depleted resources), which in time will have to be suitably restored, even for the purpose of recovering land for new investments in sprawling cities.

Recognition of the result of land remediation conducted in presented objects (including, among others, the long-term course of secondary plant succession), and the effectiveness of adaptation these locations to new functions (for example – the recreational function) may be helpful in assessing and planning subsequent future implementations of this kind in other places.

Material and methods

The authors of the publication conducted observations in two selected objects (testing grounds), i.e.: Górka Rogowska Park in Łódź (period 2011––2012) and Silesia Park in Chorzów (period 2013–2015). Both of these objects – subjected to anthropopressure for years – have been presented in the article as a case study illustrating in a model way selected results of a wider author's research on the transformation of vegetation (especially tree plantings and woodlots) in reclaimed areas. The approach of "case study" is, in this case, an adequate and convenient scientific method successfully applied in research e.g. in the field of architecture, urban planning or landscape architecture and based on the facts found – collected and processed data (analysis of the literature, field research – measurements, observations). However, due to the practical nature of the presented issues, the methodology typical of a traditional, laboratory-controlled scientific experiment, whose results are then subjected to statistical analyses, has not been applied here.

The first stage of work was a collection of data on objects on natural (climatic, soil, hydrological, habitat), functional and spatial conditions (literature, expert studies). Then, on a general scale, in situ inventories were made, which enabled a good approximation of the assessment of plant cover resources (including tree stands in particular), but at the same time – what is important – the identification of vegetation transformation directions occurring through spontaneous secondary succession. The spatial, species, age and health structure of tree-stands, as well as the course of plant succession, were analysed. Another aspect was the observation and assessment of the degree of land use in terms of recreational and leisure functions.

Due to the size of the objects and their natural, functional and spatial complexity, a division into smaller field units was introduced, e.g. in the Silesia Park (area of nearly 600 ha) two levels of area division were distinguished: sectors (e.g. A, B, C, n, …) and subsectors (e.g. A1, A2, An, ...). As part of the general tree inven-

tory, representative trees were measured. The measurements included basic external features/parameters (according to ordinance guidelines by the International Society of Arboriculture Tree and rules by the Tree Register of the British Isles – TROBI) such as trunk circumference at a height of 1.3 m and a total height of the trees. Also, the height of crown bases and their average range were determined, which reflected the degree of occlusion of tree crowns forming tree stands, both in the vertical and horizontal dimensions; additionally, the density of tree-stands was analysed by measuring the average distances between the trunks (spacing). In selected cases unit tests of the condition of trees were carried out, e.g. testing of trees using the five-grade health condition assessment scale according to Dmuchowski and Badurek (2001).

The analysis of tree stands species structure in both locations included taxonomic identification of trees and shrubs that build the basic mature stand. A representative research area (200–250 m^2) was selected in each spatially and functionally separated fragment/sector, on which it was estimated quantitatively based on the adopted scale:

– dominant species – occurrence in a clear predominance in a given area: > 50% (1⁄2) (in the case of homogeneous monoculture fragments up to 100%);
– associated species – common occurrence: from > 20 (1⁄5) to 33% (1⁄3);
– admixed species – complementary occurrence of existing general composition: from > 10 (1⁄10) to 20% (1⁄5);
– single species – sporadic occurrence: < 10% (1⁄10).

The analysis of the tree age structure was based in practice on the use of age classes (Kl.W). Estimating the age of trees, in this case, was approximate and consisted of assigning trees to a specific period. The order of numbering of age classes (rank of ordinal scale) assumed belonging to the first age class of the oldest trees in a given area. The genesis and condition of the trees in the facilities have distinguished several age classes in their structure.

Field studies also included a general assessment of flora at the phytosociological level, by identifying and determining the most representative plant communities – phytocoenoses and forecasting their ecological stability. Phytosociological assessments, which were verification of previously identified plant assemblies, were carried out based on phytosociological photos using a five-stage Braun-Blanquet scale.

