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The flora of selected urban land-use types in Berlin and Potsdam with regard to nature conservation in cities

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Abstract

Part of this investigation is the flora of three different urban land-use types which represent typical biotope characteristics of Berlin and Potsdam. The majority of these urban land-use types is located in the former GDR territory of East Berlin and Potsdam, which were almost unexplored and are therefore of special botanic interest. The focus lies on the inventory of wild-growing vascular plants, their diversity, richness, and value for nature conservation.

The first investigated land-use type are the landscape parks of Potsdam with their plant communities of meadows and lawns which differ from many other grasslands of today in having unique plant species due to their historic garden design and the continuous way of extensive garden management. Second, the residential areas of the 20/30s in Berlin and their diversity of wild-growing vascular plants and planted trees which reflect the original garden management and the gardening traditions of this decade are presented. The third urban land-use type is the area of the Berlin wall with urban wasteland communities. It will be shown that also in the inner city with a high population density a special variety of species makes urban wastelands worthy for nature conservation. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Urban ecology; Urban land-use types; Nature conservation in cities

1. Introduction

For a long time cities have been perceived as unnatural places with no rewarding ecological subjects. Therefore, ecological research took place in suburban or rural areas and excluded the city. But in the last 30 years, urban ecology became more and more important (Sukopp, 1994). This investigation should be seen in the context of urban ecology as a part of nature science. It is based on

field work in three different, very specific, unexplored urban areas of Berlin and Potsdam. The attraction of these urban land-use types lies in their different historical development. Different historical phases of urban development and land-use are reflected by the flora and vegetation. In addition to the elements of the pre-industrial cultural landscape, species occur which are directly linked to the economical and cultural life in the cities. The flora shows this specific history of the areas. Furthermore, the value of the flora and vegetation for nature conservation, urban recreation, and nature experience in the city is stressed.

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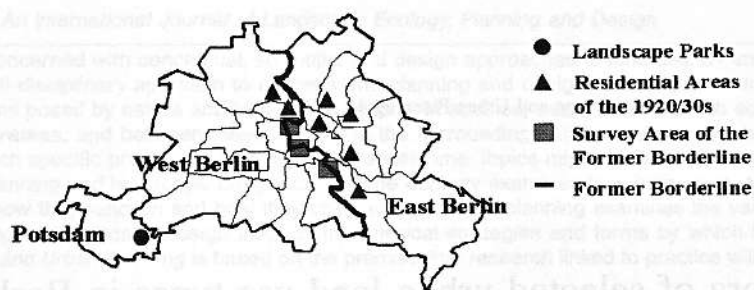


Fig. 1. Location of the study areas.

1.1. Study areas

Berlin, the capital of Germany, has ca. 312 million inhabitants. It is situated in the Northern Lowlands of Germany. The natural landscape was formed during the Weichsel glacial period ca. 15 000 years ago. Thus, the natural soils are mostly sands, poor of nutrients and dry, often covered with anthropogenic substrates. The climate is transitional between atlantic and continental (Sukopp, 1990).

The study areas are located in the cities as shown in Fig. 1: deep in the South-West are the parks of Potsdam, the residential areas of the 20/30s are mainly located in the North-East of Berlin, and finally the investigated area along the former borderline lies in the centre of Berlin.

The natural characteristics of the study areas are shown in Table 1. Besides their period of construction they differ in size, geology, soil, and previous land-use.

1.2. History

The parks in Potsdam, Sanssouci, Babelsberg, and Neuer Garten, are the oldest investigated urban land-use types with a continuous land-use of ca. 150 years. All three parks were designed at the beginning of the

19th century by J.P. Lenné as landscape gardens. In 1990, they were nominated by the UNESCO for the World Heritage List as part of the castles and gardens of Berlin and Potsdam. The meadows and lawns of the parks are of special interest because of their age and the specific garden management. Furthermore, there are special relicts of botanic heritage due to the historic garden design and the involuntary introduction of species. The landscape garden concept is characterized by large areas of meadows and lawns, also extending beneath groups of trees. Despite their significant botanical importance the parks have been only partially examined (Fischer and Sukopp, 1995).

