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History of the flora and vegetation of Berlin and their conservation

Herbert Sukopp

Abstract
The Berlin area was formed during the Quaternary and is mostly covered with Weichselian and Holocene sediments. The primeval vegetation, as reconstructed by pollen analysis, soil conditions, historical reports and recent vegetation patterns, has totally changed due to the large city development since the second part of the 19th century. Today about 3.5 million people are living in the city of Berlin on 889 sq km. To understand the relationship between the plant species and the environment, it is necessary to see the present flora and biotopes as a result of the historic development. Plants can exercise a positive influence on both the climate and the air in the surroundings. Through transpiration, humidity is increased (it is often too dry in towns), and the heat required for evaporation avoids excess temperatures. Thus green areas can help to produce cool air, which is a necessary compensation in highly built-up areas. In addition, plants in vegetation belts help, to some extent, to absorb noise. Arguments for the conservation of wild plants in the cities also lead to some remarks concerning nature conservation practices in Berlin.

Résumé
La région de Berlin s'est formée pendant le Quaternaire et est entièrement recouverte par des sédiments du Wechselien et de l'Holocène. La végétation originelle, reconstituée par l'analyse des pollens, l'étude du sol, les témoignages historiques et les relevés de végétation récents, a été complètement transformée du fait de l'important développement de la ville depuis la deuxième partie du XIXe siècle. Aujourd'hui, près de trois millions et demi d'habitants vivent à Berlin sur 889 km2. Pour comprendre les relations entre les espèces végétales et l'environnement, il est nécessaire de considérer la flore actuelle et les biotopes comme un résultat du développement historique. Les plantes peuvent exercer une influence positive à la fois sur le climat et la qualité de l'air. Par la transpiration, l'humidité augmente (elle est souvent insuffisante dans les villes), et la chaleur requise par l'évaporation évite les excès de température. Ainsi, les zones vertes peuvent aider à produire de l'air frais, compensation nécessaire dans les zones densément construites. En outre, les plantes des ceintures végétales contribuent dans une certaine mesure à absorber les bruits. Les arguments en faveur de la conservation des plantes sauvages dans les villes ont également conduit à certaines remarques concernant les pratiques de gestion de la nature à Berlin.

HISTORY OF THE FLORA AND VEGETATION OF BERLIN AND THEIR CONSERVATION

Herbert SUKOPP*

ABSTRACT – The Berlin area was formed during the Quaternary and is mostly covered with Weichselian and Holocene sediments. The primeval vegetation, as reconstructed by pollen analysis, soil conditions, historical reports and recent vegetation patterns, has totally changed due to the large city development since the second part of the 19th century. Today about 3.5 million people are living in the city of Berlin on 889 sq km. To understand the relationship between the plant species and the environment, it is necessary to see the present flora and biotopes as a result of the historic development. Plants can exercise a positive influence on both the climate and the air in the surroundings. Through transpiration, humidity is increased (it is often too dry in towns), and the heat required for evaporation avoids excess temperatures. Thus green areas can help to produce cool air, which is a necessary compensation in highly built-up areas. In addition, plants in vegetation belts help, to some extent, to absorb noise. Arguments for the conservation of wild plants in the cities also lead to some remarks concerning nature conservation practices in Berlin.

KEY-WORDS. – Urban ecology - Urban climate – Berlin - Introduction and naturalization of plants.

RÉSUMÉ. – La région de Berlin s'est formée pendant le Quaternaire et est entièrement recouverte par des sédiments du Wechselien et de l'Holocène. La végétation originelle, reconstituée par l'analyse des pollens, l'étude du sol, les témoignages historiques et les relevés de végétation récents, a été complètement transformée du fait de l'important développement de la ville depuis la deuxième partie du XIX^e siècle. Aujourd'hui, près de trois millions et demi d'habitants vivent à Berlin sur 889 km². Pour comprendre les relations entre les espèces végétales et l'environnement, il est nécessaire de considérer la flore actuelle et les biotopes comme un résultat du développement historique. Les plantes peuvent exercer une influence positive à la fois sur le climat et la qualité de l'air. Par la transpiration, l'humidité augmente (elle est souvent insuffisante dans les villes), et la chaleur requise par l'évaporation évite les excès de température. Ainsi, les zones vertes peuvent aider à produire de l'air frais, compensation nécessaire dans les zones densément construites. En outre, les plantes des ceintures végétales contribuent dans une certaine mesure à absorber les bruits. Les arguments en faveur de la conservation des plantes sauvages dans les villes ont également conduit à certaines remarques concernant les pratiques de gestion de la nature à Berlin.

MOT -CLEFS. – Écologie urbaine - Climat urbain – Berlin - introduction et naturalisation des espèces végétales.

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INTRODUCTION

Demographic predictions seem to make it advisable that ecological principles and knowledge are used more systematically than in the past in order to develop better living conditions for man and all other organisms. This is especially necessary for large urban areas which have been subject to man-made changes the most. A series of ecological resarch projects has been carried out in Berlin during the last years to investigate changes in its ecosystems.

In spite of difficulties in carrying out research into the often repeated assumption that cities are generally ecologically imbalanced, results indicate that, surprisingly, man-made habitats can offer environments for characteristic combinations of plant and animal species. The species combinations in environments such as industrial areas, railways, ports, and refuse and rubbish dumps, often vary considerably from those found in more natural environments.

Natural scientists and landscape architects are playing an important role in protecting nature and reintroducing it into cities. The system of subject planning and strategic planning required under the Berlin Nature Conservation Act of 1979 is described. Landscape architects have helped to elevate nature conservation to a strategic planning level and to make it part of political thinking. The procedure used to develop the Nature Conservation Programme, which is one of four types of programmes included in conservation subject planning, is outlined. The Nature Conservation Programme, which is part of the strategic plan for Berlin, is a good example of how a natural approach can be achieved in urban planning.

Landscape

The Berlin area geology was laid down during the Quaternary and this area is mostly covered by weichselian and holocene sediments.

The original vegetation, as reconstructed by pollen analysis, soil conditions, historical reports and recent vegetation patterns comprises three main woodland units: oak-hornbeam on arenosols, influenced by groundwater in the Urstromtal, pine-oak on dry arenosols in the sandy parts of the ground moraine plateaux, and oak with pine, hornbeam and local patches of beech on luvisols of the coversand till areas of those plateaux.

The macroclimatic characteristic is the transition from oceanic to continental climate with average annual temperatures of about 8,5°C and average annual precipitation of about 600 mm.

