Towards a Greener Green Space Planning

Urban green space planning in Lisbon (Portugal)

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Abstract

The theory of urban ecology tries to enhance the positive aspects of green spaces for humans, while at the same time decreasing the negative aspects of cities for the environment. Research on ecosystem services and urban ecology take, within Europe, predominantly place in northern Europe. The southern European municipality of Lisbon, Portugal has been selected as a case study to investigate whether the ideas of urban ecology are reflected within planning and management, and what can be done to improve current practices.

It was found that while municipal spending is increasing and the DEP is moving away from the use of quantitative space standard criteria, green space planning is currently not successful due to an overly optimistic and abstract green plan, a lack of communication both inside the municipality and with other stakeholders and a lack of stakeholder participation. The ideas of urban ecology are not present in the municipality. Ecosystem services are not taken into account in green space planning or management. In terms of governance, Lisbon still clearly follows a public administration model; to adopt an adaptive management approach the municipality has to steer to a more open, network-based style of governance, and improve communication.

A possible way to better plan for green spaces is presented. It is argued that ecosystem services should be used as criteria within a multi-criteria decision making methodology in urban green space planning. Using such a methodology could help to increase public stakeholder involvement, reach a uniform vision within the different municipal divisions and increase green space quality; both for nature and for humans.

Keywords

Urban Green Space; Municipal planning; Urban Ecology; Lisbon; Parks; Ecosystem Services; Multi-Criteria Decision-Making.

Front picture: James Torr

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List of Abbreviations

SES	Social-Ecological System
ES:	Ecosystem Services
UGS:	Urban Green Space
LMA:	Lisbon Metropolitan Area

Municipal structure (see also Appendix 1 for an organization chart)

DMAU:	Directorate for the Environment
DEP:	Planning Division
DAEV:	Department of Environment and Green Spaces
DJ:	Division de Jardim; managers of urban gardens
DM:	Division de Matas; managers of woodlands and urban parks

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Introduction

Chances are good that you are an urban resident; cities are the fastest growing regions in the world, and more than 50% of the worlds' population is living in cities nowadays. The vast majority of future population growth will also take place in cities, causing urban residents to be twice the size of the rural population in 2050. (United Nations 2008)

Cities have a multitude of problems that need solving. Among these are environmental-, transportation- and social/cultural- problems (Herbert & Thomas 1997). Cities are often criticised for their environmental footprint, which can be up to 200 times the size of the city itself (Rees 1997). If cities are to truly reduce their environmental impact we have to look at the effects they are causing on different spatial scales (Figure 1), and find ways to minimize their impact on all scale levels. The local system cannot be ignored however: if we do not deal with problems at the local level, we might counteract our efforts to reach a sustainable society (Miller 2005), as it is the local environment we encounter as children that is used as a norm against which environmental degradation is measured (Kahn (2002) in Di Giulio et al. (2009)).

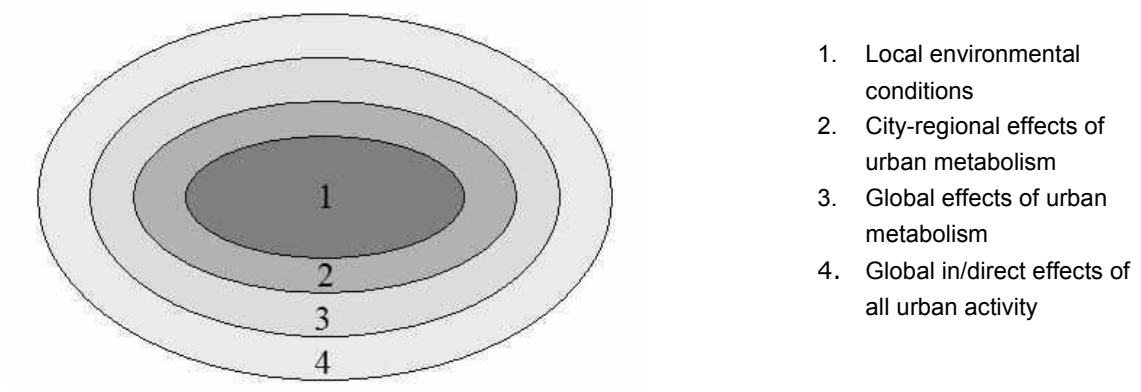

Figure 1. Layers of analysis and responsibility for urban systems and global impacts (based on Ravetz 2000).

On the local level, cities have a strong influence on the local environment. Urban landscapes differ in many ways from less human-influenced ecosystems; they are spatially highly heterogeneous (Borgström et al. 2006; Grimm et al. 2000), and are dominated by human activities (Andersson 2006). Urban systems have their own distinct ecology and biochemistry, which is in addition to natural processes driven by human practices such as engineering, urban demographics and household-scale actions (Kaye et al. 2006; Pickett et al. 2001). Urban areas are usually dominated by impervious surfaces, altering the run-off and infiltration of rainwater (Wessolek 2008). The presence of green spaces within cities varies, but is diminishing with the current trend of urban compaction (Fuller & Gaston 2009). The dominance of impervious surfaces also changes the local climate, and creates an urban heat island effect (Endlicher et al. 2008). Together with direct human actions these differences have a profound impact on urban biodiversity (Williams et al. 2009) and the provisioning of ecosystem services (Shandas et al. 2008).

However, knowledge about the importance of green areas for people is increasing. This is true even in cities. Urban green space performs important functions for peoples' needs in an urban landscape, both in a natural way, by providing contact with nature, aesthetic functions and recreation, and socially, by providing a place for social interaction, privacy and by creating a sense of community identity (Matsuoka & Kaplan 2008). The presence of green areas has been found to decrease recovery time and stress, and to improve physical and mental well-being (Maller et al. 2006). These benefits are reflected in economic terms as they have a positive effect on real estate

values, investment, tourism, and the quality of life of employees, thereby increasing productivity and reduce absenteeism (Constanza 2008).
Besides direct benefits, urban green space can also indirectly contribute to the urban environment by providing other ecosystem services such as air filtration, microclimate regulation and water regulation (Givoni 1991; Bolund & Hunhammar 1999).

If green spaces are so important for human well being, how is it possible to increase these areas and maximize the positive aspects for humans, while at the same time decrease the negative aspects of cities for the environment?
One possible direction indicated by planners, ecologists, and social scientists is the integration of biophysical and socio-economical principles into one system, the social-ecological system (Shandas et al. 2008; Andersson 2006; Pickett et al. 2001; Alberti et al. 2003).
The field of urban ecology is concerned with exactly this issue, and combines the ideas of ecology, social sciences and planning to create a broad understanding of the functioning of urban systems (for a broad overview of the field, see Marzluf 2008). The current work on urban ecology is concentrated in three cities: Stockholm (Sweden), and Phoenix and Baltimore, (U.S.). (Andersson 2007b; Grimm et al. 2000; Pickett et al. 2008; Borgström et al. 2006). The knowledge on urban ecosystem services also has this northern focus, mainly on North European urban areas[1] (c.f. Bolund & Hunhammar 1999; Tratalos et al. 2007). However, within Europe, green space provision varies between cities, with higher coverage in northern Europe than in southern Europe (Fuller & Gaston 2009). The urban history, planning and management of urban green space also differ between these regions (Chorianopoulos 2003; Breda-Vázquez & Oliveira 2008). Is the current knowledge on urban environments therefore applicable in a southern European context?

There are many questions regarding the functioning of urban systems that should be researched for a better understanding of the urban environment. Research is needed on the physical aspects of green spaces, how people experience green spaces, how they are managed and whether current and future policy is effective (Formas 2005; James et al. 2009). This thesis will focus largely on the last aspect; green space policy, within a southern European context.
The city of Lisbon, Portugal is an example of a southern European city, and is used as an exemplifying case in this thesis. Lisbon is the capital of Portugal and has a current population of around 500.000 and covers 85 km^2. The city is part of the larger Lisbon Metropolitan Area (LMA) (2,962.6 km^2), with a total population of 2.8 million people. (AML 2010) The municipality of Lisbon has 1,349 ha of green space, which converts to 16% of total land area or roughly 27 m^2/inhabitant (DMPU 2009): This is just below the 18.6% average for a European city (Fuller & Gaston 2009, p.353). Green space coverage has increased over the last decade (DMPU 2009), but still 45.2% of urban residents are dissatisfied with the green space present in the city, which is among the highest percentages for all European capital cities (Eurostat 2009). Furthermore, Lisbon has an interesting municipal structure, with one department being simultaneously responsible for environmental quality, green space management and environmental education. This structure seems to fit an integrated approach to green space management.
By using Lisbon as a case study, this thesis examines whether the used planning techniques are effective, and whether these address the ecosystem services provided in Lisbon. This will be followed by a discussion on how to improve green space planning.

[1] Recently a lot of articles on urban ecosystem services have also come from China, but the Asian megacities are expected to differ too much with the European cities to take these into account in this research.

This thesis is structured as follows. First, the research questions and the scope of this research will be presented, after which the used methodology will be explained. The theoretical framework will examine the theories of urban ecology and ecosystem services and link this to governance, as well as give a literature overview of theories used in green space planning. This last overview will be followed by a list of criteria found in green space planning literature used to assess the success of green space planning in Lisbon. The following results section will describe the way green spaces are planned and managed for within the municipality, explain the way environmental aspects are taken into consideration in current planning and management and describe the physical properties of green spaces in Lisbon.
Within the discussion the research findings will be analysed and linked with the broader literature. Furthermore, the limitations of the current methodology will be discussed. Finally a possible way to improve urban green space planning will be presented.

Objective and Research Questions

The objective of this research is to see whether the ideas of urban ecology are reflected within planning and management in Lisbon, and what can be done to improve current practices.

The main research question of this thesis is:

- How can Lisbon improve its green space planning?

Within the case study of Lisbon the following research questions were defined:

- How does the municipality of Lisbon plan for urban green space, and is this planning successful?
- Are environmental aspects taken into account in planning and management and are planning practices reflected within the actual parks?
- What are the ecosystem services connected to planning and management practices?

Scope and Limitations

This thesis looks at cities as coupled social-ecological systems (Figure 1). This thesis focuses on the planning and management of urban parks in Lisbon, and will therefore not consider the wider ecological processes within Lisbon. Looking at Figure 2, it is only the right hand side of the figure that is focused upon. This focus helped to narrow this research down and to define clear research objects.

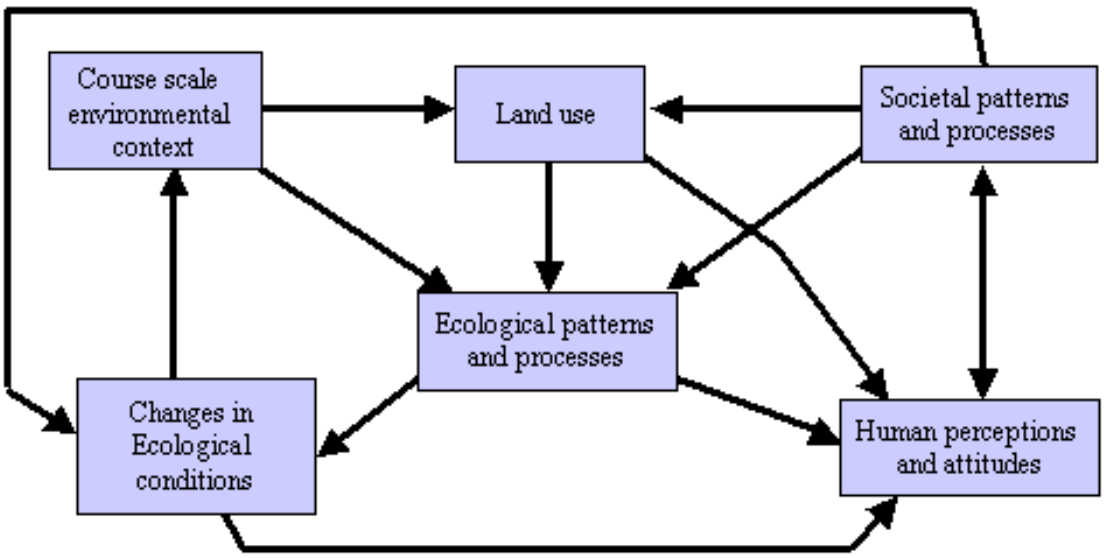

Figure 2. Conceptual model of the Social-Ecological System (adapted from Grimm et al. 2000)

The unit of analysis in this thesis is the municipality of Lisbon, and hence the neighbouring municipalities and the wider metropolitan area of Lisbon have been excluded from the present research. Due to the focus on planning and management of urban parks, other green spaces, like private gardens and urban agricultural sites, lie outside the research scope of this thesis.

In terms of time, only the planning and management of the last four years, and not the wider planning history of the city, has been looked at. Green space planning in Lisbon can be traced back to the 19th century (Oliveira & Pinho 2008; Pereira & Mata 1997). However, including these aspects within this thesis would not have led to an increased understanding of the current green space planning methods.

The major limitation in this research was the language barrier, as the author's knowledge of Portuguese is negligible. Most interviews where held in English, which meant that the interviewees where not talking their native language, and could have had problems in expressing their thoughts. In four interviews a translator was present. A translator limits the possibility to directly probe further after an answer is given, and could in the translation process have distorted the words of the interviewee. Policy documents where translated via an online translate program, and meaning can have gotten distorted in this process.
Another limitation of this research was the fact that it took longer then expected to get in contact with the municipality in Lisbon. A first meeting was arranged five weeks into the eight weeks of fieldwork scheduled. In the end the majority of interviews where therefore obtained in the last 2.5 weeks of fieldwork.

