

Ecological potential of post-industrial areas and sustainable landscape architecture

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Abstract: *Ecological potential of post-industrial areas and sustainable landscape architecture.* The reclamation of post-industrial areas is a challenging task. In recent decades an awareness has arisen that such areas offer particular possibilities with respect to aspects of nature conservation. This qualifies them as suitable objects for realization of projects of sustainable development, especially after the breakdown of industrial activity when respective regions suffer from economic depression. A review of the ecological aspect of post-industrial areas indicated that successional processes are of special importance, as well as the dispersal power of individual species. Restoration techniques have changed over the years. In order to deal successfully with post-industrial areas methods are required which enable the objective assessment of ecological values and stages of succession. An example of dealing successfully with sustainable development on post-industrial areas, the Duisburg-Nord landscape park is highlighted. The increasing awareness of the possibilities to integrate sustainable development in landscape architecture has been expressed recently by an increasing number of publications. It is stressed that post-industrial areas offer many opportunities to create landscape architecture projects with a focus on sustainability.

Key words: post-industrial area, sustainable development, biological diversity, landscape architecture

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INTRODUCTION

As a result of industrialization, drastic changes in the landscape appeared. Even at the end of the 18th century, the Ruhr Valley in Germany, for example, was a mostly agricultural landscape [Kommunalverband Ruhrgebiet, 1990]. However, at the beginning of the 19th century, the loss of a high amount of natural habitats was accompanied by the origin of areas resulting from industry, so-called post-industrial areas. Since the last decades of the 20th century there has been a rising awareness that these areas offer numerous possibilities concerning the purposes of nature conservation [Kelcey 1975; Johnson et al., 1978; Gillham and Smith, 1983; Gemmell and Connell, 1984; Rebele and Dettmar 1996].

The idea of sustainable development evolved from the Conference on the Human Environment in Stockholm in 1972 and was developed during the following decades [Adams 2006]. It became popularized in the broader political arena by the 1987 report of the World Commission on Environment and Development [WCED 1987] and subsequently by the United Nations Conference on Environment and Development (UNCED) held

in 1992 in Rio de Janeiro. There are numerous uses and definitions of the term sustainability, this includes attempts to distinguish between weak and strong sustainability [Adams, 2006]. Whereas the traditional concept of sustainability, originally coined in forestry, has a strong supply-ecological connotation, the mainstream 1987 WCED definition focuses on the demand side, and therefore the socio-economic system. However, a holistic approach focusing on the ecological, economical, and the socio-cultural component [Adams, 2006] is common. However, we have to be aware that natural resources and environmental services are not unlimited and sustainability has to take into account regenerative capacities [CIWEM 2013].

After the collapse of their industrial heyday, the industrial regions often suffer strong economic depression. However, the areas being the result of this breakdown – post-industrial areas – often offer a lot of possibilities (e.g. with respect to nature conservation, use for recreation) and it is possible to activate the potential of post-industrial areas. When activating the potential of post-industrial areas, different aspects should be taken into account. Industrial regions often show a lack of green areas, and post-industrial areas may offer possibilities to serve as green recreational areas. Moreover, they reflect diverse socio-cultural aspects which offer additional potential to be integrated into their development. Finally, as will be shown below, these areas quite often have a high ecological potential. However, this potential is not used in many cases.

Thus, the aim of this paper is to present an overview of basic ecological aspects in the context of the sustainable management of post-industrial areas. With this publication, we want to pinpoint the relevance of the ecological potential of post-industrial areas in the context of landscape architecture, landscape planning and development.

ECOLOGICAL ASPECTS OF SUSTAINABILITY OF POST-INDUSTRIAL AREAS

Basic background

The very wide diversity of types of post-industrial areas makes it difficult to state some common results. However, some general conclusions may be drawn.

When discussing the ecological potential of these areas a special focus has to be set on successional processes, this is also because in post-industrial areas we can often observe the rare process of primary succession. In many cases, due to the extreme environmental conditions, the succession is delayed, for example on areas derived from brown coal mining in Germany [Dunger, 1968; Neumann, 1971; Vogel and Dunger, 1991], hard coal mining [Schwerk 2014], strip mines in Wyoming [Parmenter and McMahon, 1987] or ash dumps in Poland [Dmowska 2005]. Majer [1989b] reported that thrip (Thysanoptera) recolonization of surface-mine spoils in Illinois had not recovered totally after 32 years.

The delayed successional process offers important opportunities for nature conservation, because the young stages of succession in particular on post-in-

dustrial areas are often characterized by high numbers of rare and endangered species [Kelcey 1975; Johnson et al., 1978; Gemmell, 1982; Gemmell and Connell, 1984; Abs, 1992; Rebele and Dettmar, 1996; Abs et al., 1999; Schwerk et al., 1999; Schwerk, 2000; Schwerk and Szyszko, 2006]. These areas constitute secondary habitats replacing habitat types which have become rare in today's anthropogenic landscapes. In this way, such areas contribute significantly to species conservation.