The landscape of the Middle Ages and its rural character has been totally changed since the second part of the 19th century by the development of a large city.

Today about 3,5 million people live in the city of Berlin on 889 sq km of which 57 % are buildings or transport networks. 43 % of the Berlin city area is not built up as a result of World War II and of the reconstruction of the city.

With the end of the division between East and West Berlin in 1989, the city faces a new situation in terms of its ecological development.

Alterations to the climate

Especially in the inner city, conditions have changed drastically with increasing human settlement.

The climate in conurbations is marked by a fundamental change in the local energy budget. Characteristics of the urban climate, as compared to the surroundings are:

• higher air pollution: gaseous pollution is five to twenty-five times higher, condensation nuclei about ten times higher.
- altered radiations: 5-15 % less hours of sunshine, 20-25 % less direct solar radiation, ca 10 % less surface albedo, 12 % more atmospheric back radiation has lead to an increased net radiation of 11 % at noon or 47 % in the evening.
• relative humidity is between 2 % (winter) and 10 % (summer) lower; on clear days this difference can reach 30 %.
- wind speeds are reduced by 10-20 %, calm days are 5-20 % more frequent.
• annual average precipitation has increased by up to 20 %.
• the most important result of these effects ecologically is an increased temperature. The difference depends on the size of the city, it can reach 9°C on clear days, or 0.5 to 1.5°C in the yearly mean temperature.
After HORBERT *et al.* 1983, figures are for the Berlin example.

Climatic conditions within a city can vary considerably, depending on the type of patches of construction, paving, location in the city and, especially, the distance to large greenspace. According to these changes, different climatic zones, usually more or less concentric can be distinguished. Plants are able to exercise a positive influence on both the climate and the air in the surroundings. The influence of green-spaces on the urban climate were investigated by Albrecht VON STÜPNAGEL (1987). He found a reduction in temperature not only in a green area but also up to 1.5 km away from it. This climatic influence grows with the size of the greenspace but is reduced where the area is divided by a road.

Plants growing on buildings influence the climate in the building positively. Extensive investigations reported by DARIUS & DREPPER (1984) confirm the considerable benefits to microclimate and air hygiene of climbing plants on walls. A cover of plants on roofs can reduce the surface temperature, filter the air, fix harmful substances and reduce heat losses during the winter (DARIUS & DREPPER, 1984).

Soils

Berlin is the first city in which soils have been systematically investigated (RUNGE, 1975; BLUME, 1981; ALAILY *et al.*, 1986). A classification of soils in urban agglomerations is given by Hans-Peter BLUME (1989), as well as information on the protection of soils (1992).

Urban biotopes

To understand the relationship between flora and environment, it is necessary to see present biotopes as a result of historic development. From the beginning, towns have been places of shelter against nature and its dangers, and nature was only tolerated for ornamental purposes. Historically, cities have fought nature back, creating a cultural – artificial – environment as opposed to the more natural environment prevailing outside (TREPL, 1993).

In the course of city historic development, site conditions have been altered by humans, intentionally or unintentionally. Thus urban open spaces represent modifications of older ones. The similarity between former and present site conditions decreases with time and along a gradient from the periphery to the center. Within the built-up area the original ecosystems are destroyed and many species become extinct, but simultaneously new organisms and new biotic communities become established in all areas of the city (Fig. 1).

The history of plant geography and plant ecology in Berlin

The 18th century saw the development of the fundamentals of natural history, the precursor of plant geography and ecology. Natural history was concerned with the description and classification of living organisms, and with their distribution. Zoological and botanical investigations on all continents led to the " discovery of diversity " (MAYR, 1982).

In Brandenburg, the region around Berlin, the botanist Johann Gottlieb GLEDITSCH (1714-1786) had already listed 1200 plants (GLEDITSCH 1789); he was aware of the existence of various floristic elements. He was also aware of the fact that each landscape in Brandenburg had its own specific species in addition to those common to all districts, but that there were no endemic taxa in Brandenburg.

The development of botany in the 19th century was greatly influenced by the founding of the Friedrich Wilhelm University in Berlin in 1809. The former Court and Academy Garden in Schöneberg, which Carl Ludwig WILLDENOW (1765-1812) directed from 1801 to 1812, was incorporated into the University as a botanical garden in 1810. WILLDENOW was granted the Chair of Botany in the Faculty of Philosophy.

He published his *Grundriß der Kräuterkunde* in 1792. It was re-edited several times (WILLDENOW, 1810), was widely read, and had great significance for plant geography, among other things. The chapter "History of plants" can be regarded as a foundation for this branch of science. The first paragraph of the book (in the fifth edition, 1810) runs :