Methods and Materials

Problems and strategies of green space planning vary between cities and even within the same country (Werquin et al. 2005). This makes it difficult to compare green space planning in different cities (Ibid). Hence a single case study approach was used to study urban green planning within a real-life context. Lisbon was chosen as an exemplifying case of a southern European city. Within the case study research, a mixed methods approach is pursued using different data sources. This allows the data to be triangulated, which strengthens the construct validity of this research. (Yin 2009) The various research strategies and data sources used are explained below.

GIS data

Creation of the park map

To get an overview of the case study area, the spatial distribution of green spaces within Lisbon, and to calculate the green space coverage in the city, a GIS map was constructed. Administrative data was retrieved from IGEO (2008), and the road network from Mapcruzin.com (2010). For all layers the municipality of Lisbon was extracted, and saved as a new shapefile. The projection of the files was transformed to the European Terrestrial Reference System (ETRS) 1989 projection. A selection of 65 urban parks in Lisbon was made using Travassos (2009); Lisboa Verde (2009); and the areas defined as '*Parques*' and '*Jardins*' on the *Lisboa Interactiva* web page (CML 2004). The selected Parks were digitized in Google Earth™, and the polygons created were exported into ArcGIS®. Park names were added as an attribute to each polygon. The resulting shapefile was transformed to the ETRS 1989 projection. A visual comparison was made using a normal map of Lisbon and the created map. The quality was sufficient for the purpose of this research.

Green space coverage

The municipality of Lisbon uses a buffer method to indicate areas that lack in green space coverage (DMPU 2009). Coverage provides a good overview of the equality of green space division. As it could not be determined whether the buffer included only parks or also other green spaces, a new buffer map was created to give an overview of the green space coverage of the selected parks within Lisbon. Buffer zones were created around the parks, depending on their size (Table 1). These buffer zones indicate whether the residents living inside the buffer have green space present within a certain amount of meters. Larger green spaces are expected to contribute more to the local green space coverage, as people will be willing to travel further to larger green spaces. These buffer distances correspond to the levels used by the municipality of Lisbon, except that the first buffer (300 m) was given extra weight, as within the first 100-300 m there is a sharp drop in the frequency of use of green spaces (Nielsen & Hansen 2007). The original park area and the airport were excluded from further calculations as it was assumed that there were no people living inside these areas.

Table 1. Size of buffer for different park areas

Size (ha)	Maximum buffer distance (m)
<2.5	300
2.5-10	500
10-50	1000
>50	7000

Park management and planning

Semi-structured interviews

To answer the three smaller research questions, interviews were held with people responsible for park management and planning in Lisbon. The planning and management of green spaces in Lisbon is taken care of by the directorate for the environment (DMAU). Their organisational structure is shown in Appendix 1. Within this research the main focus has been on the Division for Study and Planning (DEP), which designs and plans the municipal green spaces, and the Department of Environment and Green Spaces (DAEV) which is responsible for environmental control, environmental education, cemetery maintenance and park- and garden maintenance. The purpose of the interviews was to get an overview of what the different departments in the municipality were doing, and how the interviewees were thinking about urban green space planning and management. For this kind of descriptive questions a semi-structured interview is a good methodology to follow (Bryman 2008). Within case study research this methodology is also advocated (Yin 2009). For the different interviews brief interview guides were constructed, which can be found in Appendix 2.

Interviewees were selected via a purposive sampling technique called theoretical sampling (Bryman 2008). Interviewees were selected to provide a full overview of the functioning of the DMAU and of the used park planning strategies. To get an overview of the functioning of the DAEV, interviews were held with persons within each sub department. Interviews were further held with a president of the lowest level of government, the *freguesia*, as to better understand the political function of this level of government, and with people from parks that were not managed directly by the DAEV (*Parque de Monteiro Mor* and *Jardim de Gulbenkian*). An interview was also held with the communications officer of the *'Parque expo 98'* organization, as to better understand the special history of that area and the management of *Parque do Tejo e Tranco*. An overview of the interviewees can be found in Appendix 2.

A total of 11 interviews were held with 16 interviewees. The interviews lasted between 30 and 90 minutes. Interviewees where contacted by a Portuguese e-mail in which a meeting was requested and they were informed about the language difficulties of the interviewer and asked if they would like to hold the interview in English or if they would like to have a translator present. A translator was present at 4 interviews. All interviews were recorded and summarized. An exact transcription was not made, as conversation- or discourse analysis was not applied (Bryman 2008). The summaries and full recordings of the interviews can be requested from the author. From the interviews planning methods were inferred, and while discussing management it was noted which types of ecosystem services were directly mentioned or inferred upon. To classify these services the classification of the Millennium Ecosystem Assessment (2005) was used. If further questions arose after the interview, they were followed up upon by e-mail.

Planning documents

Planning and policy documents were used as a second data source to get an overview of the municipal planning system and actual plans. The head of the planning department provided a majority of these planning documents and further documentation was retrieved online. These documents were analyzed to get an overview of the different plans within the municipality. As these documents were written in Portuguese, Google Translate™ was used to get a rough translation. If aspects were unclear, native speakers were asked for help, but the combination of a rough translation together with the actual planning maps was often enough to understand the plans.

Observations of urban parks

To see first hand the parks in Lisbon, a direct observation method was used (Yin 2009). Site visits to the selected parks were made, using a structured observational protocol. Originally it was the idea to assess ecosystem services in parks, and the variables for the observational protocol were selected with this idea in mind. However, this line of research was not continued due to lack of a proper analysis method. The observation variables were used in this research to see whether the planning and management practices were reflected in the parks themselves. Variables where selected after consulting relevant literature on the functioning of ecosystem services within cities (c.f. Snep et al. 2006; Andrade & Vieira 2007; Givoni 1991; McDonald et al. 2007), and after five exploratory visits to different parks. The observational protocol can be found in Appendix 3, and is focused on vegetation structure, information provision, the presence of cultural aspects and recreational provision.

Recreation is a type of social behaviour, and is best observed using an observational survey (Bryman 2008), but it was not possible to do this at 65 different sites. Instead recreational aspects were observed: the presence of benches and tables, sport fields, running tracks and machines for physical exercise. Recreational aspects give an indication of the recreation actively planned for by the municipality, and hence give an indication of the view on recreation within the municipality. Within Lisbon children playgrounds are separate fenced entities within, or outside of, green spaces. These areas were therefore excluded from the observations.

The municipality was expected to use signs to provide information to the public about the environmental and cultural aspects of the parks. Therefore the presence of informational signs within parks was observed.

The observed vegetation structure was used to calculate habitat diversity. Habitat diversity together with the size of the park gives an indication for biodiversity (Pauleit et al. 2005).

As vegetation cover is overlapping (tree cover is located above shrubs), total coverage was larger than 100%. The coverage (P) was therefore normalized before the calculations by dividing the different coverage classes with the sum of all classes. From these values the Shannon diversity index (D) was calculated using the formula:

$$D = -\sum_{i=1}^{m} \left(Pi * \log_2 \left(Pi \right) \right)$$

Observations were made for all but five parks. *Parque Florestal de Monsanto* and *Tapada de Ajuda* were excluded due to their large size (>100 ha), which made a structured observation of the entire park very difficult. Three parks could not be visited as they were currently under reconstruction (*Jardim Henrique Lopes de Mendonça, Jardim Mahatma Gandhi* and *Jardim de Principa Real*).

Theoretical Framework

Urban ecology

Urban ecology is a field of research that has been gaining importance in the last decade. It tries attempts to highlight the interplay between humans and the environment within a coupled social-ecological system (Redman et al. 2004). A conceptual framework of this system is given in Figure 2. Urban ecosystems are described as *'complex, dynamic biological-physical-social entities, in which spatial heterogeneity and spatially localized feedbacks play a large role'* (Pickett et al. 2008, p.148). Urban ecological literature draws often on resilience theory; the resilience in urban systems is hypothesized to depend *'on the cities' ability to simultaneously maintain ecosystem and human functions'* (Alberti et al. 2003, p.1170). Current literature in urban ecology is broad, and has been proven to be a useful source in trying to understand ecosystem functioning within cities (for an overview see e.g. Marzluf 2008; Alberti 2008; Kaye et al. 2006; Dow 2000; Olalla-Tárraga 2006).

Urban ecology explores if and how the urban ecosystem differs in comparison with the more natural environment. The field is currently dominated by the legacy of the urban ecology project of the long-term ecological research program (LTER). This was the first big research program to look at cities from a social-environmental perspective, and defined many ideas and concepts within urban ecology (c.f. Grimm et al. 2000; Redman et al. 2004; Pickett et al. 2008). Urban ecology is currently focused on: the links between biological diversity and ecosystem functioning; ecological processes and their social drivers; and the spatial resilience of urban nature (Andersson 2006). Partaining to the concept of sustainability, the current interests fit the definition of ecological sustainability: *the capacity of ecosystems to maintain their essential processes and functions and to retain their biodiversity without impoverishment'* (Williams et al. 2001, p.192).
This focus has led to criticism as it lacks the integration of human aspects within the current research; Humans are currently most often present as drivers, not as concrete phenomena (Rees 2003). As such, only the left side of the social ecological system in Figure 2 is studied. It is overlooked that an integration of social- and environmental aspects will not happen unless people see the needed change as being positive (c.f. remarks in Hunter & Hunter 2008). Recently there has been a call for more inter- trans- and multidisciplinary research within urban ecology (James et al. 2009). This call is focused on urban green space (UGS). Urban green space can be defined as *'Public and private open spaces in urban areas, primarily covered by vegetation, which are directly (e.g. active or passive recreation) or indirectly (e.g. positive influence on the urban environment) available for the users'* (Baycan-Levent et al. 2009, p.195). They *'cover parks, public gardens, squares, traffic circles, urban trees, sport fields, cemeteries, urban forests, fallow lands and family gardens'* (Choumert & Salanie 2008, p.331). James et al. (2009) provide a list of research topics focused on UGS and their physical aspects, the human valuation and experience of UGS and the management and governance of UGS. The social aspects of the urban system will quite likely receive more attention in the future, although this research will take some years to be published.

Ecosystem services

To stress and to understand the interrelationship between the social and environmental aspects within the city, urban ecology often employs ecosystem services (Formas 2005). Ecosystem services (ES) are those services ecosystems provide that are beneficial for human well-being. The idea of ES has been around since the 1970s (Mooney & Ehrlich 1997), but was popularised with the book *'Nature's services'* by Daily (1997) and the estimation of the total value of the worlds ecosystem services by Constanza et al. (1997). Since then, the usage of the term ES has risen exponentially (Fisher et al. 2009). Currently the term ecosystem services is almost always mentioned in planning literature. However, the actual integration of ES within planning has been slow (Chan et al. 2006).

Although the term has been around for a long time, there is still much debate on how to define and classify ecosystem services (Haines-Young & Potschin 2009). The definitions of Fisher et al. (2009) fit the urban setting well (see Table 2). The most important difference with other definitions is the inclusion of the term *'ecosystem benefits'*. Certain ES, like cultural services, are not *sensu stricto* services provided by ecosystems. Recreation is a combined service of ecosystems and human systems. Not only is a natural ecosystem needed for recreation, but roads and other human inputs. These combined services are defined as ecosystem benefits. Within an urban setting it are probably those types of benefits that are the most highly valued (Bolund & Hunhammar 1999).

Table 2. Definitions of terms within the ecosystem services framework (Fisher et al. 2009)

Ecosystem processes	Ecosystem processes are the interactions in the system. They become services when humans use them
Ecosystem services	The aspects of ecosystems utilized (actively or passively) to produce human well-being
Ecosystem benefits	The point where other forms of capital (built, human, social) are likely needed to realize the gain in welfare from services.

Since the definitions of Fisher et al. (2009) are used in this thesis together with the definitions of the Millennium Ecosystem Assessment (MEA 2005), the definition of cultural services will have to be redefined as ecosystem benefits. This does not contradict the definitions of the MEA, who state that*: 'Cultural services are tightly bound to human values and behaviour, as well as to human institutions and patterns of social, economic, and political organization'* (MEA 2005, p.59).

Due to the human domination of the urban ecosystem, ES in cities can be expected to differ from more natural systems. Bolund and Hunhammer (1999) are the only authors found to summarize the potential of ecosystem services for an entire city, although they do not quantify these services. While this research has been cited in most papers regarding green spaces in cities, it has to be realized that their case study of Stockholm is quite unique as Stockholm has, in comparison with many other European cities, a high amount of natural and semi-natural green space (Löfvenhaft et al. 2002). Within this northern European focus, ecosystem services that have been identified within cities are: air filtration, micro-climate regulation, noise reduction, rainwater drainage, sewage treatment, cultural/recreational values (Bolund & Hunhammar 1999) carbon sequestration (Tratalos et al. 2007), biological control, and pollination (Andersson 2007b).

Ecological systems operate at a wide variety of scales (MEA 2005). These scales are spatial, temporal and functional (Borgström et al. 2006). For example, the ecosystem service pollination originates in one exact spot (the beehive), but influences a wider radius. Effects of ecosystem services might therefore be observed at different spatial levels, or over longer timescales, than currently used in planning. These scale mismatches between planning and the environment cause

many of our environmental problems (MEA 2005). Within a city we can therefore expect some services to be important at a local scale, while others will encompass the entire city region, or even larger areas. Conversely, natural aspects in cities will depend on these large scale effects as well, as e.g. species diversity is dependent on the connectivity of green areas both in- and outside of the city (Tratalos et al. 2007).

