Baltic University Urban Forum
Urban Management Guidebook V

Green Structures in the Sustainable City

Editor: Dorota Wlodarczyk

Project part-financed by the European Union (European Regional Development Fund) within the BSR INTERREG III B Neighbourhood Programme.

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Series preface

The Baltic University Urban Forum, BUUF, project was designed to develop sustainability strategies for the local level. The project, conducted in a network of 20 cities and 15 universities in nine countries in the Baltic Sea region during 2003-2006, was coordinated by the Baltic University Programme Secretariat at Uppsala University in Uppsala Sweden, in cooperation with the Royal Institute of Technology, KTH, Stockholm, Sweden and the Union of Baltic Cities, UBC, the Environmental Commission in Turku, Finland.

The project was financed by the European Union through Interreg IIIB, the Swedish International Development Organisation SIDA, the Swedish Institute, and other sources, in particular the C-Framåt office in Uppsala County, as well as by the participating cities and universities.

Built on previous experiences ten areas were selected to be in focus in the BUUF project. These were.

1-3. Energy management; Water management; Waste management.
4-6. Traffic and transport; Urban green structures; The built environment and brown field restoration.
7-9. Socio-economic development; Urban-rural cooperation; Information and education;
10. Integration strategies in sustainable communities.

During the period 2003-2005 the project organised best practice conferences in all 20 participating cities addressing all ten topics as well as the integration between the topics, and sustainability strategies used in the participating cities. The discussions and study visits at the conferences inspired a series of guidebooks on the selected topics to be used for city administrations as well as researchers and teachers at universities dealing with sustainable urban development. These are herewith offered to the readers

The guidebooks are thus not proceedings of the conferences, even if several of the participants have contributed. The ten guidebooks were planned later and editors with editorial teams recruited. Authors include both practitioners from cities and researchers from universities. The production has been done during 2006 and 2007.

The main topic of the guidebooks is to report on sustainability strategies used and evaluate these strategies, and possibly suggest new strategies for sustainable development on the local level. The books also contain a number of detailed descriptions of how to work with city development in practice as well as reports more of research character. The format of the guidebooks is about 50 pages in A4 format and some 12 chapters.

The guidebooks are published as pdf documents on Internet to be available in the public domain and thus a generally available resource at the site www.balticuniv.uu.se/buuf. The site contains further resources developed in the BUUF project. These include an indicator book, city reports and benchmarking reports.

I want to express my gratitude to all editors and authors who have contributed to these books, and hope that the results will be used widely both by the cities and universities of the project as well as by many others.

Uppsala in May 2007

Lars Rydén
Project leader
Baltic University Urban Forum

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Urban Sustainability Strategies the urban green structures

The urban green structures is a component of urban space, the surface area a city is built on. The other components of urban space are the built structures and the transport structures of the city. Urban space includes all area for which a city has planning responsibility and monopoly, both in a master plan and detailed plans.

Urban planning is a single integrated concern, as for each part of a city the three alternatives mentioned are all possible – it may become a (green) area, a street (traffic) or give place for a building. Still it is not always that management of urban space is integrated. Departments dealing with parks and green areas are not necessarily well coordinated with city departments dealing with traffic, or with those authorising building permits. This leads to sub optimisation, even conflicts. (1) Integration of urban planning is a main sustainability strategy.

The green area in a city is a limited and expensive resource. It is larger than one normally is aware or. Several studies report about 50 %, then including not only parks but also green edges of streets and traffic corridors, private gardens, and a multitude of bushes, trees small lawns etc. Studies show that the availability and character of green structures are important when people choose where to move when leaving a city for another. To promote and (2) develop attractive green areas is a main sustainability strategy. Such green areas provide opportunities for recreation, social contacts, playgrounds, concerts and other cultural events etc. all contributing to a rich and attractive city life.

It is important that these areas are available on a daily basis. Some studies use the indicator distance from nearest green structure, using 300 meters as the norm, which should not be surpassed. (3) To promote availability of the green structure is an important strategy. This strategy is supported by research showing that individuals feel better and in fact have fewer sick days if they can spend some time in green areas, and are able to see a green area outside the window where they live.

Green structures usually are taken to include areas with surface water, or blue structure. Also these blue water areas are attractive to the inhabitants of a city. To live by a waterfront is very popular as reflected in prices of homes and apartments. Many cities (4) make their waters more visible and accessible, e.g. by bringing into light previously hidden small streams, or removing obstacles to make rivers and waterfronts easier to reach. Many cities in the network have seen their citizens in large numbers spend lunch hours, afternoons, etc socialising along newly arranged riverfronts.

Greenery also has a function in protecting and conserving biodiversity. Today cities are often more biodiverse than rural areas, as they are more varied, provide food easily and offer much shelter. To (5) promote biodiversity by carefully arranged green areas is another important sustainability strategy. This function is also contributing to easily accessible opportunities to learn about nature, no the least for school children, apart from the fact that biodiversity is a sustainability value in itself.

Green areas do also provide ecological services of many other kinds. Thus wetlands and shallow surface water in general function to reduce eutrophication (nitrogen and phosphorus overload), and in general clean the water. A special category of surface water is storm or run off water in a city. To (6) arrange wetlands, and channel storm water in surface canals is also a sustainability strategy, of which several cities in the network have very good experiences. Such artificial wetland areas also promote a rich bird life and, if carefully managed, opportunities for beautiful plantations.

The expectation that green areas and parks "clean the air" seem not to have much scientific ground. Green/blue corridors across the urban landscape may, however provide a ventilation function in some cases. This is particularly true for cities with a river passing through the entire cityscape, which is the case in many Baltic cities. Green corridors may also support biodiversity in the comparatively small scale that a city provides.

In conclusion, the green areas of a city are important for making the city an attractive and rich environment for its inhabitants. This is main concern in urban sustainable development.

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Introduction

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The Best Practice Conference organized within the Baltic University Urban Forum inspired the content of this guidebook. The meeting took place in Kaunas, Lithuania in October 2003 and dealt with issues of green structure in the sustainable city development.

The definition of sustainable development was coined during the European Campaign for Sustainable Cities and Towns in 1994 and it can be paraphrased as: meeting the social, environmental and economic needs of all residents while maintaining the social, environmental and economic systems on which those depend. This definition agrees with the most quoted Brundtland's definition as well as with one proposed in 1991 by Caring for the Earth: "improving the quality of life within the carrying capacity of supporting ecosystems".

More recently in 1998, European Commission stated in the report "Toward Urban Agenda in European Union": "the green city model is an alternative model for the sustainable city, based on ecological design and the development of more or less sufficient communities. In comparison with the compact city, urban and rural areas are more integrated, and greater urban self-sufficiency promotes reduced car use. However, implementation of the green city model is based on the availability of land, which may pose a problem in densely populated countries".

During the last 300 years greenery within towns have been developed mainly for aesthetic, social and hygienic purposes. Inspired by English, German, French town planning the concept of city park was introduced all over the world only in XIXth century, although already in XVIIth century residential squares furnished with centrally located gardens for residents started to be introduced in French and English cities. The most famous Parisian green residential squares: Place de Vosges, Place Vendôme and London's: Bedford, Red Lion, Leicester, Soho Squares and some other serve until today as popular recreational urban places. Figure1. In 1898 E. Howard introduced Garden City concept, in which greenery and advantages of a country life played significant role. He envisioned a new city for thirty thousand inhabitants. In his scheme the Garden City is laid out in a circular plan divided into six wards (neighbourhoods) by six main streets. A circular space at the center contains a park surrounded by public buildings such as the town hall, concert and lecture hall, theatre, library and a hospital. Around this Central Park of 6 hectare is the "Crystal Palace" - a wide glass arcade with shops - divided by radial boulevards. Beyond this is the residential area containing 5500 house lots of 7,5x30m in size, allowing for a density of about 37-42 dwelling units/ hectare. Each house is provided with a garden. Circular avenues give further definition to the plan. One of these, Grand Avenue, contains sites for school and churches in a park-like setting. The outer ring of town is a permanent agricultural greenbelt of 2000 hectares devoted to small farms. Figure 2. In 1926, geographer Sernander was the first, who suggested preservation of green habitat corridors from the city centre to nearby green recreation areas and nature reserves. The approach to greenery in the city changed dramatically from that time.

Urban green structure today can be defined as all land of the urban landscape that is neither covered nor sealed, including parks, playgrounds, sport fields, allotments, private gardens, green space of housing districts, industrial properties as well as along streets and rail roads etc. Ulf G. Sandström refers to the green structure in an urban environment as to all non-hard and non-built areas, including surface water areas and a of 1-2 km zone between town and countryside, that are more or less connected to each other. The structure should be organised with an overruling strategy, i.e. it must be possible to recognized a system in the structure. Accordingly a green infrastructure is a network of patches of natural character including surface water and greenways, penetrating an urban built-up area. The concept should not be limited by administrative considerations; i.e. both public and private lands are including in a green infrastructure (Sandström, 2002). The City Architect Office in Lund, Sweden supports the approach stating that: "green structure include both the landscape and its nature in the city neighbourhood as well as all non-hard ground in the city. This means that the green structure in a local government plan includes not only determined green areas but also non-hard areas in housing areas,

Figure 1. In London historical, well maintained squares: Bedford Square, Red Lion Square, Leicester and Soho Square are popular places used by inhabitants and tourists also today

day nursery gardens, school yards, institutions and sports grounds, cemeteries, verges, green squares, allotments and adjacent sectors of the landscape. Also non-hard ground without any value for recreation, e.g. safety zones for traffic or industrial establishments, belongs to this category." (Stadsarkitektkontoret in Lund, 1996:5). A research Green structures and Urban Planning (2000) by a group COSTC11 (European Cooperation in the field of Scientific and Technical Research) supports the above definition by classifying the green structure as follows:

- Paved city spaces with plants: courtyards & patios, roof gardens & balconies, tree-lined alleys, promenades, city squares and schoolyards
- Parks, gardens and sports grounds: public parks, pocket parks, gardens, public sports grounds, public recreation areas and public playgrounds
- Burial places: crematorium, burial ground and churchyard
- Private open spaces: institution grounds, residential home grounds, health services grounds, private sports grounds, private estate grounds, local authority services grounds and commerce grounds
- Domestic gardens: house gardens, allotments, communal semi-public gardens and communal private garden
- Farmland and horticulture: arable, pasture and orchard
- Transport corridor verges: canal sides, rail sides and roadsides
- Water margins: wetland, riversides and lakesides
- Water: still water, running water
- Woods: woodland, timber/bio-fuel woodland, wild wood and semi-natural woodland.

In this book a reader will find a definition of greenery and differences between formal and actual green areas approach provided by landscape architects and architects. Urban planner shares his spatial planning experiences in communication of green issues.

Green structure in the sustainable city fulfils multiple functions and influences:

- Urban climate: noise moderation, air cleaning, surface water treatment, wind and snow, sun protection
- As an indicator of environmental changes
- Cultivation of energy plants
- Biodiversity: protection of valuable urban species coming from rural biotopes, acts as spreading green corridors
- Social and cultural values: health: recovery and rehabilitation, beauty and comfort, space for

Figure 2. Generous greenery in Letchworth, England - the oldest garden city built in 1903. Photo: Wlodarczyk from Chipmunk G-BCPU.

passive and active recreation, setting for cultural heritage and education
- Urban design: provides digestible city structure connecting different scales and parts of the urban landscape.

Many of these aspects are described in the book showing how important the links are between green areas in the city. First of all undisturbed green connection including water is significant for transfer of plant material, which supports wildlife. It can be maintained in form of green corridors, which can consist of all forms, mentioned in classification of green structures. Green roofs might appear efficient for nesting, open water bodies for fish, home gardens and allotments for animals and plants. Secondly the undisturbed green connection equipped with pedestrian, bicycle routes is valuable for health of city dwellers, because of their restorative qualities. Besides that it can help to create a preferred, more psychologically acceptable urban environment at a whole city scale. Importance of greenery along streets, in squares and all other urban interiors should be obvious not only because of aesthetical reasons. Creation of well-connected urban green structure adds valuable new qualities to an urban environment.

Maki addresses linkage as the most important characteristic of the urban exterior space, stating that: "Linkage is simply the glue of the city. It is the act by which we unite all the layers of activity and resulting physical form in the city…urban design is concerned with the question of making comprehensible links between discrete things. As a corollary, it is concerned with making an extremely large entity comprehensible by articulating its parts"(Fumihiko, 1964).

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Urban Green Structure
A hidden resource

2

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Greenery, understood both as single green elements (such as trees, bushes etc) and green environments (larger green areas such as woods, sport fields and shrubberies), constitutes a large amount of the urban landscape. It is very important to people as it represents many different values and meanings and it is also used in various ways. While greenery is highly valued and appreciated of urban dwellers, it is also seen and handled as a reserve for other land uses. As greenery is spread all over the urban landscape and in various scales, it is also potentially important as a key to understand and handle urban development. This somewhat paradoxical situation gives the greenery a very special position within the urban landscapes as well as within urban planning. It is possible to talk about green structure as a hidden resource.

In order to express these green resources, the concept green structure is often used in discussions related to urban development. The concept was introduced in the Swedish planning discussion in the beginning of the 1990s (SOU 1994). It emerged parallel to or maybe as a result of the increasing attention given to ecological aspects of urban development. Further, the concept is in many aspects related to landscape ecology theories (Forman & Godron 1986). Here, green structure is defined as water and all areas within a city that are neither sealed nor paved, no matter the ownership.

Traditionally, we use the word "city" to describe urban concentrations. According to contemporary urban challenges, this word tends to be too delimited in relation to the meeting between global and local, which is a prerequisite to sustainable urban development (Falkheden 1999). The word city does not catch the vast and dissolved spatial structures, which characterise contemporary urban landscapes.

This disintegration is both physical and functional and has resulted in multi-cored urban structures with several centres existing side by side. These are separated by a new type of in between landscape, often to a high degree consisting of green structure. Land-demanding traffic constructions have together with a high degree of function separation strongly contributed to a spatial expansion of the urban landscape. The former both physically and functionally relatively well-connected city has, through bigger scales and new functional connections between the city and the surrounding countryside, transformed to a vast urban region. Thus, the relation between city and countryside has radically changed. A new urban landscape has developed as a consequence of the functional distribution of the urban region(Falkheden & Malbert 2000, Lundgren Alm 2001).

In order to understand and be able to handle this urban landscape it is useful to see the city, or the urban landscape, as a complex environment – a network of urban structures. Such structures can be functional, such as building structure, traffic structure, green structure and technical support systems. However, the urban landscape also contains physical and organisational structures. These categories of urban structures create meaning, that sometimes coincide with the functional structures described above, but that also very often exceed and redefine the boarders of the functional structures (Malbert 1998, Kain 2003).

Many of the urban structures exist during a long time and can thus be seen as "sustainable", meaning long-lasting and slow in relation to changes. This can be seen both as advantages and disadvantages in a sustainable development perspective. According to this situation, urban structures can be seen as creative forces for prerequisites, which offer better or worse conditions for a sustainable urban development.

The urban green structure is multifunctional. Thus, it serves multiple uses in the urban environment. A lot of research in several countries have been and still is directed at the examination and development of different green functions and values (Horgby & Jarlöv 1991, Kaplan & Kaplan 1992, Ulrich et.al. 1991, Grahn 1991, Lieberg 1992, Kuller & Kuller 1994, Nordström1994, Florgård 1994, Berglund & Jergeby 1992, Thorén & Nyhuus 1994, Berglund 1996, Ottosson 1997, Ståhle 2000, Kylin & Lieberg 2001, Svensson 2002). The functions can be defined in different ways, for example as natural, recreational or landscape values. Another way is to define the multifunctional meaning of green structure according to spatial, ecological, social and cultural dimensions. In relation to a sustainable urban

Figure 1. Urban green structure is especially important for children and elderly people, as these groups often are reduced to stay in the city while other groups easier can go to bigger nature areas outside the cities.

development, green structure is important as functions and meanings for:

- Urban climate, noise moderation, air cleaning and handle of surface water
- As an indicator of environmental changes
- As a part of the circulation of nutritive substances
- Cultivation of energy plants
- Biodiversity; to save valuable urban species, as refuges for species from rural biotopes and as spreading corridors.
- Social and cultural values; for health, recovering and rehabilitation, to give beauty and comfort, to give room for passivity and activity, as a cultural heritage, as an arena for citizenship, for education.
- Gardening and allotments; as history of urban landscapes, as a social function, for life quality and beauty, providing a reserve.
- Urban design; to give the city an understandable structure, to connect different scales and parts of the urban landscape.

Taken together, these functions, perspectives and research results establish with no hesitation that urban green structure plays vital roles, both potential and actual, in relation to urban life and dwellers. In relation to our modern European urbanised culture, the green structure's main role is probably as a vitally important link between nature and man. Seen in this perspective it is astonishing that green structure can be defined as a hidden resource in urban development, meaning that urban planning is neither paying attention to nor making use of its multifunctional potential. The following section will deal with reasons for this situation.

Lack of visualisation

The delimited visualisation of green resources is one reason for green structure being a hidden resource. It is possible to identify the actual green structure as something else than the formal green structure. Here, formal green structure represents merely the green areas that are maintained by the local authorities, while the actual green structure represents all areas that fit the general definition of green structure (see Figure 2). The maps below show substantial quantitative differences between the formal green structure (left map) and the actual green structure (right map) in a part of Göteborg the second largest city in Sweden.

In planning practise these quantitative differences, often as big as 100%, are not being visualised (Lundgren Alm 2001). Case studies clearly show that this situation can be found in almost every Swedish city or municipality. It is very plausible that this lack of visualisation results in different approaches towards urban green planning. For example, green qualities may be hidden, or not made obvious, to

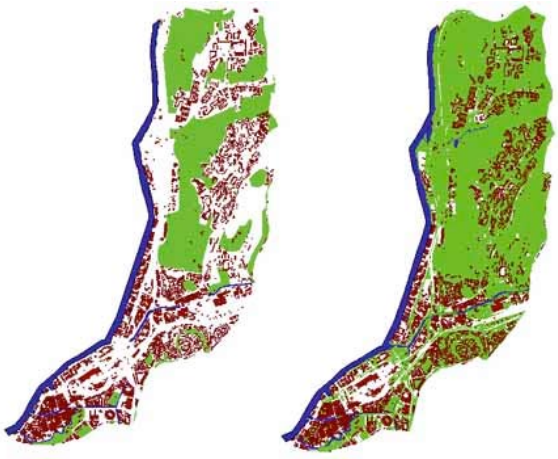

Figure 2. The maps show substantial quantitative differences between the formal green structure (left map) and the actual green structure (right map) in a part of Göteborg.

urban planners, as their physical extension is not completely made explicit. As a result, analyses of the green structure's potentials may be very restricted. This distinction shows that green structure can be seen as a both physically and functionally hidden resource of the urban landscape.

Deficits in planning practise

Planning practise can be seen as another reason for green structure being a hidden resource. When introduced, the green structure concept did create possibilities for actors within urban planning to focus the whole complex system of green areas, which are impossible to arrange according to administrative units. It has also made it possible to physically express ecological aspects of urban development. The fact that the green structure concept corresponds to concepts like infrastructure or building structure implies both risks and potentials. An obvious risk in consequently using the structure level is that the scale variation of the urban landscape is disregarded implying that the detailed level is treated according to concepts and methods developed at the urban landscape level. One can talk about the hidden detailed level of the green structure. Another risk is that the separation tendency grows stronger meaning that different structures can be seen and handled as antithesis of each other. This separation is likely to be strengthened by the fact that the first part of the concept, "green" tends to exclude certain parts of the urban landscape.

On the other hand the use of the green structure concept implies a potential for the integration of green areas and green knowledge into urban design and planning. According to planner's experiences, the green structure concept gives new possibilities to speak with for example traffic planners about greenery (Lundgren Alm 2001). However, it

Figure 3. Example of visualisation of green structure; the fair ground Liseberg in Göteborg at night, photo Dennis Bonnet, 2003.

is uncertain whether the green structure concept is sufficient for the identification of the different scale levels of urban greenery. When acting in the detailed local situation, planners need to have more precise concepts and locally adapted methods to address the role and meanings of specific green elements and qualities within the specific planning situation.

Un-sufficient validation of the multifunctional meaning

Another reason for green structure being hidden is found in the delimited way green values and qualities are being expressed and validated. As everything else used publicly, the economy of the green structure is always questioned. The dominating economic thinking of today, which pretends that everything can be expressed in monetary terms, gives very few opportunities for actors wanting to express more long-lasting effects of changes than during the next quarter's report. When compared to how much money a building project can be expected to generate, the values and qualities generated or maintained by the green structure is much more implicit and multidimensional. For example, how can an urban planner show that by saving green areas close to a school, the possibility for the children to get some exercise on this accessible area more often compared to having to go outside the city, will pay off in healthier and more concentrated pupils? It takes other ways of expressing such long-lasting human values, which calls for new methods to validate changes in society.

One way of bringing change to the problem concerning validation of public green space may be to find new maintenance strategies. Within the North-European research project Communicating Urban Green and Growth (Greenscom) case studies have been performed to focus such issues. The Swedish team performed two case studies in Göteborg. The first case deals with tools for the maintenance of areas on the urban fringe owned by the city. Leasing contracts between the Real Estate Office and farmers have been used in order to maintain the landscape and keep it accessible to the public. The second case shows how a densification project could change planning methods. One of the most interesting results from this project was the fact that by building the new houses (around 35 buildings) the green link of the over all green structure for the city that passes this area could be secured against future exploitation. This was made possible as the green qualities of the new area were used as point of departure for planning actions related to management and maintenance. The inhabitants of the new area, who did not take part in the work of the local groups, are according to the stipulations of the plan obliged to maintain the green open spaces contained in the area and at the same time keep some of them open for visitors passing by.

To conclude, while the green structure has a multifunctional meaning for urban development, it is still in many aspects a hidden resource in relation to urban design and planning. It takes new ways of viewing green values and qualities as well as new planning methods to change this situation. It is no longer meaningful to treat urban green structures as a negation of the city – something that remains when structures for housing, business, transportation and technical support has been developed. Instead, green structure should in a conscious way be used as a tool for sustainable urban development, not an obstacle. Further, as green structure is spread all over the urban landscape and thus important to urban dwellers, it should be used for communication between different actors and at different scale levels in the urban landscape.

The GREENSCOM project, which is a research project within the Fifth Framework Programme of the EU that includes the participation of five research institutions in the Netherlands, Finland, Denmark, Sweden and France, aims to improve and develop policy instruments for governance and communication in view of the integration of green space in urban development. Each participating research institute has performed case studies, which together cover the three themes of densification, developments in the urban fringe and management of green space. The Swedish research team is based at the department of Built Environment and Sustainable Development at Chalmers University of Technology, Göteborg.

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The Green Areas in Kaunas City

3

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My town.
One part reaches for the sky.
Other one touches the grass. Like me.

