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Sandström U.G., Khakee A., Angelstam P.

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PLANNERS' NEED OF KNOWLEDGE IN MAINTAINING URBAN BIODIVERSITY

U.G. Sandström*, A. Khakee, P. Angelstam*****
*Department of Natural Sciences, and Centre for Housing and Urban Research, Örebro University, Sweden
**Department of Social Sciences, and Centre for Housing and Urban Research, Örebro University, Sweden
***Department of Natural Sciences, Örebro University, and Swedish University of Agricultural Sciences, Forest Faculty, Department of Conservation Biology, Riddarhyttan, Sweden

ABSTRACT

This paper evaluates to what extent Swedish urban planners have sufficient access to adequate knowledge and appropriate tools to plan for the maintenance of biodiversity by providing green space of sufficient amount and quality in an urban setting. Three planners in each of six large Swedish cities were interviewed with respect to their interest, ability and knowledge about planning for functional networks of green spaces. The unanimous view was that they are interested, but are limited by knowledge and personnel and technical resources. The paper concludes with normative reflections about how planners' knowledge can be improved.

Keywords: Urban planning; Urban green space; Interviews; Biodiversity; Landscape ecology; Green infrastructure; Swedish green planning.

1. INTRODUCTION

Rapid urbanisation is a global phenomenon and cities require an increasing amount of land and other resources (Rees, 1997; Yokohari *et al.*, 2000). Expanding cities also generate air, soil, water, light and noise pollution (Haughton and Hunter, 1996). However, urban citizens expect a high quality of life including good public health, an unpolluted environment, good food and safe drinking water, as well as possibilities for recreation in open green spaces (Botkin and Beveridge, 1997). Satisfying these aspects, along with economical and social well-being are important components in the development of a sustainable urban environment (WCED, 1987; UN, 1992; Khakee, 2002).

The maintenance of biodiversity is of primary concern for the ecological dimension of sustainable development (Heywood, 1995). The main problem for species diversity is the increasing lack of habitat (e.g. Fahrig, 2001), which is accentuated in and near urban areas. In many types of land use attempts are consequently made to assess the quality of habitat networks (e.g., Angelstam and Andersson, 2001). The consequences of such assessments can be continued use, restoration, and even re-creation of habitats (e.g. Dramstad *et al*., 1996; Brunckhorst, 2000; Pirnat, 2000).

A quantitative relationship has been found between components of biodiversity, such as species or ecological diversity, and the amount and distribution of habitats in urban areas. For example, Mörtberg and Wallentinus (2000) used seven red-listed forest bird species as indicators of habitat quality when designing urban green space corridors to conserve deciduous forest. These bird species indicated that larger areas of natural vegetation, preferably in combination with a network of important habitats in the whole urban landscape, was important. Similarly, Wirén (1994) found that a larger number of residual habitats with high structural diversity and non-managed habitats close to urban parks, natural ponds, older plantations and large continuous habitats had a positive influence on the number and diversity of bird species in the parks. In a study of bird communities in urban woods in Seoul, Park and Lee (2000) found a positive correlation between the diversity of bird species and land area, nesting and foraging sites and migration habitats. The management guidelines favouring birds was that urban woods should be larger, contain shrubs and be surrounded by protecting green space. Consequently, the maintenance of a diverse set of not only plants but also area-demanding specialised species requires a sufficiently well connected network of habitats, which are likely to be different for different species (Scott *et al*., 2002).

Conservation planning in urban areas also has a key role in explaining to the public what biodiversity maintenance requires in practice. Young citizens of today are future decision-makers and need knowledge about consequences from exploitation of land as for biodiversity. In Sweden the local government is the level of society's decision-making which is closest to the people. The local government is responsible for water supply, refuse disposal, social welfare, education and physical planning. Consequently, it has a key role in realising sustainable development in practice, both directly in the urban setting and indirectly by taking decisions for the whole landscape (EEA, 1997).

