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THE POSSIBILITY TO RECONCILE THE CONFLICT BETWEEN THE PRESERVATION OF SYNANTHROPIC VEGETATION AND THE DEVELOPMENT OF CITIES

Ewa Trzaskowska

Landscaping Department, John Paul II Catholic University of Lublin (KUL), Konstantynów 1 H, 20-950 Lublin, Poland
e-mail: etrzaskowska@kul.pl

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Abstract

The impoverishment of synanthropic vegetation has been observed in Polish cities for at least half a century. It relates to both the decrease in the area of its occurrence and reduction in species diversity. This is associated with changes in land development, a faster construction process, and an increasingly smaller area of wasteland as well as with the fact that agricultural land and farm buildings are found in cities less and less frequently. Municipal management has been modernised and rubbish, soil or rubble dumps are encountered less often. Besides, the aesthetics adopted by modern man does not allow for the existence of spontaneous vegetation, since in an ordered world such great freedom and liberty are not accepted. Nevertheless, synanthropic flora is one of elements of greenery co-creating a unique urban ecosystem. It increases species richness, improves the climate, and contributes to a reduction in pollution and noise. The present paper highlights difficulties related to the preservation of this flora in cities, and a concept is presented how to introduce it into urban green spaces. Different forms of green spaces are presented in the case of which it is possible to use synanthropic plants, e.g.: ecological lawns and flower meadows, extensive roof gardens, and ecological parks.

Key words: synanthropic vegetation, green spaces, urban ecology

INTRODUCTION

The 19th century became a period of absolute dominance of man over nature. Plant species began to die out, while increasingly more numerous alien, unspecialised species replaced native ones (Dubos, 1986; Poskrobko, 2003; Wilson, 2003). Over the last several dozen years, it has turned out that synanthropic species are also dying out. Segetal species, accompanying crops, and ruderal species found near human settlements belong to them. The possibility of extinction of segetal plants was highlighted in the 1960's by Kornaś (1968). Later, this problem was addressed by Faliński (1972), Kornaś (1972), Mirek (1976), Olaczek (1976), Warcholińska (1986-87) as well as many other authors (Jackowiak and Latkowski, 1996). Changes have also been observed in segetal flora (Sudnik-Wójcikowska, 1987; Kornaś, 1990; Jackowiak, 1998). Endangered species and communities have been described by Ratyńska and Boratyński (2000). They drew attention to a clear regression in unspecialised ruderal communities, mainly associated with rural areas and the outskirts of cities. 16 associations, among others, *Urtico-Malvetum, Ivetum xanthifoliae, Cannabetum ruderalis, Onopordetum acanthii, Leonuro-Ballotetum, Leonuro-Arctietum,* have been recognised as endangered and critically endangered communities by the above-mentioned authors.

The idea of protection of synanthropic plants is not new. Initially, the problem of their conservation was raised on an exceptional basis; the need to undertake conservation measures was indicated in general terms but, for example, in the context of reduction in chemization of agriculture (Olaczek, 1979). The implementation of conservation measures in parts of experimental fields or in crops cultivated in open-air ethnographic museums has been proposed by Herbich (1986) and Ratyńska (2003). The idea of protection and the need of conservation of ruderal flora resources are relatively new. The introduction of

synanthropic vegetation and its conservation in green spaces has been highlighted by Janecki (1983). As a rule, however, these issues have been neglected in large-area designing as well as in the conservation of vegetation cover and landscape. They have often appeared only as an implied idea, e.g. in issues related to the protection of open areas (Smogorzewski, 1974; Andrzejewski, 1980; Głowacka, 1991) or to ecological principles of land management and green area management (Zimny, 1976; Andrzejewski, 1980, 1983, 1985; Karolewski, 1981; Woudstra, 2008). Similarly, Obidziński (1999) indicates the possibility to include in area-based conservation areas that are valuable due to the provision of a healthy environment to humans in cities, but he does not present any specific communities. Ratyńska and Boratyński (2000) wrote about the protection of ruderal vegetation, indicating the possibility of introducing and preserving such phytocoenoses, e.g. near human dwellings and in green areas. Kęsicka and Kęsicki (2007) propose that synanthropic flora be the "leaven" of new green spaces in cities. In spite of their different views on the place of synanthropic flora in cities, all these authors are in agreement that plant cover is the basis for biological management of green areas. It comprises landscaped greenery, remnants of natural communities, and spontaneous synanthropic flora. This flora, similarly to vegetation that is introduced into cities in a planned manner, performs a number of ecological and social functions (Białobok, 1978; Karolewski, 1981; Zimny, 2005). It is a factor that affects the urban climate, plays the role of a filter of pollution and noise, is a place of active rest, and performs aesthetic and decorative functions (Janecki, 1983; Sowa and Witosławski, 1989; Kazimierska et al. 2009; Trzaskowska, 2009). Moreover, synanthropic vegetation areas are important as sanctuaries of disappearing species and as experimental fields used for research on urban ecology and for education. Their advantage is much lower resources necessary to maintain them compared to traditional green spaces (Sukopp et al. 1990; Sukopp and Witting, 1998; Wrzesień and Denisow, 2007).