Introduction

Nowadays, when sustainable cities are developed, the importance of green areas is very important, because of mitigation of urbanization impact, as well as creation of fine and healthy living conditions. Presently developed urban structures could be defined as "urban structures and green structures developed equally."

The urban structures, formed by active spaces – commerce, public, trade areas as well as stable spaces, consisting of residential, educational and social areas are surrounded and separated by natural areas – water bodies, slopes, forests and open areas.

The green areas in cities are understood as part of so called "natural framework," which consists of important natural components: rivers, lakes, valleys, slopes of the hills, open natural areas. "Natural framework" is a term used in Lithuanian legislation, and there are the green areas, which are under special protection. Natural framework is developed as a logical model, where natural areas are defined according their importance and functions. It gives a possibility to evaluate all natural areas, including green areas as a system, serving for residents and sustaining the vitality of natural complexes.

The current situation

The green areas of Kaunas City cover an area of 8329 ha or 53 percent of total area of the city. The Kaunas green areas together with bodies of the Nemunas and the Neris rivers and small rivulets form a clear system natural framework, which was described above. It plays a significant role in Kaunas, as a factor mitigating negative impact of urban environment and increasing the attractiveness of the city. According inquests, the most attractive both for visitors and inhabitants city districts are these full of greenery – the City Centre, Zaliakalnis, Panemune and Aleksotas residential districts. On the other hand, most unpopular are the districts with lack of greenery: Petrasiunai, Palemonas, Vilijampole.

Figure 1. Pazaislis Peninsula Forest Park.

The main functions of Kaunas city green areas are:

1. Ecological compensation. This function may help to neutralize air pollution, to improve the microclimate, to restore the biota components, which make impact on bio-systems;
2. Open air recreation. Picturesque, well reachable, valuable green areas are favored by inhabitants. Recreational areas have several purposes: for tourism, leisure, sports, rest at waterfronts. Such areas, connected by pedestrian and bicycle routes form a network of city recreational areas.
3. Urban composition. Green areas as well as other natural elements help to develop planning composition of cities, increasing expression and identity of the city. The system of green areas consists of compositional centres, sub-centres and compositional axes. It is combined with urban framework and with system of ecological compensation.

There are three types of green areas in Kaunas, according prevailing land use:

1. The agriculture land use green areas. They lie in the outskirts of Kaunas and plays role of urban

reserve, which will be developed in near or distant farther future.

2. The forest land use areas. They are classified as follows:
   2.1. Protective forests;
   2.2. Forest parks;
3.The green areas of miscellaneous purpose. They are classified as follows:
   3.1. Parks of city importance:
      • Public parks
      • Exhibition parks
      • Memorial parks
      • Entertainment parks
      • Historic parks
   3.2. Parks of district importance;
   3.3. . Public gardens of city importance:
      • Representative public gardens
      • Exhibition public gardens
      • Memorial public gardens
   3.4. Public gardens of local importance;
   3.5. Slopes of the valleys of the Nemunas, Neris rivers and small rivulets;
   3.6. Green corridors: a linear greenery of the streets.

The green areas of Kaunas City are developed of:

1. **Natural areas**, inserted into extended city structure: natural forests, later transformed into forest parks, other natural green areas, groves and single plants (e. g. the Azuolynas, Kleboniskis, Panemune parks and forest parks);

2. **Planted green areas**, what are developed as a result of planning and activities. These green areas – parks, gardens have got several functions. Some of them have been planted earlier, so the plants are grown up now, their areas are well developed and maintained. Other group of green areas has been planted presently, so the plants are young and areas are still under formation. There are mostly the outlying areas, located in new residential districts (e. g. the Draugystes, Dainavos, Kalnieciu parks).

The most significant examples of Kaunas green areas

The Jiesia Landscape reserve

The Jiesia Landscape Reserve is situated in the Southern part of Kaunas, at the stream of small Nemunas River left-side affluent Jiesia. The area of the reserve is 382 ha, more than 150 ha belong to Kaunas now. It is one of biggest natural reserves in Kaunas now.

It was established in order to preserve unique landscape of the Jiesia rivulet: rock exposures, chalk clods, erosive slopes, banks and rare plants.

The landscape of Jiesia reserve is very picturesque. It consists of the Lower Jiesia valley and extremely steep slopes overgrown with leaf-bearing trees and shrubs. Mighty oaks testify that there was an oak wood here. A lot of rare plants grow here, among them very rare orchid family plants. The slopes of Jiesia rivulets are very sensitive for erosion, so access to some places is strictly forbidden.

Azuolynas Oak Wood

The Azuolynas Oak Wood is situated on the upper part of Kaunas Centre, bordering Naujamiestis (Central), Zaliakalnis and Upper Sanciai districts.

The Azuolynas Oak Wood is an unique park, the survival of large old wood that surrounded Kaunas in the Middle Ages from Rumsiskes up to Garliava settlements. With the growth of Kaunas in the 17

Table 1. The summary table of the present Kaunas City green areas. Source: The Kaunas City Master Plan, City of Kaunas, 2003

No.	A category of green areas	Area, ha	% of total city area
1.	Agriculture land use	2750	12.96
2.	Forest land use	2870	18.26
3.	Conservation land use, of which:	35	0.22
3.1.	Natural monuments;	0.2	
3.2.	Archaeological areas;	10	0.06
3.3.	Closed cemeteries	25	0.16
4.	The lands of miscellaneous purpose, of which:	2647	16.84
	Parks;	928	5.90
4.1.	Public gardens;	69	0.43
4.2.	The slopes of the valleys;	1020	6.49
4.3.	The green corridors;	142	0.90
4.4.	The recreational areas;	250	1.59
4.5.	Other Areas	238	1.51
	Total Area	8329	53.00

century Kaunas and Rumsiskes woods were separated , later on the most of them were felled. The expanding of Kaunas as a temporary capital of Lithuania in the period between world wars influenced the urbanization of Azuolynas Oak Wood, taking up the parts of its territory. So, only rather small part left of large territory of ancient wood.

The present area of Central part of Azuolynas Oak Wood is 89.9 ha, and the Sanciai part covers the area of 39.6 ha. Azuolynas Oak Wood is declared as a natural monument. The Girstupis streamlet flows through its territory. One of Girstupis valleys is named after the poet Adam Mickiewicz in the memory of the years he had lived and worked in Kaunas. The oldest oaks of Azuolynas are 250 – 300 years old, and their diameter is up to 1.5 meter. The oaks are replanted according project of forest exploitation instead of very old and dying trees. The Azuolynas Oak Wood is very popular among citizens of Kaunas as place for leisure, recreation and sports. Many city feasts and festivals are arranged here, among them famous Song Festival. Azuolynas is excellent place for jogging and biking in the summertime, as well as skying in the wintertime.

Panemunde Forest Park

The Panemune Forest Park is situated in the Southern part of Kaunas, within the curve of the Nemunas stream. Its area is 293.2 ha.

Its age supposed to be about 150 years. Some areas in the Eastern part were felled during World War I. They were replanted in the period from 1923 to 1925.

The area of Panemune Forest Park is grown by pine-trees. Planted fir-trees alleys join main resting places and Nemunas beaches. Panemune is outstanding of its high level of biodiversity.

Panemune forest park is very popular recreational area among Kaunas citizens. It is excellent place for jogging and walking during all seasons of the year, as well as for downhill and cross-country skiing in the wintertime. The sandy beaches of Nemunas serve as excellent place for rest at the waterfront. The air of pine-wood makes a very good impact on lunge-diseased, because of this, some sanatoriums are situated here.

The Botanical garden of Vytautas Magnus University

The Botanical Garden of Vytautas Magnus University is situated on the upper part of the left-side Nemunas valley, close to the city centre, in the Upper Freda district. Its area covers 30 ha.

It was founded in 1923 (under the Kaunas university, from 1930 under the Kaunas Vytautas Magnus University) in the territory of Freda estate park. Its history dates back to 1795, when the estate park was replanned and some kinds of limes and willows,

Figure 2. Azuolynas Forest Park

Figure 3. Vytautas Magnus University Botanical Garden

Figure 4. Jiesia Landscape reserve

yellow acacias, thujas, larches, some plane-trees as well as local varieties of trees were planted.

The area of the Botanical garden consists of these zones: open air exhibition, greenhouse exhibition, resting, both open-air and greenhouse scientific as well as administrative sectors. There are the picturesque ponds excavated, and groups of several trees looks very nice at them. The collection of dahlias is very big and popular among visitors. At the moment 700 species of trees and shrubs can be found here, some the only ones from Lithuania, rare and exotic plants among them.

Draugyste (Friendship) Park

The Draugyste park is situated in the North-eastern part of Kaunas. It is surrounded by multi-storied res-

Table 2. The data of planned Kaunas city green areas system. Source: The Kaunas City Master Plan, City of Kaunas, 2003

No.	Category	Current state	Planned state		
		Area, ha	m2/inhabitant	Area, ha	m2/inhabitant
1.	Forest parks	783	19.5	1083	27
2.	Parks	928	23.5	990	24.8
3.	Public gardens	69	1.7	75	1.9
4.	Green corridors	148	3.7	250	6.2
5.	Slopes of the valleys	1020	25.5	1020	25.5
6.	Total	2948	73.9	3418	85.4

idential areas called Dainava, which were built-up in the Soviet times. The Draugyste park is the main green area of a large district, inhabited by 150,000 people.

It was founded in 1974 and covers the area of 15.9 ha. The terrain of Draugyste park is absolutely plain, and artificial hills of 3 to 4 m high provide an original view to the plain surface. Their slopes are planted with common pines and prickly firs. In the compositions of trees local oaks and limes predominate. Some decorative sculptures are put up in the central part near the main alley. A small pond lies in the southern part of it. In the east of park the nice rock-gardens of various flowers are arranged on the slopes of hills.

The Development of Kaunas Green Areas

The development tasks for Kaunas city green areas are :

1. To improve conditions of living, work and recreation for inhabitants, taking into account optimal bio-climatic, hygienic and aesthetic factors;
2. To increase ecological sustainability, stability and biodiversity of city environment;
3. To increase attractiveness of the city environment;
4. To develop relevant green network, suitable for economic and social activities, what would stimulate the expansion of business, trade, tourism, increase investments flow.

The Kaunas City Master Plan, approved last year, has defined strategic tasks for development of city green network:

1. Creation of city natural framework.
The Kaunas Master Plan provides to join existing natural and planted areas, as well as planned ones into network of green areas. The core areas of new planned structure are valuable suburban and inner forests, parks and groves, as well as planted earlier parks, gardens and street plants. The new planned green areas and linear greenery in the streets are the missing links, that will form a new green structure.

2. Protection and use of the Nemunas and the Neris rivers valleys and slopes.
The Nemunas and the Neris rivers, two largest in Lithuania, flow together in the very center of Kaunas. The unique shape of valley slopes is very characteristic landscape element of Kaunas. They provided to be free of buildings, grown up by valuable sorts of trees, open to public purposes, equipped by stairs and paths. The slopes with adjoining green areas of city center and neighboring districts uphill do serve as an excellent open air recreation areas, at the same time being a source of ecological compensation.

3.Suitable presentation of valuable natural areas.
Kaunas belongs to a category of so called "river cities", but its planning structure is not related sufficiently to its natural values. The city must be open much more to his natural environment – rivers, slopes, hills, green areas. The Master Plan provides the measures, opening city to nature: reconstructing streets and squares, constructing quays, eliminating closed areas, preserving and planting greenery at waterfronts.

4.Green areas as component increasing a quality of residential areas.
The residential areas are planned to be adjoined to active spaces: commercial, public areas, working places, streets from one side, and to green areas, recreational and sports grounds from other one. Thus it is possible to merge all necessary everyday functions: working, living and recreational, developing more homogeneous functional spaces in cities, reducing every day commuting. The closeness to green areas increase the quality and value of residential areas.

The green areas within Kaunas City are planned as continuation of suburban green network. From western direction big Kazlu Ruda Forest inserts into city area at Noreikiskes and Freda, up to Nemunas River in the very centre. The continuations of Dubrava Forest in the south-west part are valuable Panemune, Azuolynas Forest Parks and Vytautas Park up to the city centre. Romainiai and Kleboniskis suburban forests are less dominating in the city structure, only through street greenery and a few city parks. In the Southern part lies very valuable the Jiesia Land-

scape Reserve, mentioned above, as well as Pazaislis Forest Park at Kaunas Lagoon.

These main green corridors form so called "balance spaces", which do mitigate an impact of other functional spaces and factors of urbanization.

The Kaunas Master Plan affirms, that total area of all types of green areas will increase. Especially important is small expansion of green areas in the central part of Kaunas as well as expansion of especially maintained areas: parks and public gardens.

The total present area of equipped green areas (parks and public gardens) is 997 ha (6.34 %), and planned area is 1065 ha (6.78 %), so, that extension is not very big.

The top priority of green areas development is planning of sufficient sources for maintenance. The annual demand of financial sources is 20.88 mio Litas (6 .05 mio Euro), comparing with annual present financing – 0.5 mio Litas (0.14 mio Euro). For that, it is foreseen that quality of Kaunas green areas will increase considerably.

Conclusions

- Kaunas has a great green potential. Total area of the green areas is 2984 ha, or 73.9 m2/inh. This indicator is very high, comparing with other European cities of the similar size.
- The most significant parks and forest parks are unique, outstanding of high landscape quality and high level of biodiversity. There are natural parks, which remained from old woods, surrounding formerly Kaunas. Presently these parks are replanted and maintained well, nevertheless they are overgrown by shrubs. The best examples – Azuolynas Oak Wood, Panemune, Kleboniskis, Lampedziai Forest Parks.
- The new parks, planted during Soviet times are of worse quality, than natural parks. The trees in these parks are not weeded out in time, so the trees are thin and bad looking. The shapes of decorative trees are not formed properly, some old and ill trees are not weeded out. The most successful examples are: Dainavos, Draugystes, Silainiu parks.
- The level of maintenance is insufficient, because of lack of financial sources. The financing presently is 40 times less, than required.
- The green areas are planned to increase from 2948 to 3418 ha. The green areas in the central part of Kaunas will stay with stable borders.
- The quality of green areas will increase considerably, because there is provided to finance the development and maintenance of the green areas up to 20.88 mio Litas (6.05 mio Euro,) or 0.71 Lt/m2 (0.2 E/m2) per year.

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Communication of Green Issues in Urban Planning

4

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Multi-functional green structures and multiple stakeholders

Urban green elements and areas cover, as described above, large parts of the urban landscape. The multi-functionality of the green structure have increasingly been recognised and taken in account in planning for sustainable urban development. Irrespective of the reason being prevention, improvement or exploitation of these resources various kinds of knowledge are essential in order to support clever decision-making and action. The green issues are well illustrated by the different aspects discussed in this report. Furthermore the diverse knowledge of relevance has to be communicated and utilized in urban planning processes involving many stakeholders and competing interests. Such interests might, or might not, be of equal value and importance to the support of sustainable development. Sustainable urban development can only be achieved as a result of co-ordinated decision and action of the different stakeholders and actors involved. Such co-ordinated actions, in turn, require some kind of shared understanding of the local situation and its relations to the global situation as well as the options and limitations at hand. This makes communication, mutual learning, building of commitment, and agreement crucial parts of the planning process. This was the point of departure for the already mentioned EU research project Greenscom (see also www.greenscom.com for further information). We will return to some of the findings in Greenscom and other experience in following sections. But before that, some general problems related to communication between different participants of a planning process will be touched upon with the support of a conceptual model developed and used in our research group.

Different knowledge and worldviews

Planning is the preparation of intended interventions in a local situation, may it be on a more structural or detailed level. A local situation is constituted by the social activities taking place there in turn framed by specific local conditions and influenced by external driving forces (legislation, market, etc.) and other

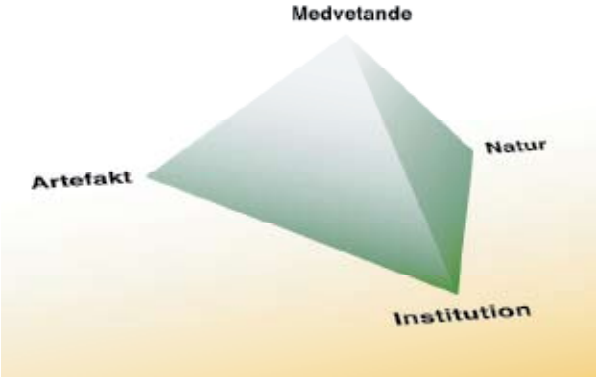

Figure 1: The MAIN tetra conceptual model (Kain 2003)

relations to the surrounding world at local, regional, and global levels. The human-made structures (e.g. buildings, constructions and technical infrastructure), the social institutions (e.g. formal and informal social organisation and power-relations), and the natural systems (e.g. flows and ecosystems dependent of geology and climate) shape the specific local conditions of a place. These inter-related dimensions are labelled Artefact (A), Institution (I), and Nature (N), respectively, in the MAIN tetra model of Figure 1. The bottom triangle of the model (AIN) can be regarded as representing different kinds of knowledge about a place. This is the field of investigation and analysis in a planning process for the better understanding of a local situation and the possible feasibility and impact of different interventions.

In planning practice many expert methods and tools are used for such investigations and analysis. They are more or less rooted in corresponding scientific fields of research. The problem is that they often give only fragmented and sector-related knowledge about the complex local situation. While the result might be valid to the sector experts involved, it is not sure that it will be accepted, or even understood, by other participants of the planning process. For instance, a complete documentation of biotopes and species for an area does not directly tell the planners the implications for future land use. Here some sort of communication is necessary if the knowledge of the biologist shall be of any use to the planning outcome. The challenge of such communication is relat-

ed to the Mind dimension of the MAIN tetra. Mind (M) is here the individual knowledge and worldview of any participant of a planning process. It is based on personal experience, cultural background, and education as well as the individual social and professional position. Additionally, coming from outside as decision-makers and experts normally do, or being inside the actual situation as a local actor or citizen, will influence the knowledge about and perspectives on the situation. Different minds understand the local situation more or less differently. Thus, the view on the options and problems that should be addressed in the planning process may vary between the actors and stakeholders involved. This makes communication and common knowledge development difficult and time-consuming, sometimes also resulting in un-necessary conflicts or deadlocks.

Furthermore, knowledge is differently expressed. Experience-based knowledge is often closely related to actions in everyday practice, may it be in political, administrative or private organisations, interest groups, voluntary associations or at home in one's own neighbourhood. Such knowledge easily gets embedded and hidden in the language, concepts and ways of thinking and acting of those involved in the same practice. If it becomes more or less taken-for-granted and not made explicit, it is impossible to communicate to those who do not share this practice. Scientific knowledge is by definition made explicit. However, the different traditions and practice of various scientific disciplines make nevertheless cross-disciplinary communication and learning difficult. The same goes for the integration of different sector expert and user knowledge in planning processes. Considering only the multi-functional urban green issues discussed in this report it is not difficult to imagine the great challenge to communication and knowledge integration involved in planning for sustainable urban development. This challenge among others concerns the constructive meeting between general expert knowledge and specific local knowledge as well as between central policies and local interests.

Context-related understanding

The findings of the Greenscom project provide good examples of the above described communication problems and different attempts to overcome them in efforts beyond established planning practice. The research was done in cooperation between researchers and city officials from five European countries including studies in seven cities of different size. Beside the cross-disciplinary communication problems within the research team, the context dependent cultural differences between the national teams are worthwhile mentioning. For instance, while growth is a continuously ongoing process of certain urban areas in densely populated parts of Europe like the Netherlands, urban growth is something asked for in smaller cities of more sparsely populated countries like Sweden. Accordingly, the aim of planning efforts may differ on a scale from the prevention to the promotion of urban growth, depending on the current situation in each city region.

Urban green resources are more or less natural. While efforts in balancing growth and green in countries with large forest and lake areas like Sweden and Finland often concern the protection of already existing green resources, the shaping and development of new such resources becomes the target in countries dominated by agriculture like Denmark and the Netherlands. In the latter case the boundary zones between urban and rural land, the urban fringe, is emphasized. In the former case concepts like "green fingers" or green corridors are used to emphasize the important connections to the surrounding natural landscape, often of great recreational and/or ecological value.

Water is a significant and visible feature of the urban and rural landscape of the Netherlands. This blue structure of waterways, rivers, channels and various water regulation systems is, and has always been, a core issue in physical planning and urban development. In Scandinavia the blue structure is more embedded and hidden in the natural landscape. Smaller water streams are often piped and covered in the cities and thus not always visible in everyday lives of the citizens. In physical planning water flows and wetlands are often seen as integrated, although very essential, elements of the green structure. In the city of Aarhus, Denmark, a hole in the street, as a result of the reconstruction of a bridge, made visible the stream of a river underneath. It had for many years been covered by a street and heavy traffic. The visualisation of the water gave birth to and promoted the idea of re-opening of the river at full length. The re-opening of the river, now partly concluded, became a main driving force for a successful revitalisation of the old city core.

Efforts for improved communication of urban green issues

The brief remarks above illustrate some differences of the local and national context, which can explain the different views and understanding of the growth and green issues revealed in Greenscom. The actual access and cultural relations to different green resources will influence the way people think about and use them (Mind). Green resources are recognised as more or less natural (on the line between Artefact and Nature). Furthermore, differences in planning legislation, organisation and traditions (Institution) will explain different focus on the communication situations involved in the case studies.

For instance in France, planning involves decision-makers and experts at several levels of public administration from state to municipal level. Here the communication between the levels of administration and the experts from different sectors was the core challenge for the management and maintenance of valuable green resources at the urban fringe and the central part of Cergy-Pontoise, a new town project north of Paris. Cergy-Pontoise contain a number of independent towns and municipalities, each led by a directly elected mayor. The mayor is supposed to represent the will of the citizens and direct participation of the inhabitants is normally not considered in the planning process.

This is in contrast to the Scandinavian situation, where the municipality level is responsible for all physical planning. The state has only advisory and controlling functions within specific areas concerning national interests, environment, health and security, and inter-municipal issues. The majority group of the municipal council, as a result of public elections, selects the leading politicians (chairs of central and sector boards). Swedish municipalities cover normally rather large territories. The contact between central decision-makers and local communities is often weak, especially in bigger cities. Public participation is supported in the planning legislation following compulsory procedures of review and exhibition. However, voluntary citizen participation is often difficult to achieve, at least in early stages of the planning process and at the over-all level. Thus, innovative efforts that can support active participation beyond formal requirements were the core challenge in the Swedish cases.

To the communication between different experts in the planning system maps, models, statistics, and written statements are often used. Such tools belong to the everyday practice of these experts and support their communication. Geographical Information Systems (GIS) is increasingly used in physical planning. It provides great potential for analysis, simulation and visualisation based on large number data from various sources. So far this potential is not much utilised. The experience from Greenscom, also supported by surveys from Sweden, shows that most cities are still in an early stage of building GIS capacity. Lots of digital maps are produced but more advanced cross-analysis is still rare in planning practice. The reasons are often bad integration between databases of different sectors, restricted access, lack of experience, and even competition between units of the city administration. This is not very surprising in an initial stage of GIS introduction. However, this is an area of rapid development further discussed in a specific section below.