The obtained results based on general dendrological inventories and phytosociological assessments made in the facilities were used to assess their ecological status and current structure (spatial, species, health, age), including the presence of invasive and expansive species. The assessment of the Silesia Park allowed conclusions to be made regarding, first and foremost, the course and effect of natural reclamation processes (soil transformation and vegetation) 60 years after the establishment of the object. However, the assessment of the Górka Rogowska Park in Łódź gave an idea of the full potential of this area as recreational use.

Results

Case study 1: Silesia Park in Chorzów, Poland

The Upper Silesian metropolitan area comprises 19 neighbouring cities of the Silesian Voivodeship in Poland (among others, Gliwice, Zabrze, Katowice, Bytom, Świętochłowice, Siemianowice Śląskie, Sosnowiec, Dąbrowa Górnicza, Jaworzno, Mysłowice, Będzin, Tychy, Ruda Śląska, Chorzów) and is inhabited by nearly 3.5 million people. The landscape of the Upper Silesian metropolitan area has been shaped for many years by development of the heavy industry based on mining and processing of raw materials (e.g. mines, smelters, steelworks, coke plants etc.). For decades such transformations of the natural environment of the area have had a negative impact on health and living conditions of its inhabitants as well as the appearance of the local landscape. Its current post-industrial identity is devoid of clear characteristics of spatial order in urban layout (Pancewicz, 2007; Kicińska, 2016), i.e. it lacks centre or a clearly defined periphery – cf. the urban sprawl phenomenon (Johnson, 2001; Frumkin, 2002; Ewing, Schmid, Killingsworth, Zlot & Raudenbush, 2008; Feliciantonio, Salvati, Sarantakou & Rontos, 2018). Silesia Park in Chorzów (proper name: Wojewódzki Park Kultury i Wypoczynku im. Gen. Jerzego Ziętka w Chorzowie – WPKiW, in English: General Jerzy Ziętek Voivodship Park of Culture and Recreation in Chorzów) was established in the 1950s and 1960s at the very heart of the metropolitan area. It stands out Among scant, scattered natural enclaves. It is the most spectacular example of landscaping of former industrial areas on a municipal scale – in Silesia as well as in Poland.

Extending over an area of about 600 ha, the park was created from scratch on extremely depleted soils, on land degraded by industry, covered with spoil tips, rubbish dumps and cave-ins (Fig. 1; Niemiec & Kuszell, 1954; Lazar, 1956; Pancewicz, 2007). The authors of the final design (1954) included architecture professor Władysław Niemirski and a team

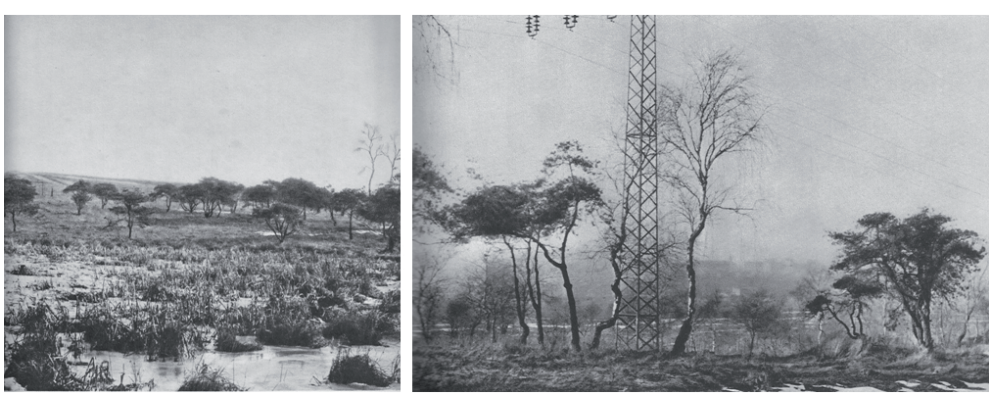

FIGURE 1. Area of the prospective Silesia Park in Chorzów, Poland. Post-industrial landscape – vegetation on the hill, the state before the construction of the park, 1930s and 1940s (Niemirski & Słotwiński, 1963)

of his collaborators from the Department of Formation of the Green Areas (SKTZ) of WULS-SGGW (Niemiec & Kuszell, 1954; Niemirski, 1971). Although officially created in the spirit of real socialism (as people's culture park, theoretically inspired by similar projects in the Soviet Union), the park in fact represents a system of best developments and is arranged basing on classic modernist principles. The park was built in the 1950s, and its construction took about 18 years (Niemirski, 1971; Fortuna-Antoszkiewicz, Łukaszkiewicz & Wiśniewski, 2016). Today it is an example of successful re-vegetation and re-naturalization of the anthropogenic landscape.