The concept of green structure (i.e. the total amount of green spaces, or habitats, in the urban landscape) is commonly used in urban planning (Jensen *et al.*, 2000). This concept, however, does not necessarily reflect the function of urban green space for the maintenance of biodiversity. To obtain functionality for biodiversity, the green structure network must be of sufficient quality, for example in terms of size, number, density and connectivity of patches of green structure elements (Forman 1995). To use the terminology of urban planners who deal with roads and technical infrastructure such as data communication and electricity, we have introduced the term 'green infrastructure' (e.g. Little, 1990; Beatley, 2000).

This study evaluates to what extent urban planners in Sweden have sufficient knowledge, resources and skills to maintain a functional green infrastructure, and thus satisfy the ecological dimension of sustainable development. The specific aims are to find out (1) to what extent urban planners consider the need to maintain green infrastructures, and not only green structure in general, in their planning work, and (2) their ability to carry out in practice the conservation, restoration and re-creation of such green structure networks. We first define a normative model for planning urban biodiversity and operationalise this concept by using landscape ecology as a tool. Secondly we report on detailed interviews with 18 urban planners in six large Swedish cities working with the planning of green infrastructure. Thirdly, the planners' answers are evaluated with the normative model. Finally, we give some recommendations on how to develop urban green infrastructure planning fostering the maintenance of biodiversity in urban landscapes.

2. METHODS

2.1. Extension of the biodiversity concept for urban landscape ecology

The starting point is to define a normative model regarding how planners can manage the network of green structure to benefit biodiversity by maintaining a functional green infrastructure. As this study is transdisciplinary between natural and social sciences, we need to explain in more detail some concepts common in the former science. To evaluate the extent to which biodiversity planning is considered in urban green infrastructure planning we use the definition of biodiversity and operationalise it by using landscape ecology as a tool.

2.1.1. What is biodiversity?

The biodiversity concept is a product of an increasing concern about the accelerated loss of natural habitats and their populations of species (Lovejoy, 1980; Wilson, 1985; 1988; Heywood, 1995). The concept was introduced to increase the awareness of the extinction of species (Wilson, 1988) and it first appeared in a foreword by Lovejoy (1980): " ... the loss of two-thirds of all tropical forests by the turn of the century. Hundreds of thousands of species will perish, and this reduction of 10 to 20 percent of the earth's biota will occur in about half a human life span. .... This reduction in biological diversity of the planet is the most basic issue of our time." In the beginning biological diversity referred to species or genetic diversity (Harper and Hawksworth, 1995) but Norse *et al.* (1986) expanded its use to three levels: genetic (within species), species (species number) and ecological (community) diversity. Wilson (1988) used the contracted form 'biodiversity', synonymous with biological diversity, coined in 1985 for the first planning meeting of the "National Forum on BioDiversity" held in Washington D.C. 1986 (Heywood and Baste, 1995).

An important milestone that placed biodiversity on the political agenda was the UN report *Our Common Future* (WCED, 1987). Biodiversity was discussed therein from a utilitarian view, mainly in terms of species and ecosystem diversity and to some extent life processes, but focused mainly on the value of genetic diversity for mankind. The report also paid special attention to the importance of protecting the living and non-living parts of our environment essential for the development of society. In line with *Our*

Common Future the Rio-summit (UNCED) held in 1992, was another milestone to support biodiversity through the document Agenda 21 and the Convention on Biological Diversity (CBD) (UN, 1992; UNEP, 1992).

The CBD endorsed the importance of the term biodiversity and outlined the three levels by Norse *et al.* (1986) (UNEP, 1992). According to the CBD "Biological diversity (or biodiversity) means variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". The CBD is one of the most significant and far-reaching environmental treaties ever-developed (Heywood and Baste, 1995). Sweden has adopted the CBD definition of biodiversity (Hedlund and Eriksson, 1993).

Biodiversity is also scale dependent (Noss, 1990; Angelstam, 1998; Larsson *et al.*, 2001). For example, the number of species within an area of a given size is called within-habitat (alpha) diversity while the turnover of species along an environmental gradient is called between-habitat (beta) diversity. At an even broader scale, i.e. at the landscape level with several environmental gradients, the overall diversity is called gamma diversity (Wiens, 1989).