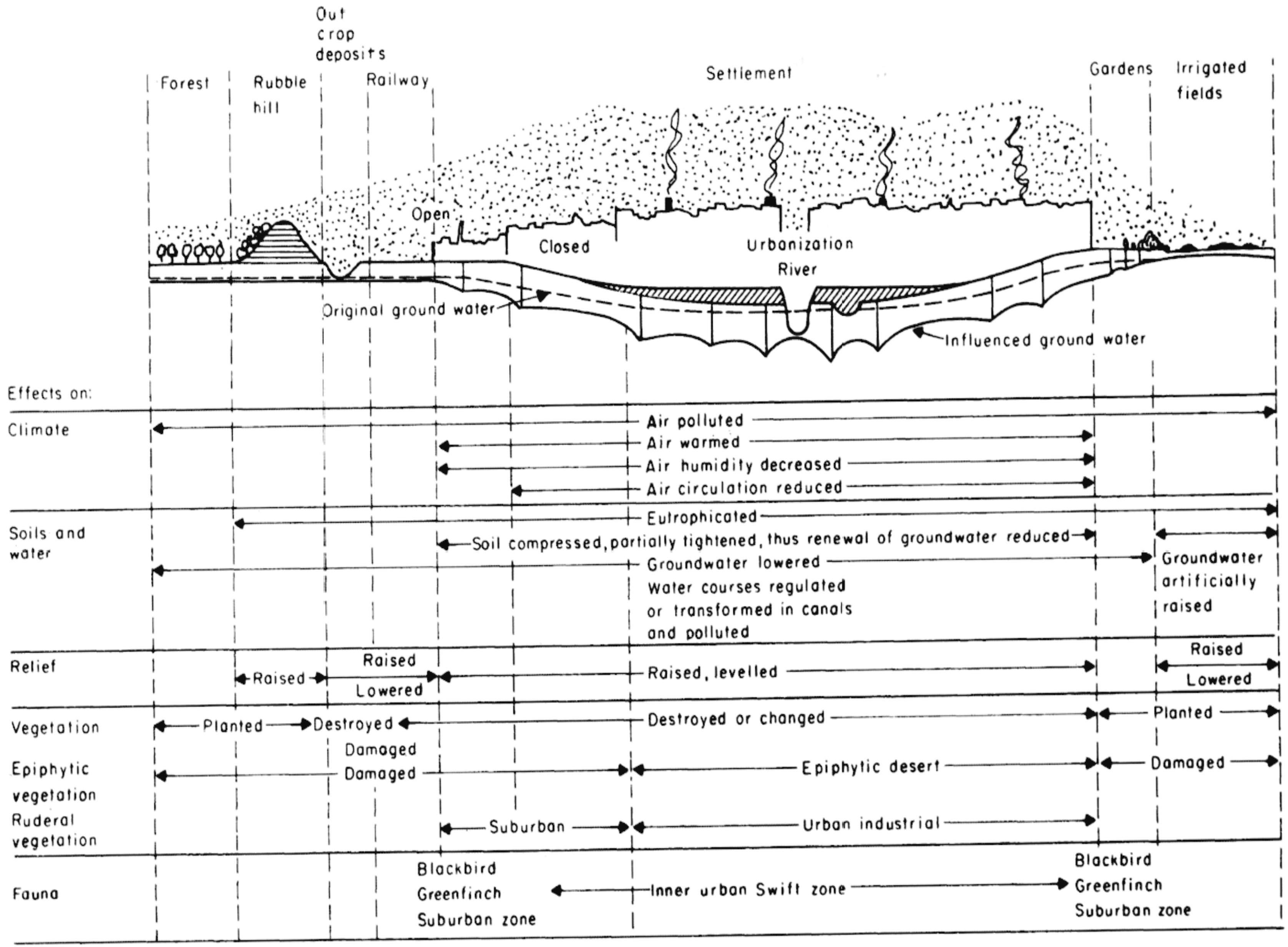

Fig. 1 - Changes of the biosphere of Berlin

> "The history of plants involves the influence of climate on vegetation, the changes of climate, endured by plants and how they have been preserved by Nature, migration of plants, and finally their distribution over the globe" (transl. H. S.).

Probably for the first time – at least in a prominent place – we find "history" used in a modern sense in a work of natural history. The term history (Geschichte) had until then not had a temporal perspective, but referred to the "reporting of facts" – in contrast to "philosophy" which sought "reasons for facts" (TREPL, 1987). In this tradition, Ludolf Adelbert VON CHAMISSO describes in 1827 the effect of human culture after his circum navigation on the sailing ship Rurik, from 1815 to 1818:

> " Wherever humans settle, the face of nature is changed. His domesticated animals and plants follow him; the woods become sparse; and animals shy away; his plants and seeds spread themselves around his habitation; rats, mice and insects move in under his roof; many kinds of swallow, fish, lark and partridge seek his care and enjoy, as guests, the fruits of his labor. In his gardens and fields a number of plants grow as weeds among the crops he has planted. They mix freely with the crops and share their fate. And where he no longer claims the entire area his tenants estrange themselves from him and even the wild, where he has not set foot, change their form" (transl. H. S.)

This quotation is taken from an instructional work *Botany for the non-botanists* which CHAMISSO (1827) wrote for the Ministry of Culture. Its title is in the tradition of natural history: *A survey of the most useful and harmful plants, whether wild or cultivated, which grow in North Germany. Including botanic and plant kingdom plates* (transl. H.S.).

WILLDENOW had developed the ideas of plant geography together with Alexander VON HUMBOLDT (1769-1859), who had been a close friend since 1788 (JAHN 1966; MEYER-ABICH, 1967). HUMBOLDT's fundamental work on plant geography appeared in Paris under the title *Essai sur la Géographie des Plantes*, then in 1807 in Tübingen as *Ideen zu einer Geographie der Pflanzen* (HUMBOLDT, 1807). In his *Ideen zu einer Physiognomik der Gewächse* (HUMBOLDT, 1806) he introduced the concept of "association" for plant communities and recognized the significance of life forms for the description of the world's vegetation.

In the continuation of the plant geography work of WILLDENOW and A. VON HUMBOLDT, Berlin provided great impetus for the study of native flora. Although the natural distribution of plants species provides no particular justification for treating Berlin as an independant area, it does play a special role in research.

Paul Friedrich August ASCHERSON published his *Studiorum phytographicorum de Marchia Brandenburgiensi specimen* in 1853, and layed down the fundamentals of floristics in Brandenburg in numerous studies. He followed his *Flora of the*

Brandenburg Province with a *Special Flora of Berlin* (1864), which, with its comprehensiveness and accuracy, represents the pinnacle of floristics in the Brandenburg. One of the earliest vegetation scientists was Georg August SCHWEINFURTH who published in 1861-1862 an *Attempt to outline the vegetation around Strausberg and Blumenthal near Berlin.*

The decades following the HUMBOLDT era up to the present are characterized by an ever-increasing specialization of knowledge.

Research after 1945 concentrated more on the rapid changes of flora and vegetation. The special situation of Berlin, has led to a particular emphasis on urban ecology (SUKOPP 1987, 1990).

History of Berlin flora and vegetation

Towns and cities are normally thought of as "opposites" of nature. On this basis, it may be surprising that the species richness of many plant taxa in cities is greater than in the surroundings. Larger cities have higher numbers of species than smaller ones. In Central Europe, the number of plants species growing in towns and cities, is correlated to the number of inhabitants (see Table 1).

Table 1: Approximate numbers of plant species (ferns and flowering plants) in Central European towns (data from SUKOPP & TREPL, 1993)

Town size	number of species
Small and medium tows	530-560
Cities with 100.000-200.000 inhabitants	650-730
Cities with 250.000-400.000 inhabitants	900-1000
Cities with more than 1 million inhabitants	> 1300

For Berlin, the change of vegetation, species composition and site conditions from the ice-age to the present has been thoroughly investigated (*e.g.* SUKOPP ed., 1993). The number of fern and flowering plant species for Berlin (889 sq km, today's area) was 822 in 1787 (WILLDENOW, 1787), 1130 in 1864 (ASCHERSON, 1864) and 1936 in 1991 (BENKERT *et al.*, 1996).