Sixty years after its establishment, from August 2013 to December 2014, the authors of this work carried out a comprehensive study of the condition of the park's natural resources in terms of such issues like spatial arrangement, composition and botany, with the intention to identify the extent to which the park's wood stand was preserved, as well as to determine the direction of changes caused by many years of re-vegetation processes, the progress of secondary succession etc. (Fortuna-Antoszkiewicz, Łukaszkiewicz & Wiśniewski, 2017).

The condition of the natural environment before the park's establishment

Before the park was established, a significant portion of its current area (about 75%) had been occupied by agricultural land, later replaced by degraded industrial sites. All original components of the environment of the Silesia Park have been transformed, particularly soils, which can be described as anthropogenic. However, before the area total degradation, there was natural vegetation, with pine wood as its main original plant formation. It had caused severe soil podzolization (Niemiec, 1953; Lazar, 1956). Finally the forest was removed, leaving only accompanying plant communities in the form of heath and mountain pine.

In the process of the park's construction, in order to neutralize the effects of industrial operations, immense scale earthworks were undertaken: about 3.5 million m^3 of soils were moved, about 100,000 m^3 of higher-class soils were delivered along with 50,000 m^3 of peat (Niemiec & Kuszell, 1954; Niemirski & Słotwinìski, 1963). Consequently, most of the area (with the exception of its northern part) features backfill covers of various physical and chemical composition and thickness. The presence of a 0.2–0.3-meter thick topsoil is a positive characteristic because of precipitation water infiltration capabilities, which is of enormous importance for vegetation in this area (Niemiec, 1953; Majewska-Duriasz, 2014).

The chemical composition of soils in the park has been shaped, among other factors, by the presence of industrial pollutants, primarily suspended particulate matter (Siuta, 1978). Considering the direction of winds prevalent in the region (W and SW) and the location of former and current emission sources (Kościuszko Steelworks in Chorzów, Jedność Steelworks in Siemianowice Śląskie, Zinc and Lead Smelter in Katowice-Wełnowiec), as well as the close proximity of the centres of cities such as Katowice, Chorzów and Siemianowice Śląskie, local soils have magnetic properties due to a considerable amount

of heavy metals, which adversely affects e.g. the park's vegetation (Siuta, 1978; Magiera, Rachwał & Łukasik, 2013). In the 1970s average particulate matter emissions reached its peak: 0.8 in Katowice; 0.9 in Chorzów and 2.6 $g \cdot m^{-2} \cdot day^{-1}$ in Siemianowice (Siuta, 1978). High readings for heavy metal content in soils are currently reported virtually all over park premises, especially in its western part (proximity of metallurgical plants). The same holds true for south-eastern section adjacent to Katowice. Among heavy metals present in the park's soils the prevalent element is zinc (Zn), whose content limit is exceeded even sevenfold, lead (Pb) – for which concentration limits were exceeded 1.9–8.5 times, and cadmium (Cd), in the case of which permissible content limits were frequently exceeded 7–20 times (Magiera et al., 2013; Kicińska, 2016).

The mechanical content of soils present in the park was mostly favourable (i.e. clay soils, medium-weight: dusty and dusty clay soils). The dust fraction originates mostly from dolomites, whereas the gravel and sand fraction come presumably from sandstone. Isolated instances of post-glacial pebbles are also present. Humus content is considerable (1.72–3.64%). Humification level is high, as confirmed by a close ratio of C to N (9 : 11), consequently indicating high biological activity (Majewska-Duriasz, 2014).