A basic requirement for the practical maintenance of biodiversity in planning and management is that components of biodiversity can be measured and assessed by comparing measurements to desired targets (Angelstam *et al.*, 2001; Duinker, 2001). Such practical measurements require knowledge about how to assess the viability of populations of different species, habitat quality and important system processes. One of the first attempts to develop a framework for this purpose was Noss's (1990) division of composition, structure and function of biodiversity. However, the implementation of policies in practice lingers. For forest biodiversity the development has gone relatively far compared to other kinds of land use. The use of species as indicators for habitat qualities makes it possible to design and preserve habitats. Angelstam (1998) and Larsson *et al.* (2001) represent the first few comprehensive approaches for designing systems to measure all components of biodiversity at multiple scales.

Land management and planning deals with the patches of different land cover types in the landscape mosaic. Consequently, structural components of biodiversity (i.e. habitat) are the focal planning units. The main unit for management in forestry is the stand, in cities the district, and in agriculture the farm or small village (see Table 1).

Humans interact with environment at local as well as regional levels indicating that the unit of management should be the entire landscape, i.e. a whole cluster of local ecosystems and not just a single one (Brunckhorst, 2000). For example, landscapes containing urban areas are continuously losing habitat and are being fragmented due to urban expansion by roads and buildings, affecting biodiversity (e.g., Yokohari *et al.*, 2000). Accordingly, urban green planning should focus on the landscape level to include effects of fragmentation on the number, size, shape and distribution of patches, and also ecological processes affecting both the dynamics of patches as well as individuals of different species, connecting to the infrastructure issue (cf. Niemelä, 1999).

2.1.2. Landscape ecology and the maintenance of green infrastructure

Landscape ecology has grown in importance due to the need for a holistic view on various environmental issues. The discipline, established in the 1980s, gives new perspectives to spatial management by including land use history, habitat loss and fragmentation, natural and anthropogenic disturbances, and biodiversity (Klopatek and Gardner, 1999; Sanderson and Harris, 2000). Landscape ecology is consequently a multi-disciplinary complex including biology, ecology and physical geography (Forman, 1995). In landscape ecology models can be developed to increase the understanding of the landscape and in the need of managing large data sets, geographical information systems are an important tool (Klopatek and Gardner, 1999). Increase in environmental awareness during the last decades has enhanced the need to understand how human exploitation and land use affects different components of biodiversity (Niemelä, 1999; Sanderson and Harris, 2000). Landscape ecology is therefore an important tool for the practical maintenance of biodiversity.

Care about the number and spatial arrangement of landscape elements in different kinds of land mosaics is a common denominator for planners and landscape ecologists. Important differences, however, are the need to consider connectivity in the landscape of the habitats required by species with different specialisation (Forman 1995), and the identity of the landscape elements, i.e. what kind of

habitat they make up. In an urban area, green spaces in the form of parks, gardens and greenways, depending on their quality and connectivity, can be considered as a green infrastructure for the maintenance of biodiversity. To ensure sufficient connectivity the different patches of green spaces should be of sufficient quality and size, and not too far apart. The spatial distribution of patches and the dispersal abilities of target species are key issues for functional connectivity of green infrastructures (Scott *et al.*, 2002). The concept of functional connectivity includes both spatial configuration of habitats, and the life history of populations of species (e.g. Forman, 1995). Sufficient spatial and temporal connectivity is a crucial prerequisite for the persistence of viable populations that specialise in particular habitats (e.g. Forman, 1995; Jansson and Angelstam, 1999). However, species differ greatly not only with respect to the kinds of environments that they require, but also in relation to the size of patches of those environments. By using several species preferably from different organismal groups, different habitats can be included, which is likely to minimise the number of important elements missing in the landscape (Thompson and Angelstam 1999, Lambeck, 1997).