From the ecological viewpoint post-industrial areas have also to be considered within the landscape context. Tropek et al. [2013] found only a very weak influence of landscape factors on the richness of butterflies and plants in black coal spoil heaps. To the contrary, Majer [1989b] indicates the several important factors for the recolonization of fauna are, amongst others, availability of suitable colonizing species in the locality, the order in which species initially colonize the area, the degree of isolation of the area, and the floristic and structural nature of the surrounding vegetation. An important role is probably played by the dispersal power of the respective species and taxonomic groups. Butterflies, for example, can be assessed as a group with comparably high dispersal power. With respect to taxonomic groups and species with lower dispersal power, landscape factors should be of higher importance.

Restoration techniques

Restoration of post-industrial areas has to take into account natural as well as anthropogenic aspects, because the eco-

logical processes taking place on these areas and practical steps in order to support the revegetation process are indissolubly linked [Bradshaw, 1984].

Different techniques are widely accepted, for example if the soil has been lost, in most cases it should be replaced by application of topsoil [Bradshaw, 1983]. Methods of restoration have changed with time. For example, the traditional method of greening colliery mine spoil was the planting of trees. However, with this method several problems occurred, as for example the high loss of planted trees (up to 80%) with the necessity of subsequent replanting, suppression of succession processes, or erosion. Based on these observations, a search for improved restoration techniques started, for example to simulate a process of natural succession with controlled seeding [Jochimsen, 1996]. An extensive review of land reclamation on areas subjected to primary succession is provided by Majer [1989a].

Several studies deal with the restoration of post-industrial areas with the main target being to enhance biological diversity. Suggestions for improvements to rehabilitation in order to benefit fauna re-establishment are presented by Nichols et al. [1989]. Viert [1989] provides information about typical wildlife rehabilitation techniques and their concomitant benefits in post-industrial areas. Since many rare species benefit from post-industrial areas as secondary habitats, these areas should provide habitats which are becoming rare in many human-affected landscapes [Tropek and Konvicka, 2011]. Tropek et al. [2013]

stress the importance of a heterogeneous mosaic of habitats in different successional stages, humps and depressions in order to increase microhabitat diversity. Similarly Kerth et al. [1988] proposes several measures (ditches parallel to the slope, micro-relief, non-regular surface structure) in order to improve ecological conditions and to enhance species diversity on colliery spoil heaps. According to Schwerk and Szyszko [2008], diversity in successional stages is at least as valuable for conservation of biological diversity as diversity of habitats. Schwerk [2014] identified stage of succession as an important factor determining carabid assemblages on ash heaps and brown coal mining heaps in Poland.

Assessment of the ecological values of post-industrial areas

In order to be able to deal successfully with the ecological values of such areas in the context of sustainable development, there is a need for their objective assessment. Since there exists a lot of methods and indicators systems, only some selected ideas and examples will be presented.

A major aspect is to assess biological diversity, which according to the Convention on Biological Diversity [Secretariat of the Convention on Biological Diversity 2005] concerns genetic diversity, species diversity, and ecosystem diversity. A review of how to choose among the large amount of measures and indicators for biological diversity is provided by Duelli and Obrist [2003]. However, the number of species within a particular area or ecosystem (alpha-di-

versity) is the simplest indicator of species diversity [Whittaker, 1972]. Besides the species itself, its functional diversity is also used as an indicator, for example Hodecek et al. [2016] compared the technical reclamation of a mine spoil heap with spontaneous succession using functional diversity. Also the rareness of the respective species, i.e. the number of red list species [Tropek et al. 2010, 2012] has indicative value.

The specific regime of succession processes on most of the post-industrial areas implies the need for assessing their successional stages. Szyszko [1983, 1990] proposed the mean individual biomass of Carabidae (MIB) as a succession indicator. The MIB indicator has been applied already on post-industrial areas [Schwerk et al., 2006; Schwerk, 2014].

However, the areas also play an important role as elements of an ecological landscape. Animal species which use both the areas and surrounding biotopes as basic elements of their habitat may be useful indicators, because they integrate information on a larger scale, and thus can be used as indicators of large-scale functionality. The use of such species ("landscape species") has been already proposed by Szyszko [2004] and Szyszko et al., [2011]. Additionally, the contribution of the respective post-industrial area to beta-diversity (species diversity between ecosystems, i.e. number of species unique to each ecosystem) and gamma-diversity (number of species over a large area or region) [Whittaker, 1972; Anderson et al., 2011] indicates its significance for the overall ecological value of the landscape under consideration.