The field of ecosystem services has been used widely in ecological economics and therefore mainly focuses on the economic valuation of these services. At the same time, the MEA states that: *'Human preferences for all values can, to some extent, be measured with economic valuation methods, but ecological, socio-cultural, and intrinsic value concepts have separate metrics and should be used in the decision-making process in their own right.'* (MEA 2005, p.129)
The concept of ES can however also be used in other ways, e.g. to quantify certain aspects of the environment or to provide a focus of beneficial aspects within society. However, due to the heavy focus on valuation, this aspect is often overlooked (c.f Baycan-Levent et al. (2009)).

Urban Governance

Before moving to actual green space planning models, it is important to understand that any municipal planning or management system is embedded in the larger organisational culture and government system. Therefore, the larger governance structure within a city has to be considered when analysing policy. Within urban ecology, cities are seen as an example of a SES in which there are inherent surprises and non-linear events (Alberti 2008). Accordingly, urban ecologists argue for an adaptive management approach to governance. Adaptive management sees planning as a continuous experiment, where via a learning-by-doing approach a wider knowledge base is created (Lundberg 2006), and actual management should be diversified, and executed through the cooperation of various actors (Andersson 2007a).
These type of ideas fit well within the concept of urban governance theory. Broadly speaking, governance is *'the setting, application and enforcement of the rules of the political game'* (Davies & Imbroscio 2009, p.142). Urban governance theory has been used to describe the recent shift within municipalities to move away from a hierarchical public administration to a more network based approach (Ibid; Kearns & Paddison 2000). For a government to adopt an adaptive management approach, the assumptions of urban governance as described in Table 3 should be visible.

Table 3. Assumptions in the old public administration and in governance theory (adapted from (Davies & Imbroscio 2009))

Key concepts in governance theory	Assumptions in the old public administration	Assumptions in governance theory
Efficiency	Secured through the bureaucratic hierarchy	Secured through cooperation and partnerships
Democracy	Secured through elected parliaments. Separation of politics and administration	Secured through participation. No analytical separation of politics and implementation processes
Power	Is visible and located in the centre of government	Is fragmented and/or shared in consensus building networks
The role of the local state	The state as steering and control mechanism	The state facilitates network governance
The role of the urban bureaucrat	Technocrat, driven by prospects of predictable career	Mediator and networker, driven partly by prospects of self-development in a dynamic working environment

Planning

Maruani and Amit-Cohen (2007) identify nine urban green space models used in planning; six of which have the right scope for the local urban setting (Table 4).

Table 4. Description of urban green space models as identified by Maruani and Amit-Cohen (2007)

Model	Description
Opportunistic	Parks are created if the opportunity arises for them (derelict sites, land donations, etc)
Space standards	Quantitative, looking at m^2 of green space per inhabitant
Park system	Parks form an interrelated whole, to provide a variety of experiences to people
Shape related	Planning using concepts like green wedges, -fingers, -ways etc.
Landscape related	Landscapes (often agricultural) are protected
Ecological determinism	Ecology is guiding in planning, green spaces are set aside for protection, after which development can take place at the rest of the spaces.

These ideas range from demand based, anthropocentric approaches to more ecocentric, supply based approaches that assign an intrinsic value to green areas. At the same time these can be ordered according to the aspects of UGS that are deemed important by planners (Table 5). Within this order the 'lower' aspects are incorporated; a greenbelt approach still addresses aesthetics and recreation.

Table 5. UGS planning models

No green	Aesthetics	Recreation	Health and social functions	Human and Natural functions	Natural functions, then human values
Opportunistic model					
Space standards model					
	Park system model				
		Shape related models			
				Landscape related models	
					Ecological determinism
Anthropocentric					*'Ecocentric'*

However, none of these methods offer a truly balanced approach between human demand and natural values (Maruani & Amit-Cohen 2007). For environmentally sound UGS planning, the different positive aspects of UGS must be integrated:

'Instead of the 'mechanical' planning procedure of determining land area according to the size of the population, it is desirable to establish a method which will enable the evaluation of the need for open spaces, aimed at fulfilling specific functions within the urban network, while striving for intensive usage of the area by the local residents.' *(Givoni 1991, p.297)*

This method should '*simultaneously optimize benefits to biodiversity value, human well-being and economic output'* (Fuller & Gaston 2009, p.354).

Within the green space planning literature some general criteria for successful planning can be found. Firstly, green space planning should be integrated with wider city plans, planning for buildings and green areas simultaneously (Baycan-Levent et al. 2009; Werquin et al. 2005). Public and stakeholders have to be included from the start of the planning process (Nuissl et al. 2009; Baycan-Levent et al. 2009; Gobster 2001). Lastly there should be more focus on the quality and multifunctionality of UGS (c.f. Werquin et al. 2005; Thompson 2002; Breuste 2004). This advice fits well with the ideas outlined by urban ecologists; that the city is an integrated system with both natural and human dimensions (Redman et al. 2004) and that management should be done in cooperation by a variety of stakeholders (Andersson 2007a). Furthermore, to achieve a learning-by-doing approach, a framework for monitoring planning and management should be in place (Carmona 2003).

Results

An overview of the study area and the urban parks are given in Figure 3. For a detailed overview of park names mentioned in this thesis, see Appendix 4. The UGS in Lisbon is dominated by *Parque Florestal de Monsanto*, a 900 ha large woodland, and *Tapada de Ajuda* (attached to Monsanto). Together these two parks cover 11% of Lisbon's land area.

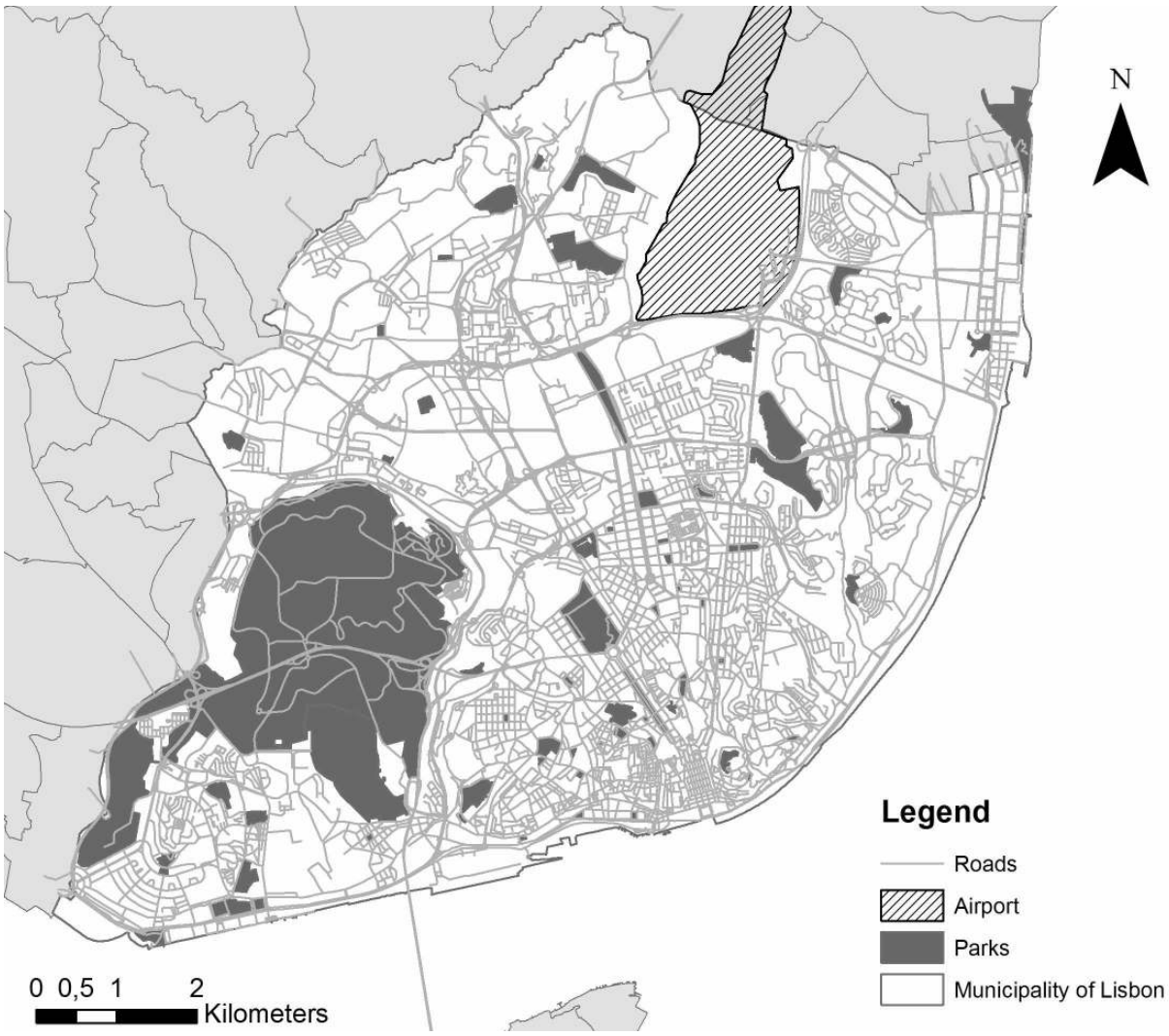

Figure 3. Map of the parks in the municipality of Lisbon

Urban planning and management

The recent expansion of Lisbon has been characterized by the formation of the Lisbon Metropolitan Area or LMA (Machado et al. 1997). This area, which covers eighteen different municipalities, houses one-forth of the Portuguese population (AML 2010) and is concentrated around the municipality of Lisbon. A larger regional council has been set up to control the planning and development of the LMA (Silva & Syrett 2006).

Within the municipality, the PDM (Plano Director Municipal), or master plan, is the main tool for urban planning. It contains planning legislation, the model for spatial planning, strategies for local development, and other rules and targets (Oliveira & Pinho, in press). The first PDM was constructed in 1994. Since 2001 work has been undertaken to revise the old PDM; this revision is still in progress (Oliveira & Pinho, in press). The LMA has its own master plan, which includes a basic greenway structure (AML 2001).

The current government in Lisbon is concerned about green space quality and coverage, and has spent more money on green space planning and management than the previous government (Henriques 2010; CML 2008)[2].

Green plan

By Portuguese law, each municipality must create a municipal ecological infrastructure (MEPAT 1999). In 2006, the municipality of Lisbon approved the Plano Verde, or 'green plan'. This plan defines a green structure through the municipality of Lisbon and indicates the most important sites with high water tables (the humid system) in the city (see Figure 4). This plan is to lead to an integration of the green areas within the wider LMA green structure (CML 2007). Within the humid system hydrological impact studies have to be made when new constructions are build, while the green structure has a larger aim (Ibid). The green structure will combine natural and cultural values in a holistic perspective, creating continuity of natural and cultural areas, ecological sustainability, a revitalisation of cultural heritage and an increase in biodiversity. This myriad of functions is brought down to aims to establish a continuous system of spaces for recreation, production, protection and increased mobility. The green zones are to be implemented by building restrictions, requiring that green structures be maintained throughout newly build areas. A building stop is imposed on geological monuments, old estates and several other areas. (CML 2007)

The green structure as presented in Figure 4 clearly overlaps large areas of existing buildings. These areas are partly neighbourhoods with a high percentage of green space coverage, but in other places there is currently no green space present. An example of this present lack of green space is the eastern riverfront, which is an important part of the green structure in the plan. An interviewee stated that the implementation of the current green plan would only be possible if the city of Lisbon we know today was destroyed (Castro 2010).

[2] The municipality was however criticised for taking credit for the execution of pre-existing plans (Portugal Zone 2008)

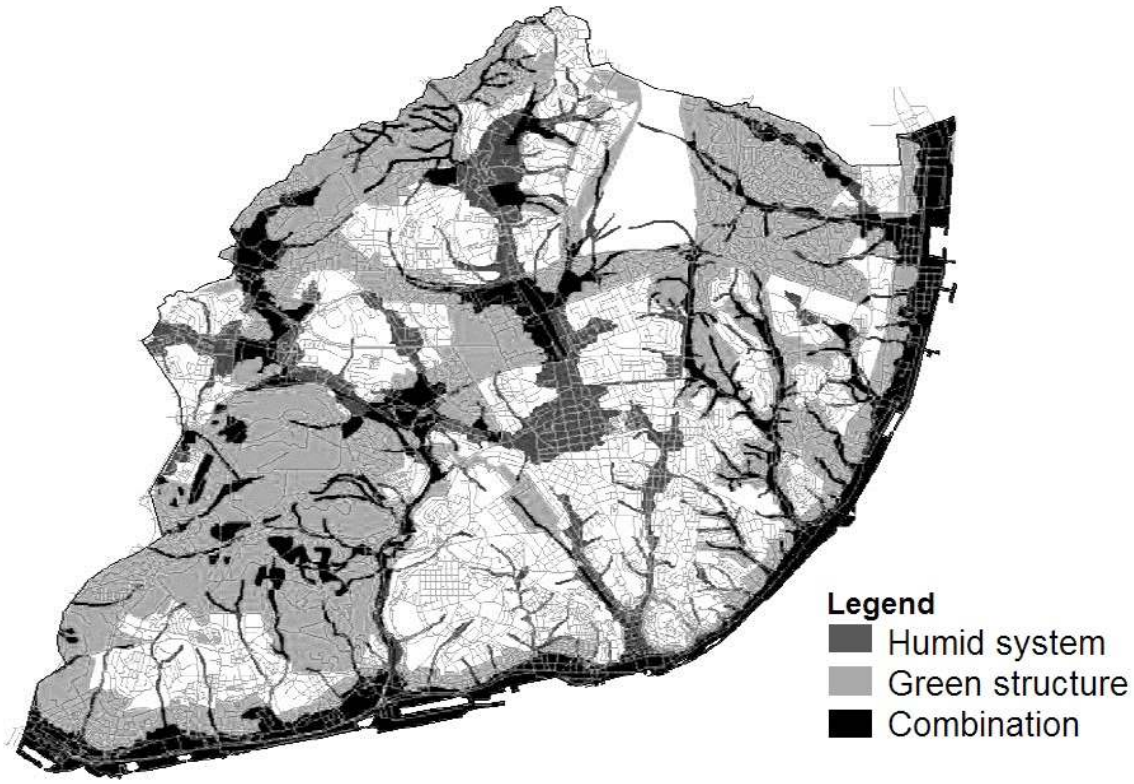

Figure 4. Green structure as proposed in the green plan (adapted from CML (2010b))

Planning

Green space planning is performed on a strategic level by the urban planning division, while the planning division (DEP) plans and designs the actual green spaces in Lisbon. At the same time the city councillor, who leads the directorate for the environment (DMAU), can create his own proposals, which must be planned and executed during the political term in which this councillor is serving. The DEP uses the municipal green plan as a tentative guideline to plan for the creation, integration and extension of UGS in Lisbon.