The residential areas of the 20/30s in Berlin were investigated for their continuous land-use of 70 years and the diversity of plants both in historical aspects and contemporary field work. In the 'Golden 20s' Berlin was the centre for many famous building and garden architects of the century. A group called 'Neues Bauen' was very remarkable for their way of dealing with plants by using them as green mediators between buildings and backyards (Kloss and Pitz, 1985). These residential areas, built in the 20s in the suburban area, were the answer to a horrible situation in the inner city residential areas. They were meant to improve the quality of life and therefore they were characterized by wide-open, sunny, green, and

Table 1
Natural characteristics of the study areas

Study areas	Period of edification	Survey area (in ha)	Geology	Soil	Previous land-use
Parks	1820–1843	246 ha	Alluvial sand, sandy till	Rusty and garden soil	Agriculture/forestry
Residential areas of the 20/30s	1925–1934	75 ha	Alluvial sand, marly till	Garden soil	Agriculture/forestry
Former borderline	Since 1961	25 ha	Alluvial sand	Rubble pararend-zina	Buildings

colourful backyards, with recreation areas often planted with trees. Even today the vegetation structures demonstrate the profound influence of socio-economic conditions and traditions in using and arranging plants.

The third land-use type is a very specific one, the so called 'Mauerstreifen', the former border area between East and West Berlin. Built in 1961, the wall divided the city along a length of 48 km. The width of the border area varies between 30 and 300 m. The whole area suffered from intensive use of herbicides during almost 30 years to prevent any vegetation growth. Only some places with dominance of Wall-pepper (*Sedum acre*) remained. After the reunification in 1989 and the destruction of the wall, the investigated area stayed unused for ca. 8 years, so that typical communities of urban wastelands could establish. The border runs through all parts of the city; there are districts with a population density of 2530 inhabitants per km² in the suburban area as well as neighbouring residential areas of more than 13 300 inhabitants per km² in the centre. The investigation reported here was made only in the inner city zone.

2. Methods

The methods of research combine both vegetation survey (see Braun-Blanquet, 1964) in the parks of Potsdam and floristic survey in the residential areas of the 20/30s and the boundary area. During the growing seasons of 1994 until 1997 all wild-growing vascular plant species were registered.

The species lists were evaluated using groups of phytosociologically and ecologically similar species (Kunick, 1974) and the information about the time of immigration were taken from Kowarik (1988). The assessment of threatened species refers to the Red List of Berlin (Böcker et al., 1991) and Brandenburg (Benkert and Klemm, 1993).

3. Results

3.1. Flora specifics of the parks

The survey of the parks in Potsdam focused on the registration of the natural vegetation and the investi-

gation of the specific landscape garden flora. During the vegetation survey of the parks 275 wild-growing vascular plants were found in the meadows and lawns. The phytosociological results show the extensive occurrence of meadow communities, which are rare outside the parks and are only partially or seldom found in the city (Peschel, 1998). Today there are only small remaining areas of large, in former times traditionally used meadows. The main reason for the presence of these meadow communities in the landscape parks is the traditional and continuous way of extensive garden management with no fertilizing and mowing the meadows only twice a year. In addition, there has never been a ploughing of the meadows. Thus, the parks have been conserved almost in their original state during the last 150 years. Furthermore, there are botanic relicts of the 18th century in the parks, which had entered this area as seeds of foreign grasses or as impurities of seeding material (see Table 2). They are described as 'grass seed invaders' (Hylander, 1943).

Since the quality and purity of the seed material was not controlled in the last century, seed material contained many so-called 'passengers'. This ended with the introduction of seed control at the end of the last century. Therefore, these species are linked to a certain period of gardening art, but despite their introduction a long time ago, they can still be found in landscape gardens today. They reflect the history of the parks and can be described as indicator plants for the gardening art of that historic phase. Just like historical monuments they represent the cultural heritage.