The numbers given above refer to spontaneously occurring species only. In addition, there is a large number of cultivated plants in parks, gardens and churchyards, in small patches of ornamental green, as street trees or even on balconies or in flower pots. Their number – in species as well as in individuals – far exceeds that of the spontaneous plants.

Urban green enhanced by city dwellers had either the function of symbolizing the superiority of humans over nature – as in baroque gardens – or to represent the dream of a natural rural life – as in landscape gardens. In both cases, "green" stands for the contrast between nature and city.

Spontaneaous urban vegetation on the other hand – as a type of nature adapted to the specific urban conditions and capable of developing under them – symbolizes the city. This is an opportunity for greening design that does not accentuate the contrast between nature and city, as used to be the case.

Although cultivated plants serve important functions in cities, e.g. with respect to climate and air hygiene or as living space for animals, the focus of the following is on spontaneously growing plants.

One unexpected result of early studies on plants in cities brought out the fact that they do not co-grow accidentally, but form distinct patterns of co-occurence and plant communities in the same way as plants do in more natural environments. Typical urban vegetation of Berlin is representated by the Prickly Lettuce-association (*Conyzo-Lactucetum serriolae*) and the Viper's Bugloss-Melilot-association (*Echio-Melilotetum*).

Berlin has been divided into concentric zones on the basis of ecological characterization (Fig. 1): closed urbanization, open urbanisation, gardens and railway, forest. These zones are, of course, not strictly concentric but their distribution and share of the total area, varies depending on peculiarities in the history of individual cities.

The floristic composition of these zones reflects the abiotic factors influencing plant growth. The sealing of surfaces with asphalt, concrete or buildings, for example, varies clinally from 85-100 % in zone 1 to 0-15 % in zone 4. Also, the heat island effect (increased temperature, see above) is more pronounced in zones 1 and 2 than in 3 and 4. Some characteristics of the different city zones are given in Table 2 (Kunick, 1974).

Table 2: Characteristics of floristic city zones in Berlin (Kunick, 1982)

Zone	1	2	3	4
Total vegetation cover (in %)	32	55	75	95
Vascular plant species/km^2	380	424	415	357
Rare species/sq km	17	23	35	58
Non-native plant species (in %)	49.8	46.9	43.4	28.5
Archeophytes [1] (in %)	15.2	14.1	14.5	10.2
Neophytes [2] (in %)	23.7	23.0	21.5	15.6

Characteristic plant species of the center of Berlin are e.g. *Amaranthus albus* L., *A. blitoides* S. Watson, *Chenopodium botrys* L., *C. strictum* Roth, *Commelina communis* L., *Parietaria pensylvanica* Muhl. Ex Willd.

One of the characteristic pioneer colonizers is the summer annual

1 - Species immigrated before 1500 AD (Schroeder, 1969).
2 - Species immigrated after 1500 AD.

Chenopodium botrys (SUKOPP, 1971) (Fig. 2). This southern Eurasian-Mediterranean plant has expanded its range due to human influence into broad areas of central and western Europe, North America and Australia. Introduced in 1889, it is now a characteristic and specific ruderal plant for the heat island of inner Berlin. Natural habitats of the plant are sandy and stony soils near river banks, rubble footpaths and at the foot of rocks, i.e. special habitats with little competition. Accordingly, roadsides, cultivated areas and fallow fields are colonized as secondary habitats. Under natural conditions the area covered by such open, low-competition habitats in Central Europe is quite small. The open calcium-rich sandy to gravelly habitats which have been created by man have allowed the appearance of *Chenopodium botrys*. Nonetheless, large and lasting populations of this species are found north of the Alps only in Berlin, Manheim, the Ruhr area and Lille. The colonies in Stuttgart, Saarbrücken and Leipzig are unstable or have disappeared.