The DEP utilises a space standard approach to defend its green space plans, but actually follows a park systems approach in their planning. This approach is created by the master plan of the DEP, in which parks are classified by the recreational functions they provide; woodlands, urban parks, gardens, proximity spaces and greenery (Castro 2010; DEP 2007a). Each of these classes is considered to differ in their recreational use. Management and planning criteria have been set to describe maximal management costs of each of these classes and what kinds of furniture and services can be provided inside the parks (DEP 2007c; DEP 2007d; Castro 2010).

In terms of monitoring, the DEP recently introduced a matrix structure on which the progress towards the aforementioned criteria is to be indicated. This is done to diminish lengthy progress reports and to make the planning and implementation process more transparent (Castro 2010). Lisbon also has an active GIS department, and more and more monitoring data is accessible via a GIS database. It is e.g. the intention that every individual tree in Lisbon will be incorporated in the GIS, coupled to management plans (Santos & Sampaya 2010).

Management

Green spaces are managed by the garden division (DJ) and the woodland division (DM) within the Department of Environment and Green Spaces (DAEV). The DM takes care of the larger urban parks, while the DJ is responsible for the smaller urban gardens. The smallest green spaces, like small roadside green, are taken care of by the *Junta de freguesia*, which are a political structure within the parishes (*freguesias*) of Lisbon. The majority of maintenance is outsourced, however this is not done willingly as it is seen as inefficient and expensive.

The distribution in management structures has a historical origin, where the DM traditionally had a stronger focus on forest management. It can be seen that the DJ takes in general more care for aesthetical aspects, while the DM, with employees who have a background in forestry, takes more ecological aspects into account. All management levels have indicated that the money received for the management of green spaces is not enough to cover expenses (Canha et al. 2010; Ferreira 2010; Costa 2010). For example: the DJ has to replace flowerbeds in some parks by grass or scrubs, as they do not have the money to maintain flowerbeds (Canha et al. 2010).

Out of the 65 parks, eight are managed by different organisations, three of which are managed by other municipal departments outside the DMAU. From interviews with managers of *Parque Monteiro Mor*, *Jardim de Gulbenkian* and *Parque Tejo e Tranco* it was found that management is done from varying perspectives, and that there is no contact with either the DEP or the DAEV, not even in municipally owned parks.

Challenges of municipal green space planning

There are numerous planning process deficiencies that hinder an integrative planning approach. The current head of the DEP indicates that he wants to plan integratively with the neighbouring municipalities, which fits the ideas displayed in the municipal green plan. The current Mayor of Lisbon, however, forbade the DEP to create cooperative plans with other municipalities, as this would increase costs (Castro 2010).
Integrative planning does not seem to be widely accepted as of yet, and the DEP still struggles with convincing the planning departments of urban space and traffic as to the importance of integrative planning (Castro 2010). There is no sign from the interviews that the managers or planners in the DMAU have contact with managers of parks outside their directorate.

In terms of internal communication the ideal within the DEP is that there should be a good communication with the DAEV during the planning process (Castro 2010). In reality this is not the case. Managers in the DAEV have indicated that feedback is normally not asked for (Canha et al. 2010; Henriques 2010). As an example: when a new plan for the restructuring of a park in Lisbon was shown to the manager responsible for this park, it was the first time she heard that plans were underway. This lack of communication has lead to the fact that newly renovated or constructed parks, although being good in other aspects, are sometimes hard to maintain by managers (Canha et al. 2010). While officially there is little contact between departments, informal routes and personal contacts are used to obtain the necessary information from different departments (Ibid). A lack of communication is also present in the implementation of the green plan. While the idea is that the green plan is being used by the DAEV (CML 2007), all managers interviewed indicated that they do not use it in their management, and are not fully aware of the contents of the green plan. The different municipal departments were never asked to give their opinion on these plans before they were approved (Canha et al. 2010).

Public participation is present in Lisbon. The municipality has regular citizen meetings within each freguesia; this helps in talking with the municipality about green spaces (Canha et al. 2010). Yearly €5 million is reserved to execute project proposals made by the public; some of these plans involve green spaces. The public can further review and comment on green plans for parks online. Therefore several options for public participation exist. However, within green space planning this happens mostly after the actual plans have been made. There is still a fear with current politicians to share data openly with the public (Castro 2010).

Environmental aspects in planning and management

The DMAU uses a sustainability framework in their urban planning. This framework is based on four criteria: water -, energy- and resource use and waste (DMAU & DEP 2007). At the same time, the green plan says it is aiming for ecological sustainability (CML 2007). In 2006, the Mayor of Lisbon stated that the purpose of the green plan was, amongst others, to improve the production of oxygen, increase the carbon sink in the city, to filter the air, enhance rainwater regulation and promote biodiversity (Morais 2006). In reality this network is being designed for humans to move from one green space to another in the form of cycling and walking routes, without clear integration of natural or ecological values (Castro 2010; CML 2007).

Within the plans of the DEP, natural or environmental values are not visible. The head of the DEP is concerned with soil quality and the energy usage of parks (Castro 2010), problems that fit the sustainability criteria of the DMAU. In contrast with these criteria Mr. Castro does not see water use as a problem, although it is an important concern within the DAEV. Currently irrigation systems are old and leaking and hence highly ineffective, and often tap water is used to water the parks (Henriques 2010).

Biodiversity aspects are not taken into account in planning since the possibility for natural areas within the municipal borders is seen as very limited (Castro 2010). In contrast, before his departure in 1998, the previous head of the DEP was working to establish an ecosystem view of park management and to use green corridors and ecological network ideas to create linked habitats within the city (Canha et al. 2010). After he left, this work has clearly been discontinued. However, in March 2010 the municipality introduced a target to increase urban biodiversity by 20% in 2020 (CML 2010). Work is currently undertaken to start monitoring biodiversity, and devise recommendations on how to achieve this target (M. da Luz Matthias, 2010. pers. comm.).

Managers have been asked what services their parks provide for the residents of Lisbon. An overview of ecosystem services mentioned by the different municipal departments is given in Table 6. Only managers outside the municipality mentioned aesthetic values as being important, but it is safe to assume that aesthetical aspects play a role in all departments. It is curious that the DJ mentioned noise reduction as an important function, while at the same time the environmental division in the DAEV, who controls the noise pollution within the city, does not consider green spaces in their models, as they say that green spaces do not have any influence on noise levels (Santos & Sampaya 2010). The largest city park, *Parque the Monsanto*, is widely recognised as providing important habitat -, noise reduction - and air filtration functions (Henriques 2010; Canha et al. 2010; Ferreira 2010; Castro 2010). The department of environmental education performs most of its activities within Monsanto as well (Gomes 2010). Monsanto is however hard to reach as it is surrounded by highways, and has still a negative image with residents of Lisbon, due to a history of drug dealing and prostitution that used to take place there (Gomes 2010).

During the interviews it became clear that while individual managers have ideas on the ecosystem services provided by urban parks, the ideas are not used in actual UGS management. This partly due to the financial situation; an interviewee stated: '*we have very few resources for maintenance; in spite of thinking globally, we really act as cleaners, as keepers'* (Canha et al. 2010).

The managers outside the DAEV keep a variety of services in mind when dealing with green space management, which is also due to a larger diversity of management ideas. All functions mentioned seemed to be guiding their management practices.

Table 6. Ecosystem services mentioned by the managers and planners of the DMAU

	DEP	DJ	DM	Other managers
Nutrient Cycling				X
Provision of habitat			X	
CO_2 uptake				
Air quality maintenance			X	X
Noise Reduction		X		X
Water regulation	X			X
Pollination			X	
Food Production				X
Recreation	X	X	X	
Inspiration		X	X	X
Educational values				X
Cultural Heritage values				X
Aesthetic Values	X	X	X	X

Green space coverage

The buffer map created to obtain an overview of the green space coverage is shown in Figure 5. Within Lisbon, 45.4% of the municipal area has appropriate green space coverage (coded with 'good' in Figure 5). Contrary to expectations, the places that lack green space coverage are not those areas with the highest population density in the city centre, but are located at the coast and the valley between Monsanto and the city.

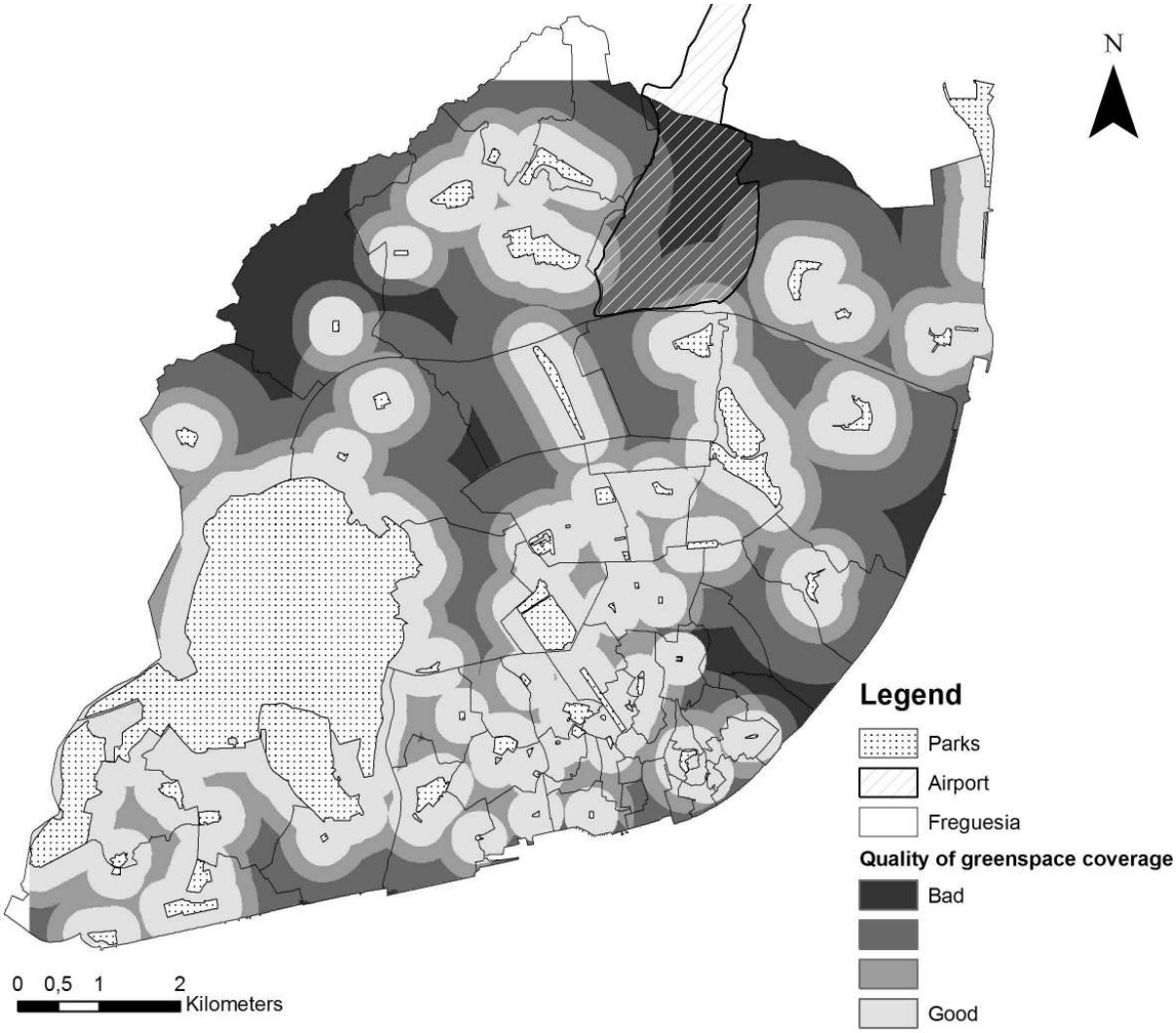

Figure 5. Green space coverage in Lisbon, the area inside the airport was excluded from the final calculations.

Observations

Overall, the 60 parks included in the observational study cover 3.5% of the Municipal area. Trees cover 40% of the total park area, and 80% of the area consists of unsealed surface. Although the *Parque de Monsanto* was not included in the direct observations, the park was visited. Data provided by the DM show that Monsanto has more than 90% tree cover (Domingos & Rodrigues 2006).

Many of the gardens in Lisbon have a long history: one third of the parks were constructed before 1900. Fourteen parks contain cultural aspects. These parks can therefore provide important cultural heritage functions if people are aware of these historical aspects. However, signs providing information about the cultural heritage values were found in just two of these parks. Other signs, besides general park overview maps, were present in thirteen parks. Ten of these parks had species information, and four of them provided information on the history of the park. Seven of the thirteen parks that presented additional information were not managed by the DAEV, but by private or other municipal management. Signs are therefore not an important way to educate the public in Lisbon for the municipality.