3.2. Flora specifics of the residential areas of the 20/30s

The impact of the historical and actual management for the diversity of wild-growing vascular plants, wild-growing ornamental plants and planted trees in the green backyards of the residential areas of the 20/30s was studied. Their dispersal as well as establishment strategies were part of the research. The characteristic biotope structures include lawns with scattered trees, front gardens, playgrounds, and tenant gardens, very often neglected. The results show a high species diversity with ca. 545 species. Typical structures of the historic garden management of the 20/30s can nowadays only be found in relict structures. In parti-

Table 2
Grass seed invaders in parks of Potsdam and Berlin

Grass seed invaders	Park Sans.	Park Babelsb.	Neuer Garten	Pfaueninsel	Schloßpark Charlottenburg	Tiergarten	Klein-Glienicke
<i>Bromus erectus</i>	● ^a	●	●	●	●	○ ^b	●
<i>Trisetum flavescens</i>	●	●	●	●	●		●
<i>Arrhenatherum elatius</i>	●	●	●	●	●	●	●
<i>Sanguisorba minor</i>	●		○		●	●	
<i>Galium pumilum</i>				●		○	
<i>Leontodon saxatilis</i>	○			●	○		
<i>Crepis nicaeensis</i>	○				○		
<i>Thlaspi alpestre</i>	●	●	●				●
<i>Poa chaixii</i>	●	●	●	●	●	○	●
<i>Luzula luzuloides</i>	●	●		●		○	●
<i>Dactylis polygama</i>	●	●	●	●			●
<i>Teucrium scorodonia</i>	○	●		○		○	
<i>Myosotis sylvatica</i>	●			●			●
<i>Festuca heterophylla</i>	●					○	
<i>Phyteuma nigrum</i>	●	●				○	
<i>Hieracium glaucinum</i>	●				●		●

^a ● is findings after 1960.

^b ○ is findings before 1960.

cular, the old park trees or old hedges, which characterize the typical backyard, have survived the past 70 years (Maurer, 1998). The garden architects often chose park trees with a 'hanging' look, e.g. birch (*Betula pendula*'Youngii'), beech (*Fagus sylvatica*'-Pendula') and willow (*Salix alba*'Tristis'), but also ornamental cherry trees like *Prunus serrulata*'Kanzan' were very popular. During the Second World War, the greatest land-use change took place because of the necessity for self-support during the war, i.e. by planting fruit trees and vegetable beds or using trees for firewood. In some cases, the inhabitants held on to their tenant gardens after the war and, therefore a great amount and variety of fruit and old park trees is found today. These old fruit and park trees are very rare biotope structures in the city representing cultural relicts.

The species composition shows the strong human influence with a majority of species of wild-growing ornamental plants (24%) followed by ruderal communities (14%) and crop and garden weeds (11%). Wild-growing ornamental plants escape from their original place and establish mostly near front yards, balconies or tenant gardens. The same tendency is observed for the crop and garden weeds which establish in bird feeding places. Therefore, the flora reflects not only the actual human influence but also the plant fashion

and the plant arrangements by man in the 1920s and in the 1950s after the war.

The most important groups of species of the residential areas and the former border area are shown in Fig. 2.

3.3. Flora specifics of the former border area

The area of the former border was investigated for its diversity of wild-growing plants. The investigation shows an amount of 249 species. Most of them belong to 18 groups with socio-ecological similarities. As expected, the most frequent group of plants are ruderal perennials or species of ruderal mesoxerophytic grasslands, which cover the investigated area (see Fig. 2).

Furthermore, a large amount of wild-growing ornamental plants, mostly casuals, was found here (Schmitz, 1998). They show the important influence of the neighbouring allotments. Thus, the most important group for nature conservation are species of dry sward communities (10%), typical for railway areas or urban wastelands in the city. They are very seldom found in other urban land-use types. Nearly half of the species of these group found in Eastern Berlin grow along the former border. Another group with a high species count are crop and garden weeds (10%) growing in rich, humid and often disturbed areas. Until