The problem of use and preservation of synanthropic vegetation in cities is revived in the context of introduction of principles of sustainable urban development and the maintenance of biological diversity, although no specific guidelines can be found. Apart from several species of segetal plants, synanthropic plants have not been included in any conservation directive (Mędrzycki, 2007). Nevertheless, they can contribute to an improvement in environmental conditions prevailing in the city and therefore it is worth identifying the parts of green areas where the reduction of tending treatments to a minimum will not collide with other aspects, e.g. safety (Trzaskowska, 2009), but will have a stabilising effect on the urban ecosystem, and properly managed land overgrown with such vegetation will become an attraction of the urban landscape.

The aim of the present paper is to highlight the problems related to the conservation of synanthropic plants in cities. The paper discusses possibilities of preserving such plants by using them in green spaces. It also presents brief characteristics of urbanised areas, difficulties in taking measures designed to preserve synanthropic vegetation in cities, and solutions aimed at preserving this vegetation, successfully applied in different countries, without arousing an aversion among urban residents. The analysis in the present study is of practical importance and can be used in the process of green space development.

Characteristics of urbanised areas

In urban areas in Poland, apart from the positive sides of socio-economic and spatial transformations, negative processes are observed which result in the deterioration in the quality of the environment, hence in the quality of human life (Eliasz, 1993). Open spaces are used for the implementation of construction projects, natural phytocoenoses are destroyed, green areas become degraded and are not adapted to modern leisure needs. Cities do not have money for new parks and green spaces (Trzaskowska and Sobczak, 2005). Unlike many metropolises of the world, most cities in our country are still characterized by high environmental potential that enables the development of human-friendly spatial structures, with a large proportion of natural open spaces. Hence, there is a possibility of working out compromise solutions that make it possible to implement investment projects and to preserve natural resources in the form of open green areas. This trend in the development of our cities, promoted for years and generally accepted, has not been implemented so far. Therefore, it is necessary to take quick action, since the largest dimension of spatial transformations manifests itself in open areas occupied by natural and synanthropic communities.

Difficulties with preserving synthropic vegetation in cities

The presence of invasive species, e.g. Japanese knotweed (*Reynoutria japonica*), policeman's helmet (*Impatiens glandulifera*), or very frequently encountered goldenrod (*Solidago* spp.), does not promote the preservation of native synanthropic plants (Galera et al. 1993; Galera, 2003, Miklaszewska and Pągowska, 2007; Bocieczko and Kochanek,

2009). The Bern Convention (1979) provides that the governments of particular countries are responsible for preventing the introduction as well as for control and destruction of alien species that may pose a threat to ecosystems, the environment, and native species. On the other hand, the Convention on Biological Diversity (1992) addresses a very wide range of problems; responding to the scale and pace of changes taking place on our planet over the last decades, it has changed to a large degree the approach to the value and importance of living elements of nature. This Convention recognises that all species and associations found on the Earth are precious, not only rare, threatened, or useful ones (Poskrobko, 2003; Kalinowska, 2008).

The problem is the attitude to nature and greenery in cities. In order to compensate the lack of green areas and natural landscapes, already in the 19th century purposefully landscaped green spaces were created. Urban green spaces were established, completely subordinate to humans, and their functions were usually considered from the point of view of two aspects – the health aspect as well as the recreation and aesthetic aspect. What mattered was, e.g., whether the park was well maintained and had a rich collection of ornamental plants, or whether it was accessible to the general public and had leisure infrastructure. It is worth highlighting that this introduction of nature into the city did not arise from the longing for nature, but it was at least partly a result of socio-economic development of the city. Such way of thinking is still present in us and today it is by and large the basic way in which urban greenery is treated.

The next problem relates to aesthetic perception of synanthropic flora. In their present form, "wild" urban lawns, overgrown with melilot, tansy, mugwort, and nettle, are often a source of dissatisfaction, as they are a symptom of neglect (Jorgensen, 2008). In cities, efforts are made to have the environment pedantically ordered. Hence, there is a need to reconcile the ecological and aesthetic approach. Janecki (1999), Gołaszewska (2000), and Böhme (2002) point out the need to reject bourgeois aesthetics. 19th-century naturalistic gardens were a good example of such an approach to nature. They were created by imitating the nature; therefore, there was space in them for spontaneous vegetation in addition to arranged greenery, whilst the minimisation of tending treatments led to naturalistic landscaping (Majdecki, 2007). The above-mentioned features of landscape gardening also prove to be a paradigm of approach to the preservation of synanthropic communities.