2.1.3. The normative model

Based on the definition of biodiversity and the use of landscape ecology, we have formulated a series of steps to be included in order to manage the network of green structure to benefit biodiversity by maintaining a functional green infrastructure (Table 2). An urban landscape usually contains parks and other near-natural environments. However, these will constitute a green infrastructure only if they are organised with an overriding strategy, for example with identified valuable green core areas with connecting greenways both among core areas and between core areas and the surrounding land (Sandström, 2001). To create an urban green infrastructure and secure biodiversity with certain ecological parameters, planners need to pay special attention to the factors described in the normative model. In addition to various sources of knowledge, it is important to enhance green thinking that includes biodiversity and its relationship to urban sustainability. Professionals from various disciplines and backgrounds, as well as representatives of stakeholders including the public, are the main actors in the planning process and therefore it is essential to have a common framework of intention. This facilitates communication and also evaluation of the planned measures.

The spatial domain of urban planning may range from the entire urban landscape, to a network connecting green spaces, down to a few blocks. Accordingly, the range of species, ecosystems and functions will vary and comprehensive planning for biodiversity can be made at different spatial scales for different purposes. In addition, as it takes a long time for ecosystems to become established history of land use, this is also an important aspect to include.

2.2. Interviews with planners

The knowledge about biodiversity maintenance planning among planners was assessed by comparing the local planning approach with the normative model in the form of detailed interviews (Kvale, 1997). We started by sending a letter to six local city authorities, asking them to choose three planners who would be suitable for interview. In each city these three planners were then interviewed on site. Besides profession, education, duration of appointment as planner, they were asked 17 questions (see Appendix). The questions were divided into six contextual categories: (i) current sources of knowledge (1 question); (ii) knowledge needs (4 questions); (iii) content of new knowledge (1 question); (iv) necessary resources (5 questions); (v) the use of knowledge (1 question); and (vi) likely consequences (4 questions). Each planner was interviewed alone for about 1.5 hours and the interview was recorded on tape and analysed afterwards. Four of the 18 planners were women. All the interviews were carried out by the same person (Sandström).

2.3. Critical evaluation of answers

The planners' answers on particular questions were evaluated further according to their agreement with the answers to other questions both within and among respondents from a given city, and to the normative model. For example, if there were discrepancies on the one hand between the answers from the respondents within the same city, and on the other between the pictures the respondents gave of the city and the impression the interviewer received. This could, for example be a demonstration of the use of GIS made by the respondents and what was actually said about how this tool was used in the city. In this evaluation we also considered documents from the city, for example the structure plan, or if present the green plan.

3. DESCRIPTION OF THE CITIES STUDIED

Six Swedish cities were chosen (Table 3). The following selection criteria were used: The city should be in a phase of expansion, with an increase in population size, a large built-up area by Swedish standards, and situated in similar biogeographic regions of Sweden. In a Swedish municipality there is both an urban and a rural area and, usually, the local government is situated in the largest urban area in the municipality. The administration of the local government is organised in several departments of which the planning department is one (Khakee, 1989).

4. RESULTS

4.1. Interviews

Out of the 18 planners interviewed nine were architects (two women), four were landscape architects (of which two were women), and the other professions were social scientist, forest officer, physical planner, ecologist, and an autodidact. On average, each person had worked as a planner for 24 years with a range between 3 to 42 years. The planners' answers are discussed under the following six captions:

4.2. Current sources of knowledge

In Sweden, national urban policy played a dominant role up to the end of the 1980s (Khakee, 1983). Consequently, it is not surprising to find that planning and environmental legislation and national policies play a major role in current planning work. Twenty-seven out of the 55 sources of information for the planning work, identified by the planners interviewed, were related to national laws and policy documents. Even though the Rio Declaration and Agenda 21 have received a wide attention in Sweden, and almost all local governments have prepared a local Agenda 21 (Lidskog and Elander, 2000), international sources like the UN documents played a very modest role as knowledge source. Only 6 out of the 55 sources reported were international publications.

Sweden has been a member of the European Union since 1995. However, only one of the 18 planners interviewed referred to the European Commission directives as a factor affecting the planning process. Research and education played equally small roles as sources of knowledge. Only two of the eighteen interviewed regularly followed research reports in the field of biodiversity and green infrastructure planning. The most surprising fact from our findings is the lack of citizens' views as sources of information. Only one planner found this source of information as relevant for the work.