Planning processes involving sectors experts in cross-disciplinary teams improve the quality of the analysis and resulting design, as showed for instance

Figure 2: Photo from Uggledal, Göteborg (Lisbeth Birgersson). The early stage involvement of local groups enhanced the constructive integration of expert and local knowledge in the planning process. Valuable green structure elements were both protected and made accessible as a result of the detailed plan and design.

in Utrecht's green structure planning, that over time developed from green sector to cross-sector planning and further on to participative planning also involving citizens. Citizens and their representatives, the politicians, are actors that not always fully appreciate the expert tools for communication mentioned above. There are at least two reasons for that. First of all, the abstract and fragmented representation of reality in expert tools is not always easy to understand. Secondly, local knowledge from everyday use of the city, or the smaller area to be planned, is normally not represented at all. Media that people are more used to like photos, concrete illustrations, video films, and 3D visualisations will improve the communication, especially if combined with oral dialogues. An example of this approach was tested in the city of Trollhättan when one of the first green structure plans in Sweden was to be presented and discussed in the town planning committee (political steering group) more than ten years ago. The planner in charge was worried if he could fully explain the concepts of core biotopes, biotope islands, and ecological corridors as lined out on the municipal map. Instead, a simple video was prepared, containing snapshots from a walk from outside the city to the city centre following one important green structure route identified in the previous analysis. The film also contained brief oral comments on qualities, problems and barriers visible on the screen. This simple approach gave a good foundation to a concrete and engaged discussion at the following meeting.

Meetings and discussions at site are very useful in communication with citizens. The possibility to point at and touch real world elements makes artificial tools and expert language not that important.

This approach was for instance successfully used for green maintenance planning in the city of Houten, the Netherlands, and in early stage detailed planning for a new housing area in the city of Göteborg, Sweden. In the latter case local groups of neighbours were invited to participate and have influence on the final design of the area. Through several meetings at the site during the planning process the planner could describe and explain the municipal intentions based on central policy and expert knowledge. In return she got access to local knowledge of great importance to the neighbours. Especially concerning the green issues this influenced and supported the detailed planning and design. The result became satisfactory to all parties involved and the plan could pass the formal stages of approval without severe complains and objections that otherwise had normally been the case in this attractive district of the city.

Concluding remarks

The intention of this paper has been to point out the reasons for and challenges of the communication of green issues in urban planning. It includes communication between different actors in various stages and levels of planning. The requirements of the methods and tools used will vary with the substantive issues as well as the actors involved. Innovative efforts beyond established practice are tried out in many cities. However, the methods and tools developed, and their usefulness, are context-dependent, just as other examples of best practice. In general terms it is however possible to conclude that communication and learning will be improved if supported by:

1. Conscious design of social settings, style and agenda of different communication situations.
2. Situation-adapted methods, tools and media for communication and visualisation.
3. Competent process facilitation.
4. Equal access of all actors involved to information and data of relevance to the planning situation as well as shared knowledge about the framing conditions.

Taken together this indicates new roles and tasks for planning professionals as well as the need for supportive research and education.

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Simlandscape
Urban green, scenarios and GIS

5

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In traditional landscapes urbanity and rurality were distinct phenomena. In the present landscapes however they tend to mix. In nowadays urban landscapes, sometimes called landscape cities, green and red occur in many forms. This applies not only to their physical outlay, but also to their function, size, ownership and governance. This makes monitoring, trend analyses, planning and implementation difficult and complex. Here the use of scenario's can be helpful. Their aim is to stretch the scoop of possible futures and to explore the feasibility of policies, ultimately to support and enhance decision-making. But how can one construct and evaluate scenarios? For that Simlandscape can be used. Simlandscape is a toolbox for research and scenario design in the context of multi actor spatial planning and development. This article gives a global overview of Simlandscape, the practise name of the scientific methodology behind it called the Cadastral Landscape Scenario Method (CLSM); First by describing the character and features of Simlandscape, followed by a description of CLSM and some examples out of Simlandscape pilots.

What is Simlandscape?

In some respects Simlandscape can be characterized as a kind of SimCity for spatial planning:

> It is a geographical model that can be used to explore the present and future developments through a kind of "simulation".

The difference with SimCity however is that Simlandscape:

- Is not a computer game but a toolbox for scenario research and design.
- Deals not with players but with the actors in the spatial planning process – researchers and designers of plans, landowners and other users.
- Works with all kind of real monitoring data, with research data and with design data.
- Can visualize scenarios and research and evaluate them in a quantative way.

Simlandscape consists of matched components – geographic, process and GIS/IT – and offers features like:

- Different actors – landowners, developers, other users and agencies – can jointly and in a transparent way develop scenarios.
- Stimulates all actors from the start to think in projects and with 'Public- Private' creativity.
- Local and regional planning levels.
- A method to create and process spatial typologies.
- Shows the structure of landscapes in detail, who are the owners, what are their future ideas and how the landscape may change because of these autonomous dynamics.
- GIS models, in which future scenarios can be constructed.
- Visualisation of scenarios and projects.
- Evaluation of scenarios and projects from the perspectives of the actor categories.
- Quantification of output with respect to for instance Multiple and Intensive Land Use (MILU).
- A game simulation, for tens of players, that simulates the participative planning process with 'dynamic' area models. Especially suited for educational and teambuilding environments.

The Cadastral Landscape Scenario Method.

The methodology behind Simlandscape is the Cadastral Landscape Scenario Method (CLSM). CLSM consists of several elements (see figure 1). Before I go into these elements it is important to stress that the term landscape in CLSM relates to a system and incorporates land use functions and land use objects and the underlying substrate.

The conceptual transformation model is about the structure of the cultural landscape and how it changes as a result of the interaction of actors. To do this CLM works with actor and agent categories, enabling frameworks (property and administration) and enabling units (f.i. parcels). The transformation model is used to develop the general scenario method into a methodology for landscape orientated sce-

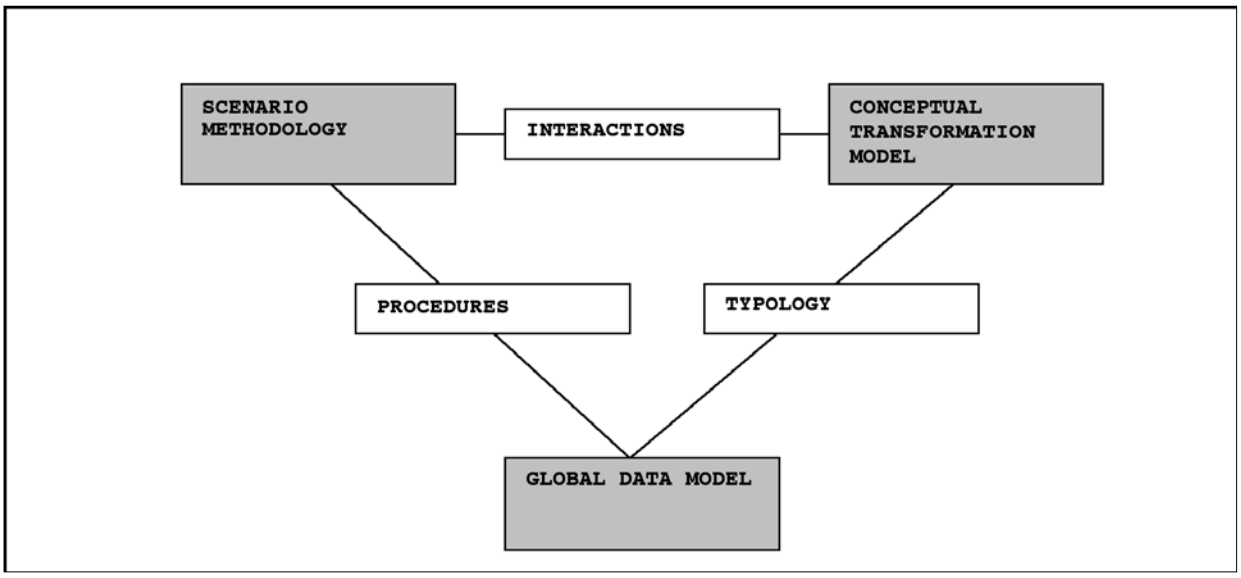

Figure 1. The Cadastral Landscape Scenario Method.

nario research and design and for a global data model (GIS). The interactions described in the transformation model are reflected in the scenario methodology, which through that has a multi actor character. The transformation model is also the framework for a methodology to create spatial and functional typologies, which can be used to describe the present situation and future scenarios of areas in a GIS environment. For scenario construction and evaluation in GIS a number of procedures is required. I will now shortly discuss these elements.

The scenario method of CLM.

Scenarios, as instruments for strategic thinking and option search, are used in many fields. Clark has pointed out some of the major functions of scenarios (Clark, K.C. and Xiang, W., 2003). Land-development scenario's can be described as "composed images of an area's land-use patterns that would result from particular land-use plans, policies, and regulations if they were actually adopted and implemented at a certain point of time". Three functions of scenarios are:

1. Bridging research (modelling) and planning.
2. Stretching the thinking about future alternatives.
3. Support decision making.

Talking about credentials for good scenarios a distinction has to be made between the internal structure – concreteness, comprehensiveness, transparency - of the used scenario model and its 'ergonomic' aspects, that is ease of use for users like planners and others. Of course some of these credentials – like f.i. comprehensiveness and ease of use - are likely to be incompatible, so compromises have to be made, depending on ones goals.

CLSM focuses on spatial planning and its implementation effects and feasibility and because of that on the interaction of landowners, users and government. This practise goal is why emphasis is also on real practise databases (see further) and on concreteness and transparency. To realize this in CLM a scenario consists always of three components; the present situation, future situations and the 'path' that links these (Doorn, J.W.M. van, en F.A. van Vught (red.) 1981; Godet, M. 1987). There is always only one present, which is the inevitable point of departure for the future and every future scenario. There are many ways to further subdivide scenarios. In CLM three main types of scenarios are defined (figure):

1. The present situation or 0-scenario (t0).
2. Prognostic or expected scenarios.
3. Propositional or plan or policy scenarios

The word planscenario is a bit confusing since it often has a different meaning for planners and for scenariologists. A plan alternative is often called a planscenario by planners. While a planscenario for scenariologists means the effect of a plan on a land use or landscape system. To escape from this semantical problem in CLM a planscenario is a proposed plan alternative – for data handling reasons conversed in the CLM datamodel - which may be then explored on its effects in planrealisationscenarios, the latter one being a prognostic scenario. So in prognostic scenarios the interaction of (changed) behaviour of agents and actors may be explored.

There are different techniques for prognostic scenarios. CLM offers especially possibilities for speculative prognostic 'what-if' scenario's with respect to the behaviour of the before mentioned actors and

the effect on the spatial and economical outlay of areas through the involved cadastral units .

Prognostic planrealisation scenarios can function in two contexts:

- In the context of planscenario feasibility studies. The results are than used for decision-making, which is the process of selecting planscenarios in the process towards constituting official policy.
- To explore and so develop parcellationplans as implementation follow-up of spatial policyplans.

Prognostic planrealisation scenarios become less speculative if data are available on owners and land markets through research like owner enquiries.

To operationalise these scenarios two things are necessary:

1. A concept or model of the paths of change, in other words of how cultural landscapes transform (see further).
2. A description of present and future situations in a similar way. This is necessary for for instance comparative analyses and scenario validations. However, the involved data are of complete different nature; present data being measured (monitored) data of the existing world and plan data being 'fantasies', many times not even standardised (see further).

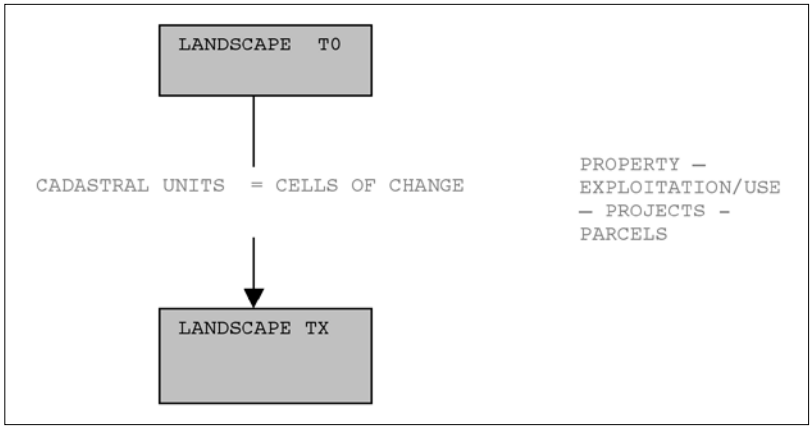

Figure 2 Cultural landscapes change, from the present (t0) to a future (tX), in units that are related to cadastral property

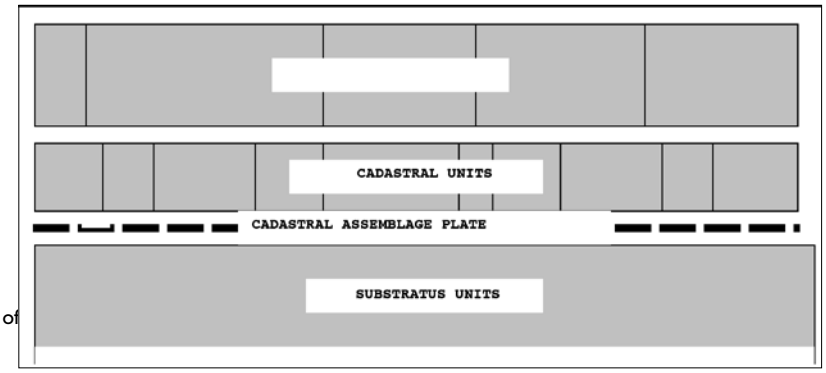

Figure 3 The polycentric and layered structure of cultural landscapes of CLM.

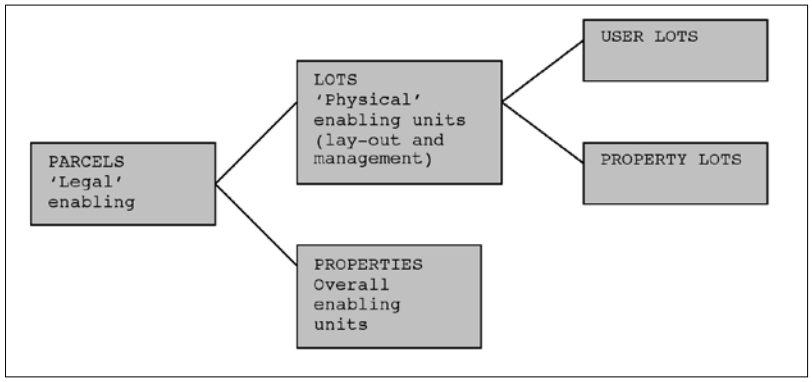

Figure 5 Cadastral enabling units in CLM.

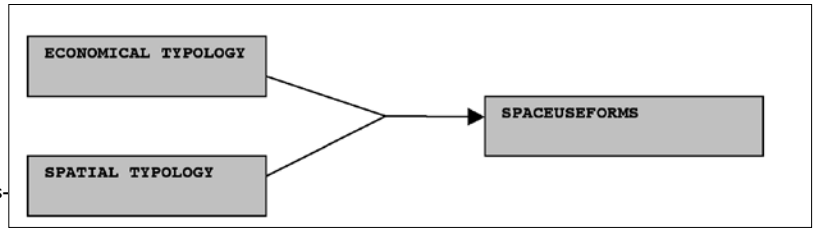

Figure 6. The three basis typologies of the cadastral units

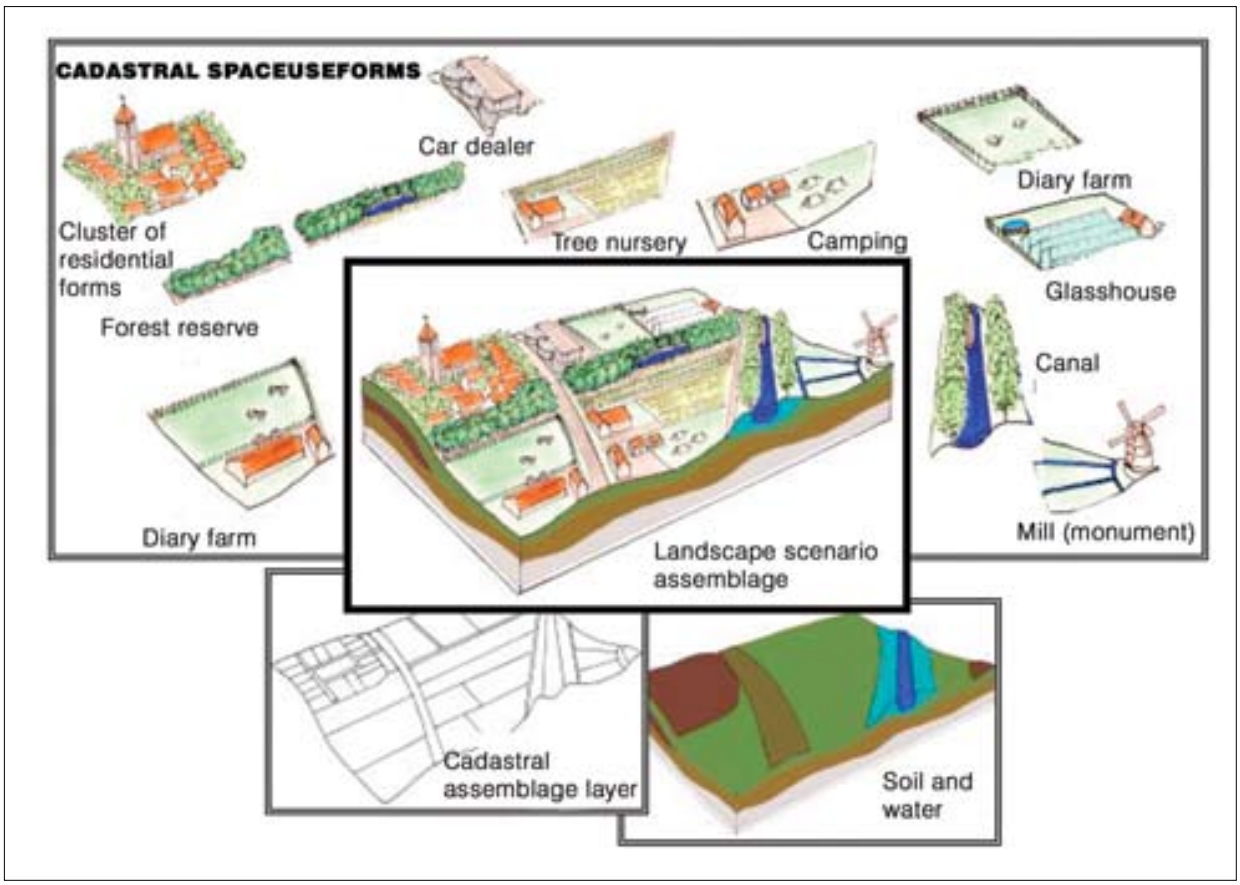

Figure 4 Artist impression of CLM (Cartoon, zie PP IAPS)

The Transformation Model of CLSM.

Scenarios are about change, so a transformation model of the subject of the scenario exercise is required. CLSM is a model of the cultural landscape as a complex and dynamic phenomenon. The landscape is seen as the result of occupation of substrates. In natural landscapes, where human culture is absent, the occupation consists only of living nature. Here the dynamics are exclusively the geological, meteorological and biological processes. In cultural landscapes these are supplemented with cultural processes– functional and physical land use -, so the occupation here is the result of the interaction of:

1. Living nature and culture.
2. And within culture, of property and governance.

Within culture, property is the ultimate enabling framework of change, of physical transformation. It is through private or public cadastral property that virtual concepts are transformed into actual change of use and outlay. Of course cadastral owners and their properties are not autonomous, there are influenced by economy, plans and regulations of government, by other users and by nature. But in the end, legally or illegally and for better and for worse the real thing happens in the context of cadastral property. This means that landscape can be regarded as consisting of (cadastral) cells of change under the influence of three actor categories; owners, government and other users (figure 2). Cadastral units play a key role in CLM, because they are as well important enabling units (transformation process) as well as area covering geometrical objects (data model).

The Transformation Model of CLSM can also be represented as a spatial layer model (figure 3) each consisting of units (objects in GIS). Two of these layers are physical; the substrate layer (or under layer) and the cadastral layer, that represents the occupation (or upper layer). The cadastral assemblage plate represents, through property as enabling framework, the spatial organisation of the transformation of landscapes. The third layer, with the policy zones of government, is a virtual one. It represents the government's interventions, its 'rules' for land use for the landowners and their cadastral units.

An artist impression shows how CLM works (figure 4). The landscape scenario in the middle is the result of the assemblage through the cadastral assemblage plate of cadastral typologies that are chosen by (or allotted to) cadastral owners.

Cadastral units and typologies.

Parcels are the building stones of the cadastral units (figure 5). The parcels of one owner make a property. These are not necessarily spatial units. Lots are spatial units, be it of one owner or of one user (f.i.

tenants). Scenario exercises may use one or all the types of units, depending on its purpose.

The cadastral units, which are building stones of which every cultural landscape is seamlessly composed have attributes or sub-objects like:

- Economical function(S).
- Land-use components.
- Owners/users.

Through the latter two also certain ecological and socio-economical attributes can be linked.

To work with these units (cells of change) in the context of analysis of the present situation of a study area or for scenario construction a typology is needed. A basic CLM typology consist of the functional and spatial attributes of cadastral units.

A third one is the combination of these two (figure 6), the so-called SpaceUseForm. The functional typology is a classification after the economical use. The spatial typology is a classification after the presence and weight of physical the land use component . The SpaceUseForm is a metatypology of economical use and outlay of in physical land use components. One of the features of SpaceUseForms is that they - when designed and used in the process of planscenario construction - force planners to think about the development feasibility of their 'physical' ideas.

Because of its importance and complexness I will now discuss the spatial typology a bit further.

The importance of a spatial typology of cadastral units is:

1. It visualizes the physical outlay of an area in relation to the size and context of the existing enabling frameworks (property). In a topographical map f.i. one can see the physical elements, but one does not see how these are related. Green elements may be part of small or big size real estate and its related future perspectives .
2. It enables scenario analysis by presenting the present situation and future scenario in a similar data format. Plans for urban development use legends that are also typologies, but often each plan uses its own typology because of which qualative and quantative comparison with the present situation or with other scenarios is difficult if not impossible.

The spatial typology methodology of CLSM offers much flexibility to define typologies according to ones needs, while still being able to conduct scenario exercises, including relative evaluation and validation that is necessary for transparency. The general methodology consists of the following aspects:

- Structure characteristics; a distinction has to be made between 'flows' (infrastructure) and 'places' (dwellings, et cetera). These have to be treated differently to obtain usable geo-data .
- The size of the units.
- The presence and relative weight of land use components in the units.