Park's vegetation during the revegetation process

The simplest (and the oldest) direct method of reducing pollutant emissions is to plant thick-leafed trees on land close to localized sources of particulate matter (i.e. today's phytoremediation, according the authors). Trees are able to directly capture particulate matter or indirectly contribute to a reduction of particulate pollutants by causing a change in climate conditions (due to transpiration). The overall content of suspended particulate matter intercepted by trees does not appear to be high, although the general impact on the environment that trees exert is significant, especially in comparison with the economic aspect of other measures intended to improve air quality (Bell & Treshow, 2004; Gawroński & Gawrońska, 2007).

Basic tree planting activities in the park usually involved plants already present in the area (according to the inventory, only 1,700 trees were present). Some of them were treated as forecrop before the subsequent, key tree-planting stage (Niemiec, 1953; Niemiec & Kuszell, 1954). Tree planting operations over the majority of the park area were actually arranged from scratch. The uplands were planted with indigenous species, characteristic of the Silesian Highland, selected according to habitat requirements, mostly according to their insensitivity to the effect of particulate matter (Niemiec & Kuszell, 1954). In order to improve habitat conditions, pioneer and fast-growing species such as: birch, poplars (white, black and aspen), larch, black cherry, hazel, elderberry, were planned as forecrop – after years these plants were to create an appropriate phytoclimate to introduce shadow's tolerant species such as beech. Around by-water habitats were applied: black and white poplar, crack and white willow, black alder, maples, birches, rowan, hackberry, viburnum, spindle, glossy

buckthorn, hawthorn, hazel, common buckthorn, dogwood and elderberry. In subsequent years, the upland parts were arranged with native species, applied in terms of habitat requirements, including: common and sessile oak, beech, hornbeam, common maple, sycamore and linden. In the western part of the park, characterised by an intensive use programme, mainly decorative species were deployed, including foreign ones (particularly shrubs) in order to create attractive combinations in plant compositions – the colour and diversity of leaves, flowers and fruits were considered (Niemiec, 1953; Niemiec & Kuszell, 1954). Generally, for tree seedlings a density of 1.0 × 1.2 m, i.e. 8,333 pcs per 1 ha was designed. However, a subsequent reduction of tree planting area in favour of larger and smaller park interiors was planned, which ultimately translated into a lower seedling density to about 4,000 items per 1 ha. According to Niemiec and Kuszell (1954), park/forest area intended for quiet leisure activities, extending over an area of about 220 ha in the central part of the park was designed as an intensively wooded area with numerous clearings (interiors), equipped with a pavilion, kiosks, etc. and the Observatory building at the top of the hill). Older trees with rootage, braced trees with developed trunks, tree seedlings and seeds of multiple species were used. Shrubs were planted in the form of nursery material. In the years 1950–1953, a total of 30,000 braced trees and about 600,000 seedlings were planted in the forest park (Niemiec, 1953). The tree stand's management design assumed at a later period the deployment of more valuable tree species intended to form the target tree stand once the optimum stage of the development of temporary tree plantings has been reached.

After 60 years, vegetation i.e. Silesia Park can be described as follows: the area is divided into two parts distinct in spatial and functional terms (Fortuna-Antoszkiewicz et al., 2016; Fortuna-Antoszkiewicz et al., 2017):

A – southwest: intensive, with abundant facilities, and vegetation arranged in classic spatial forms (solitary plants, clumps, groups, flower beds, hedgerows), surrounding clear-cut park interiors;

B – east (on a hill): extensive; this section is dominated by thick, compact tree stand. It is characterised by high structural diversity and complexity, arising from varied landform features, a mix of various plant species, but mostly the origin of the trees planted (primary plantings; plantings related to the re-vegetation of different areas; plantings on locations of specific function and composition; many years of natural succession) – Figure 2.