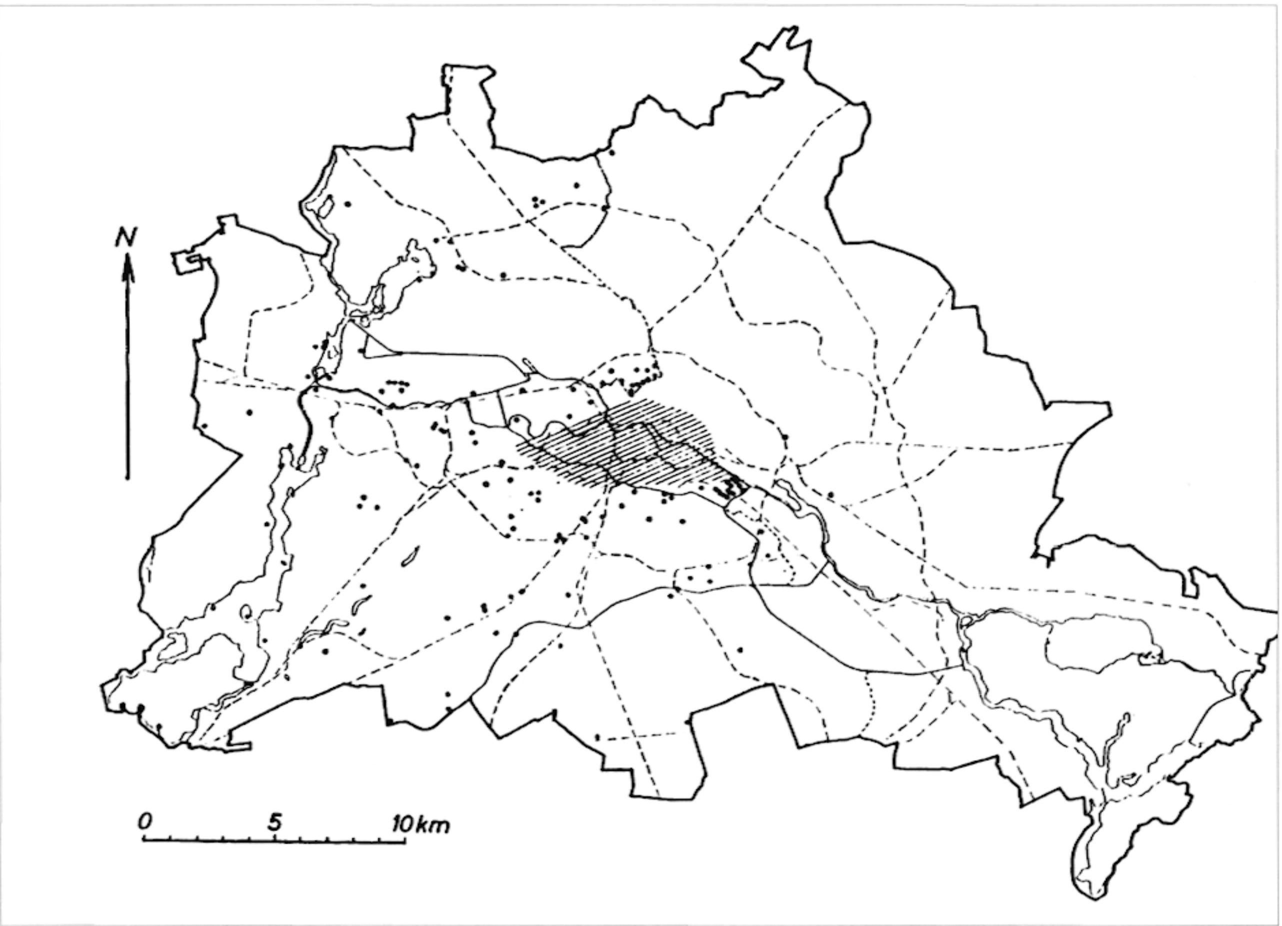

Fig. 2 - Distribution of *Chenopodium botrys* L. in Berlin -1947 to 1971.
Area of frequent occurence hatched; black points are single distribution places; dotted lines are railways.

After the War an intensive and spontaneous development of vegetation began on the rubble, proceeding in more or less rapid succession from short-lived and perennial stages of herbaceous vegetation to shrub and forest-like stands. The variety of species on such inner-city wasteland is surprisingly large. Thus a site at Berlin's Lützowplatz in Berlin-Tiergarten accomodates one hundred and forty seed plants and at least two hundred types of insect.

The carefully maintained lawns and bushes of the nearby Tiergarten Park have at the most a quarter as many insect species on the same area. This natural succession was generally disrupted by clearing then reconstruction work. The areas cleared of rubble or destined for redevelopment, which have often been recolonized by woody plants, are gradually disappearing in the course of ongoing construction.

Among the woody plants on inner city vacant land in Berlin, *Robinia pseudo-acacia* L. stands cover the greatest area. On rubble-mortar substrate, a calcium-containing loose syrosem develops into a refuse pararendzina under *Robinia* in the course of vegetation and soil development.

Among the numerous neophytic woody plants, not only the variety of species but, in particular, their lush development is surprising. Besides *Robinia pseudo-acacia* L., the tree of heaven [*Ailanthus altissima* (Miller) Swingle] is spreading on innercity vacant land (KOWARIK & BÖCKER, 1984). This vigorous drought-tolerant tree settles on extreme habitats such as railway and land adjacent to buildings, but is also frequently found in green open spaces (Fig. 3). In derelicts areas *Ailanthus* is able to establish large polycormons through suckering.

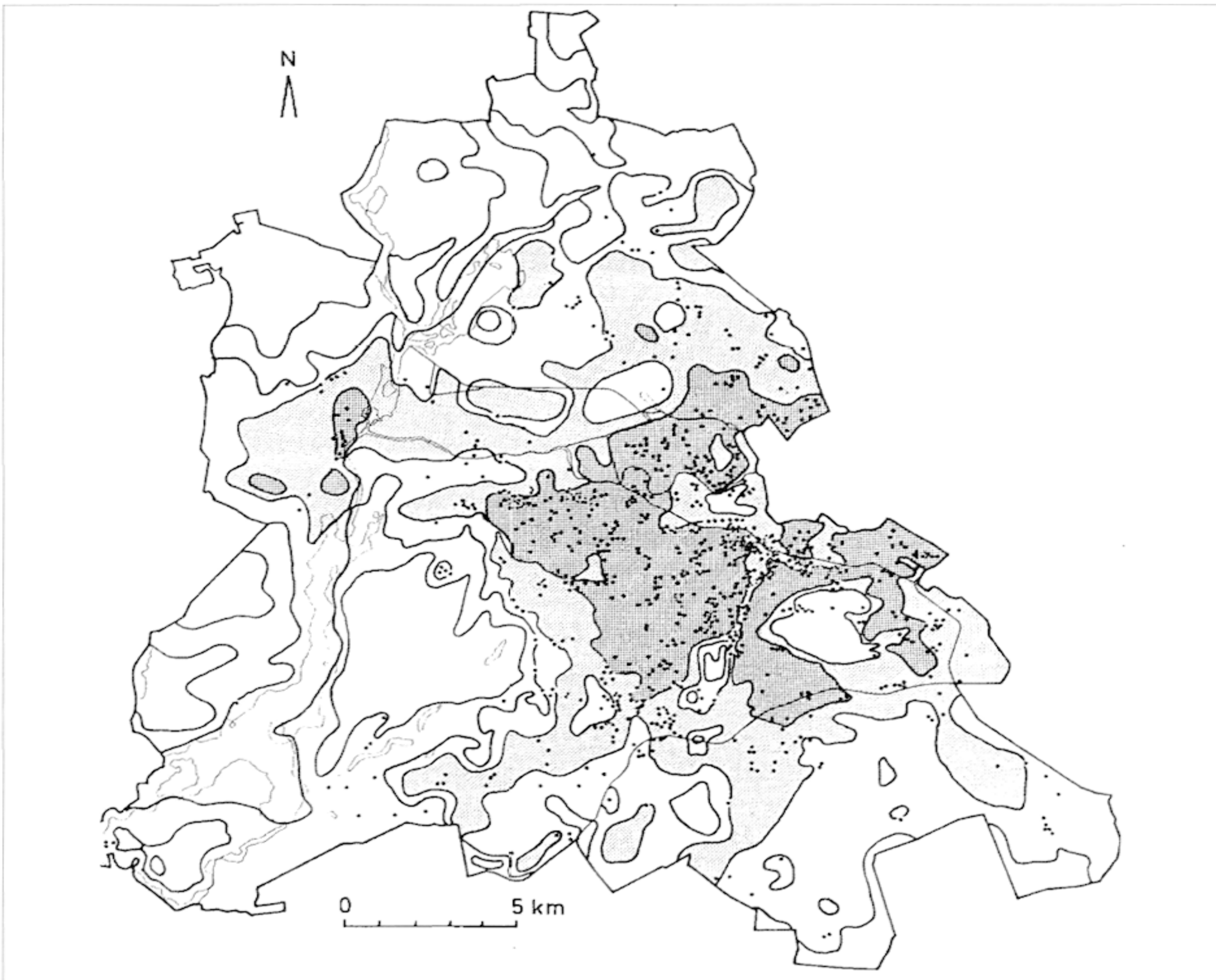

Fig. 3 - Distribution of Tree of Heaven, *Ailanthus altissima* (Mill.) Swingle, in Berlin West. Square pattern: warmer areas. From KOWARICK & BÖCKER, 1984.