About the latter one I will give some more information.

The presence and relative weight of land use components in the units is expressed through LC-component ratios. Every imaginable spatial typology can be composed for analysis and/or design reasons. Many LC ratios are possible ; some of the most important are however:

- Build Space Ratio (BSR); the buildings surface to total unit size ratio.
- Floor Space ratio (FSR); the cumulative build floor surface to total unit size ratio.
- Hard Space Ratio (HSR); meaning the pavements relative surface.
- Soft Space Ratio (SSR); meaning the non build and non paved surface.
- Tree Space Ratio (TSR); meaning the relative surface of shrubs and trees.
- Tree Foliage Ratio (TFR); meaning the relative surface of the projection of the foliage.
- Open Space Ratio (OSR); or the sum of hard and soft space.

For communication reasons metaphors and or icons can be used to help understanding the otherwise very mathematical typology, at least for the main typology; examples are parks, boulevards, city dwellings, villas, country houses, estates, farms, et cetera. Figure … shows an example of a semi-agricultural urban fringe area.

Scenario construction and analysis procedures.

Evaluation of present and future scenarios requires them to consist of compatible data. Validation requires equally compatible reference values. In CLSM scenarios are made data-compatible in several ways:

1. By creating typologies that can be used in present scenarios, in plan scenarios and in prognostic plan realisation scenarios. This is done by aggregating real world data into typologies or in GIS terms into objects of a higher hierarchy. This is especially necessary with the physical topographical data like I illustrated with the Land Use Components.
2. By using similar units in procedures used to analyses the transformation of the present situation

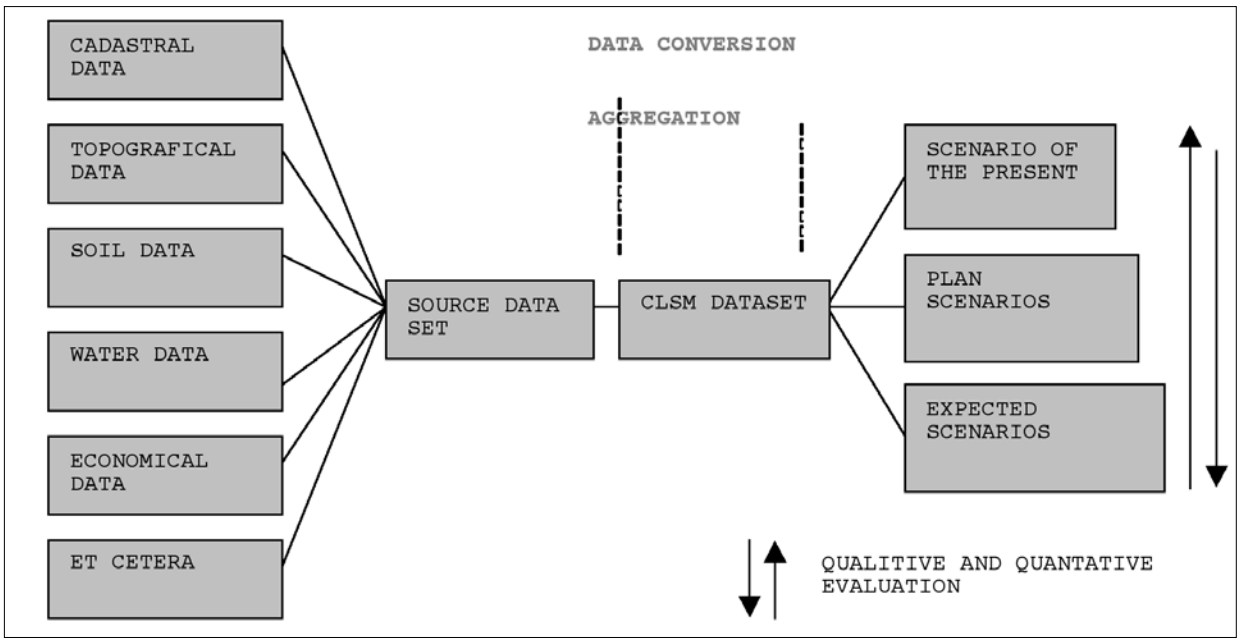

Figure 7. The CLSM GIS concept.

that is required by planscenarios. For this plan-scenario zones (plan polygons) have to be operationalised into transformation units (cadastral units, development projects) by expressing them into cadastral typologies and quantities.

3. By using the latter one as part of planning regulations and instruments (f.i. development and allotment programs) together with speculative behaviour rules of owners and their cadastral units to create prognostic plan realisation scenarios. Speculative behaviour rules of owners are related to the response of different categories of owners and cadastral typologies to economical circumstances and policy scenarios. Along these kinds of speculations, planrealisation scenarios can be explored with respect to their feasibility.

In CSLM there is no such thing as 'the' value of scenarios. Values are always relative, related to perspectives of user categories; f.i., users like residents, businesses, farmers or recreants, biological species or policy sectors like green or water management. That is why CSLM uses so called user programs to establish the value of scenarios. Of course these programs consist of a set of functional demands. User programs are described in CSLM data formats so that they can be used to analyse CSLM scenarios. The validation performance is related to the resolution (concreteness of the used units or objects) of the constructed scenarios and of the user programs; the lower the resolution (or in other words the more abstract) the less concrete will be the validation.

GIS and data model.

CLSM requires ICT for its operation. The data involved are even for modest areas to extensive for analogue operation. In turn CLSM turns GIS, mostly an analysis tool, almost into a designing tool, at least into an explorative policy tool. The global GIS model of CLSM is illustrated in figure. On the left side of this figure we see examples of applicable data. These data are more or less common to GI systems in use by government agencies. Not common however is to convert them like is done in CSLM based GI systems. In these systems in theory two datasets can be operated: one consisting of data in their source format – with the before mentioned inconsistencies - and one with data converted in CLSM format. The reason for this I explained before. Both sets can be used, for scenario exercises of course only the latter one. Because the cadastral units used in CLSM coincide with development projects CLSM GIS can in theory also be used for tracking this projects in their course of development, from participatory ('public-private') scenario development through decision-making into monitoring actual development.

Status and future development of CLSM.

CLM and Simlandscape have been extensively developed and tested in a number of pilots; a rural reconstruction area, an ecological development zone, a new neighbourhood and in a new industrial zone. These pilots were such that compared to practice conditions only a real assignment and related dynamics were missing. The pilots contained many practice elements. A neighbourhood of 2000 houses and a industrial area were designed using the spatial typology. Real data were used in 1300 hectares, 400 owners pilot in a semi agricultural urban fringe area. Owner enquiry data were used to construct prognostic scenarios. Policy documents were used to construct policy and policy realisation scenarios. Finally the game simulation of Simlandscape has been

played a number of times with 'real' (not R&D involved) players

Following these test results, the Dutch Topographical and Cadastre Service intends to further test and develop CLM. Several agencies have expressed their interest in application in a practise project; be it as a IT-tool (CLM) or as a process tool (Simlandscape). Possibilities are land use reconstruction or urban planning.

Of course further R&D is possible and necessary; for instance with respect to urban cadastral typologies or with respect to the development of the simulation game, not in the least for educational purposes.

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Call for joint R&D and application with students.

Expression of interest will be welcomed with respect to the exploration of the possibilities to share and further R&D Simlandscape and CLM with universities and institutes. This could be done through 'visits' and/or virtual communication.

If you are interested please use above mentioned addresses.

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Biodiversity in urban areas and applications in strategic planning

6

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Introduction

The ongoing global urbanisation cause changes in land use and alters natural habitats worldwide. These changes affect the living conditions for species and populations in transforming areas, and as a result the biodiversity in urban regions. In order to minimize adverse impacts of urbanisation on biodiversity, the planning of urban developments should consider the consequences of the proposed changes of land use on a landscape level, either these developments are planned within an urban or suburban landscape or in a rural landscape close to the city. Therefore, strategic decisions related to urban developments should involve a systematic assessment of impacts on biodiversity on a landscape level. However, due to the lack of knowledge on the effects of urbanisation on natural and semi-natural habitats, that are essential for supporting biodiversity in urbanising regions (McDonnell et al. 1997, Miller & Hobbs 2002), such impacts are difficult to predict.

Previously, the urban green structure, especially remnants of more natural habitats in urban regions have often been considered as reserve areas for future exploitation, without significant values (Lundgren Alm, this volume). More recently, the values of natural vegetation in urbanising environments has been recognised. Since human settlements often are located in highly productive ecosystems, on fertile soils close to rivers, coasts, and reliable water sources, they coincide in space with ecosystems that also support high levels of biodiversity (Falkenmark & Chapman 1989, Given & Meurk 2000, Cincotta et al. 2000, Ricketts & Imhoff 2003). In addition, natural habitats in urban settings provide social values, for example life quality and education (e g Thompson 2002, Nilon et al. 2003).

In the international context, political efforts have been made to further nature conservation and biodiversity. The Convention on Biodiversity states that biodiversity issues should be taken into account in environmental impact assessments, with a view to avoiding or minimising negative effects. At the European level, the EU Directive concerning the assessment of the effects of certain plans and programs on the environment (Official Journal of the European Communities, 2001) requires the integration of strategic environmental assessment (SEA) in planning and decision-making. In this way, nature conservation and biodiversity issues should be integrated in the early stages of the planning process for urban developments and infrastructure investments.

For this type of decisions a SEA can be prepared, where new plans for urban development can be presented in various scenarios, and based on these scenarios effects can be identified and described (Thérivel et al. 1992, Balfors & Schmidtbauer 2002). An assessment of the effects can be made based on defined objectives. Due to the high level of abstraction of policies, plans and programs, the prediction of impacts is a major methodological problem in SEA (Hildén et al. 1998). According to Geneletti (2002), environmental impact statements often fail to provide quantitative and spatially explicit predictions concerning nature conservation and biodiversity. These difficulties and the implementation of the Directive urge for adequate tools and methods, which are able to provide a systematic evaluation of environmental impacts and alternatives of a proposed decision.

Planning decisions, which leads to changes in the composition and pattern of the landscape, will impact on the fauna and flora. The impacts may occur on-site, just affecting the area of development, but since ecological processes like species persistence and dispersal often work on larger scales, substantial off-site changes may follow. Loss and fragmentation of natural and semi-natural habitats, caused by developments and other human activities, are major threats to biodiversity (Fahrig 1997). The impacts of such changes and the relations between landscape pattern and ecological processes are studied in landscape ecology (Forman & Godron 1986, Opdam et al. 2002). According to these authors, the quality, quantity and spatial cohesion of natural habitats are essential for the consideration of biodiversity in planning. This means that a site-based approach will not be sufficient, but it will be necessary to consider persistence requirements of species and communities in the entire landscape (Saunders et al. 1995). Suitable and accessible habitat can be planned in habitat networks, consisting of core areas sufficient for species' persistence in the landscape, linked to-

gether through corridors, which enables dispersal (Opdam et al. 2002). However, there is a gap between knowledge development and knowledge application in landscape ecology, and a lack of tools for integration in strategic planning and impact assessment. Further, in order to use the landscape ecological concepts in urbanising environments, more knowledge is needed on the wide-reaching effects of urbanisation (Miller & Hobbs 2002).

Effects of urbanisation

The polarisation of territory between urban and rural are important aspects in landscape dynamics today. While many regions are affected by marginalisation, simultaneously, other regions are substantially altered by urbanisation (Antrop 2004). In urbanising regions, urban green structure is continuously created and lost. In the urban and suburban landscapes, this dynamics is caused by intentional and unintentional changes in land use, such as new and denser developments, restoration and creation of habitat for aesthetical, recreational and/or biodiversity purposes, and vegetation successions on abandoned or unmanaged land, such as brownfields. In rural landscapes surrounding growing cities, green structure often consist of the "left-overs" of urban sprawl. From the perspective of natural and semi-natural habitats, the overall trend in urbanising regions is loss and fragmentation of natural habitats, a high pressure on the remaining areas of nature, but at the same time a creation of new habitats. These changes result in complex land cover and land use patterns, and the ecological consequences are intricate and involve many confounding factors (McDonnell et al. 1997, Pickett et al. 2001). With urbanisation, new structural elements are added, such as non-native trees, lush ornamental vegetation, lawns and technical objects including buildings, obstacles in the air, and hardened surfaces with and without traffic. Exploited areas form barriers to movement for many species, particularly roads with a high traffic intensity, which adds to the fragmentation problems (Trocmé et al. 2002). Further, the climate is warmer in cities than in the surrounding countryside, anthropogenic food is available all the year, the vegetation cover and fauna are often impoverished, and soil compaction, artificial lighting, noise, pollution and nutrient loads affect the ecosystems (Luniak et al. 1990, Botkin & Beveridge 1997). Moreover, ecological processes like fires and floods are controlled and suppressed and, from a global perspective, a biotic homogenisation occurs (Lockwood & KcKinney 2001). This homogenisation is ruled by human preferences of vegetation and hydrology and involve for instance draining of wetlands and irrigation of arid land. Human settlements also act as a source of exotic and domesticated species, and of generalist predators, which compete with or prey upon native plants and animals.

The remaining fragments of natural and semi-natural habitat are thus affected and altered by various disturbances. This means, that when habitat is characterised from a wildlife perspective, descriptions of soil types, vegetation composition, structure and age, occurrence of wetlands and decaying wood, etc, will not include all relevant information. The origin and history of sites are also important, since there are significant differences between for instance remnants of indigenous vegetation, parks with a long history of management, or sites with uncertain or no land use or management, with succession on for instance formerly open land (Florgård 2003). Park management often lead to a typical vegetation structure, with a half-open cover of large trees, mowed lawns, exotic plants and a sparse or absent bush layer (Ignatieva et al. 2000), and is sometimes applied not only to designed parks but also to native vegetation close to residential areas. Other types of human activities that may impact on habitat quality are recreation, children playing, rubbish dumping, collection of firewood and informal settlement. All these activities may occur around any human settlement, but in urban regions they can become more dominating forms of land use.

In sum, the effects of urbanisation are complex and occur on different scales. However, many of the processes involved have a spatial dimension, and are possible to quantify, analyse and visualise, for instance in geographic information systems (GIS). The measurement of urbanisation variables and their associated impacts on affected ecosystems have been studied using the urban gradient approach (McDonnell et al. 1997, Alberti et al. 2001). Urban gradients can be measured as for example the distance to a city centre, the density of the human population, or the density of the road network. This approach can be combined with landscape ecological concepts, including measurements of habitat fragmentation (Luck & Wu 2002).

When habitat loss, fragmentation and urban disturbances are quantified, studies of ecological effects of urbanisation can be performed. In the next step, when relationships between urbanisation and ecological effects are known, quantified and incorporated in GIS, these relationships can be used for predictions of effects over larger areas. They can also be used to predict long-term effects of scenarios of the future, as long as these are expressed in GIS. This will need careful considerations, though, for different reasons. Such known relationships may only be valid within the area where they were studied. Another problem is the matter of scale, since different processes are relevant on different scales, which in turn can be interacting. Further, as a result of urbanisation and infrastructure development, appar-

Table 1. Five circuits of capital and brownfields.

CAPITAL	FIRST	SECOND	THIRD	FOURTH	FIFTH CIRCUIT
economy	local	regional	national	international	global
emerging brownfields	varied brownfields	industrial brownfields	housing brownfields	technology brownfields	leisure brownfields
brownfields conversion	to industrial land-uses	to housing land-uses	to technology land-uses	to leisure land-uses	to speculative land-uses
military brownfields	few	hardly any	increasing abandonment	plenty of conversion	re- and de-militarisation
city character	city of "sweat"	city of "sleep"	city of "thoughts"	city of "play"	city of "virtual"

ently small impacts on individual sites can result in considerable cumulative effects on the availability of wildlife habitat in a region. Still, spatial and temporal predictions of the distribution of habitat, species, communities and other biodiversity components have developed considerably during recent years (e g Scott et al. 2002), and can now be considered as valuable tools for planning and impact assessment.

Landscape Ecological Assessment

In order to integrate biodiversity considerations in strategic planning in an urbanising environment, a landscape ecological assessment (LEA) was applied (Mörtberg & Balfors, submitted). The focus was on the development of methods for prediction and assessment of impacts on biodiversity components, on a landscape level. A case study was conducted in the Stockholm region, the capital of Sweden. The study area included the city, suburbs and peri-urban areas, with about 1.5 million inhabitants. The city is developed around and shaped by the radial transportation lines, leaving large areas of natural and semi-natural vegetation in between. In urban and suburban areas, the green structure includes a network of forest fragments that are embedded in urban surroundings, while within the peri-urban areas large, quite undisturbed nature areas dominate, with relatively few buildings and roads. Here, rural activities like forestry, agriculture and hunting are taking place, but most people work in the city.

The future development in the Stockholm region have been estimated to reach 250000 additional households by the year of 2030, and alternative scenarios for this development were created by the Office of Regional Planning and Urban Transportation (1995), see Figure 1. In order to perform an evaluation of these scenarios, conservation targets were defined on regional and landscape levels. In the case study, two different biodiversity targets for forest habitats were formulated, relevant for different stages of urbanisation, but still significant for the city

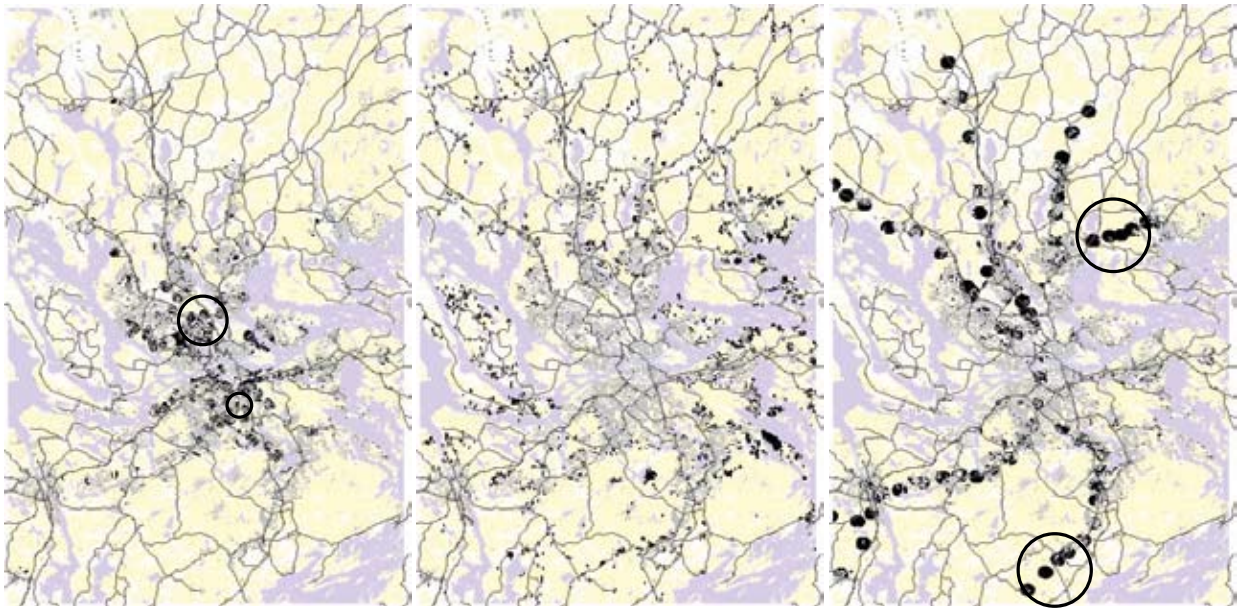

Figure 1. Development scenarios in the Stockholm region (Office of Regional Planning and Urban Transportation 1995). In Scenario Dense, the new development was concentrated within the inner suburbs. In Scenario Diffuse, the development was allowed to spread in the region. The Scenario Infra placed all development around stations of the long-reaching transportation lines. The circles represent examples of detected conflict areas, where mitigation measures would be effective.

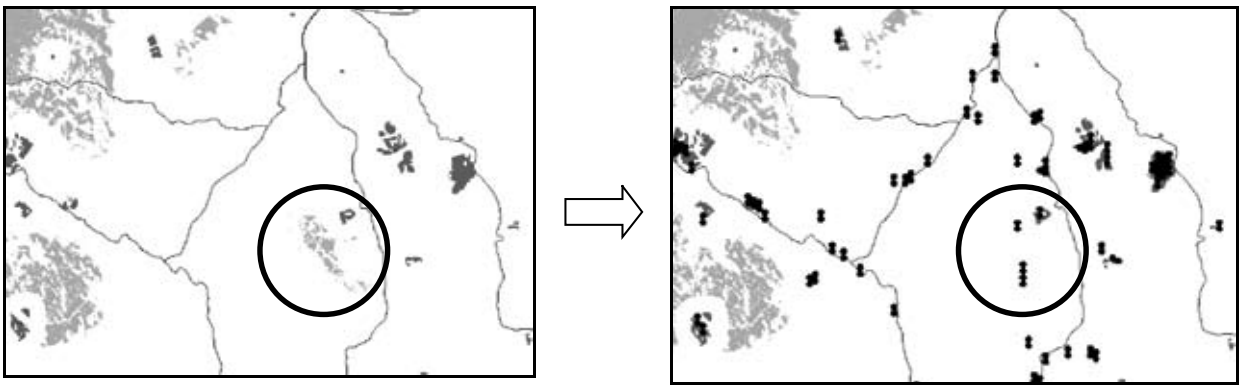

Figure 2. Detail of the present situation and Scenario Diffuse. A predicted effect of the scenario Diffuse was loss of available habitat for the capercaillie, one of the focal species, which may lead to extinction of local populations. Light grey in the figure is predicted suitable habitat for the capercaillie, dark grey is built-up areas and black is new development of residential areas in Scenario Diffuse.

as a whole. The first target was to preserve the large forest tracts in the peri-urban areas, with characteristic combinations of habitat types and bird fauna. The second target was to maintain a connected network of forest remnants in the suburbs, in order to sustain urban-sensitive forest birds. In the selection of indicators, considerations were needed both of the problem – the effects of the proposed plans and alternatives – and the biodiversity targets. For the large forest tracts we focused on two resource-demanding forest birds, the capercaillie and the hazel grouse, of which the latter also is dispersal-limited. For the suburban forest network, we focused on urban-sensitive, sedentary forest tits, here represented by the willow tit.

Relationships between species occurrences and environmental variables were obtained from statistical analyses of empirical data (Mörtberg 2001, Mörtberg & Karlström 2004). These relationships were then used to achieve GIS-based predictions of focal species distributions throughout the study area. The relationships were also applied on the scenarios, in order to predict and evaluate their impacts on the focal species (see Figure 2). The results of the evaluation indicated that Scenario Diffuse, with a scattered development pattern in future (sub-) urbanisation, may lead to adverse effects on biodiversity values of regional concern, including local extinctions and intrusion in core areas of the focal species connected with the large forest tracts. Scenario Infra would also lead to adverse effects, including significant habitat loss and isolation, while Scenario Dense mainly would lead to effects on the cohesion of the forest habitat network in the suburbs. However, both Scenario Infra and Scenario Dense could be substantially enhanced through mitigating alterations of the scenarios (Figure 1).