As years passed, the Silesia Park assumed a specific ecological arrangement, sustaining its dynamics. A varied set of conditions, characteristic of individual biotopes, emerged between plants animals and their environment. Overall, we may notice the presence of the following phytocoenoses (Fortuna-Antoszkiewicz et al., 2017): xerothermic meadows; meadows similar to pastures and pasture-like areas – in the park's vast lawns; wet meadows, e.g. in terrain depressions or near ponds; water and near-water plant communities (pond shore zone); alder forest like, riparian forest

A

B

C

FIGURE 2. Contemporary area of the Silesia Park in Chorzów, Poland: A – landscape transformed – vegetation on the hill (photo: P. Wiśniewski, April 2014); B – intensive recreational use – the ZOO entrance zone (photo: B. Fortuna-Antoszkiewicz, May 2014); C – park as a vast walking area with a dominant matured, diverse tree stand (photo: P. Wiśniewski, May 2014)

like, oak-hornbeam forest like, oak forest like, forest border like communities – in the extensive forest area; communities of synanthropes ore semi-synanthropes – in extensive areas or areas where secondary succession was allowed to progress.

Phytosociological assessment allowed us to conclude that there were six herbaceous plant species and two tree species regarded as highly invasive on a country-wide scale (Resolution of the Environmental Ministry of 9 September 2011; Tokarska-Guzik, Dajdok, Zając, Urbisz, & Danielewicz, 2012). The identified species are expansive (e.g. *Quercus rubra* and *Prunus serotina*) in that they create strong competition while displacing indigenous plants from their previously occupied locations in a given phytocenosis (Fig. 3).

Case study 2: Górka Rogowska Park in Łodź, Poland

Górka Rogowska Park is located in the north-eastern part of Łódź, a city in Łódzkie Voivodship, in Bałuty city district bordering Łagiewnicki Forest. The site has an area of 27 ha, including 5 ha over former landfill so-called Górka Rogowska (Rogowska Hill).

The area has been used as a landfill already since the second half of the 20th century in the first post-war years. In the

FIGURE 3. The Silesia Park's stand species structure – existing condition (2014) – made on the basis of dendrological inventory and phytosociological assessment. The biggest squares denote dominant species and the succession of smaller squares denote species which are less frequent – accompanying species and supplementary species. Colours in squares denote certain species of trees and for example yellow means silver birch domination and dark green – maples domination

1950s Rogi village, one of the oldest settlements, was surrounded mainly by open fields and had sparsely distributed buildings. At the beginning of the 1960s the village was included in the Łódź city. In the 1970s a number of city spatial management plans were drafted which among other regulated use of open spaces in Rogi district. These however have not survived to this day. No technical documentation which might provide a presence of raw materials in contemporary park's area is extant. According to Ziomek (2011) prior to Park establishment the area comprised mainly empty fields with individual gravel and sand stacks. These stacks were not used for construction or road building but rather by the local population who excavated these materials for their own purposes. This is when it was decided that such a desolate and unmanaged area will be a proper location for a waste site of construction materials. It was in this period that the idea to store construction waste i.e. damaged precast concrete slabs, used to construct high-rise building in Łódź in the years 1960–1980 was proposed. Along with these slabs various other wastes from the demolition of old buildings – mainly rubble – was disposed of as well. As time went by municipal waste disposed of mainly by local population

was also brought in to the landfill. Such waste did not pose a great threat for the environment, as it was mainly disposed of on top of the landfill and underwent quick decomposition. Storage of construction waste ended in the first half of 1980s when the urban plant located in Olechów city district (in the south-eastern part of Łódź) manufacturing the precast concrete slabs went bankrupt. In order to remove the unsightly waste site from the vicinity of a newly constructed housing estate and elementary school, it was covered with soil. In the mid-eighties it was proposed to create a ski slope including a ski lift on the man-made hill. Zajazd na Rogach, built in 1980 and recently rose in 2016–2017, was intended as the base of tourist infrastructure for the incoming visitors. Due to lack of funds this plan never came to fruition. However the man made hill, commonly called Górka Rogowska become a vantage point for the whole city district (Bałuty) and neighbouring Łagiewnicki Forest located within the administrative boundaries of the city (Długoński, 2018), but also a breeding ground for many bird species. In July 2011, based on a management plan for the researched site which won the competition held in 2007, a detailed design for modernization of the southern area was prepared. City Council provided 200,000 PLN for this purpose. These funds were used among other for in-situ testing, new pavements for paths and a few hard landscaping structures (Długoński, 2018). In 2012 a conceptual plot plan was prepared (Fig. 4) which accounted for both individual features of the site such as location, space and natural aspects but also included its adaptation for needs of contemporary users (Długoński, 2018).