The source of problems with the preservation of the above-described flora in cities is the lack of ecological awareness in urban residents and authorities as well as in green area designers (Jorgensen, 2008). The study conducted by Zheng et al. (1999), which shows that well-maintained and well-arranged green areas have greater acceptance in cities, can be cited as an example. Communities that accept green spaces with the participation of synanthropic plants and natural landscapes in the city are students in life sciences, members of groups involved in nature conservation, the so-called ecological organisations, and their families as well as older residents with higher education.

The use of synanthropic vegetation in green spaces

Synanthropic communities appearing spontaneously, oftentimes rich in impressively flowering species, also appear in green areas. Control of synanthropic plants and communities formed by them in these areas entail high costs and does not produce lasting results due to natural succession processes that they are subject to. In many countries, e.g. in Germany, such vegetation has gained supporters and is used in the enhancement of green spaces (Sukopp et al. 1990). A wider attitude that allows synanthropic vegetation to be preserved or used in urban green areas, the so-called ecological trend in green space development and design, is promoted by Dunnett and Hitchmough (2008). A similar approach to synanthropic plants is present in naturalistic landscaping and natural gardens (Berry, 1998; Kleinz, 1999; Harper et al. 2000; Swift, 2008). In Poland, for example, Janecki (1983) was a supporter of the use of synanthropic vegetation. Three trends using selected synanthropic species and vegetation can be distinguished in green space development.

The first one involves the use of **synanthropic plants in borders and flower beds**. In order to make synanthropic species more widespread in the city and to increase their acceptability by urban residents, Janecki and Sawczuk (1990), Oudolf and Gerritsen (2003), Stawicka et al. (2007), Stawicka (2010), and Hitchmough (2008) propose the introduction of single species into flower borders, lawns, and parks in exposed places. These should be nicely arranged plants, with high aesthetic values, sometimes combined with ornamental plants.

The second trend in ecological design is the application of synanthropic plants in the so-called **ecological lawns** (Haber and Urbański, 2005) and **flower meadows**. Synanthropic plants appear spontaneously on lawns in the city (Wysocki, 1994). In spite of the fact that grassy plants persist in habitats with a huge ecological amplitude, from wet to extremely dry and from very hot to arctic cold (Matuszkiewicz, 2004; Frey, 2007), they do not always

tolerate the conditions prevailing in large cities. Even selected grass species sown in lawns in cities have relatively low resistance to drought, salinity, treading, and shading. They are exposed to many diseases: pink snow mould (*Microdochium nivale*), tan spot (*Pyrenophora tritici – repentis*), powdery mildew (*Erysiphe graminis*), pink patch (*Limonomyces roseipellis)*, red thread (*Laetisaria fuciformis),* Rhizoctonia root rot (*Rhizoctonia solani*), and fairy rings (*Marasmius oreades)* (Prończuk, 2000). As a result of that, the areas where lawns are established change in short time into neglected and dry spaces that are devoid of plants at places. Hence, the maintenance of lawns in good condition requires labour- and time-consuming tending treatments (mowing, fertilization, weed control). Synanthropic plants occurring in lawns can not only enrapture with their beauty, but they are also a guarantee of persistence of urban green areas. The rich palette of colours and forms, attributable to species diversity of these spaces, gains acceptance more and more frequently in the places where there are extensive lawns. Such lawns have lower soil requirements, while an addition of non-grass species make these spaces less susceptible to the most dangerous grass diseases. Turfs of this type also occur on slopes on which grass species usually used in lawn mixtures grow more poorly. The presence of synanthropic plants in lawns gives these places an interesting look, associated with their natural appearance; it is commonly treated as something positive that is linked to the human need to create enclaves of nature in urban agglomerations (Jorgensen, 2008). Such places are a source of food and the environment of life for animals (Mędrzycki, 2007). Comparing the production of biomass and oxygen in carefully tended lawns and in the so-called weed-infested lawns, it has been shown that the latter are more effective (Wysocki and Zimny, 1983). Besides, "meadow lawns" usually appear spontaneously, without using any technical means, usually in places where a lawn is rarely tended. In urban lawns, there are found both synanthropic associations, e.g. wall barley (*Hordeetum murini*), hoary alyssum (*Berteroëtum incanae)*, whitetop (*Cardario drabe-Agropyretum repentis)*, warty cabbage (*Bunietum orientalis)*, and communities rich in synanthropic and meadow species that cannot be classified in any specific association (Fijałkowski, 1967; Janecki, 1983; Trzaskowska, 2008).