In the evaluation, essential biodiversity values were addressed on a landscape scale. Still, an obvious problem with the use of any indicator, even if carefully chosen, is that unforeseen needs of other species or groups may be left without consideration. More research is needed on indicators for biodiversity, in order to get a more complete representation, which will encompass an essential part of biodiversity in a landscape. Measures are necessary, though, and the assessment of impacts needs to be based on systematic and quantified predictions. This is a way to make knowledge about species distributions accessible to the planning process and expressed spatially in a format suitable for scenario-testing.

The results of the prediction of the species' potential distributions provide a valuable input in the SEA. In accordance with the European regulations the SEA, the assessment of potential impacts of different planning options is required in order to select the alternative that minimizes adverse impacts and to identify mitigating measures. The LEA method offers a transparent framework, in which biodiversity issues are assessed by relating the distribution of impacts on a set of species to specific landscape targets. Moreover, the spatial predictions facilitate a quantification and visualization of the effects of urbanization scenarios on biodiversity on a landscape level. This implies that the ecological impacts of alternative urban developments can be assessed and compared before a decision is made. In this way LEA offers a useful tool in strategic planning and impact assessment, which contributes to the quality

Table 2. Characteristics of military brownfields in Western and Eastern Europe. Source: modified from Jauhiainen 1999; 2002; Myrttinen 2003.

	Western Europe	Eastern Europe
economic	in/direct job losses abundance of sites	poor conversion viability poor infrastructure quality
political	decision-making regarding base closure	unclear land ownership lack of political capacity
social	loss of long traditions local / non-local staff	vandalism in sites closed military towns
cultural	preservation of military heritage	gender perspectives memories of occupation
environmental	economic viability of clean-up	serious pollution endangers the re-use

of SEA and ultimately to sustainable planning and decision-making.

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Urban Soundscape Patterns

7

by Per Hedfors, Swedish University of Agricultural Sciences

The acoustic dimension needs a different approach and more attention in city planning. The attempts for beautification of cities are meaningless as long as sounds are neglected. The beautification is an aesthetic concern for sustainability to improve the health situation and strengthen the urban identity and social interactions between citizens. The city planners got to be reminded of a universal design, which includes the view that city environments generate total appearances to the citizens. Beautification is therefore not only a visual matter, but a multisensory. Neither is the acoustic aesthetics only a matter of noise protection, but it encompasses a soundscape entirety. In this paper, the urban soundscape patterns are suggested to be identified and used as resources in urban planning.

From noise protection to a listening design of cities

The soundscape patterns need to be identified in urban planning. Landscape and urban planners have to stress the fact that sounds of motor vehicles dominate most urban sonotopes, at least in daytime. By sonotope is meant a place including its site specific soundscape. Mankind has to question if the steady sounds of vehicles should be dominant in most urban sites – even at low sound levels. The strategy that most authorities use to sounds in outdoor environments is noise protection. In this paper, we suggest a progressive acoustic design of cities (Hedfors 1993) that can develop into a wide repertoire of sonic qualities.

If the patterns of urban soundscape were separated and distinct, the citizens might not need to travel far to reach the qualities they search for. If cities could offer both lively environments with bracing atmosphere, and relaxing milieus in outdoor environments, the growing leisure traffic and its environmental consequences might be reduced. Growing leisure traffic is a major environmental problem in developed countries.

There is a need for strategies to lift forward certain sonic qualities. Obvious sources of sound that might be more prominent than today are wind, water, birds, people chatting, marketplaces, buskers etc. (Southworth 1969). In some acoustic communities (Truax 1984) might also church bells or minarets be more prominent than today. Every single sonotope has its own specific mixture of sound sources that contributes to the soundscape at site. These individual values should be considered in urban design.

Loud corridors and auditory refugees

Today's strategy against noise is to limit the sound levels (expressed in dB) equally all over the cities. It's like putting some, but not too much of our litter all over the city. As everybody knows, we have a totally different strategy to refuse collection that is to gather the rubbish to a few sites, where we effectively manage to handle with it.

The strategy put forward here doesn't focus on limiting noise, but to get varied urban soundscape patterns. The loud activities should be directed into a few corridors through the cities. This strategy for loud activities is the cardinal approach to give space for completely other soundscapes to supplement the urban patterns.

The argument against a corridor strategy is that people who are living close to these corridors will suffer a lot. Therefore, like the strategy for refuse collection, we got to be successful in managing the loud sounds in a few corridors, instead of managing slightly weaker sounds all over the cities.

Initially, we got to accept higher noise levels in the loud corridors than our local standards proclaim. At the same time, we got to offer auditory refugees that possess totally other sonic qualities close to people. The distance shouldn't exceed 300 meters between where people have their place to live and the refugee (Alexander et al. 1977).

Compact city with spacious greenery

A spacious network of urban greenways with branches like the blood circulation system would offer the citizens a fundamental structure of auditory refugees. Cities can be analysed into three physical structures incorporated into one another: structure of buildings, structure of greenery and infrastructure.

The variation of urban spaces and sonotopes is supported by the active management of the three structures together. The buildings next to the loud corridors become effective barriers while being high, close together and overlapping. The structure of greenery offers other sound qualities than the infrastructure, and will be understood as different types of auditory refugees. Therefore, the greenery should be designed as corridors rather than as isolated gardens, so that citizens can move through them without hindrances.

The compactness of the compact city should be concentrated into narrow urban corridors, while the citizens should have close to urban greenery in between the compact corridors. The edge zones along the compact corridors will need intricate landscape design. The landscape and urban designers have to notice the positioning of fans and air condition to avoid sounds of fans undermining the appearance of an auditory refugee.

This strategy isn't meant to be normative like giving preferential treatment to certain sounds, like sounds of nature. However, the strategy is normative in suggesting a variety of sonotopes close to where people dwell.

Research for urban sonic strategies

The research behind this new approach to urban acoustics is presented in a thesis titled "Site Soundscapes – landscape architecture in the light of sound" (Hedfors, 2003a). In the thesis issues of acoustics are introduced to the profession. The thesis includes four papers and a CD titled "Comparisons of Acoustic Images from two Landscapes". The research was based on the assumption that landscape architects work on projects in which the acoustic aspects can be taken into consideration (Hedfors & Grahn 1998).

The research raised the orchestration of the soundscape as a new area of concern in the field of landscape architecture and a rich array of methods of approaching the problem was suggested. The research task was to develop methods for planners and designers to heighten their awareness, develop their notion of soundscapes and to involve sonic design into their daily work. The research task was not to study correlations between for instance peoples reaction to certain parameters of urban sounds.

Professionals can learn to recognise the auditory phenomena which are characteristic of certain patterns of land use. Both existing and proposed acoustic sources are obvious planning elements which can be used as a starting point in urban and landscape development processes. The effects on the soundscape can subsequently be evaluated according to various planning options.

The landscape is viewed as a space for sound sources and listeners, where the sounds are transferred and coloured, such that each site constitute a specific soundscape - a sonotope. This raised questions about the landscape's room acoustic characteristics with respect to the physical layout, space, material and furnishing. Questions related to the planning process, land use and conflicts of interest were also raised, in addition to design issues such as space requirements and aesthetic considerations.

A computer tool to promote listening

A prototype of a computer tool for use in landscape architecture was developed (Hedfors 2003b). This was intended to promote listening as well as to stimulate an appreciation of the soundscape approach in the processes of planning and design. The purpose was to illustrate auditory problems and raise the aural awareness of the practitioners, for example, while carrying out visits on site. The tool provided a means through which researchers, practitioners and members of the public could meet to facilitate a mutual exchange of ideas.

The tool was based on the results of qualitative interviews on two urban settings (Hedfors & Berg 2002; 2003). These were referred to as reference objects – the location, design, functions, building material, plant material and traffic conditions – of which have characteristics which practitioners can compare with their ongoing projects. One of the locations was a pasture on the outskirts of a city, while the other was a public garden which was located towards the centre of the same city. The pasture's sonotope was characterised by clear, distinct sounds which were neither drowned out by sounds which were emitted a short distance away nor by those emitted at much greater distances. In contrast, the sonotope of the city garden was characterised by the sounds of its surroundings (Hedfors 2005).

Basic knowledge for the understanding of sonotopes

The thesis (Hedfors, 2003a) portrays some basics for the planning process of urban soundscape patterns. The process involves survey, analysis, design and communication of sonotopes. In the following, three figures (1-3) are used to introduce basic knowledge of sonotopes. The figures will be supportive to the implementation of a planning process considering the urban soundscape patterns.

A prominent sound that appears clearly in a soundscape is called a sound figure or a sonic feature. It consists of an attack, a body and decay (figure 1) (Schafer 1977). Obviously, a powerful background drowns out more of a figure than a mild does. The attack of the figure conveys important information

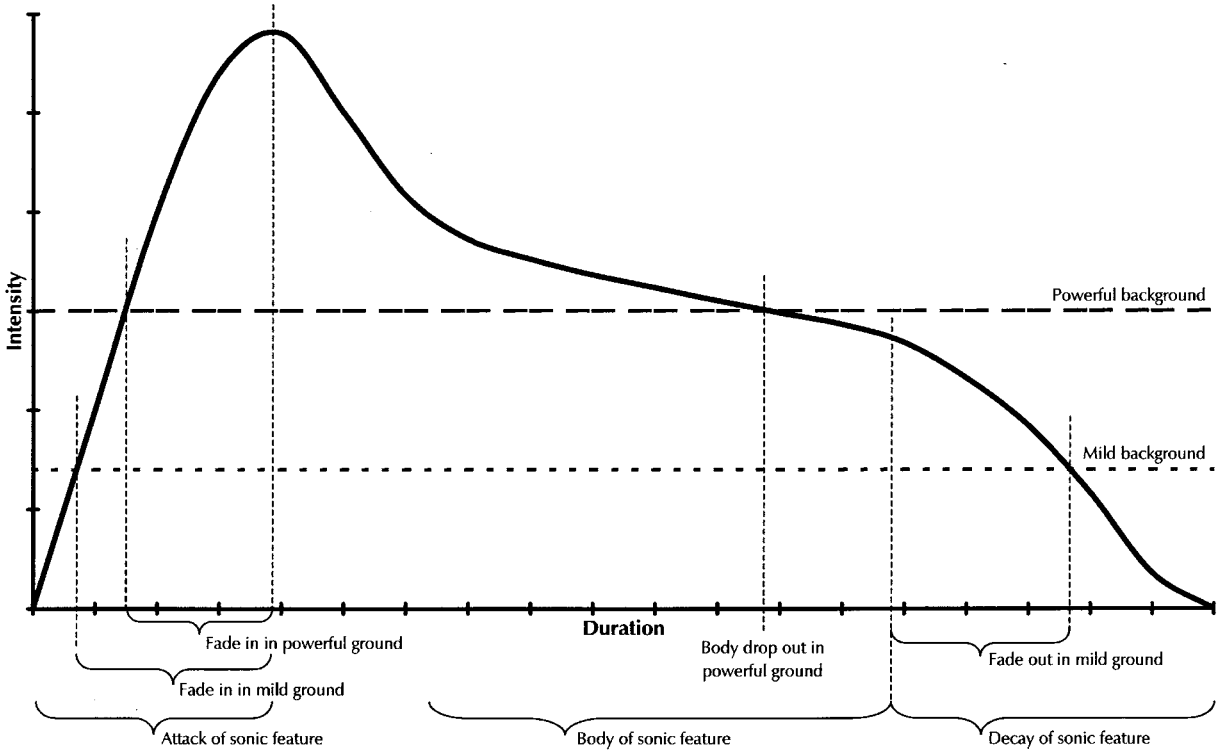

Figure 1. A prominent sound figure against 1) a powerful and 2) a mild background (Hedfors 2003a).

used by the (human) ear and brain to identify the sound, as well as the source of the sound. The degree of the background masking of the attacks, limit the listeners' possibilities to identify single sound figures. Obviously, it's challenging to trace and understand a crowded soundscape with a powerful and ever changing background. It becomes demanding when figures turns into background rapidly and vice versa.

Approaching the communication of sonotopes

Urban planners need to develop their listening habits to be able to communicate about sonotopes. The communication act will be based on concepts for sound and place. Sound and place can be expressed by recordings and acoustic simulations. They can also be pictured or articulated in words. In this paper the articulation in words is introduced. Recording and simulation are advanced and more complicated techniques, which will be discussed as future prospects below. The picturing of sounds is tested in the thesis (Hedfors, 2003a) and is also an advanced technique, as the transformation of something heard into something seen is complicated.

The most basic communication act is listening exercises in groups. The dialogue between group members breeds the use of words and the growing of a conceptual repertoire for sounds, not the least onomatopoetical words will be used, that sounds like the sound it selves.

The description of sonotopes can be supported by the following model called "the Model of Prominence" (figure 2). The proportions between sound figures and their background are described. The model distinguishes between experienced intensity and experienced clarity of sounds.

The Model of Prominence becomes useful in the syntax matrix (figure 3) where urban planners and other listeners get advice for structuring their descriptions. The auditory elements of the soundscape on site are divided into Atmosphere, Keynote (background), Feature (sound figure), Potential sounds and Proposed sounds (figure 3).

The atmosphere is the immediate impression on site. The keynote (background) is during a visit on site experienced as being always present. The features are ranked from very often present to seldom present. Potential sounds are sounds that can occur on site but not during the visit. So far, we have been analysing an existing sonotope. The design stage – for the future sonotope – is noted under the heading proposed sounds.

Giving structure to sentences

The elements of the syntax are arranged so that a complete sentence occurs for each of the auditory elements. The syntax elements are Duration, Techniques, Onomatopoetics, Source, Appraisal and Sig-

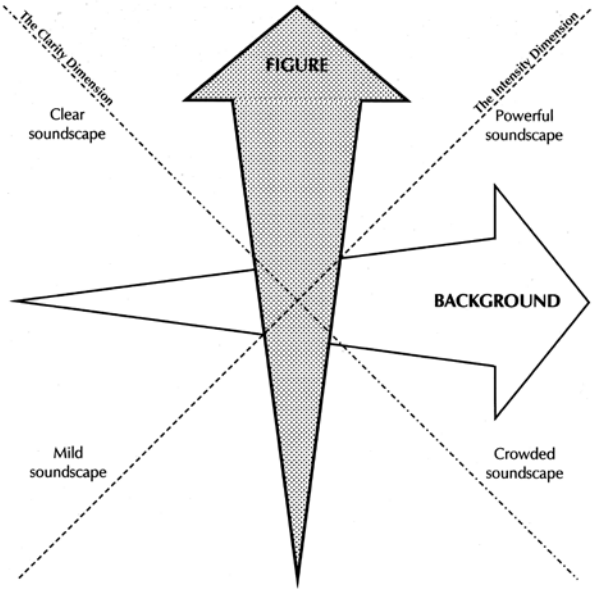

Figure 2. The Model of Prominence distinguishes between experienced intensity and experienced clarity of sonotopes (Hedfors 2003a).

ELEMENTS OF SOUNDSCAPE	ATMOSPHERE	ANALYSIS						DESIGN	
		Keynote	Feature 1	Feature 2	Feature 3	…n	Potential	Proposed	…n
	always present						seldom present		
ELEMENTS OF SYNTAX									
DURATION									
TECHNICS									
ONOMATOPOETICS									
SOURCE									
APPRAISAL									
SIGNIFICANCE									

Figure 3. The syntax matrix is recommended as support when describing the soundscape of a sonotope (Hedfors 2003a).

nificance (figure 3). For the keynote sound the duration will often be expressed as continuous, while the features will be expressed as shorter in time – more or less rapid. The technical description can for instance be homogenous, mild, low frequent. The onomatopoetical description is the heart of the syntax and it can be a trial to imitate the sound it self. It can also be the use of existing words that are imitating, like murmur, chatter, dripping.

The sources of sound are probably the easiest part of the syntax, but are recommended to be ranked after the onomatopoetical element, so that the sentence deals with the acoustic properties and not with the physical objects. The appraisal is an evaluation of the sound described as being wanted or unwanted. As there are many listening habits in the society, the urban planners are recommended to be careful in evaluating the sounds of their own. A passable road can be to develop well justified propositions for alternative evaluations. The same approach is recommended for the significance of each sound. What does it say or mean to different listeners?

Future prospects

Future research is suggested to aim at the development of a tool for the simulation of 3D-sounds. The practical use of such a tool should lead to a general increase of awareness of sounds as elements of urban and landscape development. The sense of hearing contributes for instance to the detection of human surroundings, spatial experiences, orientation, wayfinding, availability, place identity etc. These dimensions are central to future 3D-sound research.

The research must take principal decisions on the users' technical devise. Low requirements on the devise should be efficient to reach a majority of consultants in the field of landscape architecture and related professions. Thereby, existing computers will be possible to use for low-cost solutions. Headphones are efficient for small offices and will easily be connected to existing computers. Headphones facilitate a personal studio used without being disturbed by/disturbing other activities at the office. The professionals' communication with stakeholders in development processes about planning options is more complicated. Such dialogues require special listening settings.

Methods for simulation

There are no standard methods for simulating outdoor acoustic. Traditional methods are designed for enclosed spaces and collapse when brought out in a complex outdoor environment. There are tools available for a quantitative simulation of soundscapes but almost no research has been done on qualitative. A major question in designing such tool is the different simulation methods needed for the diverse components in soundscapes. Specific questions are how to create realistic 3D-simulations of the sound from a crowd of people, from the traffic in a street or from other sources that cannot be simulated as point sources. Pre-recorded sounds will not be convincing enough, as the natural outdoor room acoustics differs between the originally recorded space and the site in question. Consequently, simulations of sounds and spatial acoustics are needed to give an accurate impression of planned spaces.

Conclusions

A new strategy for urban sounds is recommended. There is a need for an auditory awareness on all levels in the planning process. The area of concern must be highlighted in strategic comprehensive planning

as well as in detailed planning. Surveys and analysis of the urban soundscape patterns are recommended. A communicative approach to the problem that includes interviews with the citizens, can lay ground for a progressive acoustic design.

A certain strategy for loud activities is highly recommended to limit such activities to urban patches and corridors. This will be a basic step to have auditory refugees close to people. A compact city with spacious greenery will have a beneficial structure for the listeners, based on greenways and edge zones of buildings and vegetation structures. A strategy for certain sonic values like the sound of water falls or church bells, are also recommended. Protected sonotopes are areas with a valuable sound quality in some respect. Sound quality needs to be articulated and described in each situation, and a syntax matrix is proposed as means for the description of sonotopes.

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Sustainable Rainwater Management and Green open Space

8

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Rainwater in urban spaces

Rainwater is a mean for creating greener urban areas and communities through generous landscaping integrated with infiltration-based open spaces, streetscape and wetlands. The major challenge lies in a new look for public infrastructure and the open space around private development. A new attitude towards managing rainwater as a resource should recognize its role in maintaining environmental quality, biodiversity and liveability. A conventional storm system of underground pipes is substituted by surface water drainage system designed as open channels along the street collecting water from adjacent rooftops and paved areas. Impervious area is made up of roads, parking lots, and rooftops. If conditions allow pervious surfaces that can support vehicles are recommended. There is a whole spectrum of products, which range from porous version of asphalt and concrete, to paving blocks of various materials that can be placed to allow water to infiltrate in spaces between them. There are also recycled plastic products that spread the weight of vehicles while allowing the finished surface to be grass or gravel.

In neighbourhoods, recently built with ambitions towards sustainable design (i.e. Kronsberg and Tübingen in Germany, Hammarby Sjöstad in Sweden) precipitation is absorbed, collected and often gradually released enriching urban space. The grassy open ditches are equipped with hollows and soakways. The topsoil cleanses the rainwater, which percolates into gravel-filled sumps and through drainpipes runs into the public surface-water drain or where it is possible appears as picturesque stream in open spaces filling artificial retention ponds or channels. Water improves microclimate by stabilizing temperature and damping down dust, attracts wildlife.

Civilization has dealt with wastewater for thousands of years. Normal storm water and uses of water for hygiene, consumption, manufacturing generates a pollutant load on the resulting wastewater. In order to prevent contamination of drinking water supplies and the surrounding environment, wastewater must be isolated until pollutant removal is accomplished. Vegetation can absorb a range of pollutions including nitrogen, phosphorus and heavy metals such as cadmium, copper, lead and zinc. Wetland as one kind of methods can efficiently reduce BOD, suspended

Figure 1. Water enriches urban environment – Stockholm 2002

Table 1: EU requirements for urban wastewater Source: EC Directive 91/271/EEC
p.e. = Population equivalent, defined as contributing 0.06kg BOD5 per person per day
COD = Chemical Oxygen Demand
TSS = Total Suspended Solids
P = Phosphorous
N=Nitrogen
BOD = Biochemical Oxygen Demand

Parameter	Concentration	Minimum Reduction %
BOD (at 20°C without nitrification)	25 mg/l	70-90
COD	125 mg/l	75
TSS	35 mg/l (p.e. > 10,000) 60 mg/l (p.e.< 10,000)	90 70
P	2 mg/l (p.e. 10,000-100,000) 1 mg/l (p.e.>100,000)	80
N	15 mg/l (p.e. 10,000-100,000) 10 mg/l (p.e.> 100,000)	70-80

solids, N, P, heavy metals, organics and pathogens. EU defines the requirements for reduction of pollutants in urban wastewater. Table 1.

Storm Water

Storm water originates from runoff of rainfall on roofs and streets. Pollutants in storm water result from surfaces which are washed with the rainwater. The variation in pollutant content is large and varies

Table 2: Different amount of pollutants in storm water from different sources Source: EC Directive 91/271/EEC
High = *** Medium = ** Low = *

	COD	N	P	Pb	Zn	Cu
Traffic	***	**	*	*	**	*
Erosion	**	*	**	*	***	***
Precipitation	-	***	**	**	***	**
Animal droppings	*	**	***	*	*	*

depending on the type of surface that the run off comes from. Table 2 shows the contribution of different sources in urban runoff. After a rainfall or an occasion of snow melting, when water is the most polluted it is important to treat flush before it enters a distribution system, wastewater treatment plant or natural recipients. In general, after treatment storm water can be used for clothes washing, city parks and garden irrigation and for recreation activities such as boating and skating.