FIGURE 4. Land use design concept of Górka Rogowska landfll, as urban park (Długoński, 2018)

Geological stability of the hill

In June 2011 geological stability of Górka Rogowska was examined with special attention to the amount of organic waste left over from former landfill (Computer Thermography Laboratory DMCS, 2011). This research conducted by employees of Łódź Technical University using a thermographic camera proved that there are no visible surface organic residues in parts of waste layers; hence there are no harmful effects for the natural environment. At the same time it was proven that the base of the landfill is composed mainly of construction rubble covered with a layer of soil (Długoński, 2018).

The recreational function of the park

Currently Górka Rogowska is an open, publicly accessible space (recreational park) with some parts under the management of Urban Forestry Department of Łódź (former communal landfill) and other parts under the management of Łódź borough (among other the elementary school site). Remaining areas are privately or state held (including motel area) or its legal ownership is undetermined. The hill, a former municipal landfill, located in the south-western part is one of the most prominent landscape and natural features. Land use plan for Łódź city lists Górka Rogowska as a strategically important area for the city functional structure in its role as a recreational and sports area and envisions establishing it as a recreational and educational complex (Fig. 5; Study of conditions and directions of spatial development of the city of Łódź).

FIGURE 5. Górka Rogowska Park in Łódź, Poland. Lookout on the top of the hill with elements of infrastructure (photo: A. Długoński, December 2011)

Park vegetation

Vegetation within the park is dominated by high plant communities classified as a mixed pine-oak forest *Querco roboris-Pinetum*. In the southern part of the site is dominated by ruderal species, while the northern part is dominated by abortive forests and man-made tree-stands growing in a degraded environment (Hereźniak, Kurowski, Olaczek & Witosławski, 2002). Trees growing in the eastern part of the research site are mixed coniferous and deciduous type while in the western part solely deciduous. The most valuable tree-stand with a large number of black pines (*Pinus nigra* Arn.) and Scots pines (*Pinus sylvestris* L.) is located in the northern part of the site along Rogowska street. In the central part, groups and individual specimens of common oak and northern red oak, black locust (*Robina pseudoacacia* L.) and small-leaved limes (*Tilia cordata* Mill.) which are at the same time the oldest specimens can be found.

As the eastern part of the research site is dominated by plants growing mainly

in landscaping arrangements, a few internal scenic links may be identified. In the western part vegetation has a free-form composition, arranged in groups surrounding open spaces — clearings provide many scenic views. In the south--western part the highest point of the park providing w panorama view of Łódź and Łagiewnicki Forest is located (Fig. 6).

FIGURE 6. Górka Rogowska Park in Łódź, Poland. Extensive interiors and spontaneous forest stand surrounded by a hill (photo: A. Długoński, August 2011)

Role of the site in the urban structure

The hill is eagerly used by cyclists, mainly for amateur "down-hill" type sports. Until July 2011 the area had a number of bicycle routes of varying difficulty level constructed in most part by their users. Some of them were removed during modernization works. There are a few walkways in the park. Some of them are transit in nature, mainly those connecting southern and northern part of the area. Other, narrower paths, usually more winding, were naturally formed relatively the o spatial distribution of vegetation. They are often used by the local population for strolling mainly in the summer season.

Discussion

In Silesia Park (case study 1) one can speak about successful nature and landscape reclamation. The creators of the Silesia Park intended it to become a possibly sustainable and self-regulating environmental system according to the principle that the larger the area of the park and the longer it lasts in a given place, the more ecologically balanced it is and the stronger its impact on its environment (Niemiec, 1953; Niemiec & Kuszell, 1954; Bartman, 1974). The effects of these assumptions can be observed after 60 years (Fortuna-Antoszkiewicz et al., 2017).