A particularity of urban flora is the fact that it is richer in non native species than the surroundings of cities. The proportion of non natives in the floras of regions of the world is between 5 % and 25 %, on islands it is often higher (JÄGER, 1988). In Berlin, the proportion of non native species varies from 28.5 % in the outer fringe – zone 4 – to close to 50 % in the inner city – zone 1– (KUNICK, 1974, 1982) with an average of 41 % for the whole city (KOWARIK, 1990). These numbers are in sharp contrast with a mere 20-25 % of non natives in surrounding districts. Of these species it is especially the neophytes that are more frequent than in the environs, whereas the proportion of archeophytes is not significantly higher than in rural areas. Native and naturalized alien woody species in Berlin are given in Table 3.

Table 3: Native and naturalized alien woody species in Berlin (KOWARIK, 1992)

	Natives	Introduced aliens	Established aliens
Trees	30	68	25
Shrubs	57	109	29
Woody climbers	2	5	2
Sum	89	182	56

Altogether one hundred and forty-five species form the woody flora of Berlin. The most frequent spontaneous tree species, ranked according to their frequency on natural and man-made sites in Berlin (KOWARIK, 1992) are:

Natives	Aliens
Acer platanoides L.	
Betula pendula Roth.	
Quercus robur L.	
Acer pseudoplatanus L.	
	Robinia pseudo-acacia L.
	Acer negundo L.
Sorbus aucuparia L.	
	Prunus serotina Ehrh.
Pinus silvestris L.	
	Æsculus hippocastanum L.
Cratægus monogyna Jacq.	
Salix caprea L.	
	Quercus rubra L.
Ulmus glabra Hudson	
Acer campestre L.	
Tilia cordata Miller	
	Ailanthus altissima (Miller) Swingle
Populus tremula L.	
Fraxinus excelsior L.	
Carpinus Betulus L.	

The high proportion of aliens in cities is partly due to the fact that cities are centers of spread because new species arrive there. On the other hand, anthropogenic changes to growing conditions facilitate their spread : many non natives originate from warmer regions and depend on the higher temperatures in cities *e.g. Chenopodium botrys* L. or *Ailanthus altissima* (Miller) Swingle.

Due to the high level of human influence on urban ecosystems many native species are in danger of becoming extinct there, or are already extinct.

Red Data Lists of endangered flora and fauna. are particularly valuable tools for urban nature conservation The first Red Lists for Berlin (then Berlin West) appeared in 1982 (SUKOPP & ELVERS, 1982). A revised list was published in 1991 (AUHAGEN *et al.*, 1991). It contains information on the status of five taxonomic groups of plants (vascular plants, mosses, lichens, rust fungi and algae) and seventeen groups of animals (mammals, breeding birds, amphibia and reptiles, fish, spiders, molluscs and various insect groups). The lists contain all species of the mentioned taxonomic groups that were found in Berlin and information concerning the level of threat to them split into five classes:

0- ALREADY EXTINCT
1- THREATENED WITH EXTINCTION
2- HIGHLY ENDANGERED
3- ENDANGERED
4- POTENTIALLY ENDANGERED

The proportion of threatened species in various groups of organisms is often considerably higher in cities than in areas outside the cities. Table 4 gives data for Berlin and for all of Germany (West). From AUHAGEN *et al.*, 1991, p. 7.

Table 4: Examples for threatened species in Berlin and Germany

Taxonomic group	Berlin West		Germany	
	Number	%	Number	%
Ferns and flowering plants (indigenous and archeophytes)	993	49.2	2728	32.0
Mosses and liverworts	405	75.8	ca. 1000	13.9
Mammals	53	54.7	93	53.8
Amphibia	14	78.6	19	57.9
Butterflies and moths	1014	58.5	1300	41.1

Urban nature conservation

Biological species have developed in the course of evolution over millions of years. Each species contains a unique set of genes. Once a species becomes extinct it can never be brought back. This thought along with ethical reasons should be sufficient reason to preserve all species in the world. On a smaller scale, the argument is less valid: because most species are not restricted to a single country or even a city, their vanishing from one of them would not mean their extinction (although taxonomic entities on a lower level such as subspecies or ecotypes may be very locally distributed and consequently more threatened).

In politics and public planning, the aim of conserving nature is often countered by economic arguments. Therefore the protection of nature requires convincing grounds. These can be divided into cases valid on world, country and city scales. The direct value of plant and animal life for man on different levels is shown in Table 5. From the above it is clear that the aim of urban nature conservation is not so much the prevention of extinction of species but rather the preservation of diversity. A main group of reasons focusses on the need which people have for contact with nature. The recognition of this need is also a basic feature of urban nature conservation strategies which were developed in Britain.

Table 5: Reasons for the conservation of wild plants and animals (AUHAGEN & SUKOPP, 1983) in different units of area. + indicates that an argument is valid and important on the respective regional level, (+) indicates that it is less important on that level.

	World	Country	City
Conservation of functions of biological systems			
Production of food	+	+	
Stability of ecosystems	+	+	+
Biological pest control	+	+	(+)
Pollination of cultivated plants	+	+	
Biological filter and decontaminator	+	+	+
Humus production in soil for agriculture and forestry	+	+	(+)
Bioindicator potential	+	+	+
Preservation of biochemical information			
Conservation of evolutionary adaptive potential	+	+	+
Breeding for new varieties or races and for resistance	+	+	+
Pharmacology	+		
Protection of research objects and sites			
Discovery of new food species	+	+	
Bionics	+		
Biotechnical energy production	+		
Bioengineering research	+		
Fundamental research in biology and ecology	+	+	+
Recreation and preservation of local, natural and cultural heritage			
Phenological diversity	(+)	+	+
Diversity in spatial composition, landscape scenery	(+)	+	+
Diversity for the sense	(+)	+	+
Diversity of colour, form and pattern of movement	(+)	+	+

Nature Conservation practice (Berlin examples)

Many European states develop programs for nature and nature conservancy in towns and cities. The chief aspects are contained in the Global Biodiversity Strategy (WRI, IUCN, UNEP, 1992).