Storm Water Treatment Process

Primary treatment is to reduce big particles from storm water
Secondary treatment method is using the green roofs to absorb particles, heavy metals and nutrients
Tertiary treatment methods are used in the wetland systems:

- *Physical* process: sedimentation, filtration, infiltration and evaporation
- *Chemical* processes: adsorption and crystallisation
- *Biological* processes: plant uptake, biological degradation, nitrification and denitrification

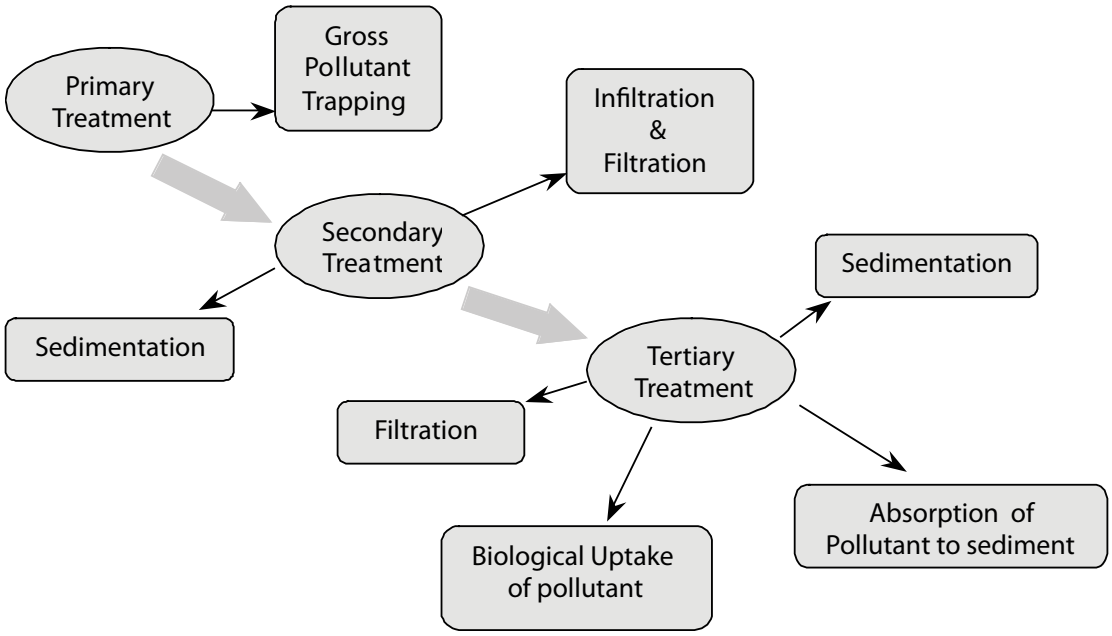

Figure 2: Storm water treatment process. Source: Chen, J, Master Thesis 2004

Wetlands

Storm water treated by constructed wetland systems is a component of a treatment processes characterized by:

- *Minimal energy consumption*: elevation differences in the wetland allow wastewater to flow by gravity through the wetland system. Energy consumption in the treatment system is generally limited to the amount of energy consumed by the primary treatment method.
- *Minimal use of chemicals*: the wastewater treatment reactions in a wetland depend on physical, chemical, and microbial processes that occur naturally in the system. In some wetland systems long detention times and exposure to sunlight provide sufficient disinfections and as a result additional means of disinfections are unnecessary.
- *Low-tech*: wetlands are designed to have simple hydraulic and mechanical systems. Since the treatment processes are naturally carried out, operators do not have to monitor the treatment process. The primary tasks of the operator are to keep the hydraulic system running, manage wildlife and the occasional harvesting or burning of excess vegetation.

Wetlands not only efficiently reduce storm water pollutants, but can constitute an aesthetic element and enhance recreational activities (i.e. biking, bird watching etc.). At the same time it provides a buffer to natural aquatic ecosystems, and create habitat for flora and fauna. Wetlands are the most productive among all habitat types, (Adames et al.,1986; Tiner, 1984). A number of animals spend all or part of the year in or near wetlands and animal diversity is generally greater in inland wetlands than in other inland areas (Tiner, 1984). These wetlands ecosystem can be very biologically productive. Wetland plants thrive in constant or intermittent soil moisture. Ideally, these plants contribute to the shelter or sustenance of the native wildlife while adding to the natural beauty of the area. There are three basic types of wetland systems: natural wetlands, constructed wetlands with surface flow (Figure 3a) and constructed wetlands with subsurface flow (Figure 3b). FWS (free water surface) wetlands are characterized by an open water surface exposed to the atmosphere. FWS are typically composed of one or more shallow cells ranging in depth from 5 cm to more than 1m, fringed with emergent reeds and macrophytes. FWS wetlands are diverse system containing both shallow and deep zones, aerobic and anaerobic conditions and a broad range of habitats from ephemeral to aquatic.

Wetlands Construction Design

Sedimentation basins are located within a storm water wetland system to capture coarse sediment from storm flows. Sedimentation basins differ from constructed wetlands in that they reply primarily on physical processes to treat the water, whereas a wetland relies primarily on biological processes. However, it is important to remember the limitation of sediment basins with respect to the treatment of dissolved pollutants that are not associated with sediment and so cannot be treated through physical process.

Sedimentation basins are designed to trap coarse sediment upstream of a natural or constructed wetland or creek system. The basins temporarily detain storm water so the velocity of storm flows is reduced and the sediment falls from the water column. Typically, a large proportion of nutrient in storm water will be bound to the suspended sediment particles. Therefore, since sedimentation basins are designed to facilitate the settling of sediment, they are also effective at removing a large proportion of particulate-based nutrients from the water column. The rate at which a sedimentation basin removes sediment from the water column is affected by the sediment particle size, the velocity of the water and detention time (the length of time that the basin retains the storm water). Meanwhile, the basin is designed as flow management to release the volume of storm water gradually over time. Water should be provided to the constructed wetlands during summer dry periods with minimal rainfall. The primary concern during the summer dry periods with minimal rainfalls is maintenance of water depth in the constructed wetlands. Both the base flow from the process area and the water from the flow management basin can be used to assure the constant presence of water in the constructed wetlands.

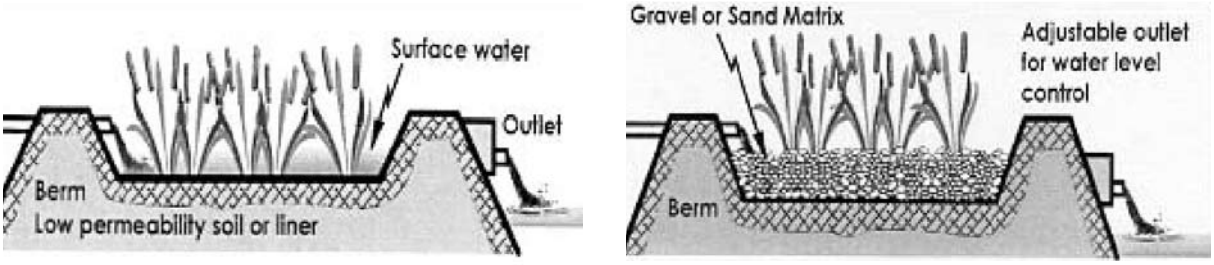

Figure 3a and 3b: Constructed wetland with surface flow. Source: Komex Environmental Ltd, 2004

N Removal

Nitrates are converted to dinitrogen gas by denitrifying bacteria in anoxic zones. Nitrogen is also taken up by plants, and incorporated into the biomass. There are several genera of heterotophic bacteria including, Achromobacter, Aerobacter, Alcaligenes, Bacillus, Brevibacterium, Flavobacterium, Lactobacillus, Micrococcus, Proteus, Pseudomonas and Spririllum, which are capable of dissimilatory nitrate reduction. This is a two step process. The first step is conversion of nitrate to nitrite. This stage is followed by the production of nitric oxide, nitrous oxide and nitrogen gas. The conversions are shown as below:

$$NO_3^- \Rightarrow NO_2^- \Rightarrow NO \Rightarrow N_2O \Rightarrow N_2$$

The presence of dissolved oxygen suppresses the enzyme system needed for denitrification and is a critical parameter. The optimum pH range lies between 7 and 8. However, alkalinity produced during denitrification can result in rises in pH. Denitrification is also strongly temperature dependent and only proceeds at very slow rates, if at all, at temperature below 5°C.

P Removal

The interaction of redox potential, pH, Fe, Al and Ca minerals control phosphorus sorption in wetland. Fe and Al oxides and hydroxides, calcite and organometallic complexes retain inorganic P. Biological oxidation results in the conversion of most P to the orthophosphate forms ($H_2PO_4^-$, HPO_4^-, PO_4^{3-}). Removal of these latter forms in wetland occurs mainly as a consequence of adsorption, complexation and precipitation reaction with Al, Fe, Ca and clay minerals in the bed matrix. Although there is some uptake of P into plant biomass this is insignificant compare to the effects of adsorption. In acid condition inorganic P is rapidly adsorbed in wetland on hydrous oxides Fe and Al may precipitate as insoluble Fe phosphates and Al phosphates. Reduction of phosphorous to gaseous hydrogen phosphates under anaerobic conditions by a particular strain of anaerobes and subsequent release to the atmosphere is theoretically possible.

Heavy Metals Removals

Wetland species have a well-established ability for direct up take of heavy metals. It should be noted that direct up take is an active process, requiring the plant to be alive. Plant matter will liberate its metal content when decomposing.

Copper removal: weathering of copper minerals results in background copper concentrations in natural surface waters usually well below 20ug Cu/L (USEPA 1980) and sediment concentrations ranging from 1 to 10 mg Cu/Kg. However, much of the copper entering aquatic systems is due to anthropogenic activities (Moore 1990; Dugan 1991). When copper enters wetland systems in solution, it will speciate into numerous forms or compounds as it interacts with components of the ecosystem.

Several processes determine the fate of copper in wetlands: complex formation, sorption to hydrous metal oxides, clays or organic materials, formation of insoluble species (e.g. metal sulfides), and bioconcentration / bioaccumulation. Because of its lithic biogeochemical cycle, copper has a high affinity for sediments and a short residence time in solution. In this system, the copper is sequestered from the aqueous matrix to the hydrosoil of the wetland and allowed to speciate to nonbioavailable forms.

Lead removal: to permit particulate lead to settle and to precipitate the soluble lead in the wetland hydrosoil as PbS. Lead will also bind with carbonates and hydroxyl ions at circumneutral and higher pH with both $PbCO_3$ and PbOH settling rapid to the hydrosoil. The lead compounds in the hydrosoil should be stable and retained within the system. Further, the plants in the constructed wetlands will serve to filter any particulate associated lead from the water column.

Mercury removal: constructed wetland system can be designed to precipitate mercury in the wetland hydrosoil as cinnabar (HgS). Mercury in bottom sediments is strongly held by the following binding mechanisms: (1) sorption on hydrated ferric oxides (2) surface sorption or ion exchange on mineral ion exchangers such as montmorillonite or (3) sorption and or chemical binding with organic material and sulfur containing matter. The fundamental principle for sequestering mercury from the effluent in the constructed wetland system is via formation of relatively insoluble HgS and precipitation in hydrosoil. It will be important to avoid methylation of mercury in these constructed wetlands by regulation of water depth and flows to maintain the desired reduction-oxidation (redox) potential in the hydrosoil.

Total Suspended Solids Removal

The process used for treatment of total suspended solids (TSS) in the constructed wetlands system is based on Stokes' Law. As the velocity of the water flow into the flow management basin and particulates can settle from the water column. Thus, settleable and suspended solids are removed from effluent by physical sedimentation and filtration processes. A significant portion of suspended solids will settle from the water in the upstream flow management basins prior to entering the constructed wetlands. If water leaving the retention basins still contains appreciable amounts of suspended matter, the con-

Figure 4: The Water Park in Enköping. Source: Vatten & renhållning, 2004

structed wetlands will provide filtration by wetland vegetation to further remove residual suspended solids.

BOD Removal

Removal of biochemical oxygen demand from effluent is achieved primarily through sedimentation/filtration processes in the constructed wetlands. Organic matter (BOD) accumulated in constructed wetlands is largely degraded through aerobic microbial metabolism, and to a lesser extensive surfaces (plant and hydrosoil) in the constructed wetlands provide numerous opportunities for BOD transformation. The relatively high surface area to volume relationship in the water column of the constructed wetlands assures that ample dissolved oxygen is available for sufficient aerobic decomposition of BOD in the wastewater. These processes (both physical sedimentation and microbial metabolism) will function to decrease the BOD associated with the effluent outfall.

Case study - Enköping

Due to the increased effluence of nitrogen and phosphorous in the Baltic Sea and Lake Mälaren since 70s, the Enköping local council launched the project "Lake Mälaren Water" in 1995. The goal of this project is to reduce the pollution discharge to Mälaren River, especially to control nitrogen, phosphorous contents, thereby improving quality of daily water provided to Enköping residences.

The storm water is not filtered through the Enköping sewage works, but is running out into the Korsängen dyke and the Enköping River and finally finding its way into Lake Mälaren untreated. The first drafts to the storm water treatment facility were produced in 1998. The goals of the water park are not only treatment of different pollutants, but also creation of an aesthetically pleasant environment and inspiring recreation area for the local community. At the same time, it supports biodiversity.

The Water Park is developed on municipally owned arable land and consists of a shallow watercourse

with a system of dams, meandering through the landscape. Its work principles are based on storm water treatment by wetland. The Water Park flow process is shown in Figure 5.

The storm water accumulated from 1700 hectare outflow area including streets, roads and fields converging into the Korsängen Dyke (Inlet No.1 - Figure 5) is filtered through the Water Park, where bacteria living on the water plants transform nitrogen into harmless nitrogen gas. The sedimentation process of particle retained phosphorous eventuates. The water dwell time varies depending on the weather but the estimated average dwell time is between 5 and 10 days. The total water area comes to 90 000m2 and the calculated absorption of nitrogen is 3 to 5 tons and nearly 1 ton of phosphorous per year (Vatten & Renhållning, 2004). It means the contents of nitrogen and phosphorous after filtered through the Water Park can be approximately reduced 64% and 56% respectively. The Water Park also substantially reduces heavy metals between 53% and 86%. BOD, COD could be reduced 11% and 20% respectively.

Figure 5: Water Park Flow Chat. Source: Vatten & renhållning, 2004

In the water park, the important factors that control the treatment processes are the water's contents, composition of various materials, light, temperature, pH and flow conditions. Sedimentation as the purification process is of crucial importance for the treatment of many polluters in Stormwater. Long renewal time and thereby low flow velocity is particularly desirable. The weir (No.2 - Figure 5) regulates the water flow to the Water Park.

The Purification Process: the reaching water will filter through an over-flow surface (No.3 - Figure 5) and a filtering bed (No.7 - Figure 5), which main functions are the removal of particles and reduction of the level of nitrogen, phosphorous and other heavy metals at this stage. This is where the main purification process is accomplished. On the over-flow surface, it functions as a reservoir when there are excessive flows of water, the water is pumped into the filtering bed by pumping station (No.6 - Figure 5) through the intake pipe (No. 5 - Figure 5). Normally, a regulated amount of water (ca. 59-100 l/s) is being pumped out to the sprinklers on the filtering bed. On the filtering bed, the thin layer of water is slowly filtering through the grass-covered ground thus supply the water with oxygen and eliminate odorous smells. When the water has passed through these sections, most of the polluters will have been sifted away. The water is relatively clean and clear when it reaches to the accumulation dyke (No.8 - Figure 5). No.4 - Figure 5 is snow tip. It is used for cleaning the melted snow after heavy snowing in the wintertime.

Denitrification Process: in the Water Park denitrification is the main and final process to remove nitrogen. Nature's own resourcefulness is the main driving force in this bioprocess, the watercourse has three different depths. The deepest part of the section (No.9 - Figure 5) is 1.5 m deep and this is where the most essential part of the process takes place, the denitrification process, and the reduction of nitrogen effluence. Denitrification demands oxygen free (anaerobic) conditions and rich access to carbon. Bacteria in oxygen deficient water, converts nitrogen nutrients into nitrogen gas. The conversion reaction is shown below:

$$24NO_3^- \Rightarrow 5C_6H_{12}O_2^- \Rightarrow 12N_2 \Rightarrow 30CO_2 \Rightarrow H_2O \Rightarrow 24OH^-$$

In the denitrification process, pH is controlled between 7 and 8. The temperature is below 5 . In the deeper sections of water, substance making the water cloudy will also together with heavy metals sink to the bottom. The accumulation of sediment on the bottom of the water will have to be scraped off approximately every eight years and then disposal with special landfill that the landfill bed bottom is sealed in order not to pollute the groundwater.

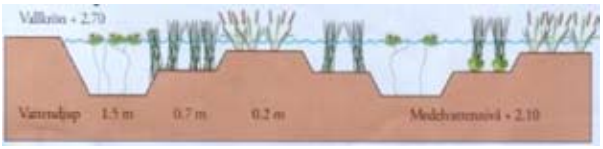

Figure 6: Denitrification Process. Source: Vatten & renhållning, 2004

The next water level has an average depth of 0.7 m and it is at this section of the dam where the water is oxygenated utilizing the undergrowth. The low water threshold is only 20 cm deep, but provides a very important function. Through this passage the water runs very slowly, filtering through the densely growing vegetation. A variety of border plants, a variety of sedges, herbaceous plants and flowers, grow alongside the water bank.

Vegetation in the treatment processes increases the possibilities for an even distribution of water flow and reduction of water velocity. Vegetation also plays an essential role in the nitrogen reduction process by immobilizing oxygen and carbon. It is important to choose such species that form sparse and continuous plant covers and has thin and streamlined shoots. This gives appropriate resistance to the water flow. The plants are harvested 10 times every year. Some of them are composted, others disposed at landfill.

Figure 7: Survey of Pedestrian Routes in Water Park. Pedestrian routes (identified during site's observation. Oct. 6th 04 by Chen Jie)

Finally, the purified water runs into the Korsängen dyke, this time either to be transported into the Enköping River or to go through the Water Park process once again. (No.12 - Figure 5)

Water Park is a well known place in the city, because it attracts people who look for recreation. Figure 7.

A naturally looking and inviting park is located near residential area, school and sport field. It invites those, who like biking, walking, jogging along pathways through meadows, over bridges. It attracts nature lovers. The Enköping Municipality plans to build a tower for birdwatchers. Park became an important habitat for plants and animals. Since the Water Park was constructed 180 new spices of birds have been found around.

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Neighbourhood Nature

Nature in the city of today – beloved as well as feared

9

by Ulla Berglund, Swedish University of Agricultural Sciences

Introduction

This report reflects research and reading conducted by the author during a long time – from the early 1980s up till today. It was my concern and confusion about an emerging ambiguity in attitudes to the green structure in the city that inspired me to write it. I wanted to sort out for myself and discuss with others, who might be interested in green space and town planning, what was/is going on with the appreciation of the nature on the door-step, the neighbourhood nature.

When following debate I found more and more negative opinions concerning the green spaces in Swedish towns. It seemed to me that this asset usually associated with nice things like beauty, health, peacefulness and children's play had got charged with more and more negative associations, to emptiness, ugliness and fear of crime. And this was not only in the critique of modernist housing projects. More so that the idea of nature as a prominent element in the city was questioned.

There was claimed that a city with only some small parks and no wild nature must be the most sustainable and most attractive one. Could that be true? Where are all the good things in nature gone, or are they really gone? If people still love their neighbourhood nature and make use of it, this is something I as a landscape architect should learn about and then tell others. If they don't, I must understand and handle that situation as well.

The report is an attempt to elucidate, at least in part, a complicated situation with many actors and different attitudes to life in the city. The text has got good response by colleagues in seminars, but showed hard to publish in all its length in a journal. In order to keep it as a whole I found this way for publishing. The writing started during my time in Södertörn University College, then financed by the Baltic Sea Foundation. However, changes have been made under ways until today.

City nature and the inhabitants

Most Swedish towns and cities are indeed green. The total extent of "green space" often exceeds 30 percent of the town area (SCB, 1991). According to more recent estimates, however, this statistical category that includes parks, wooded land and other unexploited land, is shown to be slowly diminishing. In the major cities of Sweden: Stockholm, Gothenburg and Malmö, the average amount of "green space" has decreased from 27,3% in 1980 to 24,8% in 1995 (Hans Ansén, SCB - Swedish Statistics, personal communication, 9 June 2002).

The greenness of these cities may be understood as having resulted from the late onset of urbanisation and the rapid growth of towns and cities during the last century, more especially during the decades following W.W.II. The layouts followed the then dominant modernist planning principles. There was also a plentiful supply of cheap land and, in many cases, also nature suitable for recreational purposes. Open-air recreation was regarded healthy and was popular with the Swedish public. In Stockholm there was also a concerted campaign fought against overexploitation by park admini-strations already during the 1950s and 60s. Holger Blom, prominent city gardener of Stockholm for more than 30 years, wrote:

"Now there are people who think that the city should be densely built and be intense. There you are supposed to make yourself useful, and when you then need to rest you shall have access to a second

Abstract

The almost self-evident appreciation of nature in the immediate proximity of urban living areas that has been attested to in much research on Northern countries, is under threat. This has similarly been observed for the cases of two high-rise districts: Bredäng in Stockholm, Sweden and Mezciems in Riga in Latvia respectively, both of which have been investigated using qualitative methods. This article does not go into details of the studies but reflects on some results towards a background of earlier findings and of different aspects relevant to urban life of today. The city nature can be said to be a cause of both joy and fear. (This text is based on Berglund, 2005.)

Figure 1. Bredäng, Stockholm. Well kept nature near by is appreciated as a sign of a descent place, a place fore play and leisure.

settling in a place suitable for recreation, whether this be in the vicinity of the city or in the Canary Islands. The reasoning falls on its own preposterous-ness. It is absolutely necessary to have daily and constant access to fresh air, sun and outdoor life, this especially holds for children. Parks are needed in the cities." (Blom 1969, s. 75, authors translation)

Today, old city parks appear to be highly appreciated by almost everyone, professional planners included, while the newer modernist green areas have a more dubious reputation. Prominent architects have, for a considerable period of time; blamed the "green deserts" for the "lack of urbanity" they are said to be causing. They are blamed for diverting pedestrian traffic from the streets onto separate paths and their space is seen as increasing distances between urban elements.

This is of course not the whole truth. Inhabitants in the green outer districts of Stockholm, for example, often mention nature as the "best quality" of their neighbourhood. I was clearly and quickly told this when I asked about neighbourhood qualities at a public meeting in my study area Bredäng on the outskirts of Stockholm in 1999 (Berglund, 2001). The importance of greenery as a quality of both neighbourhood and town was also evidenced in studies carried out in the mid 1980s in two outer districts of Stockholm (Berglund and Jergeby, 1989) as well as five years later in two Swedish towns (Berglund and Jergeby, 1992). Qualitative as well as quantitative methods were used and different aspects investigated, but all of the data pointed in the same direction.

In a Danish study Attwell et al. (2002) found that nearness to nature was the main factor for choosing to settle in a new "town" outside Copenhagen, although the traditional urban structure and the good and varied architecture were the qualities especially stressed and successfully carried out in this project. In fact, during an earlier study (Berglund, 1996) when I asked architects about their own personal "favourite places" in their own towns, these places turned out to be substantially more green than urban. Within all investigated groups (architects, landscape architects and "ordinary" inhabitants) parks constituted by far the most frequently chosen place category, and recreational potential seemed to be the key quality guiding most choices. Around half of the "inhabitants" who answered an open-ended question in a mailed questionnaire, and a somewhat lower figure among the interviewed architects, directly mentioned nature-related aspects as essential for their choice. Many "inhabitants" simply mentioned that the place was beautiful. That people on the whole judge nature as aesthetically more attractive than urban elements is attested to in numerous studies carried out by environmental psychologists (e.g. review in Herzog, 1989; Kaplan and Kaplan, 1989; Ulrich, 1993). The Kaplans note that the most common reasons for this judgement is that people "enjoy" nature or simply appreciate it for its "beauty" (ibid., p. 157).