4.3. Need of knowledge

Conventional thinking about urban planning of green spaces is justified as a tool to promote recreation and public health in towns and cities. By contrast, planners seem to pay little attention to biodiversity aspects that have received recent attention. Of the 60 reasons for requiring new knowledge put forward in the interviews, 28 % were related to recreational and public health issues in urban planning. It seems that the work with the local Agenda 21 has had some impact on planners because a little more than one fourth of the reasons were related to the importance of green infrastructure for sustainable urban development. Five of the respondents were of the opinion that new knowledge would improve green planning in urban environments.

As for new knowledge, about one sixth of the reasons were related to the development of new housing, commercial buildings and other physical structures. Five of the 60 reasons had to do with the work regarding the local Agenda 21. Planners felt that new knowledge would contribute towards improving their work with sustainable development policy in the local Agenda 21. Finally, there were a few more specific reasons for requiring new knowledge, for example for improved management of storm water, organic waste recycling, public parks and air quality.

4.4. Content of new knowledge

While there was no consensus about what kinds of new knowledge that local governments would require in planning for biodiversity, three themes could be identified from the total of 28 items about knowledge contents.

The first set of items refers to knowledge about special environmental assets within the municipal territory on which current knowledge seemed to be inadequate. These assets included gullies, wetlands, meadows, and primeval forest and endangered species. The second was about how knowledge concerning biodiversity can be applied to the management of natural resources. In this case the planners felt that the provision of knowledge should not stop at the survey stage but go further and provide the necessary ideas of how to make practical use of knowledge for management and planning. As an example, planners maintained that existing inventories and surveys of different components of biodiversity were not implemented adequately. Special issues named under this category were ecologically sensitive areas, surface water, valuable green spaces and other objects of high value for biodiversity. Finally, some planners suggested a third set of knowledge items that related to truly long-term sustainable development. Here the planners referred to different types of species and natural habitats.

4.5. Necessary resources

With a few exceptions, there seemed to be a general agreement that, at present, local governments lack necessary resources to plan for biodiversity. However, except for this general agreement, there was a diversity of opinions (109 altogether) about what is required in order to consider maintenance of biodiversity in the planning process.

As many as 44 out of the 109 suggestions dealt with the need for more education about biodiversity planning in theory and practice. The suggestions included several requests about how to improve available resources in order to focus more on the issues related to biodiversity. Examples were how to apply a holistic perspective in the planning process, and to improve planners' skills in green infrastructure planning. A third set of suggestions were more specific, that is, they were related to special topics where education is required, for example knowledge of ecosystem ecology, re-use of former exploited land, environmental impact assessment and sociotopes. The latter are non-exploited places valued by citizens, that describe social and cultural values of a site. This was considered especially important for urban green planning in Stockholm (Ståhle and Sandberg, 2000).

Nearly one fifth of the suggestions dealt with organisational inadequacies. Planners felt that in principle the local government had some competence, but that this was not utilised properly because it was not located where it was most needed, namely in the planning department. In some cities as many as three or four departments, for example the environmental office, the technological office, the city garden office and the planning department, could be involved in or have responsibilities relevant to urban green planning. Others felt that the organisation was too slim-fitted and that this hindered a proper use of the existing competence. A few of these interviewed felt that some of the planners should be given the task of green planning rather than entrusting the task to the entire planning department. Finally, one of the planners interviewed suggested that the inadequate use of available resources had to do with the inefficient flow of information within the organisation.

Another fifth of the suggestions concerned the personnel situation. Most of the suggestions referred here to shortage of competent personnel to deal with issues related to green infrastructure planning. This included for example re-organising the planning organisation in order to establish proper relations between local government officials and decision-makers and also with business community and other community interests.

In about a tenth of the suggestions it was implied that local governments would never be able to have permanent resources for dealing with planning for biodiversity. Several of these appeared to favour the use of external consultants whenever necessary. A few others called for establishing contacts with universities and other research institutions in order to make use of relevant competence for this purpose.

Finally a small number of suggestions stressed the need for knowledge additional to biodiversity and green planning, such as the local government's skills in negotiations with businesses and other community interests, and for project management.