The presence of "weed-infested" lawns is particularly beneficial in housing estates and along transport routes. On hot summer days, a flower-covered meadow, among others, reduces temperature, increases air humidity, and absorbs pollution (Zimny, 2005). This substitute for natural meadows can also perform the role of a square or a green space in the areas where there is no place for a real garden (Bogdanowski, 2001). In proposing meadows as an alternative to traditional lawns, one should remember about balancing the proportions between both types of space. The proportion of flower meadows in urban grassy areas should depend on the following: the character of a given space, its location (in the city centre or in the outskirts), natural conditions (soil nutrient and water availability), the presence of toxic substances, expectations of the residents of a particular area with regard to, e.g., recreational grounds (Gawłowska, 2007). Already existing ecological lawns are worth protecting, even more so that there is a fear that so far neglected areas will be put in order in an effort to improve the aesthetics of cities.

The establishment of a lawn "from scratch", by sowing seeds using ready-made seed mixtures already available on sale, e.g. "Field flowers", can be more time-consuming, but sometimes it is the only way. Such landscaping can better meet the expectations of residents as regards the variety of flower colours and the duration of flowering of plants growing in a lawn (Kühn, 2006). Both annual and perennial plants can grow in lawns. The overriding principle is to use native species. It is also possible to use mixes in which a part of grass seeds is replaced by seeds of drought-resistant plants, e.g. common yarrow (*Achillea millefolium*), kidney vetch *(Anthyllis vulneraria*), brown knapweed (*Centaurea jacea*), St. John's wort (*Hypericum* spp.), meadow salsify *(Tragopogon pratensis*), and viper's bugloss (*Echium vulgare*) (Marcinkowski, 1999). It is sufficient to sow some species in several selected places or transfer a piece of turf from a natural community, and the plants will spread by themselves in the next years (Filipiak and Kucharski, 2000). The above described type of landscaping can be applied in commons or in large-area lawns in parks (Hitchmough, 2008).

The third trend involves the acceptance and protection of synanthropic vegetation and flora in places of its occurrence or even allowing such communities to appear in spaces prepared for this purpose. In cities that lack green spaces, worth noting are unused roof surfaces. **Gardens** can be created on the rooftops of large-area buildings. This form of greenery has a long tradition (the Hanging Gardens of Semiramis) and for centuries it has been used in, e.g., Scandinavia, Iceland, or Turkey (Lundholm, 2006; Dunnett and Kingsbury, 2008). For nearly 20 years, we have witnessed a renaissance of this type of landscaping. Two approaches can be distinguished in this type of garden landscaping: intensive and extensive garden landscaping. In the case of intensive gardens established on the ground, greenery is arranged and completely subordinate to man (soil moisture control

technologies, fertilization, etc., are used). Grasses, perennials, shrubs, and sometimes also trees are found in such plantings (Osmundson, 1999). The structure of buildings on which intensive gardens are established requires proper construction and strength.

Extensive garden systems on flat rooftops of buildings (up to 10 % inclination) are a much cheaper solution. They are characterized by relatively low unit weight and therefore they do not have a significant effect on the increase in the cost of roof structures supporting them. Extensive systems are termed non-utility systems. Sedum mats, mixtures of meadow plants, and segetal plants are used as green roofs, while the so-called brown roofs are covered by a layer of soil reinforced with mesh. Building materials are also used, such as crushed brick and concrete. In order to increase habitat biodiversity, various coverings with a different thickness are used at the same time and, additionally, tree branches and trunks are incorporated. In this case, plants appear spontaneously. This type of roof landscaping has been used in Switzerland for many years; since 1986 the canton of Basel has been considered to be the best organised and specialised region in this type of investment. Gardens are located on most flat rooftops with an area of more than 500 m^2. In Basel, the roofs are covered with local material, soil, stones, or rubble, and they are colonised by mobile pioneer species of animals. Among them, 79 beetle species and 40 spider species have been noted, including 13 beetles and 7 spiders from the list of protected species (Brenneisen, 2006). In London, where during the reconstruction of the city after World War II habitats of birds were destroyed, among others, black redstart *(Phoenicurus ochruros*), the rooftops have been adapted for its conservation (Grant, 2006; Kadas, 2006). In Switzerland habitats for northern lapwing (*Vanellus vanellus*) and little ringed plover *(Charadrius dubius*) are created on rooftops (Baumann, 2006). Roof gardens are particularly valuable for birds in the outskirts of cities where manufacturing facilities and warehouses occupy agricultural land. 175 plant species, including 9 orchids included in the Red Book, among others, *Orchides mario* and *Orchis militaris*, occur on a rooftop that imitates a meadow habitat (Brenneisens, 2004). In Berlin segetal species, various species of the genus Sedum, and mixtures of meadow plants are used to set up roof gardens. Most species that appear spontaneously are accepted, but tree and shrub seedlings are removed. Over a period of 20 years, 110 plant species were observed on such roofs, i.e. 7% of the total number of species found in this region. In periods of low rainfall, synanthropic species are predominant (Köhler, 2006).