When observational data was compared with the different management divisions, no great differences were found between the different managerial styles. While it can be seen from the data that on average the DM takes care of larger parks, there was no difference in the measured habitat diversity between green spaces managed by DJ or DM (Table 7). This does not correspond to the statements made by the interviewees, which suggested that the DM paid more attention to the habitat function of parks. Other types of management have a higher habitat diversity, which can partly be explained by the presence of botanical gardens in this group.

Table 7. Statistical overview of the size and habitat diversity (D) of UGS per management type, indicated are the mean and the standard deviation (SD)

Department	Mean size (m^2)	SD size	Mean D	SD D
DJ	24633,32	*46265,21*	1,72	*0,39*
DM	124167,45	*134458,56*	1,72	*0,25*
Other	82397,11	*89172,52*	1,94	*0,31*

The classification method that the DEP uses was not visible in the green spaces themselves. While in general it can be said that gardens have the highest amount of paved surface, and woodlands the highest amount of tree cover, the values between these groups do not differ significantly from each other. Extra recreational aspects besides benches and tables were present in only seven out of sixty parks, all of which are managed by the municipality. These seven parks were not all urban parks, which the DEP expects to have the most varied recreation, but consisted of woodlands, gardens, urban parks and proximity spaces spread over the municipality. It was observed that where extra recreational provisions were present, the local population is using them.

Discussion

Urban planning and management

The green structure devised in the green plan (Figure 4) gives an overly optimistic picture of the green space in Lisbon, and cannot be implemented by enforcing building restrictions alone. It is the author's understanding that this green structure will function more as a guiding plan for green space development in Lisbon. The green plan works, like the PDM, on a citywide level and the current tools for implementation are only relevant for city planners. While a city green plan should ideally lead to an overarching goal within the city (Carmona 2003), the current green plan lacks a translation of the larger policies into responsibilities at the local level, and was implemented in a top down approach without the participation of local managers. Hence there has been no commitment or interest from managers for this plan. Due to current restrictions on intermunicipal planning, the goal to incorporate this plan in the wider metropolitan green structure will be difficult to achieve.

The DEP is moving away from quantitative space-standard approaches towards more qualitative measurements for green space. At the moment only recreational aspects are taken into consideration, while the actual recreational provision in parks does not reflect these categories. However, the current classification has been around for just three years, and therefore these changes in planning and management aspects can very well not yet be visible within the parks.

The problems as identified in this research within the municipality of Lisbon coincide with critique present in literature. The municipal system of Lisbon and the LMA are criticized for being heavily centralized; lacking leadership and vision in planning and environmental control; lacking accountability and transparency; and for the absence of public participation (Silva & Syrett 2006). Furthermore, there are many divisions within the municipal government with overlapping responsibilities (Oliveira & Pinho, in press). These responsibilities often do not match the allocated financial resources (Ibid), which leads to budget deficits. The culture and structure within the municipality of Lisbon still follows the public administration model of governance, with separated political and administration bodies, a strict hierarchy and the state providing a steering role to its city (see also Table 3).

The lack of formal communication between different departments can be explained by the theory on hypertrophy of relational power (Ruivo, 2000 in (Breda-Vázquez & Oliveira 2008)), or easier said, the dominance of informal networks and contacts within and between organisations. These types of friendship bonds can be classified as strong ties within social capital theory, while weak ties are lacking within the Portuguese government (Breda-Vázquez & Oliveira 2008). An organisation bound by strong ties is however less efficient than an organisation bound by weak ties (Adler & Kwon 2002) and also leads to a high fragmentation of institutional resources, hampering integrative planning (Breda-Vázquez & Oliveira 2008). The focus on strong ties within Portuguese government is a historical and cultural artefact, and can be seen as typical in the southern European context (Ibid). It is probably one of the main differences between North- and South European politics.

Portugal is furthermore characterized by a climate of distrust towards public officials (Rego et al. 2005). This was also found in personal communications with local residents. Within a European context, Portugal ranks fourth in 21 questioned countries in the percentage of people stating that they have *'no trust at all'* in politicians; 30% of Portuguese agree with this statement (NSD 2008). This lack of trust has its origin in frequent stories regarding petty corruption within the political system (Rego et al. 2005). Although the frequency of petty corruption is decreasing, it is still

present in many aspects of Portuguese society (Ibid). This distrust hampers public-private partnerships and stakeholder engagement (Ibid), and can be expected to cause decreased interest in public participation. At the same time, public participation is a tool that, when handled correctly, helps to increase trust (Halvorsen 2003). Therefore, a reinforcing loop exists between trust and the amount of participation, and this is currently being negatively affected by stories of corruption and by a highly centralized governance system. This loop will have to be reversed for public participation to be effective.

According to the literature there are at least three aspects that indicate successful green space planning: integrative city planning, public and stakeholder involvement and a focus on quality and multifunctionality of green spaces. The green plan is working to integrate green space planning with wider city planning, but at the same time it fails to integrate local park managers into the plan. Public participation increasing in Lisbon, although mostly after the actual green plans have been made. Other signs of stakeholder involvement have not been found, and literature also indicates that this is nearly absent in municipal planning (Chorianopoulos 2003; Silva & Syrett 2006). It is positive however that the divisions are aware of the communication issues, and that the DEP is moving away from space-standard methods. It is concluded that Lisbon's green space planning is currently not successful.

Environmental aspects in planning and management

Within the municipality there exists a large discrepancy between the sustainability framework used by the DMAU and the ecological sustainability framework presented in the green plan and in the media by politicians. The four sustainability criteria set up by the DMAU (water, energy, resource use and waste) reflect a weak sustainability model (Carter 2007), aimed purely at limiting resource consumption and waste production. Ecological sustainability is far more ecocentric, and looks foremost at the protection of ecosystem functioning and biodiversity. Looking from the simplistic model of the three pillars of sustainability, the DMAU is largely located in the interplay between the environmental and economical pillar, while the green plan is claiming to focus only on the environmental pillar (Figure 6). In reality the green plan does not have this single focus and also takes social and cultural aspects into account. This discrepancy between the different models used and the actual policy being implemented reflects a failure to understand that to reach sustainability the different pillars need to be integrated within all levels of policies. A discrepancy in the sustainability frameworks used further means that the vision of what the city of Lisbon will be in the future will differ as well. It has to be understood that when each department follows their own vision, none of the different visions will be reached.

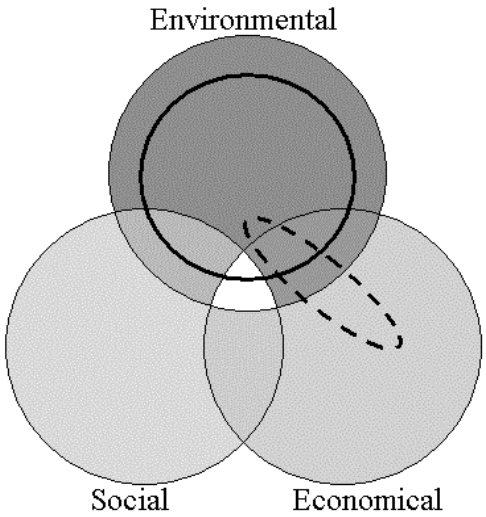

Figure 6. Pillars of sustainability. Indicated are the vision of the DMAU (dotted) and the green plan (solid)

Ecosystem services are currently not used within green space planning and management. The differences in the ecosystem services mentioned by the various managers is clear, and although not reflected in the observations, does show a variety of ideas as to what the important functions of parks are. This is partly due to the fact that these kinds of questions are not topics discussed within this institution. If discussion was started among managers about the ecosystem services in parks, these views will probably come closer together.
The two managers that were interviewed outside the DAEV manage their gardens with a wider range of ecosystem services in mind than managers within the DAEV. This fits the findings of Andersson (2007b), who states that managers who are more often present in their parks have more local ecological knowledge, which enables them to understand and manage their parks more effectively. As only two managers were directly interviewed, no definite conclusions can be drawn in regards to this.

The green space coverage buffers (Figure 5) reflect a lack of parks along the eastern riverside. Many of the parks in the city centre are smaller than five hectare, and are not able to provide enough recreational services for the public. Indeed, when parks which did not provide extra recreational functions besides benches were excluded from the calculations, the level of sufficient green space coverage lowered to 35.1%; a 23% decrease. This is not to say that this is the only criterion that should be taken into consideration, but it does follow the critique on quantitative planning approaches (c.f. Nuissl et al. 2009; Maruani & Amit-Cohen 2007). The fact that *Parque Florestal de Monsanto* contributes roughly two-thirds (10%) of the 16% green space cover in Lisbon explains the lack of citizen satisfaction with the current green space. Monsanto is hard to reach as highways fully surround it, and there is a negative image of the park. The municipality is currently trying to change this (c.f. DEP 2007b), and has had some success in improving the image of the park (Lisboa Verde 2010; Gomes 2010).

Urban ecology

The conceptual idea of Lisbon as a coupled social ecological system is not yet present in the municipality. This idea can however be seen in the green plan, where green permeates existing build structure and the green structure takes both natural and cultural aspects into account. However, the plan itself is too optimistic as to what can be achieved, and its larger view is not translated into practical guidelines nor known by the park managers within the city. In terms of adaptive management, the governmental structure does not reflect a movement away from a public administrative type of governance towards the assumptions in urban governance as shown in Table 3. This, together with the lack of trust in municipal planning, contributes to an absence of contact with other park managers. Hence local knowledge of park management is not shared amongst them. The same is true with the contact between planners and managers; both could learn from each other. Park managers should be involved from the start of the planning process, as to create new parks of higher quality and better manageability. Landscape architects should also be able to 'have a say' in the practices of park managers. (Carmona 2003). The managers within the DJ would rather see that the planners had to create a management plan in their park designs instead of being involved themselves (Canha et al. 2010). A more intense cooperation will however lead to a common vision between managers and planners, which allows for them to advocate together the importance of green spaces within the wider municipal government (Carmona 2003).
In conclusion, theories on adaptive management are not present within the municipality. The government will have to steer towards a more open, network-based style of governance before adaptive management can be implemented.

It is possible to use urban ecology in a southern European context, although the possibilities for urban green are lower due to an on average smaller green space coverage (Fuller & Gaston 2009). Other ecosystem services will be appreciated more by residents in a hot climate (e.g. shade, open

to wind, water consumption of vegetation, designed for passive recreation) than in a cold climate (open to sun, protected from wind, more active recreation) (Givoni 1991).
In terms of natural values, one important aspect that this thesis did not address is the presence of natural vegetation in Lisbon. The Mediterranean biome has, especially on the Iberian Peninsula on which Lisbon is located, unique flora and fauna (Ramos et al. 2001; Medail & Quezel 1997). Natural areas are no longer present inside Lisbon, and hence the potential for incorporation of natural values is far more limited in a city like Lisbon than in Stockholm, which has more than double the green space coverage (Fuller & Gaston 2009) in addition to nature areas which are important for national biodiversity (Löfvenhaft et al. 2002). However, the idea of urban ecology to integrate nature in the city can be used in different ways, emphasizing either the natural or anthropological demands, and offering the benefit of an explicit assumption that nature is an inherent part of a city.

Case study

The unit of analysis in this thesis was the municipality of Lisbon. During the research it quickly became clear that it is hard to look at the municipality of Lisbon without also looking at the bigger picture of Lisbon as a metropolitan area. Yet, even though Lisbon is a small part of the total metropolitan area (LMA), it has the most power within the LMA (Silva & Syrett 2006). Furthermore, inter-municipal cooperation was found to be discouraged within green space planning and management. Interviewees also did not indicate that the LMA had any influence on UGS planning. Therefore the selected case study has not lost its validity. The LMA was too big to be studied in detail during the time of this thesis. Further research could look at the interlinkages of the municipal planning with the other municipalities of the LMA and with higher government levels.

The choice to look only at urban parks was made in order to narrow the focus of this research as well as to fit the duration of the fieldwork. It is not argued, however, that the current focus in parks is enough to analyse green space management in its totality. It is important to look at other UGS as well; for effective green space planning we need an integrative approach on different scale levels, ranging from a landscape level to an individual park setting. Still, the current focus on urban parks has provided a good insight into the current planning and management practices within Lisbon.

Discussion of methods

Semi-structured interviews

The semi-structured interviews held during this research proved to be a valuable data source. The language barrier proved to be less of a problem than originally expected, as the proficiency in English amongst interviewees was high. Due to the time it took to arrange the interviews, the theoretical sampling was not exhaustive and theoretical saturation was not fully reached. This research would have benefited from a wider selection of interviewees with more people within the respective departments and more managers and other informants outside of the municipality. Due to the potential language barrier it was deemed important to have a face-to-face interview and since the current qualitative interview might have proven too long for a telephone interview (Bryman 2008), no additional interviews where held. Further interviews with different actors could be conducted to validate the conclusions made in this thesis.

Observations

The data gathered by the observational survey was useful to consider whether planning methods were reflected into actual parks. Originally, this thesis set out to approximate the ecosystem services in parks using these observations. It proved difficult to find a way to truly approximate ecosystem services. Approximation could have been performed using models, but current models can only roughly estimate a small variety of ecosystem services, and not ecosystem benefits (c.f. the InVEST or CITYgreen models: Daily et al. 2009; Longcore et al. 2004). These models have not been used in a European context. The use of these models would therefore have been an interesting thesis in itself, but was not the objective of this research.