4.6. Likely consequences

The planners interviewed suggested three sets of likely consequences of making use of the new knowledge about biodiversity. The first dealt with the planning process. For example, environmental

impact assessment would become a key aspect of the planning process; local development objectives would have an ecological bias, as well as involvement of ecologists and other competent personnel in the planning process. The second set of likely consequences emphasised the need to analyse the deviations from the current structural plan when environmental goals were taken into considerations but without adequate knowledge of biodiversity. New knowledge about biodiversity also would draw attention to how planning deviates from national, European and international directives and environmental standards.

A third set of consequences was more substantial in character. Here the planners interviewed drew attention to the impact of new knowledge on building green space networks, creation of green corridors, that is the development of green infrastructure that would fulfil the objectives outlined in the report *Our Common Future*, as well as in European Commission directives and Swedish legislation. The planners' felt here that another substantial consequence would be the proper use of current green assets, for example parks and other green spaces, green corridors etc.

5. DISCUSSION

Although an overwhelming majority of the planners found urban green spaces very important, the overall result of this study is that the planners' knowledge and understanding of biodiversity components is insufficient for the maintenance of urban biodiversity. This applies in particular to what green infrastructures actually mean in practical planning, that is for taking the step from green space in urban planning to a green infrastructure. There can be several reasons for this.

Urban planning in the six cities can be regarded as 'conservative' in the sense that it did not take into consideration new findings, for example in the form of new research results. As one planner put it: “We do not need to learn about new things all the time. This is a conservative world. Streets are streets and parks are parks”. Some planners also mentioned that there was conservatism in other departments that made it difficult to work with urban green planning. In one case the urban development department said, “so you have become farmers” when the planning department had suggested preservation of an unexplored public green space. On the contrary several planners used national laws and policies, which stress the importance of green space for urban areas, as sources of knowledge. For example, the Planning and Building Act states that cities should plan for a well developed green structure in the urban landscape (Regeringens Proposition, 1994/1995). Also, since 1999 one of the National Environmental Quality Objectives is that “areas of unspoiled nature and green spaces close to built-up areas, which are easily accessible, should be protected in order to meet the needs for recreation, local farming and healthy local climate. Biodiversity should be preserved and enhanced” (Regeringens Proposition, 1997/1998, p.145). As all of the six cities are expanding and have compaction as one important objective in order to meet population growth, there is certainly a need for investigation on which knowledge and how it is being used in relation to the overall goal of sustainable development.

It takes between four to eight years for local authorities to prepare a structure plan. The time horizon of such plans is often set between 10 to 25 years, with an update of the plan every fourth year. Even if a structure plan may be ambitious regarding the development of green spaces, planners considered the period 10 to 25 years too long for its implementation of development plans. One aspect of structure planning is to develop a local green plan as a supplement to the structure plan. The latter contains data about green spaces in the urban landscape and their potential value in cities. The document should contain an overriding perspective about urban green space and detailed information about land use, taking into account various aspects of biodiversity. This is one way to implement new knowledge in the planning process, especially if the green plan is developed by planners with various backgrounds such as architecture, landscape architecture, ecology and public health. In this work there is also important with public communication, which was not common in the six cities according to our respondents. The lack of dialogue with citizens is remarkable as the work with local Agenda 21s is important in Sweden and in this process such a dialogue is very important (UN, 1992; Lidskog and Elander, 2000). Among the planners interviewed, even from the same city, there was often confusion about the relationship between the green plan and the structure plan. Some planners maintained that the green plan is a separate plan, others regarded it as a part of the structure plan. In analysing plans of the six cities only two could be regarded as local green plans, others lacked an analysis of urban green spaces and their multifunctional uses, for example for biodiversity.

