

Urban woodland flora and vegetation on industrial fallow land in the Ruhrgebiet as a product of culture and nature – an outline of general tendencies¹

PETER KEIL & GÖTZ HEINRICH LOOS

Biologische Station Westliches Ruhrgebiet e. V., Ripshorster Straße 306, D-46117 Oberhausen; E-Mail: peter.keil@bswr.de

Abstract

Urban woodlands on industrial fallow land combine parts of culture (or nature 4) and nature in the sense of landscape ecology. While some of the trees and shrubs of urban woodlands in the Ruhrgebiet are native, a lot of others are present in cause of human activities, especially of cultivation for ornament. Different wood communities and stadiums could be found near by near and build up specific and variable patterns of such communities. The phytotaxa of these communities include anecophytes (i.e. plant taxa with habitats only in cultural landscape, so they are called "homeless") in high frequencies. The floristic phytodiversity of urban woodlands on industrial ground in the Ruhrgebiet is significantly high - even higher than in natural or near by nature placed forests of the vicinity of the Ruhrgebiet. If protection is caused on quantitative floristic phytodiversity, urban woodlands should be protected.

Keywords: Urban woodland, cultural landscape, ergasiophytophyts, hybrids, anecophytes, evergreen foliated taxa, invasive alien species, industrial area, Ruhrgebiet, Northrhine-Westphalia, Germany

Kurzfassung (entsprechend KEIL & Loos 2003)

Im Gegensatz zu den Resten alter naturnaher Waldflächen im Ruhrgebiet, die überwiegend durch forstliche Nutzungen geprägt sind, gehen die Vorwälder der Brachflächen i. d. R. auf sukzessive Entwicklungen zurück. Am Bestandsaufbau beteiligen sich sowohl indigene und apophytische Pionierarten wie *Betula pendula*, *B. ×aurata*, *Salix alba*, *Salix caprea*, *Salix cinerea*-Hybriden, als auch neophytische Sippen, häufig Kultur- und Gartenflüchtlinge wie *Buddleja davidii*, *Crataegus monogyna*, *C. ×subsphaericea*, *Ailanthus altissima*, *Robinia pseudoacacia* und neuerdings auch *Paulownia tomentosa*. Auffällig ist ebenso der Anteil an „Heimatlosen“, sogenannte Anökophyten wie *Populus maximosiczii*- und *P. nigra* cv. *Italica*-Hybriden. Daneben siedeln zahlreiche weitere gebietsfremde Holzgewächssippen, die lediglich vereinzelt auftreten (z. B. *Berberis (Mahonia) aquifolium*, *Crataegus persimilis*, *Prunus mahaleb*, *Cotoneaster* div. spp. u. a.). Je nach Standortbedingungen, Sukzessionsstadien und Grad der Beeinträchtigungen, findet sich auf den Flächen eine Vielzahl an Pionierwaldgesell-

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schaffen, angefangen bei monostrukturierten *Betula pendula*-Beständen über das typische Salweiden-Birken-Gestrüpp bis hin zu holzgewächsartenreichen, gut strukturierten Weiden-Birken-Pappeln-Wäldern – nicht selten auch mosaikartig nebeneinander oder sogar miteinander verzahnt. Durch das Zusammenspiel zwischen „künstlichem“ Standort und „natürlicher“ Entwicklung ergeben sich „neue“ ökologische Nischen, insbesondere für eine Vielzahl gebietsfremder Holzgewächssippen. Das sich hieraus etablierende Sippenspektrum führt zu Bildung neuer Vegetationseinheiten in der industriellen Stadtlandschaft.