The Berlin species protection programme describes measures for the conservation of the flora and fauna for fifty-four types of biotope, thirty-six biotope development areas and eighteen groups of organisms. The cartographic part comprises the following maps and plans : Value of the biotopes, care and development measures for types of biotope, protected areas, priority areas for nature conservation, biotope development areas (ARBEITSGRUPPE ARTENSCHUTZPROGRAMM 1984). In the description of the various types of biotope a short history is followed by details of the number, size and distribution of the individual biotopes and site conditions. The stocks of animal and plant species are described. After naming threats and their origin, the important structural and sub-structural elements for species stocks are listed. They are followed by recommendations for their protection, care and development. The current type of use will not be questioned, with a very few exceptions. The aim is rather to integrate nature conservation into existing land use as much as possible. The functions of a given type in terms of nature conservation are listed under the heading "specific values of types of biotope". Finally particularly valuable types of biotope are listed, together with a summary of the features which warrant this classification. Recommendations may be made for some biotopes to be classified as protected areas.

In built-up areas recommendations for biotopes might include: No cutting of hedges ; no hoeing of leaves and ruderal plants ; no removal of dead leaves, twigs or dead wood from wooded areas ; transformation of close-mown lawns into grassland ; development and encouragements of spontaneous vegetation; planting of appropriate woods typical for the area ; reduction of tree surgery; on-site composting ; measures to encourage typical local fauna e.g. creating flight access to undisturbed, unheated cellars and attics ; climbing plants for facades or grassing over roofs.

The traditionally developed system of parks and green areas can be expanded by a system of existing, ecologically functioning areas, which have not yet been "planned": areas resulting from war damage or demolition which are spontaneaously settled by animals and plants.

In the school system, school gardens (WINKEL, 1979), which provided plants for school lessons have developed into environmental centres over recent years. Their function in environmental education is described by WINKEL (1986) as:

- Developing an emotional link to nature through personal experience;
- Learning details and interconnections ;
- Evaluating such interconnections from an individual, social, ecologi cal or economics point of view; and
- Acting (or not acting) in the environment according to this evaluation.

With the unification of Berlin in 1989, natural landscapes came together again, which – despite wall and barbed wire – were never completely divided from each other and from their hinterland. But land use and laws had been different for more than forty years. With the decision for Berlin to resume as the capital of Germany, a second "Gründerzeit", a time of rapid expansion, started. To guide the expected urban development in a sustainable way for the nature and the environment, the planning system for nature conservation and landscape management in Berlin was completed for both parts of Berlin in 1994.

CONCLUSION

With the existing inadequate adaptation of society to its environment, many problems can only be solved if due consideration is paid to the ecological views and the social needs. Ecological criteria should serve primarly to make plain the consequences of actions for the environment, the society, and for the individual.

Nature must develop in close relationship with local inhabitants and their customs.

Organisms and biological communities should be conserved to allow people direct contact with the natural elements of their environment. Only such open spaces can lead to the experience of natural beauty which permits coexistence between a nature existing in its own rights and people who are free to determine their own actions in this space.

Urban development needs reliable knowledge of the environment and the conditions of its protection. Two models of the relationship of science and policy exist. In a normative model, the role of science is "speaking truth to power". Policies shape aims, strategies and tools. But in reality there is often an uncertainty of problems and an uncertainty of knowledge.