Man-nature from a psychological perspective

As human beings we are in part nature. Mankind has also spent most of its existence on earth in natural settings and genetically speaking nature is that which we are adapted to. With this in mind, the biophilia hypothesis (Kellert and Wilson, 1993) suggests that we generally like to have nature around and that we feel at ease when we are 'in' nature. Ulrich (ibid.) notes that numerous studies have empirically shown that people of different cultures throughout the world tend to appreciate half open wooded landscapes and prefer "natural" forms to regular ones. Even if we are not in total agreement with the biophilia hypothesis, it might seem reasonable that human beings as living creatures also take an interest in and have feelings for nature as a symbol of life in different respects.

A large body of research carried out in laboratories as well as in the field and employing different kinds of manipulations and methods of measurement, lend considerable support to the idea of nature being a generally restorative environment. The positive emotional effects (people become relaxed/gain positive feelings) are particularly evidenced in these studies. On the whole, the idea of the restorative potential of nature on mental capacity is also supported. A strong link between aesthetic preference and the positive emotional effects of nature has also been shown. (Cf. Hartig et al., 1991; Hartig et al., 1996; Herzog and Barnes, 1999; Kaplan, 1995; Ulrich et al., 1991.)

Joy, pride and comfort

Nature seems to represent a basic quality as a symbol, a place for viewing, for being and for acting in. Perhaps we can also claim that there exists a special Nordic attitude to nature as has sometimes been proposed by researchers within architecture and ethnology (e.g. Löfgren, 1989; Norberg-Schulz, 1986, p. 306). Löfgren comments on studies on national heritage in Europe. While people of central and southern Europe tended to emphasise their historic built up heritage, Swedes instead pointed to their nature. In my study in Mezciems, an outer district of Riga in Latvia, I have met similar attitudes. The surrounding woods and small lakes are regarded by many – adults and school children alike – as the principle qualities and sources of pride in the area. The joy of simple activities in nature such as fishing, swimming and gardening, often at an old family farm or summerhouse, were frequently reported as being essential sources of joy by ten-year-old school children in their compositions. In a similar manner, the school children saw their most desired future home as being a house in close contact with nature. For them, nature seems to serve as a link with the past as well as to the future (Berglund, 2004). Similar attitudes have previously been found in Swedish studies (e. g. Berglund, 1998; Nordström, 1998).

Joy, in the sense of the pleasant feelings of satisfaction that experience of nature and activity in nature can generate, appears so obvious that it seems to lack the need for much explanation. The Kaplans comment on the findings of different researchers that suggest that physical settings seem to be closely related to "life satisfaction" and that this is especially the case for people of low social and economic status. They conclude: "People feel more satisfied with their homes, with their jobs, and with their lives when they have sufficient access to nature in the urban environment" (Kaplan and Kaplan, 1989, p.162). This conclusion is supported by later research. Kuo, (1998) suggests, for example, that vegetation around public housing can have positive benefits for people trying to cope with major life issues. Herzog and Chernick, (2000) found nature in urban settings to be a significant indicator of tranquillity. Tests showed that a relaxing walk after mentally fatiguing work resulted in higher levels of satisfaction when taken in a natural park than in urban settings (Hartig et al., 1991). Francis and Cooper, (1991) found that students of architecture tended to visit settings with vegetation and water to lift their spirits when they were feeling low or depressed.

A Swedish study (Uddenberg, 1995, Appendix 1) supports these results. In this 94% of those answering to a mailed questionnaire agreed with the statement: "Being in nature makes me relaxed and harmonic" and 92% disagreed with the statement: "I have no need for being in nature". In another study based on a mailed questionnaire, most respondents related how "nature and greenery" was the far most desirable view from their home - as compared to people, playgrounds, streets/parking lots, and buildings (Berglund and Jergeby, 1992).

I would conclude that people derive a considerable amount of joy and satisfaction from nature in the city. This derives from experiences of beauty and wellbeing, but also from participating in pleasant activities and from meeting and watching friendly people. This has been a finding of a large body of research, including my own (qualitative) research in Bredäng and Mezciems. On the other hand, I also found indications in these studies that positive experiences of nature in the city are under threat.

Fear and concern about safety and orderliness

Fear of nature is as old as mankind, but fear today is not exactly the same as it was before. Fear of neighbourhood nature on the outskirts of modern cities nowadays rarely derives from ghosts, witches and other dangerous beings. It is much more likely to relate to violent and dangerous people or a fear of dogs. Blomqvist (2003) however, found that fear of wild animals like snakes and insects (beside "darkness" and dangerous people) seemed to make adults as well as children to diminish their use of nature close to urban settings. The same causes of fear also appear in my ongoing study on school children in the Sätra-Bredäng area. The children living in this district of mostly public housing seem to keep to a number of centrally located places. Such a tendency was observed in a study by Gustafson (2001), where the children of a public housing estate were found to use much less of the neighbourhood and its nature than was the case for children living in an adjacent home owners district.

In Bredäng it seems not uncommon that even adult women restrict themselves from walking alone in the adjacent wooded areas, even during the daytime and even if they wish to get out of the house for some exercise. There is no longer the attitude that: "it will not happen here", on the contrary, and as someone directly related: "if it happens there in Tensta [another outer district of Stockholm], it might happen here as well". This, and similar comments, were made about cases of rape and other sexual crimes that, perhaps not surprisingly, seemed to especially alarm young women. As such, one's own neighbourhood is not regarded as a safe home place but a place like all the others, filled with strangers and people who one cannot trust. The findings of a quantitative study by Ivarsson (2000) can be mentioned as an example indicating an overall feeling of insecurity in the neighbourhood of Bredäng. It shows that almost

Figure 2. Mezciems in winter. For children the nearest nature is the most useful, and often the only one that parents regard safe enough.

50% of the respondents in the Skärholmen-Bredäng area reported that they avoided walking alone outside after dark.

In the case of Mezciems in Riga, attitudes that I found relating to risks in the neighbourhood are largely contradictory. These ranged from no worry at all to high levels of fear that had resulted in an extreme level of protective control of children. Some people related the changes that had taken place since the Soviet era when the police had been highly visible everywhere in the city and the control of errant behaviour stringent. Whilst this may have been perceived as annoying in other respects, it may have resulted in less concerns over violence when walking in the neighbourhood, as indeed one of my informants directly reported. The fairly new situation with no police visibility in the neighbourhood and with homeless people and youth gangs hanging around has lead to feelings of insecurity among residents. Another factor that was missing during the Soviet era was the reporting of crimes in the media, something that is now common in Latvia, while the image of a good and safe society of the socialistic system previously was to be promoted. (Cf. Berglund, 2002.)

These speculations are drawn from results of a largely qualitative study, but which also included questionnaires answered by some 100 school children's (10-15 years of age) concerning their attitudes to the neigh-bourhood. Although some parents really worried about safety in the neighbourhood, most of the children reported that they, with or without permission, used places in the surrounding nature without adult company (Berglund, 2004). This kind of use was also confirmed through observations. (None of the children in Mezciems mentioned fear of animals like snakes and insects.)

There are potentially many explanations as to why these children use the neighbourhood nature more extensively than is suggested in Swedish studies of high-rise housing estates. One explanation might be that this place represents quite a normal housing situation in Latvia. In spite of its somewhat degraded appearance this is not a segregated district with a bad reputation but is instead a fairly stable place. Compared to the Swedish situation, life on the whole might be judged as being less safe in Latvia, and attitudes therefore may be different. It seems that aspects pertaining to personal safety are not focused upon in the Latvian media to the extent that is the case for Sweden, and, as such, might alarm fewer people. With a low indoor living standard – around 20 square meters per person – that is more comparable with the circumstances in Sweden during the 1950s, the need to be outdoors to escape stressful situations and reduce conflicts is apparent. The greater need to spend time outdoors may act to block thoughts of risk or unease.

In my Bredäng study some of my informants told me that they "have decided not to be afraid" about walking through the forest to the shore of the lake. These informants, three middle aged women and one elderly man, valued this place highly, and two of the women also told me that they wanted to be

there to make younger women and girls feel safer. In a manner of speaking they guarded the place. Because of their strong motivation, they had made a conscious decision not to give in to eventual feelings of being unsafe.

Research done by American environmental psychologists shows that for urban settings the issue of safety and security is very salient. Drawing on the findings of a number of studies, Herzog and Chernick (2000) conclude that natural elements may act to increase concerns over safety when they are viewed as possible hiding places for criminals, while more open urban natural settings show a positive relationship with perceived safety. They also point to the importance of tending nature. Kuo et al. (1998) came to a similar conclusion when studying attitudes in a public housing development in Chicago. Here, basic landscaping in the form of planted trees and well-maintained lawns appeared to have beneficial effects on preference to place as well as sense of safety. The overall role in dominant American culture of neatness and order as "signs of sociable human intentions" in yards etc. is demonstrated by Nassauer (1995). It might be stated that neatness reflects care and belonging – the opposite of the neglect and abandonment that often characterises stigmatised neighbourhoods.

Conclusions

In places where residents do not really feel at home and do not trust each other, fear is fairly likely to affect the way in which the outdoor environment is used. The need to be on one's guard tends to make people fear not only darkness itself, but also all the things that diminish the overview. Consequently, whilst nature might be generally perceived as "the best quality" of a certain district, people may still wish to remove any wooded areas on the way to the centre, or the bushes surrounding the little park. An appreciation of nature is not unique to Nordic or Western cultures. It seems to exist everywhere even if the way we use and "respect" nature may differ. Perhaps the attitudes of professionals to nature (in a broad sense) in city planning vary more with place and time than is the case for the public.

Modern life affects the use of neighbourhood nature negatively. The differences in the everyday use of nature between two outer districts in Stockholm and Riga respectively, are noticed in my studies. In Riga one can still witness a more outdoor lifestyle of the kind I can remember from decades ago in Sweden, a time when we also lived more densely and also had fewer computers and other advanced "amusement-machines" at home. On the whole, even young school children in Riga seemed well acquainted with the place and its natural settings and most of them seemed to be allowed to move around fairly freely. Experiences from studies in Stockholm suggest more restrictions for children and also more self-restrictions for women in the use of parks and wooded areas. There is no evidence to suggest that the investigated district in Stockholm is more dangerous, but information in the media about unpleasant things happening in the region is commonplace in Stockholm and it is something about which people talk. In Riga, as far as I have understood, this kind of information is not as common, or at least it is not raised in conversation very frequently.

When it comes to the differences observed between the two neighbourhoods in Stockholm and Riga respectively concerning attachment to and use of the nearby nature, my conjecture is that the fast accelerating modernisation of life conditions in Riga fairly soon will drive us more alike. Migration and segregation as well as influences from West and Central Europe on personal life styles and urban ideals, I guess, will influence both cities to move in the direction of something like a European standard.

There are many decisions that need to be made concerning how green or how urban our cities ought to be in the future. These will for example be about quality of life as well as other aspects of sustainability. My argument is not that it would be better with fewer but better green areas, and neither am I arguing that all green areas should be preserved. I would say, however, that we have to accept that people living in the city today, spend less of their time outdoors and have lower levels of trust in each other. If we, the planners, want them to spend more time outside – for exercise, for play, for contemplation, for the promotion of health etc. – we have to find solutions whereby the places that are provided are attractive. This means a need for places where joy outweighs fear, and where beauty, not ugliness is, that which signifies nature even where it is close to where people live. Finally, perceptions of nature as "the best quality" of many urban neighbourhoods mean that all parties involved must share the responsibility of handling this resource with care.

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Urban Green Space in Transition
Historical parks and Soviet pustyr in St Petersburg, Russia

10

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Introduction

The global issue of urbanization is becoming more and more urgent. Metropolises as well as smaller cities of the world are growing and within 50 years more than 80 percent of the world's population will live in an urban environment. It is therefore important that the city develop in a sustainable way. Urban green areas have great potential in many aspects working towards a sustainable development as they fill various functions such as ecological, cultural and social. In the Russian Federation the urban population is decreasing since the dissolution of the Soviet Union in 1991, but the larger cities continue to grow and the urbanization rate is increasing (UN Population, 2004).

St Petersburg is the second biggest city in Russia and the largest city in the Baltic region with its five million inhabitants. Together with the Leningrad Region, it covers an area of 84,600 km_ (0.5% of the Russian Federation) (Kuznetsov et al, 2003). It is statistically a green city, with a large number of parks, gardens, squares, boulevards, green areas and urban forests, but the last decades of transition in Russia have affected the park situation economically, culturally and socially. Many parks are deteriorating due to lack of finances and the number of green areas is decreasing rapidly in favour to urban development. Moreover, the Soviet park tradition, based on a communist ideology, is dead; depicting a large discrepancy between what was left and what is needed today. The situation is far from sustainable.

The Danish Centre for Forest, Landscape and Planning, has since 1999 been involved in two development projects, focusing on strategic and practical development of planning and management of the urban green areas. In this chapter, based on the experience gained working with the two projects, we aim to high-

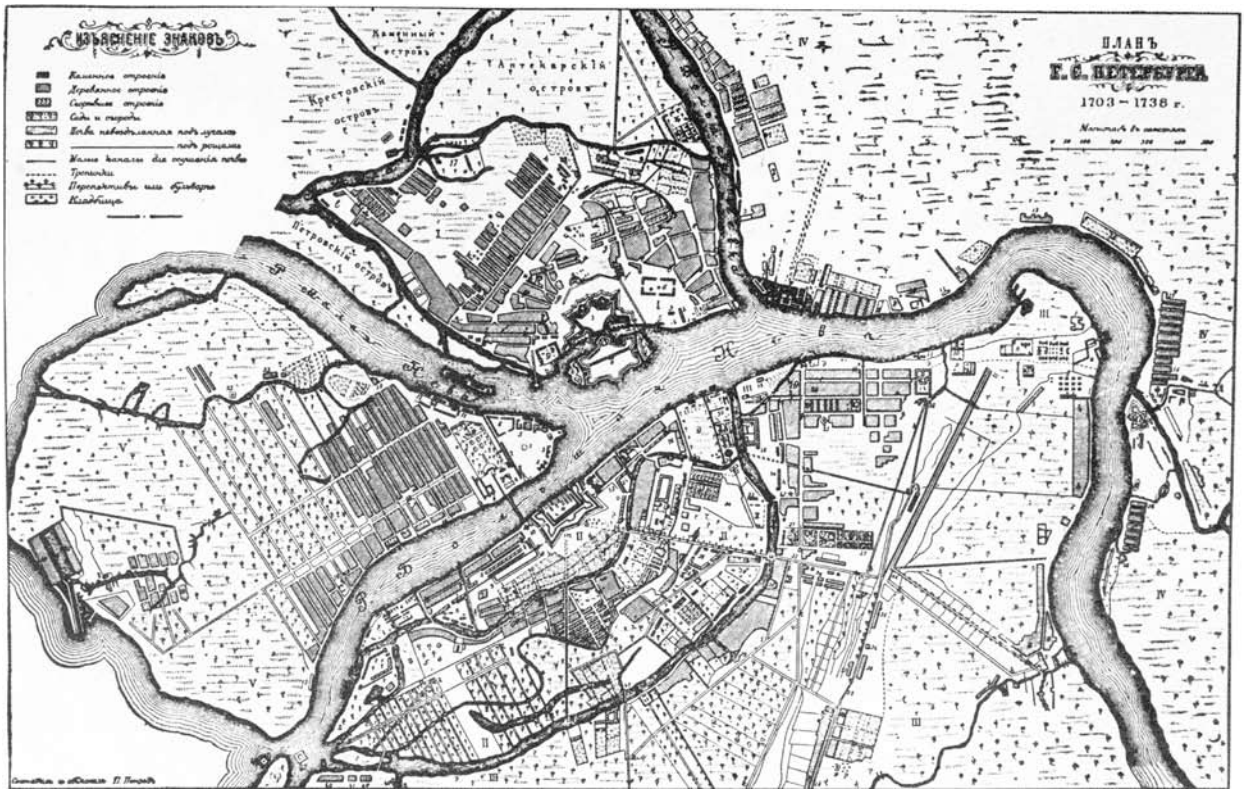

Figure 1. Map of St Petersburg from 1738 shows an established city only 35 years old. St Petersburg was by the time for its foundation in 1703 consisting of the delta of the River Neva, streams and marshy islands covered with vegetation. Peter the Great designed his new capital together with European architects, constructing a grid of streets and canals covering the delta, lined by grand palaces of classical architecture in stone. (Egorov, 1969)

light the problems and potentials of St Petersburg's urban green resource in a sustainable urban development context. The discussion deals with St Petersburg in particular, but in general similar phenomena can be found in many post-soviet cities today.

The urban green resource – historical background

St Petersburg is located in the very end of the Finish Bay in the delta of River Neva. Tsar Peter the Great conquered the land in the beginning of the Great Nordic Wars (1700-1721) and founded St Petersburg in 1703. Together with the French architect Alexandre Le Blonde, Peter the Great started a metamorphosis of an inhospitable coastal area into a superb city where palaces, churches, and two-storey stone houses all fit into a strict urban plan. The wet, scant landscape, with damp and unfriendly climate and regular flooding was transformed, the land drained, banks covered in granite and around the impressing mansions impressing parks and gardens, planted with lime trees and oaks. Of the natural vegetation of willow and pine, little is left in the current St Petersburg.

The delta was perhaps not the most suitable place for dwelling, or for creating a new capital for that matter, but to Tsar Peter, the action of placing this new capital of Russia by the Baltic Sea literally was to open a window towards the west, opening up for warfare, trade and new ideas from the west (Egerov, 1968). The reign of Peter the Great was the start of Russia's modernization and in this process St Petersburg, as Russia's capital 1712-1918, was the key location for development, involving the Golden and Silver ages of Russian literature, cease of serfdom in 1861, the painful industrialization and finally the Russian Revolution in 1917.

The historical parks

By the time for the foundation of the city, parks and gardens surrounding the palace was a symbol of great status. In St Petersburg parks and gardens were established in and outside the city. Peter the Great started the tradition in 1704 and established the Summer Garden in baroque style by his summerhouse on the bank of Neva. The magnificent garden, designed by the Dutch landscape architect Van Rozen, was the starting point for the park culture in St Petersburg, followed by the imperial summer residences outside St Petersburg in Peterhof, Pavlovsk and Pushkin as well as the noble mansions like Tavrichesky and Oranienbaum. They were all built with great parks in baroque and landscape style. The imperial gardens and parks were together with the historical centre, declared a cultural UNESCO World Heritage in 1990 (www.unesco.org).

Figure 2: The historical parks of St Petersburg, in baroque and landscape style, are remarkable pieces of European and Russian garden history. Peterhof, Peter the Great's summer residence outside Petersburg built in 1710, is called the "Russian Versailles" and is one the most famous and most visited sites in St Petersburg (Pict. Ulrika Åkerlund).

Figure 3. The park of Culture and Recreation is the most refined example of Soviet urban park tradition. Well equipped with sports facilities and pavilions for reading, playing chess and demonstrations. The picture shows the 1 May in 1975 in Moskowsky Victory Park (Picture from Departments of Gardens and Parks, 1976)

The Soviet green heritage

Even though St Petersburg is most famous for its historical parks and gardens, 80 percent of the urban green areas were established during Soviet time 1917-1991 (Personal communication, Alekseev, 2003). During this time St Petersburg, or Leningrad as it was renamed in 1924, expanded threefold. Hence most of the current urban green resource was established during the communist era, and is still characterized by the communist ideology and Soviet planning methods, in which green areas had three major functions; providing space for sports and recreation, sanitation (cleaning the air from industrial emission) and as memorial to Soviet history (Kuznetsov et al. 2003). The Soviet elements of the urban green resource, with a similar design, can today be found in any post-soviet city, from Tashkent to Minsk.

Parks of Culture and Recreation

One of the classical Soviet urban green elements is the Park Kultury i Otdykha (park of Culture and Recreation), which illustrates the finest example of communist public parks. In the Soviet urban society,

people should devote spare time to sports and cultural activity in order to keep their body and mind fit. Hence these parks were designed and equipped with sports facilities as well as conveniences for specific cultural activities such as pavilions for reading, playing chess, theatre stage for performances and cafés. In St Petersburg several classical parks were re-designed and equipped with such facilities. For example, the former mansion park on Yelagin Island was turned into the Central Park for Culture and Recreation. Another two Parks of Culture and Recreation were planned before the Great Patriotic War 1941-1945 (The Second World War in Soviet Union), one on Krestovsky Island and one in the new Moskowsky District. However, the war and the devastating 900-day German siege of Leningrad interrupted the development of these parks and after the war they were partly redesigned and established as memorial parks, in memory of the victims and the victory over the fascists, so called Victory Parks (Park Pobedy).

The forest park

Another typical kind of Soviet park is the lesopark (forest park). The term appeared in 1924 and was suggested to be "forest located not far away from the city" in order to be reservoirs of clean air in the industrial city and to be a place for recreation. According to their location, forest parks are classified as urban, suburban or semi-urban. Leningrad was the pioneer in planning of forest parks. The project of "Nevski" forest park was the first in the country (1936), but most forest parks were however not established until the 1960-1980's. The largest urban forest park in St Petersburg is Park Sosnovka (The Pine Park), in the northern part of the city. Its 302 ha of mixed forest was once located on the urban fringe, but is now totally surrounded by large roads and city districts of multi-family houses. As the lesopark primarily was designated to remain as forest, a forest park is usually less well equipped with functions and facilities than a park of culture and recreation, even though they can have the same number of visitors as regular urban parks. Other examples of urban forest parks are Udelnij Park, Piskarevka Park and Park Alexandrino.

The micro-rajon and pustyr

Development of the new modern Soviet urban society from the 1950's onwards was based on the concept of the mikro-rajon, literally meaning micro-district. The basic idea was to create smaller units of dwelling areas outside the city centre, entities where people had close to services, transports and recreation. Inspired by the Western architects and city planners, large blocks of houses, built in prefabricated elements, of five, nine and 15 storeys were put out on the Leningrad wetlands. Each micro-district could house 6000-15000 people. During the period 1960-1990 the urban population increased from 3.2 to 5 million inhabitants and 2 million m_ of apartment buildings was constructed every year. The micro-district concept was used all over the Soviet Union and forms today the largest Soviet landscape heritage (Borén, 2005). Only in Saint Petersburg 70 percent of the population lives in these areas (Lavrov et al. 2003) (For spatial distribution of micro-district, see Figure 4).