Schlüsselwörter: Industriewald, Industrienatur, Stadtwald, Kulturlandschaft, Ergasiophytophyten, Hybriden, Anökophyten, immergrüne Gewächse, invasiv, Industriegebiet, Ruhrgebiet, Nordrhein-Westfalen, Deutschland

Introduction

Urban woodlands are products of human activities – in a direct or an indirect way. Directly, forests are planted on fallow ground to replace the cleared woodlands from former periods when the urban areas were not yet built. Also parks and comparable places (e.g. cemeteries with a high frequency of trees) ought to be mentioned here. These urban woodlands are placed within nature types 2 und 3 by KOWARIK et al. (2003). As many of corresponding urban woodlands seem to be close to natural vegetation (nature 1 in the sense of KOWARIK et al. 2003), it could be justified to call these woodlands natural – and in colloquial speech there is no doubt that this must be nature. From a landscape ecological viewpoint, urban woodlands are parts of the cultural landscape because of their anthropogenity. So it seems that there is a close link between nature and culture in urban areas, not only with respect to urban woodlands.

This link is best illustrated by nature type 4 by KOWARIK et al. (2003), the “new“ wild urban woodlands. These woods are spontaneously established and contain a mixture of origins of wood building plant taxa: natural colonizers, taxa with spreading along railway tracks or with ground, relics from former plantations within the woodland area, escapes (and throwouts) from gardens, parks, cemeteries, roadside plantations, nearby situated forests etc. Therefore, urban woodlands of nature type 4 consist partly of natural, partly of cultural elements and the site of these woods is located on urban fallow ground – former used for cultural aspects (urban and industrial areas) and often used today for certain anthropic – cultural – purposes (e.g. local recreation, „wild“ playgrounds, but also illegal waste disposal).

Urban fallow sites are characterized by special floristic and vegetation structures. A great number of studies could be mentioned that present results of investigation of

urban-industrial flora and vegetation from different parts of the world. The present paper deals with aspects of urban forest flora and plant communities of the Ruhrgebiet (Germany, Northrhine-Westphalia). This area was the biggest industrial agglomeration of Germany and of Europe in general. Its borders are somewhat unclear as coal mines and ironworks as the characteristic types of the Ruhrgebiet industry were also distributed in peripheric and adjacent regions that are not dominated by urban structures like the central parts. Therefore, Fig. 1 presents only the central Ruhrgebiet, the area between cities of Dortmund and Duisburg, which is characterized by wide urban-industrial zones, often without a clear-cut border between the individual cities. Coal mining is closed within central Ruhrgebiet and only continued in the northern peripheric regions. Blast furnaces are also closed, only in Duisburg and Bochum steel mill working is going on. Structural change to the service sector has carried out wide areas of fallow land, but most of these areas are now used to build up business parks which include companies of service sector and specialized industries (above all IT companies), residential districts and recreation areas (a short topical overview of the Ruhrgebiet and its development is given by ECKART et al. 2000, see also the essays in "Beiträge aus Anlaß des 49. Deutschen Geographentages in Bochum 4.-9. Oktober 1993" and STOTTROP 2000 for a popular introduction in linking nature and culture of the Ruhrgebiet).