Due to the original focus of the observation survey, the selected variables were not optimal for the characterisation of parks, and the inclusion of other variables would have benefited the observations (c.f. the variables in Grahn & Stigsdotter (2010)).

The calculated habitat diversity did not match the authors expectations as to which parks would have the best habitat. This was due to two reasons; firstly, the surroundings of the park were not included in the calculation, and secondly, naturalness of vegetation is not included. A park that contains a (semi-) natural forest will therefore rank lower in the diversity calculation than a heavily managed park with grass, scattered trees and flowerbeds. Although a correlation is observed in urban areas between the species richness and habitat diversity of green spaces (Pauleit et al. 2005), habitat diversity is a poor indicator of species richness when human disturbance is prevalent (Honnay et al. 1999). It can therefore not be concluded that there is a difference in the habitat provision between the areas managed by the DJ and the DM. Personal observations indicated that while areas containing woodlands looked more natural, this was not the case for other urban parks managed by the DM.

Towards a better green space planning approach

Within cities there is substantial potential to increase the ecosystem performance of green spaces (Tratalos et al. 2007), and within urban ecology there is a growing understanding of the functioning of natural systems within the urban environment (c.f. Kaye et al. 2006; Andersson 2006; Wittig et al. 2008). A focus on ES could lead to a better understanding of the connections between humans and the environment. Therefore, ES must be explicitly integrated in decision-making (Daily et al. 2009). ES could be used as criteria in green space planning, both to evaluate and to provide goals for management and planning. This is often done for one or two ecosystem services already. For example, the city of Malmö, Sweden is using the water regulation services of urban green as an extra asset in their green management (Stahre 2008). Approaches using multiple ES criteria are scarce.

These ES criteria should be combined with other criteria in green space planning. Recently Nuissl et al. (2009) proposed such a combined framework to evaluate land use change. They suggested an assessment that takes several criteria into account, including many ecosystem services (see Table 8). This could lead to an analysis that not only provides a more integrative way of looking at urban areas, but also gives new insights within a discussion that has a strong focus on spatial criteria (Nuissl et al. 2009).

Table 8. Proposed criteria from Nuissl et al. (2009)

- Surface run-off (mm)
- Groundwater recharge (mm)
- Evapotranspiration (mm)
- Air filter Capacity (mg)
- Noise (dB)
- Maintenance costs (€)
- Soil life (no. of species)
- Biodiversity (no. of species)
- Habitat integrity
- Global warming, (CO2, UV)
- Municipal taxes (€)
- Usability

To quantify these different aspects, one could either use an economic evaluation, which translates the supply of ecosystem services in monetary terms, or an approach that compares different types of variables in non-monetary terms (Daily et al. 2009).
The economic valuation of ES is a useful tool when making an initial planning decision, for example whether or not to develop an empty lot into a park. However, when this decision has been made and the question becomes how best to design and manage the park, valuation does not offer many useful insights as it fails to show causal relationships between services. For instance, it has been calculated that in the USA a singly tree, over a 50-year lifetime*, 'generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion'* (Sherer 2003, p.20).
This knowledge could change decision-making in favour for the protection of trees, but fails to show causal links; e.g. that air pollution increases death of trees, that a tree provides aesthetical benefits, how the value of air pollution control differs with trees standing together or alone, etcetera. Yet, making the tradeoffs between ES explicit is a core function of ecosystem assessment (Carpenter et al. 2009) Even just describing the causal relationships within the generation of ES can be beneficial in decision-making (Ibid). Hence, the author argues for a non-monetary approach: multi-criteria decision-making (MCDM).

MCDM is an analysis technique able to value different units at the same time. Within MCDM a problem definition is followed by a selection of alternatives, after which evaluative criteria are set up. These criteria are weighed in accordance to the importance given to them by the decision maker, after which the outcome is calculated and the most preferable option is chosen (Munda et al. 1994). It is an explicit method, as preferences for certain criteria are clearly visible within the analysis, making trade-offs in decision-making clear to policy makers (Munda et al. 1994). If well executed, MCDM can be a transparent tool, and can also be used as a participatory tool in creating a common perspective amongst government, NGOs and local residents (Nuissl et al. 2009). For example, Snep et al. (2009) used MCDM to combine preferences of businesses, employees, local government, NGOs and local residents to see how best to enhance biodiversity at business sites. This participatory stakeholder approach is useful, as different stakeholders have been known to perceive benefits from ecosystem processes differently (Turner & Daily 2008).
On the other hand, MCDM is a method that will require many resources and much energy to execute (Herath & Prato 2006), and due to the large amount of different MCDM methods (c.f. the extensive overview in the MSc thesis of van Moeffart (2003)) and technicalities involved, the help of experts will be required.

To apply such a framework to urban green space, the list of criteria has to be adapted. Table 9 provides a proposal for this list, with an overview of which criteria are important at different (tentative) scale levels, indicated by grey squares. The *'capacity to cope with recreation'* category was added after discussions with the head of the DAEV, who indicated that recreational activities are sometimes planned in parks incapable of dealing with the recreational pressure, leading to high repair costs (Henriques 2010). These criteria can either be quantified using direct measurements, or be estimated using GIS based models.

Table 9. Proposal of criteria to be used for MCDM in Lisbon

	Local	Neighbourhood	City
Irrigation system and source of water			
Surface run-off (mm)			
Groundwater recharge (mm)			
Evapotranspiration (mm)			
Shade (%)			
Air Filter Capacity (mg)			
Biodiversity (no. of species)			
Habitat integrity			
Global warming, (CO_2, UV)			
Food production			
Recreational functions			
Capacity to cope with recreation			
Aesthetic values			
Cultural heritage values			
Maintenance costs (€)			
Green space coverage (m^2/inhabitant)			

Within Lisbon, public stakeholder participation could be used to devise weighing factors for these different criteria. This wider discussion could help to reach a uniform vision within the various municipal divisions on the functions of green spaces, and reinforce public participation during the planning process. Different weighing criteria can be set up for the different green space groupings, prioritizing human values in areas meant for intense recreation, and natural ones in others. Further research will be needed to study whether MCDM really is the best technique to use, how these ideas can be integrated in the municipal structure, and to validate the criteria proposed in Table 9.

This advice can in all likeliness not be realised in Lisbon however, as it requires a change in mentality within the governance system, which will prove difficult to implement. Furthermore, Portugal has fallen into an economical crisis (see e.g. Paphitis & Pylas 2010) that has restricted any large investments, and will lead to cuts in government expenditures. It therefore seems unlikely that more money will be allocated to green space management in the near future.

Conclusion

This thesis set out to examine whether the ideas of urban ecology are reflected within park planning and management in Lisbon, and what can be done to improve the current management practices. Urban ecology argues for adaptive park management, in which management should be executed through the cooperation of various actors, in a learning-by-doing approach in order to create a wider knowledge base. A mixed methods approach was used to look at the management and planning of parks in Lisbon, using field observations, interviews, GIS- and documental research.

It was found that while municipal spending is increasing and the DEP is moving away from the use of quantitative spatial criteria, green space planning is currently unsuccessful. The municipal green plan gives an overly optimistic picture of the green space in Lisbon and lacks a translation of the larger policies to responsibilities at the local level, therefore failing to integrate local park managers into the plans. Public participation in green space planning mostly takes place after the actual plans have been made, while other kinds of stakeholder involvement are absent. There is a lack of formal communication between different municipal departments, which is due to a historical dominance of informal networks within society.

The ideas of urban ecology are not present in the municipality of Lisbon. Ecosystem services are not taken into account in green space planning and management, and while some ideas of urban ecology are reflected within the green plan, planners or managers have failed to incorporate these ideas due to the problems mentioned above. There are different definitions of sustainability being used simultaneously within the municipality, and there are also different ideas as to what the important functions of parks are. In terms of governance, Lisbon still clearly follows a public administration model. To adopt an adaptive management approach the municipality should steer towards a more open, network-based style of governance, as well as improve communication, both inside the department as between different green space managers.

A potential way to better plan for green spaces was presented. It is argued that ecosystem services should be used as criteria within a multi-criteria decision-making methodology of urban green space planning. These ecosystem services should be combined with more traditional planning criteria; a proposal for such criteria has been suggested. Using this methodology could help to increase public stakeholder involvement, reach a uniform vision within the different municipal divisions and increase green space quality, both for nature and for humans. Further research will be needed to see whether MCDM really is the best technique for this, how this proposal can be integrated in the municipal structure, and to validate the proposed criteria.

References

Adler, P.S. & Kwon, S., 2002. Social Capital: Prospects for a New Concept. *Academy of Management Review*, 27(1), 17-40.

Alberti, M., 2008. *Advances in Urban Ecology*, New York, USA: Springer US.

Alberti, M. et al., 2003. Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems. *Bioscience*, 53(12), 1169-1179.

AML, 2010. AML em Números [Lisbon Metropolitan Area in Figures]. Available at: http://www.aml.pt/index.php?&iLevel1=actividades&iLevel2=smig&iLevel3=amlnumeros&iContent=index.html [Accessed March 30, 2010].

AML, 2001. ATLAS - Ordenamento e Planeamento do Território [ATLAS - Regional Spatial Planning]. Available at: http://www.aml.pt/index.php?&iLevel1=actividades&iLevel2=smig&iLevel3=atlas&iContent=index.html [Accessed March 31, 2010].

Andersson, E., 2007a. *Managing the Urban Greens*. Doctoral Thesis in Natural Resource Management. Stockholm University.

Andersson, E., 2007b. Measuring Social-Ecological Dynamics Behind the Generation of Ecosystem Services. *Ecological application*, 17(5), 1267-1278.

Andersson, E., 2006. Urban Landscapes and Sustainable Cities. *Ecology and Society*, 11(1), 34 [online].

Andrade, H. & Vieira, R., 2007. A Climatic Study of an Urban Green Space: The Gulbenkian Park in Lisbon (Portugal). *Finisterra : Revista Portuguesa de Geografia*, 42(84), 27-46.

Baycan-Levent, T., Vreeker, R. & Nijkamp, P., 2009. A Multi-Criteria Evaluation of Green Spaces in European Cities. *European urban and regional studies*, 16(2), 193-213.

Bolund, P. & Hunhammar, S., 1999. Ecosystem Services in Urban Areas. *Ecological Economics*, 29(2), 293-301.

Borgström, S.T. et al., 2006. Scale Mismatches in Management of Urban Landscapes. *Ecology and Society*, 11(2), 16.

Breda-Vázquez, I. & Oliveira, C., 2008. Coalition-building in Portuguese Spatial Planning: Is There a Southern European Context? *European Planning Studies*, 16(6), 761.

Breuste, J.H., 2004. Decision Making, Planning and Design for the Conservation of Indigenous Vegetation Within Urban Development. *Landscape and Urban Planning*, 68(4), 439-452.

Bryman, A., 2008. *Social Research Methods* 3rd ed., Oxford: Oxford University Press.

Canha, A. et al., 2010. Group interview with managers from DJ [date interviewed: 24-03-2010].

Carmona, M., 2003. Is the Grass Greener…? Learning from International Innovations in Urban Green Space Management. Available at: http://www.cabe.org.uk/publications/is-the-grass-greener [Accessed November 14, 2009].

Carpenter, S.R. et al., 2009. Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *PNAS*, 106(5), 1305-1312.

Carter, N., 2007. *The Politics of the Environment* 2nd ed., Cambridge: Cambridge University Press.

Castro, J., 2010. *Interview.* Head of DEP [date interviewed: 22-03-2010].

Chan, K.M.A., Shaw, M.R. & Cameron, D.R., 2006. Conservation Planning for Ecosystem Services. *PLoS Biology*, 4(11), 2138-2153.

Chorianopoulos, J., 2003. North-South Local Authority and Governance Differences in EU Networks. *European Planning Studies*, 11(6), 671-696.

Choumert, J. & Salanie, J., 2008. Provision of Urban Green Spaces: Some Insights from Economics. *Landscape Research*, 33(3), 331-345.

CML, 2008. Apresentação da 1ª fase do Plano de Intervenções no Espaço Público e Espaços Verdes de Lisboa 2008/2009 [Presentation of the 1st phase of the Intervention Plan in the Public Green Spaces of Lisbon, 2008/2009]. Available at: http://www.cm-lisboa.pt/?idc=42&idi=35027 [Accessed May 21, 2010].

CML, 2004. Lisboa Interactiva. Available at: http://lisboainteractiva.cm-lisboa.pt/ [Accessed April 12, 2010].

CML, 2010. Lisboa quer ter mais 20 por cento de biodiversidade até 2020. Available at: http://www.cm-lisboa.pt/?idc=41&idi=51973 [Accessed May 7, 2010].

CML, 2007. Plano Verde - Medidas Cautelares (Green plan - Preventive Measures). Available at: http://lisboaverde.cm-lisboa.pt/fileadmin/LISBOA_VERDE/Documentos/Plano_Verde/Plano_Verde_-_Regulamento_das_Medidas_Preventivas.pdf [Accessed March 31, 2010].

CML, 2010. Plano Verde - Medidas Cautelares [Green Plan - Preventive Measures]. Available at: http://lisboaverde.cm-lisboa.pt/fileadmin/LISBOA_VERDE/Documentos/Plano_Verde/PLANO_VERDE_Medidas_Preventivas.pdf [Accessed May 12, 2010].

Constanza, R., 2008. Ecosystem Services: Multiple Classification Systems Are Needed. *Biological conservation*, 141(2), 350-352.

Constanza, R. et al., 1997. The Value of the World's Ecosystem Services and Natural Values. *Nature*, 387, 253-260.

Costa, R., 2010. *Interview.* Park manager of Parque de Monteiro Mor [date interviewed: 25-03-2010].