In three of the six cities a wide range of inventories and surveys of biodiversity components had been carried out, mostly by university students. Most of these inventories were a record of species, but not of other dimensions of biodiversity, for example habitat connectivity, patterns and processes of habitat

renewal. Consequently, the planners in these three cities had access to some information about the urban biodiversity but the information was not used, mainly because the planners did not know how to deal with it. For example, habitat remnants with the longest histories of settlement in urban areas usually have the highest regional species diversity. Urban forests are examples of patches supporting many more bird species compared to lawns or grassland patches of similar size (Murphy, 1988). Important properties of urban forests are to contain old deciduous trees, preferably broad-leaved, dying or dead trees, and tree-cavities. Even solitary trees have several important properties. For example, they offer foraging, nesting or protection sites for bird species (Sandström, 1991; Carlson *et al.*, 1998). The planners interviewed took none of these dimensions into consideration.

Another difficulty in the organisational structure is that the responsibility of green planning was spread over several departments with divergent objectives. For example, a city gardener may introduce an alien species at the expense of a native species or remove old grown trees because they are considered a danger in a recreation area. The urban development department may allow exploitation of green space without taking habitat values into consideration. Therefore, fragmented organisations do not favour maintenance of biodiversity. It is probably an advantage if biological/ecological knowledge is spread out in the organisation preventing contradictory decisions in different apartments.

Successful green planning requires simultaneous consideration of ecological, cultural, demographic, sociological and physical aspects of the urban landscape. To handle such multitudes of information, modern techniques such as advanced GIS are very useful. GIS was available in five of the six cities, but even in these cases it was not developed nor used completely because of lack of knowledge. The impression is that the planners did not realise the value of this tool. Co-operation between the city and a university can be one fruitful way dealing with obsolete education and conservative thinking, and to develop planning tools such as GIS. This gives advantages for both parts. For example, in a specific planning project the planners can take part in relevant research results and receive education at the same time, as their ordinary work will be done. This will open up possibilities for further education for planners, save time for the department, and develop the urban green planning as well as the local planning department. It will also benefit the university to receive insight in the planning process and have possibilities to apply theories in practical work. In such a planning process we consider the dialogue with the citizens important in obtaining a long-term sustainable urban green planning.

6. CONCLUSIONS

Generally, understanding about the implications of biodiversity in urban planning was low. Biodiversity was often interpreted too narrowly or in spatial terms. Several of the planners interviewed were educated when the terms ecology and biodiversity “were not even invented”. There was also a conservative thinking among the planners and the reason was probably because the respondents had worked a long time as planners with little possibility for further education due to limited resources in the form of time and personnel. This shows the need for ongoing education of planners.

The planning organisations were inadequate, namely too slim-fitted and with difficulties in accessing existing knowledge which is not favourable for effective green planning. An organisation that does not allow easy access to pertinent knowledge is an aggravating circumstance. Preferably biological knowledge should be spread out in the organisation and the creation of temporary networks between planners in different departments will give access to relevant knowledge present in the organisation. Also very few of the respondents took part of research reports in the field of green planning. Co-operation between the city and a university can deal with this, and as a synergy effect develop planning tools such as GIS. In the planning process the planners must develop a dialogue with the citizens, as this was not common.

Because nature is not homogenous and spatial heterogeneity is created by environmental gradients, most organisms are dependent on heterogeneity on one scale or another. We believe this is also valid for man as humans to a large extent concentrate on urban landscapes and this must show heterogeneity. Accordingly, besides hardened areas, there should be non-hardened areas, that is green spaces in the urban landscape organised with an overriding strategy, with identified valuable green cores and connecting greenways in between and with the surrounding land to become an urban green infrastructure.

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Table 1. Examples of planning units in the three components of biodiversity.

Components of biodiversity		**Scales with a forest, city and agricultural perspective**		
Parameter	**Explanation**	**Tree** **Block** **Field**	**Stand** **District** **Farm/village**	A forest landscape **A city** **An agricultural landscape**
Composition	Species, genetic diversity	A lichen	A bird	A large mammal
Structure	Habitat complexity	A tree	A patch	A landscape mosaic
Function	Processes	Nitrogen fixation	Habitat renewal	Dispersal allowing recolonization after local extinction

Sources: Noss, 1990; Larsson *et al*., 2001.

Table 2. A normative model for the knowledge needed to work with urban planning focused on securing biodiversity.