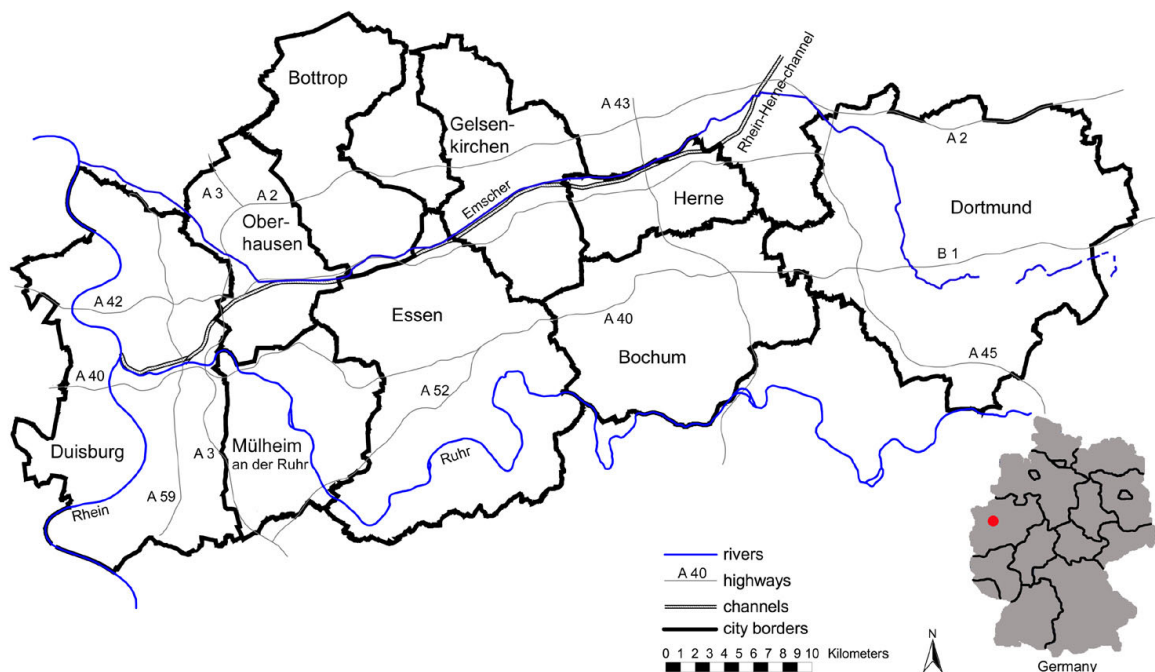


Fig. 1: The cities of central Ruhrgebiet

Investigations of industrial fallow land in the Ruhrgebiet have pointed out that there are typical successions of vegetation from pioneer colonization to woodlands (see fig. 2). Stands of different ages are often situated side by side as certain parts of industrial areas were fallow while other parts were used at the same time. Climactic or so called “end” stadiums of woodland successions are absent, but the real climactic development even of older stands is unknown. By now, it seems that birch-oak-forests (in details somewhat different from the *Betulo-Quercetum* association of natural stands) could be the climax community in most cases. In the following chapters an overview of succession and the urban forest communities in the Ruhrgebiet is given, some important taxa of the wood flora are presented and the meaning for protection of floristic phytodiversity is briefly discussed.



Fig. 2: Typical successions of vegetation from pioneer colonization to woodlands

Urban woodland communities in the Ruhrgebiet – an overview

Flora and vegetation of the urban-industrial zones of the Ruhrgebiet were thoroughly investigated within the last quarter of century, principally initiated by DÜLL & KUTZELNIGG (1980), presented or summarized especially by BÜSCHER et al. (1997), DETTMAR (1991, 1992), DETTMAR & REIDL (1993), GÖDDE (1986), HAEUPLER (1992), KEIL & LOOS (2002a) and REIDL (1989). Investigation projects and a lot of examination theses on

this subject were made at the geobotanic working groups and geographic institutes of the universities of Bochum, Duisburg and Essen. Two floras which would include extended parts of the Ruhrgebiet are in preparation (BÜSCHER & LOOS for the Westphalian part, KEIL, VOM BERG & PIEPER for the Mülheim an der Ruhr area). But hitherto a comprehensive syntaxonomic study of the nature 4 communities in the Ruhrgebiet is missing. Up to date, numerous data are present and an appropriate presentation could be given in near future. Here, only the essential features of succession and the woodland communities will be described briefly.

The colonization of open ground starts with communities of therophytes. Very frequent species are *Arenaria serpyllifolia*, *Bromus sterilis* and *B. tectorum*, *Epilobium adenocaulon*, *Erigeron (Conyza) canadensis*, *Senecio viscosus* and *Tripleurospermum perforatum*. Typical annual species of industrial sites in the Ruhrgebiet are *Apera interrupta*, *Herniaria glabra*, *Inula (Dittrichia) graveolens*, *Saxifraga tridactylites*, *Spergularia rubra* and *Festuca (Vulpia) myuros*. Also some biennial and few perennial species appear, especially *Echium vulgare*, *Oenothera* spp., *Reseda luteola*, *Senecio inaequidens*, *Verbascum* spp. and remain while therophytes disappear after ground is mainly covered by perennial herbs. These stadium is mostly dominated by *Solidago gigantea* and *S. „canadensis“*, ruderal meadows of Arrhenatherion or *Calamagrostis epigejos*. There are slight to obvious differences from region to region, from site to site (coal mine area specific or ironworks specific species and communities) and from habitat to habitat (for more details see DETTMAR 1991, 1992, DETTMAR & REIDL 1993, LOOS 1999, KEIL & VOM BERG 2002).