Daily, G.C. ed., 1997. *Nature's services*, Washington D.C.: Island Press.

Daily, G.C. et al., 2009. Ecosystem Services in Decision Making: Time to Deliver. *Frontiers in Ecology and the Environment*, 7(1), 21-28.

Davies, J.S. & Imbroscio, D.L., 2009. *Theories of Urban Politics* 2nd ed., London, UK: Sage Publications Ltd.

DEP, 2007a. PRJ0460 - Estrutura / Matriz dos Planos [Structure/ Matrix of Plans].

DEP, 2007b. PRJ0461 - Plano de Estrutura Verde [Green Structure Plan].

DEP, 2007c. PRJ0469 - Plano de Concessão de Equipamentos [Equipment Provision Plan].

DEP, 2007d. PRJ0470 - Critérios Para a Elaboração / Apreciação de Projectos [Criteria for the Elaboration/Valuation of Plans].

Di Giulio, M., Holderegger, R. & Tobias, S., 2009. Effects of Habitat and Landscape Fragmentation on Humans and Biodiversity in Densely Populated Landscapes. *Journal of Environmental Management*, 90(10), 2959-2968.

DMAU & DEP, 2007. Enquadramento Estratégico para o Espaço Público de Lisboa [Strategic Framework for the Public Space of Lisbon].

DMPU, 2009. REOT- Relatório do Estado do Ordenamento do Território [Report on the State of Spatial Planning]. Available at: http://habitacao.cm-lisboa.pt/documentos/1238771728D1ySW7zj9Hn25NA7.pdf [Accessed February 23, 2010].

Domingos, L. & Rodrigues, R., 2006. Carta de Vegetação Arbórea do PFM [Tree cover map of Parque Florestal de Monsanto].

Dow, K., 2000. Social Dimensions of Gradients in Urban Ecosystems. *Urban Ecosystems*, 4(4), 255-275.

Endlicher, W. et al., 2008. Heat Waves, Urban Climate and Human Health. In J. Marzluf, ed. *Urban Ecology; An International Perspective on the Interaction Between Humans and Nature*. Springer US, pp. 249-262.

Eurostat, 2009. Urban Audit - Perception Survey. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/city_urban [Accessed May 21, 2010].

Ferreira, I., 2010. *Interview.* Park manager within DM [date interviewed: 26-03-2010].

Fisher, B., Turner, R.K. & Morling, P., 2009. Defining and Classifying Ecosystem Services for Decision Making. *Ecological Economics*, 68(3), 643-653.

Formas, 2005. *State of the Art - Sustainable Urban Development in Sweden*, Stockholm, Sweden: Forskningsrådet Formas. Available at: http://www.formas.se/upload/dokument/PDF%20filer/state_of_the_art.pdf [Accessed May 12, 2010].

Fuller, R.A. & Gaston, K.J., 2009. The Scaling of Green Space Coverage in European Cities. *Biol. Lett.*, 5(3), 352-355.

Givoni, B., 1991. Impact of Planted Areas on Urban Environmental Quality: A Review. *Atmospheric Environment. Part B, Urban Atmosphere*, 25(3), 289-299.

Gobster, P., 2001. Visions of Nature: Conflict and Compatibility in Urban Park Restoration. *Landscape and Urban Planning*, 56(1), 35-51.

Gomes, C., 2010. *Interview.* Head of DESA [date interviewed: 15-03-2010].

Grahn, P. & Stigsdotter, U., 2010. The Relation Between Perceived Sensory Dimensions of Urban Green Space and Stress Restoration. *Landscape and Urban Planning*, 94(3-4), 264-275.

Grimm, N.B. et al., 2000. Integrated Approaches to Long-Term Studies of Urban Ecological Systems. *Bioscience*, 50(7), 571-584.

Haines-Young, R. & Potschin, M., 2009. *Methodologies for Defining and Assessing Ecosystem Services*, Joint Nature Conservation Committee.

Halvorsen, K.E., 2003. Assessing the Effects of Public Participation. *Public Administration Review*, 63(5), 535-543.

Henriques, I., 2010. *Interview.* Head of DAEV [date interviewed: 22-03-2010].

Herath, G. & Prato, T., 2006. *Using Multi-criteria Decision Analysis in Natural Resource Management*, Surrey, England: Ashgate Publishing.

Herbert, P.D. & Thomas, D.C., 1997. *Cities in Space: City as Place* 3rd ed., David Fulton Publishers.

Honnay, O. et al., 1999. The Role of Patch Area and Habitat Diversity in Explaining Native Plant Species Richness in Disturbed Suburban Forest Patches in Northern Belgium. *Diversity and Distributions*, 5(4), 129-141.

Hunter, M.R. & Hunter, M.D., 2008. Designing for Conservation of Insects in the Built Environment. *Insect Conservation and Diversity*, 1(4), 189-196.

IGEO, 2008. COAP 2008.1. Available at: http://www.igeo.pt/produtos/cadastro/caop/inicial.htm [Accessed February 15, 2010].

James, P. et al., 2009. Towards an Integrated Understanding of Green Space in the European Built Environment. *Urban Forestry & Urban Greening*, 8(2), 65-75.

Kaye, J., Groffman, P. & Grimm, N., 2006. A Distinct Urban Biogeochemistry? *TRENDS in Ecology and Evolution*, 21(4), 192-199.

Kearns, A. & Paddison, R., 2000. New Challenges for Urban Governance. *Urban Studies*, 37(5-6), 845-850.

Lisboa Verde, 2009. Lisboa Verde. Available at: http://lisboaverde.cm-lisboa.pt [Accessed December 7, 2009].

Lisboa Verde, 2010. Parque Florestal de Monsanto. *Lisboa Verde*. Available at: http://lisboaverde.cm-lisboa.pt/index.php?id=4051 [Accessed May 20, 2010].

Löfvenhaft, K., Björn, C. & Ihse, M., 2002. Biotope patterns in urban areas: a conceptual model integrating biodiversity issues in spatial planning. *Landscape and Urban Planning*, 58(2-4), 223-240.

Longcore, T., Li, C. & Wilson, J.P., 2004. Applicability of Citygreen Urban Ecosystem Analysis Software to a Densely Built Urban Neighborhood. *Urban Geography*, 25(2), 173-186.

Lundberg, J., 2006. *Rethinking Urban Nature*. Doctoral Thesis in Natural Resource Management. Stockholm University.

Machado, J.R. et al., 1997. Greenways Network for the Metropolitan Area of Lisbon. In J. Machado & J. Ahern, eds. Lisbon: CNIG, pp. 281-289.

Maller, C. et al., 2006. Healthy Nature Healthy People: "contact with Nature" as an Upstream Health Promotion Intervention for Populations. *Health Promotion International*, 21(1), 45-54.

Mapcruzin.com, 2010. Portugal Roads. Available at: http://www.mapcruzin.com/free-portugal-arcgis-maps-shapefiles.htm [Accessed March 23, 2010].

Maruani, T. & Amit-Cohen, I., 2007. Open Space Planning Models: A Review of Approaches and Methods. *Landscape and Urban Planning*, 81(1-2), 1-13.

Marzluf, J. ed., 2008. *Urban Ecology; An International Perspective on the Interaction Between Humans and Nature*, New York, USA: Springer US.

Matsuoka, R.H. & Kaplan, R., 2008. People Needs in the Urban Landscape: Analysis of Landscape and Urban Planning Contributions. *Landscape and Urban Planning*, 84(1), 7-19.

McDonald, A. et al., 2007. Quantifying the Effect of Urban Tree Planting on Concentrations and Depositions of PM10 in Two UK Conurbations. *Atmospheric Environment*, 41(38), 8455-8467.

MEA, 2005. *Ecosystems and Human Well-being; Synthesis*, Washington D.C.: Island Press.

Medail, F. & Quezel, P., 1997. Hot-Spots Analysis for Conservation of Plant Biodiversity in the Mediterranean Basin. *Annals of the Missouri Botanical Garden*, 84(1), 112-127.

MEPAT, 1999. Decreto-Lei N.o 380/99 De 22 De Setembro. Available at: http://www.dre.pt/pdf1sdip/1999/09/222A00/65906622.PDF [Accessed May 16, 2010].

Miller, J., 2005. Biodiversity Conservation and the Extinction of Experience. *Trends in Ecology & Evolution*, 20(8), 430-434.

van Moeffart, D., 2003. *Multi Criteria Decision Aid in Sustainable Urban Water Management*. MSc Thesis. Stockholm, Sweden: KTH.

Mooney, H.A. & Ehrlich, P.R., 1997. Ecosystem Services: A Fragmentary History. In G. C. Daily, ed. *Nature's services*. Washington D.C.: Island Press, p. 392.

Morais, F., 2006. Plano Verde de Ribeiro Telles de Volta à Câmara [The Green Plan of Ribeiro Telles moves to the Municpal Vote]. *Diario de Noticias*. Available at: http://dn.sapo.pt/inicio/interior.aspx?content_id=643530 [Accessed April 1, 2010].

Munda, G., Nijkamp, P. & Rietveld, P., 1994. Qualitative Multicriteria Evaluation for Environmental Management. *Ecological Economics*, 10(2), 97-112.

Nielsen, T.S. & Hansen, K.B., 2007. Do Green Areas Affect Health? Results from a Danish Survey on the Use of Green Areas and Health Indicators. *Health & Place*, 13, 839–850.

NSD, 2008. European Social Survey. *ESS Data*. Available at: http://ess.nsd.uib.no/ess/round4/ [Accessed May 16, 2010].

Nuissl, H. et al., 2009. Environmental Impact Assessment of Urban Land Use Transitions-a Context-Sensitive Approach. *Land Use Policy*, 26(2), 414-424.

Olalla-Tárraga, M., 2006. A Conceptual Framework to Assess Sustainability in Urban Ecological Systems. *International Journal of Sustainable Development & World Ecology*, 13(1), 1-15.

Oliveira, V. & Pinho, P., in press. Lisbon. *Cities*, In Press, Corrected Proof.

Oliveira, V. & Pinho, P., 2008. Urban Form and Planning in Lisbon and Oporto. *Planning Perspectives*, 23(1), 81-106.

Paphitis, N. & Pylas, P., 2010. Europe Debt Crisis Spreads to Portugal. *Bloomberg businessweek*. Available at: http://www.businessweek.com/ap/financialnews/D9FBINE00.htm [Accessed April 29, 2010].

Pauleit, S., Ennos, A.R. & Golding, Y., 2005. Modeling the Environmental Impacts of Urban Land Use and Land Cover Change: A Study in Merseyside, UK. *Landscape and Urban Planning*, 71(2-4), 295-310.

Pereira, T. & Mata, M.E. eds., 1997. *Urban Dominance and Labour Market Differentiation of a European Capital City*, Norwell, USA: Kluwer Academic Publishers.

Pickett, S.T.A. et al., 2008. Beyond Urban Legends: An Emerging Framework of Urban Ecology, as Illustrated by the Baltimore Ecosystem Study. *Bioscience*, 58(2), 139-150.

Pickett, S.T.A. et al., 2001. Urban Ecological Systems: Linking Terrestrial Ecological, Physical, and Socioeconomic Components of Metropolitan Areas. *Annual Review of Ecology and Systematics*, 32, 127-157.

Portugal Zone, 2008. Lisboa: Câmara Anuncia Mais De 200 Intervenções Nos Espaços Verdes, Presidentes de Junta Abandonam Apresentação [Lisbon: Municipality Announces more than 200 Interventions in Green Spaces; Presidents of the Junta Leave Presentation]. *Portugal Zone On-Line*. Available at: http://lisboaverde.cm-lisboa.pt/index.php?id=4425 [Accessed May 21, 2010].

Ramos, M.A., Lobo, J.M. & Esteban, M., 2001. Ten Years Inventorying the Iberian Fauna: Results and Perspectives. *Biodiversity and Conservation*, 10(1), 19-28.

Redman, C.L., Grove, J. & Kuby, L., 2004. Integrating Social Science into the Long-Term Ecological Research (LTER) Network: Social Dimensions of Ecological Change and Ecological Dimensions of Social Change. *Ecosystems*, 7(2), 161-171.

Rees, W., 2003. Understanding Urban Ecosystems: An Ecological Economics Perspective. In *Understanding Urban Ecosystems*. pp. 115-136. Available at: http://dx.doi.org.ludwig.lub.lu.se/10.1007/0-387-22615-X_8 [Accessed May 12, 2010].

Rees, W.E., 1997. Urban Ecosystems: The Human Dimension. *Urban Ecosystems*, 1(1), 63-75.

Rego, A., Sarrico, C.S. & Moreira, J.M., 2005. Trust in Portuguese Public Authorities. *Public Integrity*, 8(1), 77-93.

Santos, J. & Sampaya, P., 2010. *Interview.* Employees within DEC [date interviewed: 22-03-2010].

Shandas, V., Graybill, J. & Ryan, C., 2008. Incorporating Ecosystem-Based Management into Urban Environmental Policy: A Case Study from Western Washington. *Journal of Environmental Planning and Management*, 51(5), 647-662.

Sherer, P.M., 2003. *Why America Needs More City Parks and Open Space*, San Francisco: The Trust for Public Land. Available at: http://www.tpl.org/content_documents/parks_for_people_Jan2004.pdf [Accessed March 8, 2010].

Silva, C.N. & Syrett, S., 2006. Governing Lisbon: Evolving Forms of City Governance. *International Journal of Urban and Regional Research*, 30(1), 98-119.

Snep, R., van Ierland, E. & Opdam, P., 2009. Enhancing Biodiversity at Business Sites: What Are the Options, and Which of These Do Stakeholders Prefer? *Landscape and Urban Planning*, 91(1), 26-35.