Factors	**Knowledge**
Sources of knowledge	International, national and local objectives and research about biodiversity; the multifunction of an urban green infrastructure
Implementation of new knowledge	Put new knowledge into practice; anchor new knowledge in the organisation
Terminology	Define terms to prevent multiple meanings for participant stakeholders
Interactive learning	Communicative skills: consensus in objectives of green planning; dialogue with stakeholders including citizens
Organisational facilitation	Facilitation of exchange of knowledge between officials and other involved in local planning
Knowledge areas (levels):	
Habitats	Distribution and quality of habitats, temporal and spatial aspects
Species	Populations; metapopulations; if possible identify indicator or key species
Patterns	Connectivity; fragmentation; vegetation structure
Processes	Human impact; habitat dynamics
Techniques	Digitised geographical information, preferably in several layers (GIS) as a planning tool; sufficiently skilled personnel
Use of knowledge	Develop long-term and short-term objectives for urban green planning; its importance for sustainability; outline implementation procedures and initiate them

Table 3. The main features of the municipalities and cities (SCB, 2000a, b).

	Area (km^2)		No. of inhabitants	
Urban area	Municipality	City	Municipality	City
Stockholm	188	35	1 212 196	736 113
Göteborg	449	199	495 849	467 736
Malmö	154	69	259 562	248 520
Uppsala	2 465	48	190 276	124 036
Linköping	1 432	42	133 375	94 248
Örebro	1 372	43	124 234	95 354

Table 4. Quantitative results of interviews of the 18 planners in the six cities. I - VI correspond to the six captions in the results (For details of questions, see Appendix).

Caption	Question no.	Short description of the question	Good conditions in the urban planning (% of 18)	Neither good nor bad conditions (% of 18)	Bad conditions (% of 18)
I	1	Sources of knowledge?	33	39	28
II	7	Need of urban green planning?	78	22	0
	14	Importance of urban green spaces in the future?	89	11	0
	15	Handle future city expansion?	56	33	11
	16	Green infrastructure important for sustainability?	56	44	0
III	8	Data recorded concerning biodiversity?	22	56	22
IV	5	Competence in the new planning?	50	44	6
	6	Sufficient no. of staff?	11	33	56
	11	Shortage in competence?	0	39	61
	12	Need of further education?	28	22	50
	13	Resources for further education?	28	22	50
V	9	Planning tools?	39	33	28
VI	2	Strategies expressed?	56	22	22
	3	New in your planing work?	50	28	22
	4	What does this planning mean?	44	44	12
	10	Impact in local development plans?	11	56	33

APPENDIX

Questions:

Name, profession and education?

Years in the profession (a) as a planner?; (b) as a planner in this municipality?

1. What kind of knowledge do you obtain in connection with the community planning? What strategies and objectives according to green planning rule your work?
2. How are these strategies and objectives expressed in the planning work?
3. Have these strategies and objectives meant something new in your planning work? For example for the green planning in general, for urban biodiversity or something else?
4. What actually does this new planning mean?
5. Has the municipality this competence in this new planning?
6. Has the municipality sufficient number of staff?
7. Do the municipality see any need of, or have intentions for urban green planning? If yes, why? Give examples.
8. In the work with green planning - what data has been recorded concerning biodiversity:
   a) On the overall level? (E.g. green cores or corridors, etc.)
   b) On a more detail level? (E.g. habitats, species, etc.)
   c) Others similar processes? (E.g. fire, problems related with winds, floods, etc.)
9. What planning tools do you use, e.g. GIS, own databases or other tools? Give examples.
10. What impact do the intentions have on the structure plan according to green planning implementation in the local development plans?
11. Have planners and other persons involved any limits in competence according to green planning?
12. s there any
    a) need of further education in the area green planning for planners or other people involved?
    b) interest to learn more about green planning?
13. Are there any resources for further education? If so, in what form?
14. What importance do you believe green spaces in urban environment will have in the future?
15. How will the municipality handle future expansion of the city? Which areas will be exploited?
16. Is a developed green infrastructure important to obtain local sustainability?
17. Something else you want to add?