But in all succession stadiums woody species, trees and shrubs, are present. The most frequent woody pioneer species are birch, *Betula pendula*, and goat willow, *Salix caprea*. Sprouts of both species could be found at least scattered on open ground with very dispersed therophyte vegetation. Both are native in the Ruhrgebiet, but the sources of the occurrences are of different quality: *Betula pendula* is a native species, but also widely planted in parks and gardens, at roadsides etc., so the populations are partly of natural and partly of cultural origin. *Salix caprea* seems to be a similar case but it is planted much more rarely and so the populations are probably predominantly native. It should be noticed that these birch-goat willow-primary forests as all urban woodland communities only exceptionally include relics from plantations, in the most cases the stands are completely generated by succession. One important exception ought to be seen in pithead stocks where trees for forestry and shrubs for

ornamental purposes were planted and now are included in primary forests consisting partly of the former planted taxa. In such circumstances it could be problematic to differentiate between nature 3 and nature 4.



Fig. 3: Birch-goat willow-primary forests are the most frequent urban woodlands of nature 4 in the Ruhrgebiet

Birch-goat willow-primary forests are the most frequent urban woodlands of nature 4 in the Ruhrgebiet (see fig. 3, apart from almost monostructural stands of birch or goat willow). These are typical primary forests or woodlands, not a climactic stadium of succession as both species prefer light habitats. When these primary forests get older, sprouts of oak, *Quercus robur*, could be detected between birches, willows and single individuals of accompanied other woody taxa. Stands which are fallow for decades contain communities which are similar to *Betulo-Quercetum*, a natural association on sandy ground, predominantly distributed in the northern peripheric regions of the Ruhrgebiet, but somewhat different in the herbal species inventory of the community. Not all birch-goat willow-primary forests consist nearly solely of these species. Among predominantly native taxa often *Salix alba*, hybrids of *Salix cinerea* (*Salix ×reichardtii*, *Salix ×multinervis*) and *Betula ×aurata* are present in greater abundances, also escapes from cultivation (ornamental and forestry), especially *Crataegus monogyna*, *Crataegus ×subsphaericea*, *Ailanthus altissima*, *Populus hy-*

brids and *Robinia pseudoacacia*. The successional development leads to willow-birch-poplar forests – in phytosociological separation from birch-goat willow-stands sometimes problematic. Poplar hybrids (*Populus maximowiczii* hybrids and *P. nigra* cv. *Italica* hybrids) frequently build up own monostructural communities.



Fig. 4-5: The North-American Hawthorn Species *Crataegus pedicellata* in a birch-primary forest on a pithead stock (Oberhausen). Climbing False Virginia-creeper, *Parthenocissus inserta*, on an embankment (Oberhausen)

Salix alba dominated primary forests are also frequent, not only in damp sites. The floristic composition of these woodlands is very similar to birch-goat willow-primary forests, but the abundances of the taxa have changed. In *Salix alba* woodlands *Buddleja davidii*, a frequently cultivated species for ornament, is present in many instances. *Buddleja davidii* itself forms a characteristic primary woodland community, often accompanied by *Betula pendula*, *Salix* species and hybrids and *Sambucus nigra*. Within the primary forests there are many single or few occurrences of escapes from ornamental cultivation like *Mahonia* or *Berberis aquifolium*, *Crataegus persimilis*, *C. pedicellata* (see fig. 4), *Paulownia tomentosa*, *Prunus mahaleb*, *Cotoneaster* spp. etc. Nowadays a lot of occurrences of escaped evergreen foliaged species could be noticed, especially *Berberis aquifolium*, *Prunus laurocerasus*, *Berberis julianae*, *Lonicera nitida* and most recently *Viburnum rhytidophyllum*. The new spreading tendency of these taxa was investigated in most biotope types of the Ruhrgebiet, not only on industrial fallow ground – though most of the species are cultivated within the