Snep, R., Opdam, P. & Baveco, J., 2006. How Peri-Urban Areas Can Strengthen Animal Populations Within Cities: A Modeling Approach. *Biological conservation*, 127(3), 245-355.

Stahre, P. ed., 2008. Dagvattenstrategi för Malmö. Available at: http://www.vasyd.se/SiteCollectionDocuments/Vatten%20och%20avlopp/Dagvatten/Dagvattenstrategi_2008.pdf [Accessed November 12, 2009].

Thompson, C., 2002. Urban Open Space in the 21st Century. *Landscape and Urban Planning*, 60(2), 59-72.

Tratalos, J. et al., 2007. Urban Form, Biodiversity Potential and Ecosystem Services. *Landscape and Urban Planning*, 83(4), 308-317.

Travassos, D. ed., 2009. *Guia dos Parques, Jardins e Geomonumentos de Lisboa [Guide to the Parks, Gardens and Geomonuments of Lisbon]*, Lisbon: Camera municipal de Lisboa.

Turner, R.K. & Daily, G.C., 2008. The Ecosystem Services Framework and Natural Capital Conservation. *Environmental and Resource Economics*, 39(1), 25-35.

United Nations, 2008. *World Urbanization Prospects; The 2007 Revision*, UN; Department of Economic and Social Affairs.

Werquin, A. et al. eds., 2005. Cost Action C11 - Green Structure and Urban Planning; Final Report.

Wessolek, G., 2008. Sealing of Soils. In J. Marzluf, ed. *Urban Ecology; An International Perspective on the Interaction Between Humans and Nature*. Springer US, pp. 161-179.

Williams, J.W. et al. eds., 2001. Biodiversity Theme Report, Australia State of the Environment Report 2001. Available at: http://www.environment.gov.au/soe/2001/publications/theme-reports/biodiversity/index.html [Accessed May 17, 2010].

Williams, N. et al., 2009. A Conceptual Framework for Predicting the Effects of Urban Environments on Floras. *Journal of Ecology*, 97(1), 4-10.

Wittig, R. et al., 2008. What Should an Ideal City Look Like from an Ecological View? – Ecological Demands on the Future City. In J. Marzluf, ed. *Urban Ecology; An International Perspective on the Interaction Between Humans and Nature*. Springer US, pp. 691-698.

Yin, R.K., 2009. *Case Study Research: Design and Methods* 4th ed., London: SAGE.

Appendix 1 – Organisational Structure of the DMAU

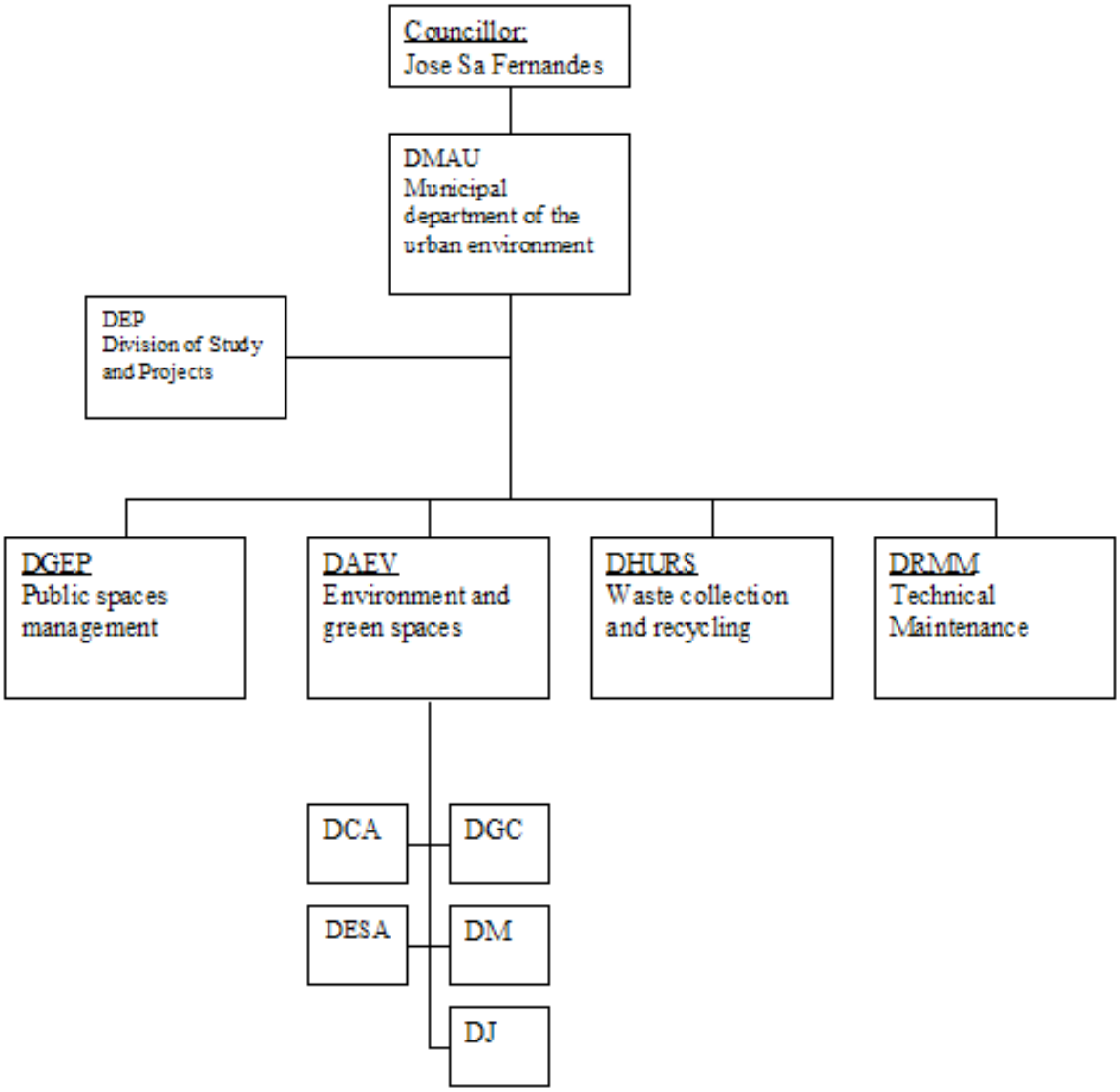

Figure 7. Organization chart of the DMAU, similar sub-structures as shown for DAEV exist in the other departments. These have been left out for simplicity. Abbreviations: DCA: Division of environmental control; DESA: Division of environmental education; DGC: Division of cemetery maintenance; DM Division of park maintenance; DJ Division of garden maintenance.

Appendix 2 – Interviewees and Interview Guides

Table 10. Interviewees

Person	Function
João Castro	Head of DEP
Ines Henriques	Head of DAEV
Sara Goncalves	Employee within DGC
João Santos and Pedro Sampaya	Employees within DEC
Ines Ferreira	Park manager within DM
Christina Gomes	Head of DESA
Alexandra Canha; Margarida Ferreira; Maria José Cabrita; Louro Alvares	Group interview with 3 managers within DJ, and with Louro Alvares[3]
Rui Costa	Park manager of *Parque de Monteiro Mor*
Morgado Fonseca and John Matthew	Park managers of *Jardim de Gulbenkian*
João Serra	President *Junta de Freguesia de Santa Isabel*
Paulo Loff	Communication of *Parque expo 98*[4]

Interview guides for the different interviewees

Planning department:

- What is your function here?
- What does the department do?
- Could you explain what plans Lisbon has for urban green? What do these plans entail?
    - What are the concrete goals of these plans? And how are they being met?
    - Short term / long term goals
- Is the green plan made to connect species or humans to the different areas?
    - Is this plan connected to regional plans within the Lisbon Metropolitan area?
    - In what way? Effects on different scales taken into consideration? (e.g. water/ air pollution, habitat etc.)
- Are there any conflicts in the execution of this plan? Could you mention some examples?
- Did your budget in the last years increase or decrease?
- Is there any planning to deal with climate change, air quality etcetera?
    - Are green areas part of this planning?
- Using ecosystem services in management, how do you think this would work? *Explain my ideas, Use examples of climate regulation, water retention in Malmö, air quality, and different ecosystem benefits.*

[3] L. Alvares was present as a translator, but is also the former head of the DEP, and provided additional information during the interview.

[4] Via P. Loff more detailed management questions where sent to the manager of Parque Tejo e Tranco. The answers to these questions are included as an appendix in the interview summary.

Municipal employees

- What is your function here?
- What does department X do?
- What are the main objectives within the management of X?
- What are the problems you encounter, and how do you try to solve them?
- Budget situation; is it going up/down?
- Using ecosystem services in management, how do you think this would work? *Explain my ideas, Use examples of climate regulation, water retention in Malmö, air quality, and different ecosystem benefits..*

Private / municipal park managers

- What is your function here?
- What are the main objectives with the management of Park X?
- Could you mention 3 functions that park X provides for the citizens of Lisbon:
- How do you maintain the management, what aspects are important for you? How do you see if the area is in a good state?
- Which are the regulations you have to follow in the management of park X?
    - Do you have the possibility to move away from these regulations?
- Do you provide special attention to human well-being in parks, e.g. manage to have enough shade etc?
- Do you provide special attention to plant and animals in the parks, e.g. manage so that pollinators can nest, nest boxes for birds etc?
- Do you know the content of the Plano Verde plan in the municipality?
    - Has this plan changed the way this, or other parks under your control, are managed?
- Do you have contact with local people about the management of parks? What kind of contact?
- Budget: is this enough, tight what is the trend in budget?

Freguesia

- What is your function here?
- Could you explain to me what a freguesia is and how it functions?
- What are your goals?
- Do you manage green spaces as well?
- What are the problems you encounter?

Appendix 3 – Observation Sheet for Structured Observations

Table 11. Variables selected for estimating ecosystem services

Group	Service	Variable
Supporting services	Provision of habitat	Coverage and variety of vegetation layers
Regulating services	Air quality maintenance	Tree cover
	Water regulation	Sealed surface (%)
Provisional services		Products being sold
		Provisional potential (fruits, vegetables grown)
Ecosystem benefits	Educational values	Presence of information signs
	Cultural Heritage values	- Presence of historical aspects; - Year of construction - Information provision of historical aspects
	Recreation	Recreational equipment present

Table 12. Observation sheet for park observations

Variable	Subvariables	Unit
Amount of vegetation layers	Grass	(%)
	Herbs	(%)
	Shrubs	(%)
	Trees	(%)
	Paved surfaces	(%)
	Open water	(%)
	Wetlands	(%)
Products being sold		Types of products
Presence of	Fruit trees	Present - absent
	Olive trees	Present – absent
	Cork oaks	Present – absent
	Vegetable gardens	Present – absent
Signs	Contact information	Present – absent
	History of park	Present – absent
	Botanical/ animal information	Present – absent
	Cultural / Historical aspects	Present – absent
Historical aspects		Present – absent
Recreational structure	Sport fields	Present – absent
	Running course	Present – absent
	Exercise machine	Present – absent
	Benches	Amount
	Tables	Amount

Appendix 4 – Overview of Parks and Park Names

Figure 8. Park overview, numbers correspond to table 9 on the next page

Table 13. Names of selected parks, numbers correspond to Figure 7

#	Name	#	Name
0	Avenida de Liberdade	33	Jardim Garcia da Orta
1	Jardim Braamcamp Freire	34	Jardim Gomes de Amorim
2	Jardim do Campo Grande	35	Jardim Henrique Lopes de Mendonca
3	Castelo de Sao Jorge	36	Jardim Mahatma Gandhi
4	Conjounto Monumental de Belem	37	Jardim Marques de Marialva
5	Parque Eduardo VII	38	Jardim Miradouro da Bela Flor
6	Jardim de Gulbenkian	39	Jardim Nuno Alvares
7	Jardim 9 de Abril	40	Jardim Olavo Bilac
8	Jardim Alfredo Keil	41	Jardim 5 Outobro
9	Jardim Amalia Rodrigues	42	Jardim Sa de Bandeira
10	Jardim Amelia Carvalheira	43	Jardim Teofilo Braga
11	Jardim Antonio Feijo	44	Miradoura de Santa Luzia
12	Jardim Arco de Cego	45	Parque do Vale Fundao
13	Jardim Avelar Brotero	46	Parque de Alvalade
14	Jardim Botanical da U.L.	47	Parque de Bela Vista
15	Jardim Botanico de Ajuda	48	Parque de Bensuade
16	Jardim Botanico Tropical	49	Parque de Vale de Silencio
17	Jardim Cesario Verde	50	Parque do Monteiro Mor
18	Jardim Constantino	51	Parque dos Moinhos de Santana
19	Jardim de Estrela	52	Parque Florestal de Monsanto
20	Jardim da Quinta de Santa Clara	53	Parque Silva Porto
21	Jardim da Torre de Belem	54	Parque Teja Tranco
22	Jardim das Amoreiras	55	Principa Real
23	Jardim de Agua	56	Quinta das Conchas e dos Lilases
24	Jardim de S. Pedro de Alcantara	57	Quinta Pedagogica dos Olivais
25	Jardim de Torel	58	Tapada de Ajuda
26	Jardim do Beau Sejour	59	Tapada des Necessidades
27	Jardim de Cabeco	60	Alameda
28	Jardim do Seminario da Luz	61	Jardim Botto Machado
29	Jardim Ducla Soares	62	Parque de Madre de Deus
30	Jardim Elisa Baptista	63	Jardim Lisboa Antiga
31	Jardim Fernando Peca	64	Parque Oeste
32	Jardim Fialho de Almeida		