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DISCUSSION

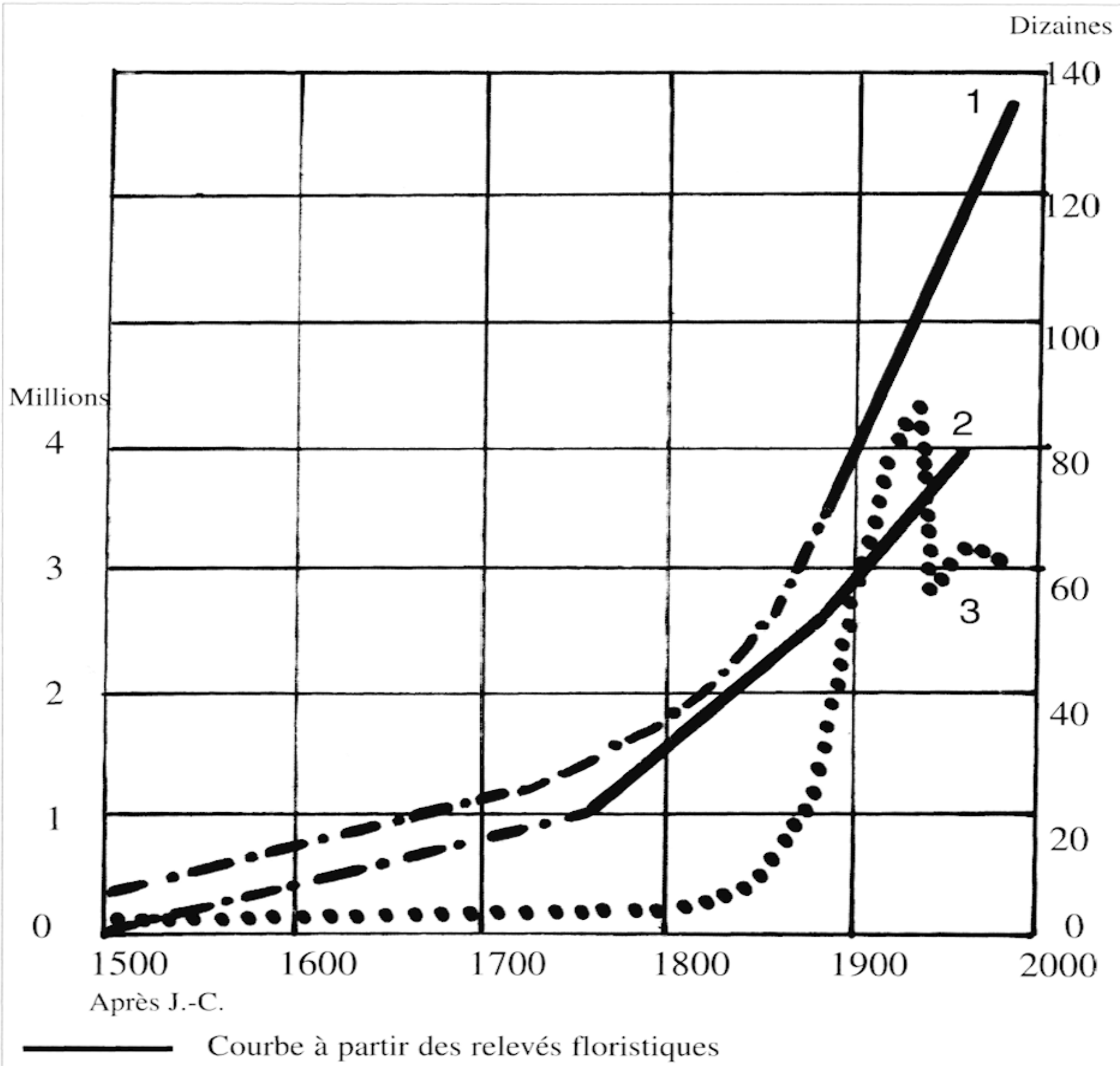
Valentin PELOSSE *

Pour contextualiser le bel exposé du Dr Sukopp sur Berlin, à l'intention de ceux qui n'ont jamais eu l'occasion de s'y rendre, j'esquisserai une rapide comparaison, et d'abord avec Paris. Pour des raisons historiques, Berlin est une ville infiniment plus verte que Paris ; c'est une ville récente, en partie reconstruite après 1945. Deuxièmement Berlin n'a pas de périphérique[3], c'est-à-dire il n'y a pas cette coupure drastique qui existe dans l'agglomération parisienne, entre le centre et la banlieue. Je vous rappelle que le périphérique s'étale sur les anciens terrains militaires déclassés, des fortifications qui entouraient Paris. Ce sont des terrains militaires qui ont été déclassés à partir de 1920, qui étaient théoriquement prévus pour faire une ceinture verte et qui sont devenus cette large double voie rapide, au flux quasi ininterrompu. Prenez la Porte d'Orléans, vous voyez ce qui s'étend entre le boulevard Jourdan et Gentilly. Par contre, entre 1960 et 1989, il a y eu effectivement à Berlin une fortification qui s'étendait sur plusieurs centaines de mètres, qui était un *no man's land* complètement gelé où une faune sauvage a pu se développer, à ce moment là. C'est sans doute vrai aussi d'un point de vue botanique, mais je suis beaucoup moins compétent dans ce domaine et ceci me servira de transition pour poser une question au Dr Sukopp : que s'est il passé depuis la réunification du point de vue d'un botaniste ? Je suis sociologue, plutôt spécialisé sur les rapports entre les hommes et les animaux, et je formulerai une question pour faire le lien d'une discipline à l'autre.

* - Discutant
3 - Une voie rapide circulaire d'une trentaine de kilomètres autour de Paris.

Herbert SUKOPP

Il reste très peu de l'ancien mur, peut-être quatre petits sites. Deux espèces végétales résultent de la guerre, un Chénopode de Russie, non encore décrit, un *Salsola*[4] et aussi deux graminées typiques des Etats Unis d'Amérique[5], venues avec la guerre. Pendant la guerre on faisait peu de botanique... Des mauvaises herbes pour la plupart américaines, apportées au Kazakhstan, puis en Allemagne, à Berlin-Est particulièrement, *Iva xanthifolia*[6] certaines particulièrement rapidement répandues comme *Kochia scoparia*[7], distribuée par les chemin de fer est-allemands, n'usant pas de sel contre la glace mais un liquide. C'est à ce moment que ces plantes continentales sont parties pour l'Ouest.



Développement de la population de Berlin et accroissement des espèces adventices. Courbe 1 : ligneuses adventices (agriophytes, époécophytes, éphémérophytes) d'après KOWARIK (1985) ; courbe 2 : herbacées rudérales naturalisées néophytiques (époécophytes) d'après SCHOLZ (1960) ; courbe 3 : population du Grand Berlin en millions d'habitants.

X

L'un de vos graphiques montrait une corrélation entre l'accroissement du nombre d'espèces et de la population. J'ai cru comprendre que – dans la partie haute de cette courbe – , quand la population diminue, le nombre d'espèces continue à croître. J'aimerais avoir votre point de vue sur cette interprétation que je risque, de la dernière phase d'évolution figurant sur cette courbe.

Herbert SUKOPP

Actuellement Berlin est dans une phase de suburbanisation et pour le moment nous ne savons pas si le nombre d'habitant décroît ou si la place utilisée augmente, et donc je ne sais pas le résultat. Dans un siècle nous saurons ...

C'était en 1945, avec une diminution très forte de la population et une augmentation des espaces libres au centre de la ville, ainsi beaucoup de plantes qui étaient là depuis plus de cent ans se sont développées. Par exemple *Chenopodium botrys* qui était très rare pendant les quatre-vingt premières années, est devenue très fréquente. Mais la population est décomptée chaque année, et il n'en est pas de même pour les plantes.

G. AYMONIN **

On pourrait examiner la situation dans d'autres grandes villes comme Bruxelles (900 000 habitants) par exemple où une étude de l'évolution des flores a été récemment faite. Et si on avait analysé le nombre d'espèces à Paris *intra muros*, quand il y avait environ 3000000 d'habitants, pour le comparer avec maintenant (2200000 habitants, zone péri-urbaine incluse), on arriverait à un schéma comparable à celui du Dr SUKOPP.

John CELECIA

Je voudrais souligner l'intérêt de l'exposé du Dr. SUKOPP en ce qui concerne les sols urbains. Même dans des pays qui se sont spécialisés dans la science du sol, comme en Hollande, il y a des vides cartographiques simplement parce que on n'a pas pensé aux sites urbains et péri-urbains. Au dernier congrès de la Société internationale de la Science du sol, j'ai réussi à faire établir un sous-comité pour les sols urbains. Nous découvrons que les espaces verts ("ouverts" disent les Anglo-saxons) permettent de résoudre des problèmes concernant les sols et l'eau, son épuration, sa décontamination, sa filtration, etc. On va donc plus loin que l'aspect simplement esthétique – l'apport de verdure – pour analyser les relations entre l'économie de la ville et ses sols.

G. AYMONIN

Cette remarque sur le lien entre le sol et la végétation urbaine et le constat de méconnaissance qu'on en a, apporte une excellente conclusion à notre débat.

** - Président de séance.
4 - *Salsola collina* Pall.
5 - *Panicum buachucae* Ashe et *Bromus carinatum* Hook. & Arn.
6 - *Iva xanthifolia* Nutt.
7 - *Kochia scoparia* (L.) Shrader