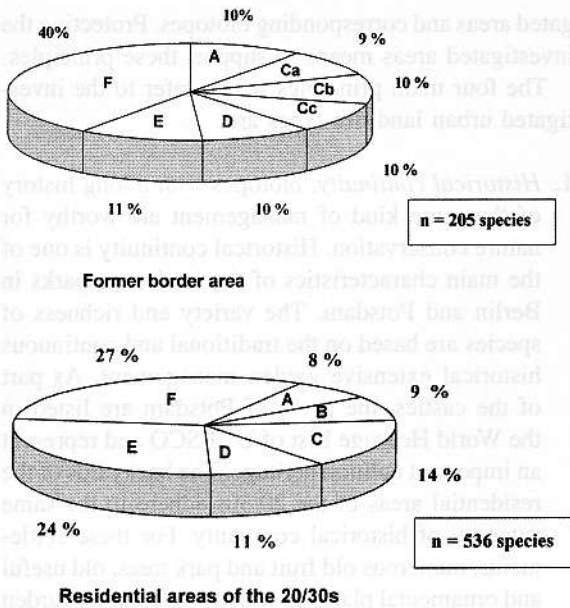


Fig. 2. Most important groups of species of the residential areas and the former border area: (A) dry sward communities; (B) grassland communities, (C) ruderal communities; (Ca) ruderal perennials; (Cb) ruderal mesoxerophytic grasslands; (Cc) ruderal short-lived communities; (D) crop and garden weeds; and (E) wild-growing ornamental plants; and (F) other groups.

today woody plants are rare on the former border. Only in some parts shrubs and pioneer woods like Black-berry (*Rubus*), Birch (*Betula pendula*), Ash-leaved Maple (*Acer negundo*) and Tree of Heaven (*Ailanthus altissima*) begin to invade the area.

The area of the former borderline represents in a special way the resettlement and the 'pioneer stage' of vegetation, which is indicated by the high amount of anemochorous species. Fifty-four percent of the species are mainly wind dispersed and therefore able to travel long distances and invade new areas. In the total flora of Berlin a much lower percentage of species is anemochorous; also, the amount of therophytes (33%) in the former border area is elevated.

4. Discussion and conclusions

4.1. Peculiarities of flora in all urban land-use types

The main factor determining living conditions in cities is the human impact. Densely built-up areas, loss

of biotope structures, and the introduction of species are only few examples. In relation to the decrease of human impact from the center to the suburbs a concentric zonation exists.

Kunick (1974) divided the city of Berlin (West) in four zones characterized by floristic attributes. There is an increase of neophytes and therophytes and a decrease of rare species from the suburbs to the centre. The highest amount of species per square kilometer can be found in the transitional zone between centre and rural areas where the mosaic of land-use types is most heterogenous.

The investigated land-use types are situated in different zones. Whereas the wastelands of the former borderline are located in the centre, the residential areas are located in the inner margin zone, characterized by built-up areas as well as green open spaces. The landscape parks are located in the outer marginal zone.

The comparison of the inventory of plant species and their time of immigration is shown in Fig. 3 and demonstrates the general characteristic of city vegetation zones with a decrease of indigenous species from the suburban area to the centre but an increase of neophytes.

The high proportion of indigenous species in the parks of Potsdam with 81% is due to their age and continuous extensive garden management which made it very difficult, e.g. archaeophytes or especially neophytes to invade the meadows and lawns. In the backyards of the residential areas of the 20/30s

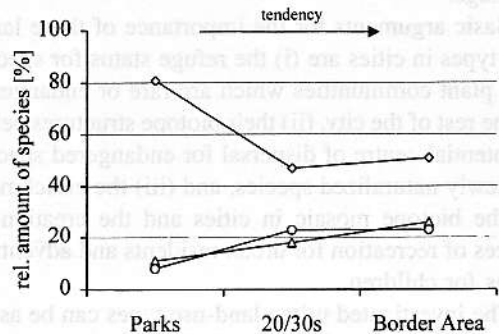


Fig. 3. Peculiarities of the flora of the urban land-use types in Berlin and Potsdam. The city vegetation zones are arranged by the time of immigration on the x-axis and the symbols denote the relative amount of species [%] of indigenous species (□), archaeophytes (△) and neophytes (○).

indigenous species (47%) and neophytes (23%) dominate as a result of the former agriculture, the former activity in tenant gardens (garden soil = hortisole), and the high human influence by care and planting species. In the area of the former borderline, the component of indigenous species is lowest because the areas are young and often disturbed.