In most of Silesia Park, the environmental factors create a relatively well--balanced system. The balance is maintained, among other things, thanks to the vast area of the park (about 600 ha), occupied for the most part by rich plant arrangements (park tree stands). Currently the risk of destabilization of the natural environment in the park might be caused e.g. by inappropriate maintenance of the vegetation or its giving up, which may prove critical in the event of an unfavourable plant succession such as the expansion of invasive plant species (both arboreous and herbaceous); such phenomenon has already been observed in the park (Fortuna-Antoszkiewicz, Łukaszkiewicz, Rosłon-Szeryńska, Wiśniewski, & Wysocki, 2018).

In Silesia Park the direct relationship between vegetation maintenance (care) and soil contamination level is noticeable. In locations where there is a need to care for various forms of vegetation, e.g. due to intensive leisure activities,

some soil contaminants are present in lower concentrations (Magiera et al., 2013). It is the effect of maintenance efforts undertaken in such areas, including but not limited the meadow- and lawn-mowing, as well as the removal of the leaves fallen in autumn. As a result of these efforts, heavy metals accumulated in certain parts of plants over the years are successively removed together with plant biomass (Bell & Treshow, 2004). Hence the heavy metal content in the soil in certain areas of the Silesia Park is lower than in municipal forests located outside the city, which are characterised by extensive maintenance and different forms of recreational use.

As regards leisure activities, Silesia Park has performed its function ideally from the beginning – not only for the surrounding parts of agglomeration but also the region as a whole. Due to elaborate, diverse facilities (e.g. the Planetarium, ZOO, the Ethnographic Museum, the Amusement Park, the Silesian Stadium, theme gardens such as the Rosarium, the Perennial Garden; the "Elka" cable car as the means of transport) it is visited by approx. 3 million people annually. It is the venue of many sports events and cultural events, as well as concerts. Such a great inflow of visitors leads to severe human pressure, largely affecting the functioning of the local natural environment. As this severe human pressure poses a significant threat for its current status is, there is the need for constant supervision and methodological maintenance of the entire area, adjusted to the intensity of use of its sections.

On the other hand, in Górka Rogowska Park (case study 2) the overall land use of the site can be evaluated as largely inadequate. The communication network is in general, not a product of deliberate design as it is composed mainly of paths and bicycle routes with a low number of paved paths. Vegetation is neglected – without proper maintenance; road surfaces meet neither technical nor aesthetic criteria. Parts of park equipment are insufficient for the needs of its users and their form and quality leave a lot to be desired as well. Additionally, recreationally-wise the Park is grossly underutilised, especially considering its location and potential. The area is neglected but offers great opportunities due to its location and the attractiveness of the hill set against the landscape of Łódź and Łagiewnicki Forest. The Park due to its location at the border of Łagiewnicki Forest is also an important link in the Łódź public space system as a recreational area suitable for strolling. It is characterised by high natural potential and is an important constituent of the urban natural system. It is also a functionally and alternative site of recreation for city denizens heading to Łagiewnicki Forest and further North. The main group of users of the research site consists of cyclists and population living in the nearby Rogi housing estate. It is less frequently visited by saunterers and tourists as it does not provide many pleasing aesthetic experiences or tourist attractions. All this resulted in decreasing frequency of visiting the site by the population of the city.

However, it seems possible to make the site more attractive as a place of recreation for a larger group of users. Firstly, numerous park clearings provide an opportunity to introduce facilities for various sports (among other, a meadow for golf practice, alleys for sauntering,

water reservoirs as well as making the terrain hillier to create new bike routes of varying difficulty level). Secondly, in terms of spatial and natural features, it is largely possible to preserve existing vegetation formations, assuming that plants growing in this area (often spontaneously) are considered as an essential element contributing the o stability of the entire system (Długoński, 2018).