area for some decades (KEIL & LOOS 2002a and b). Thicket building species on industrial fallow land in the Ruhrgebiet include some perennials and pseudophanerophytes that are similar to woody species, above all the escaped species *Fallopia japonica* and *Rubus armeniacus*. The thickets become very dense by the presence of woody climbers like the partly native (but apophytic) *Clematis vitalba* and the escaped *Parthenocissus inserta* (fig. 5).

An overview of the most frequent escaped taxa in the Ruhrgebiet which all could be found on industrial fallow land is given in tab. 1.

Habitat differences, different succession stadiums and degree of human impact even at one industrial fallow area cause a multitude of primary woodland communities side by side, in different patterns and often linked together (fig. 6). As the more complex and dominated by escaped taxa communities are absent in nature 1 to 3 (including „real“ nature in the sense of landscape ecology) only in nature 4 completely new ecological niches are brought forward which are important for establishment of the escaped – cultural – taxa.

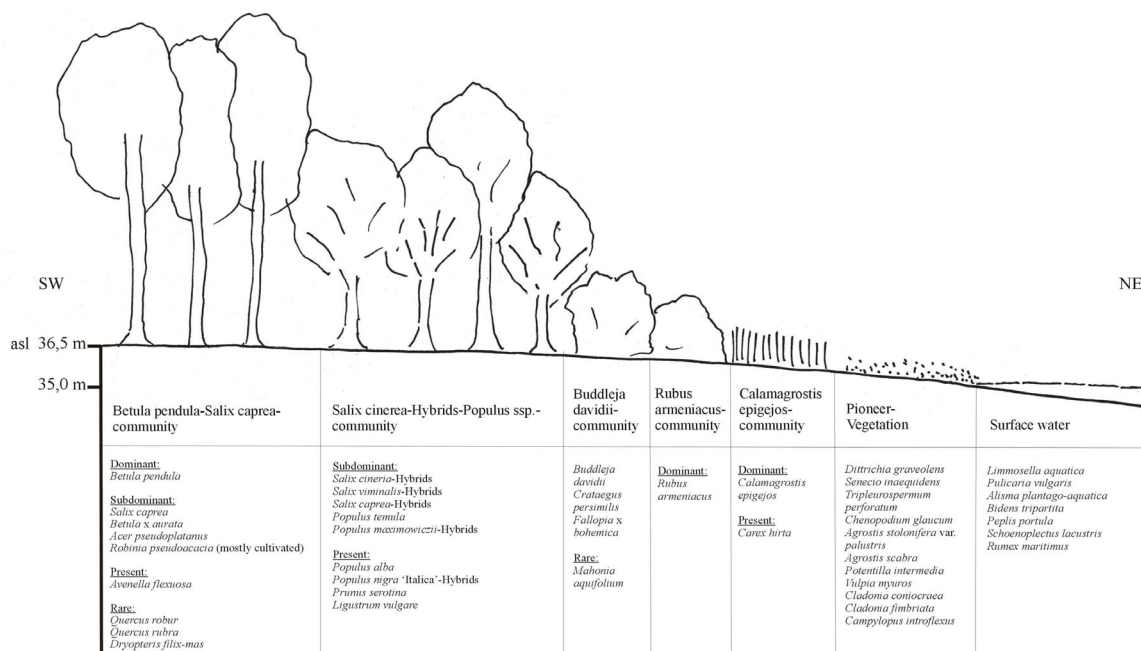


Fig. 6: Vegetation profile of a typical industrial fallow area in the Ruhrgebiet (location Waldteich, Oberhausen)

Tab. 1: Overview of the most frequent woody taxa in central Ruhrgebiet escaped from cultivations (1980-2002). - Including data from DÜLL & KUTZELNIGG (1987), REIDL (1989) and DETTMAR (1992). - I = indigenous (native), E = established, U = casuals, S = spontaneosynanthropics (i.e. no decision whether casual or established); * = predominantly spread vegetatively; L# = locally expansive taxon