"Ecological" parks, or nature parks, are characterized by the protection of synanthropic vegetation with low human intervention**.** Such parks are set up on long-term wasteland or post-industrial land, in abandoned workings, railway junctions, etc. (Rostański, 2000; Haber and Urbański, 2001; Fronczyk and Trzaskowska, 2007). To create such a park, a necessary condition is to use the natural values of the land and to maintain its topographic features, surface waters, and diverse habitats. The scope of work carried out in such type of landscape is much smaller than in traditional parks; this involves putting in order the bottom and slopes of abandoned workings, the enhancement or creation of water bodies, setting out paths that allow a given area to be used recreationally. At the same time, their naturalistic formula and landscaping principles with a low level of intervention in the environment result in the creation of ecological niches for various species; thereby, such parks remain an important element in the system of environmental relationships which facilitates ventilation of the city, affects local climate conditions, and enriches urban green areas with semi-natural vegetation associations. These forms of green spaces usually enjoy great popularity among residents who come into contact with "nature" as well as they serve educational and scientific purposes. An interesting park landscaping concept was worked out in a disused railway station in Schönenburg in Berlin. The area where the park was established had been inaccessible for nearly 50 years due to the existence of the Berlin Wall. This had an effect on the rich development of the flora (366 plant species were recorded) and the colonisation of this area by a rich fauna, since 26 bird species nest there, whereas insects number about 100 species, including endangered bee species. In effect, a valuable enclave of nature developed in the city centre; a part of the park was made available to the general public as a nature park, while the rest of it is protected as a nature reserve (Knoll et al.1997) (http. 1, http. 2).

At the beginning of the 1990's, an "ecological park" was established in Breda, mainly due to modest funds of the city which were not sufficient to create a traditional urban park and on account of the need to quickly use this land in order to prevent building developments there. Zaartpark was set up on wasteland located in the valley of a stream between residential quarters and a hospital. For the needs of this park, land with an area of ca. 6 ha was adapted, small water bodies were introduced, combined with canals, and new paths were built. Aquatic vegetation was planted around the water bodies, and this allowed these placed to be colonised by birds almost immediately. The cost of maintenance of the park is lowered by using reduced mowing (systematically only twice a year on a small area) and tree tending limited to sanitary cutting. In effect, spontaneous plant communities predominate, primarily synanthropic ones (Haladyn, 2001).

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Możliwość pogodzenia konfliktu pomiędzy zachowaniem roślinności synantropijnej a rozwojem miast

Streszczenie

Od co najmniej pół wieku w polskich miastach obserwowane jest ubożenie roślinności synantropijnej. Dotyczy to zarówno zmniejszenia areałów jej występowania jak i różnorodności gatunkowej. Jest to związane ze zmianami zagospodarowania, szybszym procesem budowlanym, coraz mniejszą ilością nieużytków, rzadziej występującymi w miastach terenami rolniczymi i zabudowaniami gospodarczymi. Unowocześnieniu uległa gospodarka komunalna, rzadziej spotykane są wysypiska śmieci, ziemi czy gruzu. Poza tym, estetyka przyjęta przez współczesnego człowieka nie pozwala na istnienie roślinności spontanicznej, gdyż w uporządkowanym świecie nie jest akceptowana aż tak duża dowolność i swoboda. Tymczasem roślinność synantropijna jest jednym z elementów zieleni współtworzącym specyficzny ekosystem miejski. Zwiększa bogactwo gatunkowe, poprawia klimat, wpływa na zmniejszenie zanieczyszczeń i hałasu. W pracy zasygnalizowano trudności związane z zachowaniem tej roślinności w miastach oraz przedstawiono koncepcję wprowadzenia jej na tereny zieleni. Zaprezentowano różne formy zieleni, gdzie możliwe jest zastosowanie roślin synantropijnych np.: trawniki ekologiczne i łąki kwietne, ekstensywne ogrody na dachach oraz parki ekologiczne.