A peculiarity of the flora of these three land-use types are rare and threatened species. As expected, there is a large number of species in the flora of the landscape parks (59 species) endangered or threatened by extinction. But surprisingly a high amount of species is found in the residential areas of the 20/30s (49 species) and even on the former borderline (7 species) species are growing which are noted in the Red List. This is again based on the age of the areas, the garden management, and the human influence. The endangered species in the backyards of the 20/30s are often garden relicts or relicts of seeds for meadows.

4.2. Value for nature conservation

For a long time, nature conservation in cities has been restricted to relicts of the natural landscape such as moist regions or woods. However, for a more general evaluation of urban land-use types, nature conservation in cities should not only focus on primary 'natural values' but include other important, more or less subjective arguments. All the urban land-use types reflect the historic artificial landscape as well as the economic and cultural changes in cities. The vegetation thus represents relicts of historic and botanic heritage.

Basic arguments for the importance of these land-use types in cities are (i) the refuge status for species and plant communities which are rare or endangered in the rest of the city, (ii) their biotope structures being a potential centre of dispersal for endangered species or newly naturalized species, and (iii) the enrichment of the biotope mosaic in cities and the creation of places of recreation for urban residents and adventure areas for children.

The investigated urban land-use types can be associated with main principles of urban nature conservation defined by Sukopp and Sukopp (1987). These principles are closely related to the maintenance and development of biological diversity in cities by giving answers to the importance of protecting the investi-

gated areas and corresponding biotopes. Protecting the investigated areas means to support these principles.

The four main principles which refer to the investigated urban land-use types are:

1. *Historical continuity*: biotopes with a long history of the same kind of management are worthy for nature conservation. Historical continuity is one of the main characteristics of the landscape parks in Berlin and Potsdam. The variety and richness of species are based on the traditional and continuous historical extensive garden management. As part of the castles, the parks of Potsdam are listed in the World Heritage List of UNESCO and represent an important cultural heritage. The backyards of the residential areas of the 20/30s adhere to the same category of historical continuity. For these settlements, numerous old fruit and park trees, old useful and ornamental plants as well as the original garden design are unique. As a consequence, the backyards are protected as garden monuments by the law (Landesdenkmalamt Berlin, 1995).
2. *Maintenance of local variety*: All places which are habitats for plant and animal species uncommon in the area, especially for rare and threatened species should be identified and protected. Concerning this principle, the investigated areas are of a high value for nature conservation because their species inventory includes many endangered and rare species in the city. This includes, e.g. the meadows and lawns of the parks in Berlin and Potsdam with their ancient 'grass seed invaders' of the 19th century or the relicts of old park trees and hedges in the backyards of the 20/30s. Species of the Red List are considered as rare cultivated plants as well. In the former border area, some species, which are normally very rare in the inner city zone were found. Especially in the inner city zone, a sealed area with a high population density, the enrichment of species diversity is important. It is a habitat for species growing mainly in dry sward communities which are rare in other urban biotopes.
3. *Maintenance of land-use diversity*: one of the main objectives of urban nature conservation strategies should be the avoidance of uniformity when managing traditional land-use structures or creating new open space. The leveling of site conditions is one of the most important reasons for

the decline of species (Sukopp, 1994). The three investigated biotopes are unique in many respects and enrich the mosaic of urban land-use structures and biotopes in the city.

4. *Urban ecological zonation*: remnants of natural and semi-natural ecosystems as well as ecosystems which depend on agricultural or forestry management are most easily maintained in the outer districts. The inner city, where the effects of urbanization are more intense, can more easily support the specialized urban plant and animal communities. Whereas the landscape parks are situated on the fringe of the city, the residential areas of the 20/30s are mainly located in the actual transition zone between city center and outskirts. The wastelands of the former border area range from the inner-city zone to the margin. Because of the lack of open space and space where wild plants can grow, they are of special importance in the city center.

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