Taxon	Status	expansive	research-area							sources						
			Oberhausen	Duisburg	Mülheim a.d. Ruhr	Essen	Geisenkirchen	Bochum	Herne	Forestry	Gardening (ornamental plants, herbs)	Cemeteries and Parks	Flower beds at public places	Hedging and Roadside plantings, railway and channelside plants	Botanical Gardens (outside)	Xenophytic
<i>Acer negundo</i>	S	#	x	x	x	x	x	x	x			x		x		
<i>Acer platanoides</i>	S; E	#	x	x	x	x	x	x	x	x	x	x		x		x
<i>Acer pseudoplatanus</i>	S; E; I?	#	x	x	x	x	x	x	x	x	x	x		x		x
<i>Aesculus hippocastanum</i>	U	#	x	x	x	x	x	x	x		x	x		x		x
<i>Ailanthus altissima</i>	E; S	#	x	x	x	x	x	x	x		x	x		x		x
<i>Alnus cordata</i>	S	L#				x		x						x		
<i>Amelanchier lamarckii</i>	S	L#	x	x	x	x	x	x	x		x			x		
<i>Berberis julianae</i>	S	L#		x	x	x	x	x	x		x	x		x		x
<i>Buddleja davidii</i>	E; S	#	x	x	x	x	x	x	x		x	x				x
<i>Caragana arborescens</i>	S	L#				x	x					x		x		
<i>Cotoneaster divaricatus</i>	S	#		x	x	x	x	x	x		x	x	x	x		x
<i>Juglans regia</i>	S	#	x	x	x	x	x	x	x		x					
<i>Ligustrum vulgare</i>	S	#	x	x	x	x	x	x	x		x	x		x		
<i>Lonicera xylosteum</i>	S	L#	x	x	x	x	x	x	x		x	x		x		x
<i>Mahonia aquifolium</i>	S; E	#	x	x	x	x	x	x	x		x	x		x		x
<i>Parthenocissus inserta</i>	S*; E*	#	x	x	x	x	x	x	x		x	x		x		
<i>Platanus (x)hispanica</i>	S	#	x	x	x	x	x	x						x		
<i>Prunus laurocerasus</i>	S	#	x	x	x	x	x	x	x		x	x		x		x
<i>Prunus mahaleb</i>	S	#		x		x	x	x	x					x		x
<i>Prunus serotina</i>	E; S	#	x	x	x	x	x	x	x	x	x	x		x		x
<i>Rhus typhina</i>	S*; E*	L#		x	x	x	x	x	x		x	x				x
<i>Ribes sanguineum</i>	S	#		x	x	x	x	x	x		x	x				x
<i>Robinia pseudoacacia</i>	S; E	#	x	x	x	x	x	x	x	x	x	x		x		x
<i>Rosa rubiginosa</i>	S; E	L#		x	x	x	x	x	x		x	x		x		x
<i>Rubus armeniacus</i>	E	#	x	x	x	x	x	x	x		x			x		?
<i>Rubus ulmifolius</i>	E	L#		x		x		x						?		x
<i>Taxus baccata</i>	S	#	x		x	x	x	x	x		x	x		x		
<i>Viburnum lantana</i>	S	#		x	x	x	x	x	x		x	x		x		

Remarks on floristic phytodiversity of urban woodlands in the Ruhrgebiet

The floristic inventory of industrial fallow ground contains native and not native taxa. Native taxa imply a wide ecological range and are present in natural, seminatural and cultural habitats (like *Betula pendula*) or such species intrude in new niches that are different from their natural habitats (apophytes; most occurrences of native taxa on urban-industrial land should be placed here). Taxa that escaped from cultivation could be casuals, but in most cases it seems that most of the escaped trees and shrubs are persistent and become established within new niches.