The concept was also reflected in the amount of open green space. In the city centre, the population density was 800 people per ha_, while the micro-district accommodated only 300 per ha_ (Kondryateva, 2001). The open green space was never professionally designed but the new residents cared for the space and planted trees and bushes (Personal communication, Sokol, 2003). Not all micro-districts were built according to the plan, leaving open space and vacant lots between the houses, designated as pustyr (literally vacant lot or non-built up space). In some cases the vacant lots have been invaded by nature and turned into wild areas and the local residents use the space for recreation (Borén, 2005). Together with the large backyards between the houses the vacant lots comprise a significant share of the urban green resource. Even though poorly developed, these areas have a large potential for the future.

Figure 4. The spatial distribution of micro-rajons in Saint Petersburg 2003. The city centre in the middle surrounded by industries and enterprises. Mikro-rajons are located all around Saint Petersburg and today 70 percent of the population live in this kind of dwelling (Map developed by Ulrika Åkerlund from Lavrov et. al. 2003).

Figure 5. The mikro-rajon, the dwelling concept of Soviet Union in 1960-1990, involved a high ratio between green space and built up space. The open green space was seldom designed but planted and cared for by the new residents. A backyard in Kupchino, micro-district in the southern part of the city. (Pict. Ulrika Åkerlund).

The forest greenbelt

The greenbelt of Saint Petersburg is a 145 000 hectare forest zone surrounding the city. The greenbelt consists primarily of more or less natural forest and was declared protected in 1948 by the verdict of the Soviet Government, for its environmental values, pollution, watershed management, for creating a natural border between urban and rural land, and providing space for recreation and sports. The forest belt has a radius of roughly 60km and closely located to the forests are sanatoria, holiday resorts, recreation resorts and camps for children (Ignatenko et al, 1980).

Officially the greenbelt forests are seen as forest parks, albeit in the suburban or semi-urban category, instead of the earlier mentioned urban forest parks. Not having an example of specific forest-park management from Russia or abroad, city experts began developing management methods for the suburban forest-park zone of Leningrad. The management of the greenbelt forest is based upon the principle that no commercial forestry is allowed and that all forestry activity should serve the aim of making the forest better suitable for its recreational functions.

Transitional processes in the urban green structure

Today the effects of the transition are noticed in several levels and aspects, concerning changes in planning, management, restoration policies, design of new parks and not the least the use of the urban green resource. Most of the urban green resource is today planned and managed by the St Petersburg Department of Gardens and Parks (DGP). The department was established in 1933 and is hence the oldest green department in Russia. Their organizational structure was a model within park management in the whole Soviet Union. But today the department is struggling with management and planning of a large number of parks, gardens and green areas, but with a largely reduced budget. The problems are handled in different ways.

Restoration or renovation

One of the transitional processes is related to the renewal of existing parks. The Soviet culture is of very low status in present Saint Petersburg. In search for a new identity, the cultural politics in Saint Petersburg is rediscovering its pre-revolutionary history from the period 1703-1917. From a park perspective this means that historical parks, which during Soviet time were re-designed with communist functions, are now regaining their historical appearance, while Soviet parks loose their green space.

Tavrichesky Garden

The recent restoration of the Tavrichesky Garden is a good example of the regaining process. Tavrichesky Garden, established in 1780, is probably

Figure 6. Tavrichesky Garden after restoration completed in 2003. The park, designed by William Gould, the Russian Capability Brown, in 1780 is one of the finest pieces of landscape style parks in Russia. Located in the city centre, the park also one of the most popular in St Petersburg and the social pressure is very hard (Pict. Ulrika Åkerlund).

Figure 7. The urban parks are attractive land to build upon, both for the central location and for the green environment. The combination of weak protection of parks, high commercial interest and income generating possibilities for the park management leads to a reduction of parkland. The picture shows commercial for a new exclusive residential house built in the middle of Primorsky Victory Park on Krestovsky Island.

one of the best pieces of landscape style parks in Russia. It is located in the city centre and is one of the most appreciated and visited parks in Saint Petersburg. In 1956 it was re-designed in Soviet style into 'The Children's park'. The park was equipped with sport grounds and playgrounds as well as a cinema and merry-go-rounds. The drainage has however always been a problem in the park and in 1990 a thorough restoration of the drainage system and the whole park started (Ignatieva, 1999). Due to lack of finances the restoration was first finalised in 2003, partly funded through the Danish project. As a part of the restoration the park regained its "original appearance", where all Soviet monuments and many facilities were removed and the recreational functions of the park for the people living in the area were reduced. Signs and information boards on the park's history were put up, but the park manager has discussed to shut the park to the public, due to vandalism and lack of respect for the historical values. People tend to use the park in the same way as they always have done, playing football on the lawn, taking a bath in the ponds, drinking beer, activities which means a much higher wear than the restored park can handle (Personal communication, Ivanova M. 2003). This might be explained by that the restoration was carried out without almost any involvement of the public. But another explaining fact might be that the restoration should have taken into account the large societal pressure and designed according to these needs rather that just returning to the historical appearance. The situation in Tavrichesky Garden illustrates a common conflict between cultural politics and people's current need for social and cultural space.

Figure 8. Few people in St Petersburg have their own house and garden. For daily recreation parks function as a second living room. They are used all year around for all different kinds of activities. Here pensioners play cards a cold November day in the Pavillion for Pensioners in Park Sosnovka (Pict. Ulrika Åkerlund).

Figure 9. Subbotnik, a public cleaning day in Tavrichesky Garden, organized during the Danish project (Pict. Cecil Konijnendijk).

Primorsky Victory Park

In Soviet parks, such as parks of culture and recreation and forest parks, the transition is seen in another way. The low status of the Soviet culture has lead to deteriorating state of all kinds of functions from this time and a shift to more economical activities, primarily due to a lack of funding for the maintenance of these parks. Park managers responsible for a specific park are to a large extent responsible for proving the necessary funding for the park maintenance, as they only receive 30-40 percent of the needed funding from the city budget. This situation has lead to 'creative thinking' in how to use the public facilities; many are now rented out for commercial purposes. For example the former reading pavilion in Moskowsky Park Pobedy has been rented out and is now turned into a youth entertainment centre

with video games and gambling machines. In other cases the economical thinking reduces the number of square meters of green space in the parks. On the central land in Primorsky Victory Park, parts of the park has been fenced and turned into an amusement park, a restaurant with a brewery and a residential house with luxury apartments have been built by the pond. It is uncertain to what extent the money earned from these concessions is used in the maintenance of each park.

One of the main questions of the parks' future is for whom and what are the parks for? What function will the park fill in the future, and is then proposed restoration or development suitable for this purpose? To only return to the historical plan or to turn former public facilities into money generating activities, with a direct impact on the existing green areas, seems unlikely to be sustainable solutions.

Figure 10. One of the few parks established after Soviet Union – 300-anniversary park by the bank of the Finnish Gulf. The design of the park resembles of the monumental communist tradition and only two years after the establishment several of the trees are dead. (Pict. Ulrika Åkerlund)..

Exploitation and densification

Since the fall of the Soviet Union and the entrance of market economy there is no master plan of St Petersburg. Very little was built during the first years in the 1990's, but the last years construction is going on, carried out mainly by private firms. In the transition era the city's economical and political power to invest in development of infrastructure, housing and green areas has been reduced. Meanwhile private firms investing in construction of new real estate, avoid expenses for infrastructure and build mainly in existing housing areas, changing the ratio between built up and open space. Everywhere in the city, in the micro-districts in particular, a process of densification is going on. Small squares disappear and parks are being built upon. Especially threatened are the vacant lots and the yards between the high-rise blocks, where new, even higher blocks are being built for the growing middle class in St Petersburg. The former Soviet idea of having large open green space for recreation and sports close to the dwelling is lost and the dense urban core is expanding out in the suburbs increasing the recreation pressure on the historical parks and on the forest green belt.

Social and cultural aspects

Using the urban green space as social space is very common in St Petersburg today. This might be explained by several factors. One important factor could be considered to be the Soviet social heritage. Private space, such as apartments, were deliberately built very small in order to encourage people to spend more time in public space (Personal communication; Uzhinova, 2003). When Stalin died in 1953, the average living space was 4 m_ per person (Borén, 2003). There simply was a lack of private social space in the Soviet society and people met in parks and gardens. Another factor could be considered as the Russian heritage with the Russians having a close relationship to nature and especially to the forest, picking mushrooms, berries etc. Even though St Petersburg is developing, the apartments are still rather small and the tradition of using the parks, gardens and forests as an arena for social and cultural activities, sports and recreation is still alive. Pensioners continue to gather in the Pensioners' Pavilion in Park Sosnovka playing cards a cold November day. Men meet by the Chess pavilion in Moskowsky park Pobedy, playing chess a sunny day in February. Children are skiing on the artificial mounds in Tavrichesky Garden, and teenagers can be seen hanging out, in parks all year round. Public cleaning days, subbotnik (deriving from the Russian's Saturday, expression for voluntarily working day), are still organized in parks and gardens and in the yards, gathering people.

Yet, the decreasing finances to manage the parks have made the societal changes evident. There might be more problems with visitors causing littering and vandalism today than during Soviet time. But the financial means to deal with these problems are also less. Park managers tend to see park visitors as a problem. In the Summer Garden the park management has solved the problem by introducing an entrance fee and close the park at night in order to reduce the number of visitors. In other parks, like Tavrichesky Garden, there are discussions to do the same. Meanwhile, there are few attempts in involving the public in the planning and management. An attempt of involving the local public in activities was made in Tavrichesky Garden, but apart from a number of 'local cleaning days' within the frames of the Danish project, the results were short-lived, probably due to the fact that there is little tradition for public involvement in Russia. The important social space is becoming less and less public.

Figure 11. A part of the new nature trail in Toksovski Forest district, which attracts hundreds of schoolchildren out in the forest. (Pict. Jasper Schipperijn)

Few new parks and gardens have been established since the Soviet Union fell. Most work carried out by the Department of Gardens and Parks has focused on restoration of historical parks and on the daily maintenance of the remaining urban green space, with a decreasing budget. But a large investment was made for the 300-anniversary of St Petersburg when the 300-anniversary park was established on the bank of the Finnish Gulf. Because of the anniversary the design should appeal to the classical ideals on which Saint Petersburg was founded. The result is however a mix of baroque and Soviet style, monumental in its appearance, but weak because of the fact that the design commits many of the same mistakes that Peter the Great once did, the most important mistake being that the design is not really adapted to the climate and the location. The large seashore boulevard and beach would have been very suitable in a Mediterranean city, but seem a bit out of place in Russia. Foreign countries contributed with trees and money, and as a result the banks were covered with a large quantity of high quality granite and the marshy land was planted with trees that are not at all suited for the windy, costal location.

Future perspectives

Changes in planning and management

In 2003 the Department of Gardens and Parks presented a Green Plan of St Petersburg, which could be seen as an important tool to develop the green structure. The plan was however based on data from the 1990's and several of the squares and vacant lots on the map were built up already. The plan was out of date, even before it was published. The urban development is much faster than the planning documents. In contrary, the strategic planning for the forest greenbelt has been more successful.

The interest among decision makers for urban greenspace has however increased greatly since 2003, partly as a result of an intensive process of creating public and political interest by the Russian-Danish cooperation projects. Among other two television documentaries about the forest greenbelt and its benefits were created and repeatedly shown on local television. And furthermore, the mentioned greenbelt strategy has created political attention for greenspace in general, which has lead to a 30 minutes television interview with the governor of St Petersburg and the director of DGP in which they were asked to explain their plans for improvement of the cities greenspace.

As mentioned above, the greenbelt is under strong pressure and therefore a taskforce of all involved parties was established in 2003. This taskforce prepared a 'greenbelt strategy'. This strategy document is briefly listing the problematic issues and giving detailed suggestions for how this situation could be dealt with. One of the most important suggested changes is a new organisation structure in which the whole forest greenbelt will fall under the cities responsibility, also financially. The strategy document has received broad political support, among other strong personal support from the governor of St Petersburg, and is likely to be adapted by the city council of St Petersburg in fall 2005.

The park as a nature classroom

The educational potential in parks is large as they often are located close to schools and kindergartens. In Moskowsky Park Pobedy and Park Sosnovka attempts were made to encourage teachers to use the park as a classroom for ecological and biological education. In both parks a nature playground was built with wooden play equipment and flowerbeds. In Moskowsky Park Pobedy a so called Nature Base was built – a room equipped with books and video films about nature, a microscope, tables to study by and a sink to wash your hands. Seminars for schoolteachers were arranged to teach them how to use the base in their tuition. Unfortunately the nature base is closed today due to lack of financial resources. Even though the park directors and management have realized the importance of educating children in ecology and use the park for this matter, there is very little effort made to support it, probably because of lack of experience in working with the public.

Nature education has then been more successful in one of the urban forests. In the Toksovski forest district in the forest greenbelt, the Danish project funded the establishment of three nature trails in 2003, which lead to an incredible increase in the use of the area by school classes, and at present it is not uncommon to see hundreds of schoolchildren out in the forest on a beautiful spring day. Nature education facilities and at a range of nature education material has been established and an agreement has been signed for the forest district to employ a specialist in nature education as the regular staff has little or no experience with this.

Figures 12a and 12b. How to develop the urban green resource? Maybe through finding the balance between the imperial and Soviet heritage and especially start to see the potential of the latter. To the left; Jekaterinsky Palace in Pushkin. To the right; A vacant lot or a potential park? (Pict. Ulrika Åkerlund).

The potential of Soviet green space

In the cultural shift from Soviet to Russia, from Leningrad to St Petersburg the historical parks have definitely regained a large part of their former glamour and they certainly play an important part in search for the new social and cultural identity. But the historical parks alone will not increase the quality of urban life. In this context the Soviet landscape heritage of St Petersburg – the parks of culture and recreation, the forest parks and the vacant lots could through proper planning and management contribute to a more sustainable urban development. One of the main challenges that lies ahead is dealing with the awareness, among stakeholders, decision makers as well as the public, about the values of the urban green areas – their ecological, social and not the least the cultural values. St Petersburg has with its high number of green areas, formal and informal, a large potential for developing a sound and sustainable green structure, which could enhance the quality of urban life.

The key to sustainable green development might not lie within keeping the number of square meters green space per inhabitant, but in an enhancement of the quality of the green areas and a proper distribution of green space throughout the city. A recent study in one of the micro-districts in south St Petersburg show that although the neighbourhood is very green, people would like to have more green areas. This probably has to do with the low quality of the greenery in the micro-district. Improved planning, pustyry acknowledged as potential green space and not only as future land for exploitation, and suitable design and management could raise the quality level enormously.

To return to the ideals of Peter the Great also means to return to the idea of St Petersburg as a modern and dynamic city. This involves to search for new ideals and traditions, finding a balanced way through history, respecting the historical layers and traditions, including those from the Soviet period, but also be open to new solutions in planning, design and management.

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From Introduction to Culture

I.B. Aleksandrov, Ye.M. Litvinova, N.G. Uralskaya

Historically the system of planting trees and greenery in cities has been developed through application of introduction. In translation from Latin to English introduction means deliberate transfer of some species beyond the bounds of their natural habitat. (N.F. Rejmers, 1995). This trend in planting trees and greenery is quite pronounced in the cities of the North-West of Russia.

Primarily introduction of such species was connected with monastic gardening. According to Bible canons monastic gardens were to imitate paradise gardens, therefore they were filled with ornamental, beautifully blooming, and fragrant plants of Abies, Tilia, and Rosa genuses. Some species, such as Malus, Salix daphnoides Vill, and Prunus spinosa L. had symbolical Bible meaning. As early as from 15th century people in Russian cities actively use these and other species brought from different countries in greenery planting. So the Novgorodians planted poplars in the streets of the city. The data about "planting of poplars in Slavkovaya Street" we find out in annals of 1469. Later a lilac ordinary, the bush originating from the Balkans and South-Eastern Europe, becomes one of the most favourite plants in the streets of Veliky Novgorod, the city in the North-West of Europe.

The vast surge of "the invited foreigners", as T.K. Goryshina, the known botanist from St-Petersburg, calls them is due to Peter's-the-Great town-planning activity. The Tsar took an active part in creation of the first gardens in St-Petersburg. Under his decree such not peculiar for the North-West of Russia plants as Armenica vulgaris Lam, Buxus sempervirens L, Taxus baccata L, Pinus sibirica Du Tour appeared on its territory. (T.K. Goryshina). Expansion of the foreign species took place mostly because of creation of the botanical gardens in the cities and steading parks in the countryside in 17th-19th centuries. The fashion on introduction had been fixed and kept later on.

During the last years we witness especially considerable introduction of "the invited foreigners" among shrubs and herbaceous forms of plants. Such shrubs as Syringa vulgaris L., Spirea nigra L., Crataegus sp., Caragana sp., Cotoneaster sp., and Philadelphus sp. become favourite and widespread both in cities and villages of Novgorod region and on the whole territory of the European part of Russia. At the same time practically no one of local species of shrubs is used in planting of greenery. The exception probably is Viburnum opulus L, and in cities with ancient history, this is Sambuscus nigra L. Similar tendencies are observed in the case of ornamental herbaceous species. Primarily the territory of the North-West of Russia adopted plants from Western Europe (Tulipa, Narcissus, Diantus caryophyllus, Tagetes, Calendula). Then Pelargonium, coming from South Africa, which for long years had been "a mistress of window-sills" and symbol of narrow-mindedness, started to be actively used in planting of greenery in the streets. Nowadays various forms of Japanese Hosta sp., North-American Solidago Canadensis L., and many other ornamental kinds of grass became masters of flowerbeds and lawns of the Russian cities. Their list is being replenished every

Figure 1. Lythrum salicaria L

Figure 2. Anemonoides ranunculoides L.

Figure 3. Ajuga reptens L.

year and imported seeds and planting material prevail at florists'.

Introduction of new species into human habitat is explainable, as it allows forming its unique bright shape, distinguishing from nature, that satisfies human need for novelty and induces its feeling of surprise.

However botany finds out many problems connected with the use of imported plants in planting of greenery and trees.

One of them is hybridization. Species of one kind, moved from different geographical areas to the same territory, show the ability to cross and produce posterity distinguishing from parental forms in combination of features. Special susceptibility to hybridization is shown by species of such kinds as Populus, Tilia, Crataegus, and Salix. There is known the hybrid of West-European kind of Tilia platyphyllos Scop. and local forest kind Tilia cordata L. This kind (Tilia x vulgaris Hayne) is rather common in gardens and parks of Russian cities. Sometimes trees of the given kind run wild. As a whole, hybridization is a phenomenon contributing to increase of variety of forms, but there arise a number of questions about the future of hybrids. Do they always possess features useful for a human being? What is the degree of their aggressiveness towards natural communities into which they are able to penetrate?

The second problem is transformation of cultivated kinds into wild forms, as some plants show the ability to be independently reproduced and grow without human help. Initially they settle in places, which were not inhabited by the representatives of local flora, then some of them move into natural communities, occupying there steady positions and competing with wild kinds. The examples of such kinds among wood plants in Novgorod region may be Amelanchier spicata (Lam.) C. Koch and Acer negundo L. Caragana arborescens Lam. shrubs are quite often met in natural communities. Cultivated North-American kinds of herbs Aster lanceolatus Willd, Solidago Canadensis L., Impatiens grandulifera Royle and others also show the ability to run wild. Especially glaring example of aggressive expansion with negative consequences has been shown by Heraclium sosnovkyi Manden. At one time this plant was grown for silage. Nowadays its brushwood of human height can be seen along the roadsides, on waste grounds, field and forest edges, and in the meadows, where it practically suppresses the development of local kinds. Besides, Heraclium sosnovkyi Manden has rather unpleasant feature: the touch to its leaves and stalk causes heavy stings. Nowadays botanists actively investigate the process of introduction of new species and there is arising a problem of biological pollution on protected natural territories intended for preservation of aboriginal types of vegetation and regional flora.

There also exists the third problem, which consists in the inadvertent drift of organisms of different systematic groups, which accompanies the introduc-

tion. As a rule, such drift takes place along with the drift of the rudiments of the kind introduced. First of all these are weeds. Alliaria petiolata, which got to the territory of Russia along with the kinds, which were ordered in Western Europe for gardens construction in Russia in 18th century, can exemplify this process. Kinds of Galinsoga sort are examples of modern introduction of weeds originated from Northern and Southern America.

Insects, animalcular fungi, bacteria and even viruses can travel with ground and packing used for transportation of plants. These kinds are out of human control, and their drift and consequences of their introduction into local communities have not been enough investigated. More appreciable cases are those connected with the diseases of plants, animals, and human beings. So, it is known about one kind of animalcular foliicolous fungi delivered from Western Europe in planting material in 18th century. This fungus causes Dutch illness of desiduous trees mostly affecting elms. It germinates into plant vessels, clogs them and the tree dies from lack of mineral feeding.

It should be noted that many scientists wrote in their works about the investigation of the problems specified here (see the collection of materials of a conference "Problems of studying adventive and synanthropic flora in regions of CIS", 2003). We, in particular, investigate processes of flora genesis in Veliky Novgorod, which have more than a thousand-year history.

As to planting trees and greenery, the authors of given article, having noted the above negative aspects of introduction of ornamental plants, in no way deny its positive role. At the same time we would like to draw reader's attention to one more very interesting method of enrichment of cities environment. This is cultivation and use of wild kinds of local ornamental sorts in city planting. Besides, introduction of local kinds of plants into city environment has no disadvantages observed at introduction of alien kinds.

Transfer from introduction to cultivation of local wild plants would result in a number of positive effects.

In Veliky Novgorod, as well as in other cities of Russia, a great part of land belongs to municipal government. Therefore, considerable funds from the city budget are allocated for planting trees and greenery. When introducing new plants, planting material and care costs are especially high. Use of local wild-growing kinds in planting greenery is economic. Kinds of local flora are often capable of self-reproduction directly in the city's environment. Seeds of wild-growing plants have better germinating capacity, up to 90%. For example, one gram of seeds of Jacea phrygia L. contains 300-350 pieces, which retain their germinating power for 3 years. Wild-growing plants are less freakish and are noted for their resistance to illnesses and pests, and climatic changes. Therefore they do not need additional special care as the introduced plants do.

A number of Russian cities, such as Veliky Novgorod, Pskov, Tver, Smolensk and others have on their territories ancient centers rich in architectural monuments, which date back to 11th-12th centuries. Frequently they are located on multiple relief, being surrounded by the territories of protected areas, and it is not possible to use there modern methods of planting trees and greenery in built-up city areas, because it is necessary to save the historical landscapes. The concept of planting developed by a group of members of Novgorod Antiquity Society for protected area of Novgorod Creml is an example of the approach based on reconstruction and preserving of natural environment surrounding ancient monuments. In particular, they offer planting wild-growing ornamental kinds of local regional flora on the sides of the Creml wall.

And finally, it appears, that nowadays' city-dwellers, which live far from natural environment and are more and more absorbed by virtual world, will be glad and surprised having seen wild-growing flowers from Russian meadows and forests among already usual marigolds and begonias.

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