DUISBURG-NORD LANDSCAPE PARK AS AN EXAMPLE

A well-known example of activating the potential of a post-industrial area is the Duisburg-Nord landscape park in the Ruhr Valley in western Germany. The park was created in the 1990s on an area of about 200 ha. More than half is located on former industrial areas, especially the former Thyssen metallurgical plant. Concerning many of the former industrial areas, the conservation of rare species of plants and animals had priority. A special focus was set on successional stages. Some areas are subject to spontaneous natural succession processes, on other parts specific stages of ruderal vegetation will be conserved. Since the implementation of the design concept of the park required advanced knowledge about the ecological aspects of animals and particularly plants on post-industrial areas, vocational training providing that specific knowledge was initiated (Rebele and Dettmar, 1996).

Apart from the focus on nature conservation in significant parts of the park area, former technical facilities serve as elements for recreation and economic activities, and also commemorate and keep alive the cultural identity of the region. For example, the blast furnaces serve as characteristic land marks and are accessible as observation towers, and parts of the walls of former buildings are used by a climbing club as an outdoor climbing garden [Rebele and Dettmar, 1996; Latkowska, 2014]. At weekends, the park is illuminated by a light installation by the British artist Jonathan Park

(<https://www.duisburkontor.de/hallen-landschaftspark/landschaftspark-duisburg-nord/?L=0>).

The significance of the ecological potential of the whole park was highlighted in 2001, when as part of the 3rd GEO-day of species diversity (“GEO-Tag der Artenvielfalt”) about 150 researchers conducted an inventory of animals and plants over a 24-hour period. Amongst other things, this inventory resulted in several first evidences of species on the regional level [Sparmann, 2001].

LANDSCAPE ARCHITECTURE AND SUSTAINABLE MANAGEMENT OF POST-INDUSTRIAL AREAS

Landscape architecture has to be understood as a multidisciplinary subject [Zachariasz, 2010; Rylke, 2016] and landscape ecology is one important component of this. Since landscape architects work on the interface between basic environmental research (inventory and monitoring) on the one hand, and spatial management on the other hand, a landscape architect has to be aware that each project has an influence on the resources which a project touches. However, this also implies a lot of opportunities. According to Dunnett and Clayden [2000], landscape professionals are very well placed to promote principles of sustainable design, because of the fundamental relationship of landscape architecture with the environment. Schwerek [2016] underlines the opportunities which landscape architecture offers with respect to conservation of species and biological diversity. He particularly stresses the importance of managing successional stages.

There seems to be an increasing understanding of the possibilities of landscape architecture to contribute to sustainable development, expressed by books and scientific papers published more recently [Benson and Roe, 2000; He and Nie, 2014; Toofan, 2014]. The European Landscape Convention [Council of Europe 2000] emphasizes sustainable development within the scope of landscape management. Sustainability has become an important feature of contemporary landscape design.

With respect to post-industrial areas Latkowska [2014] summarizes that parks created on such areas “perfectly match the concept of sustainability”. He and Nie [2014] emphasize the opportunities to save resources to achieve social, economic, cultural and emotional consistency of artistic value when converting old industrial areas and old mining buildings into modern parks. An aspect not to forget about is the importance of such areas for research and education, as it was already stressed by Rebele and Dettmar [1996]. Thus, landscape architecture in post-industrial areas may be an important tool to make future generations familiar with the principles of sustainable development.

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- Streszczenie:** *Potencjał ekologiczny terenów przemysłowych a zrównoważona architektura krajobrazu.* Rekultywacja terenów przemysłowych jest istotnym zadaniem. W ostatnich dekadach wzrosła świadomość, że takie obszary oferują możliwości dla ochrony przyrody. To kwalifikuje je jako obiekty odpowiednie do wdrażania projektów realizujących założenia zrównoważonego rozwoju. W szczególności dotyczy to terenów, gdzie przemysł upadł, na skutek czego całe regiony cierpią z powodu ekonomicznej zapaści. Przegląd zagadnień ekologicznych dotyczących obszarów poprzemysłowych wykazał istotność/wagę takich czynników, jak proces sukcesji i siła dyspersji poszczególnych gatunków. Techniki rekultywacji zmieniają się z upływem lat. Aby uzyskać cele rekultywacji, niezbędna jest obiektywna ocena wartości ekologicznych oraz stadiów sukcesji. Przykładem projektu zrównoważonego rozwoju terenu poprzemysłowego zrealizowanego z powodzeniem jest park krajobrazowy Duisburg-Nord. Rosnąca świadomość możliwości wdrażania zasad zrównoważonego rozwoju do architektury krajobrazu wyraża się poprzez wzrastającą liczbę publikacji. Podkreślono, że tereny poprzemysłowe oferują wiele szans na realizację projektów z zakresu architektury krajobrazu, nakierowanych na zrównoważony rozwój.