Tab. 2: Number of tree and shrub taxa (species, hybrids, subspecies) of primary forest communities on selected urban-industrial fallow areas (nature 4 sensu KOWARIK et al. 2003) in central Ruhrgebiet

Location (DU = Duisburg, E = Essen, MH = Mülheim a. d. Ruhr, OB = Oberhausen, GE = Gelsenkirchen)	Number of tree and shrub taxa	Source
Former coking plant (DU)	> 40	MEßER, pers. comm.
Former ironwork part „Sinteranlage“ (DU)	> 30	own investigations
Former ironworks area, now called „Landschaftspark DU-Nord“	> 40	investigations at the „Geo-Tag der Artenvielfalt“
Former coal mine area Zollverein (E)	29	GAUSMANN, in litt.
Former bread factory area Rugenberger (MH)	25	own investigations
Fallow area Vondern (OB)	> 35	own investigations /RIEDEL, pers. comm.
Former coal mine area Alma (GE)	> 30	GAUSMANN, pers. comm.
Former coal mine area Rheinelbe (GE)	> 40	GAUSMANN, pers. comm.
Former Mannesmann ironworks area (MH)	42	own investigations
Waldteich fallow area (OB)	> 25	own investigations

In addition to these two categories, there are taxa which are only present in cultural landscape, so called anecophytes (SUKOPP & SCHOLZ 1997; „homeless“ taxa). The frequency of anecophytes on industrial fallow land is significantly high. The poplar hybrid communities which are typical for a lot of industrial woodlands, especially near the Rhine, but also in Dortmund and other cities, consist of very complicate generated *Populus* hybrids (see KOLTZENBURG 1999): Among the ancestors in one group *Populus maximowiczii* of east Asia seems to be present in all hybrids, in the other group *Populus nigra* cv. *Italica*, the Lombardy Poplar, a taxon only known from cultivation, is the dominant parent taxon - certainly. The parents of the anecophytic poplars in the Ruhrgebiet are complex hybrids as well, which were artificially produced by

crossing natural species or cultivated types of natural species. So these poplars are the living references of the link between nature and culture.

Environmental and nature protection strategies mostly exclude nature type 4 from their programmes. The primary aim of nature protection is preservation of nature 1, and the importance of nature 2 to 4 is decreasing from type to type in this respect. If the number of phanerogamic taxa is taken into consideration (floristic phytodiversity, see e.g. HAEUPLER 2000), woodlands of nature 1 on limestone could contain most taxa. The floristic diversity of trees and shrubs is somewhat different from this general statement. Tab. 2 presents the number of woody taxa of selected industrial woodland areas in the central Ruhrgebiet; 25 to more than 40 taxa were recognized within the areas. Compared to the number of tree and shrub taxa of nature 1 and 2 woodland communities (Tab. 3), floristic diversity is significantly higher. A detailed comparison of the whole floristic phytodiversity of woodlands of the different nature types is missing up to now, but it seems that the greater number of herbs in nature 1 and 2 could be compensated by the greater number of trees and shrubs in nature 4. However, quantitative floristic phytodiversity is apparently not a suitable parameter for justifying a more severe protection status of nature 1 compared with nature 4. If emphasis is only directed to the number of taxa, urban woodlands on industrial fallow lands ought to be protected. But in summary it is necessary to take a differentiated view to nature 4 and handle with all interests in an adequately way to get compromises. On the other hand, the paradigm of protection of more natural-(nature 1-)like habitats should be evaluated in areas where nature 1 is nearly extincted.

Tab. 3: Number of tree and shrub taxa of forest communities closer to nature (nature 1 sensu KOWARIK et al. 2003) in the Ruhrgebiet and peripheric regions

Community and location	Number of tree and shrub taxa
former managed forest on limestone (Weißenstein, Hagen)	max. 20
<i>Betula pendula</i> - <i>Salix caprea</i> -primary forest on sand after clearing by storm (Duisburg-Mülheimer Wald)	max. 15
<i>Galio odorati</i> -Fagetum (Mastberg, Hagen)	max. 15
<i>Luzulo</i> -Fagetum (Auberg, Mülheim an der Ruhr)	max. 10

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