Generally, it should be noted that abandonment of all basic forms of vegetation maintenance and lack of deliberate shaping of the area led to the degradation of its environmental and recreational functions. It is advisable to make design and maintenance decisions that would make it possible in the future to preserve and display natural values (naturally formed plant communities) and landscape values (internal and external view openings), which will make the this site more attractive in terms of recreational functioning (Fortuna-Antoszkiewicz, Łukaszkiewicz, Rosłon-Szeryńska, & Woźnicka, 2018). It is advisable to properly shape the stand structure and maintain numerous open interiors that provide opportunities for various forms of active and passive recreation (Łukaszkiewicz, Fortuna-Antoszkiewicz, Janeczko, & Wiśniewski, 2018; Łukaszkiewicz, Fortuna-Antoszkiewicz, Rosłon-Szeryńska, & Wiśniewski, 2018). In cases such as Górka Rogowska Park (a former landfill) it is important to maintain stabilized plant communities that meet specific technical functions (e.g. cover, protection against erosion – on slopes of a hill) (Koda & Pachuta, 2001; Pachuta & Koda, 2004; Długoński, 2017; 2018).

Conclusions

1. Implementation of the Silesia Park in Chorzów with its localization in the site of an ecological catastrophe (degraded, post-industrial and poor in terms of habitat), resulted in land's reclamation which has been gradually achieved over the years, with the aid of such activities as e.g. by shaping plant cover – including multi-hectare planting of trees and shrubs. This process has led to the favourable transformation of soils (e.g. increasing the abundance, improvement of the structure, a significant increase of dead biomass – humus, development of soil microorganisms cultures), which are all important for plant growth.
2. Research of the Górka Rogowska Park in Łódź shows that it is a restored area with high natural potential, which due to wrongly set design priorities and lack of funds cannot achieve its full functionality. Nonetheless, the area does have enormous recreational potential and can attract many visitors form Łódź agglomeration, taking some of the anthropogenic pressure of Łagiewnicki Forest. This park, just like Silesia Park, should be open during all seasons and provide means of recreation by the introduction of varied facilities adapted to the needs of different groups of users. Moreover, an equally important aspect is the use and arrangement of existing scenic views from the top of the hill (panorama of Łódź and Łagiewnicki Forest) and between various clearings in the

remaining parts of the area, as well as varying the terrain by the introduction of hills. Suggested design solutions may additionally improve recreational functionality and positively influence Park utilization as well as emphasize its value for the landscape. Presented design approaches and adopted solutions may be used as an example for other sites of this type.

3. Properly planned and executed restoration of public degraded areas may yield expected results in terms of natural processes and natural succession, but in areas subject to strong anthropogenic pressure (cities and suburban areas) this favourable result may in time get disrupted (loss of benefits for the natural environment). In restored urban areas it is necessary to provide monitoring and counteract the negative impact of anthropogenic pressure by proper management and caretaking. These tasks should be aimed at improving natural and recreational features of these areas including an adaptation of their function the needs of various groups of users.

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Summary

From the heap to the park – reclamation and adaptation of degraded urban areas for recreational functions in Poland. The article covers the issue of land reclamation of two degraded urban areas: Silesia Park (Chorzów city, Southern Poland) and Górka Rogowska Park (Łódź city, Central Poland). The research raises the subject of vegetation condition, plant succession, and the usage of a given area in terms of recreational functions. The first example of Silesia Park (case study 1) indicates a successful nature and landscape reclamation. The intention of park's designers was to create a permanent and self-regulating natural system in accordance with the principle that the wider the area of the park and the longer it exists, the more it is ecologically sustainable and the more it affects its surroundings. The second example of Górka Rogowska Park (case study 2) shows that despite numerous sensible design ideas for satisfactory development, the area has not been properly reclaimed. In this location, the conducted works have degraded landscape values and recreational opportunities. Nevertheless, the research showed that this park is an area with high natural potential, and with properly designed decisions and contribution of city' authorities might become a popular year-round and multi-functional public space offering a various range of recreational activities similar to the Silesia Park. The research led to the conclusion that constant monitoring is necessary to counteract the negative effects of the anthropopression through appropriate care (plant control, elimination of invasive plants) and design (rational development of leisure activities of a given place) decisions on reclaimed urban areas.

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