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Editorial

Landscape Metropolis – Metropolitan Landscape

The metropolitan region is a form of urban territory in which city and landscape re-array into an urban-landscape system characterized by multiple modes of organization and dynamic socio-spatial processes. Perspectives on the operative relationship between landscape and city emerging in recent decades present new ways to understand, order and act in metropolitan territories. To what extent landscape as permanent underlying substructure, or as physical open space system, or as metabolic process has a bearing on the future of the metropolitan region are the broader lenses of these perspectives.

In European metropolitan areas, historical accretion and mature planning cultures have lead to distinctive urban-landscape configurations with their own particular morphologies, systems and dynamics. The aim of this issue is to present state-of-the-art research engaging with the metropolitan landscape in European urban regions from the perspective of spatial planning, urbanism and landscape planning disciplines. Presented papers focus on three specific research fields: Landscape planning for peri-urban areas, metropolitan landscape characterization, and landscape design in metropolitan contexts.

Dr. Alexandra Tisma & René van der Velde
Issue editors

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The rural-urban fringe in the Netherlands: recent developments and future challenges

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Abstract

In recent decades, most rural-urban fringes in the Netherlands have seen substantial urbanisation. Urban expansions at the rural-urban fringe have formed complex hybrid landscapes consisting of residential areas, commercial zones, agricultural land, recreational and nature areas. In certain regions, urbanisation is rather compact and concentric, whereas others show dispersed and polycentric morphological patterns. Based on quantitative and qualitative spatial research, this article analyses recent urban developments and urbanisation patterns along the rural-urban fringe in the Netherlands, and identifies challenges for planning and design at national, regional and local levels.

Urban compaction policy has prevented urban sprawl in the Netherlands. However, in some regions traditionally unwanted urban development patterns can be discerned. On a national level, an important question is how increasing dispersed urbanisation may affect the economic performance of cities and the efficient use of existing infrastructure. On a regional level, there is a need for urbanisation strategies that transcend municipal boundaries. On a local level, innovative urban design/re-design strategies may help improve connections between separated functions, involve local stakeholders, and upgrade the identity of places at the fringe.

Key words

Rural-urban fringe; urban morphology; suburbanisation; spatial policy; spatial planning; regional planning; urban planning; urban design

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1. Introduction

The Netherlands has a distinct and internationally much acclaimed tradition of spatial planning on national, regional and municipal levels. In a context of limited space, challenges of water management and a strong demographic and economic growth, Dutch planners and policymakers have strived for compact and well-organised forms of urbanisation, since the 1950s. Nevertheless, over the past decades, urban developments at the rural-urban fringe have accelerated in response to growing welfare, global economic forces, improved transportation links and increased personal mobility. This has made it possible for people to live and work increasingly farther away from city centres, while retaining all the advantages of a central city location. Large-scale residential areas and recreational parks have been developed. Furthermore, a considerable number of commercial areas, business parks and retail centres have been constructed around cities, mostly in locations near motorways.

In general, in the Netherlands, as in many other countries (see Bryant et al. 1982; Audirac 1999; Furuseth and Lapping 2006; Gallent et al. 2006), the rural-urban fringe is characterised by a large degree of spatial and functional heterogeneity. At the rural-urban fringe, new urban expansions emerge adjacent to established areas, large-scale developments take place near small-scale locations, and urban functions are developed next to rural functions. Former agricultural and nature areas around villages and cities have slowly transformed into a complex and hybrid landscape with a combination of rural and urban functions. Compared to other countries, most of the urban developments in the Netherlands take place close to city edges due to urban compaction policies. Therefore, here, we define the rural-urban fringe as a rather narrow area (with a maximum width of approximately 2 kilometres) between the city and the countryside. This area is like a shell around the existing urban area and follows its irregular contours. In other countries, such as the United States and Canada, definitions of the rural-urban fringe in metropolitan areas often describe much larger areas, in some cases up to 50 kilometres.

Rural-urban fringes in the Netherlands still have a predominantly green character (MNP 2007; Vreke et al. 2007; Piek and De Niet 2010). However, various land-use functions compete over the scarce amount of space available in this area. Nature and agricultural areas have lost space to benefit the urban functions of housing, employment and recreation. It is expected that, also in the future, pressure on the rural-urban fringe will remain strong (Ritsema van Eck et al. 2009; Hamers and Piek 2012). Moreover, the recent liberalisation and decentralisation of Dutch spatial policy is expected to accelerate the shift towards the rural-urban fringe. This process is likely to have different results in different regions, since more responsibility concerning spatial planning is given to regional and local authorities (PBL 2011).

Research questions

This article addresses five main questions: What is the scale of recent urban developments at the rural-urban fringe in the Netherlands? What types of urban developments can be distinguished? What are the morphological structures of new urban developments on a regional scale? How do urban developments relate to the policy ambitions of keeping urban areas compact? And finally, what are future challenges for policymakers, urban planners and designers concerning urban developments at the rural-urban fringe?

First, a short overview is given of the history of relevant Dutch spatial policy, including its main objectives of urban compaction and more liberal spatial planning. The following section introduces seven significant types of urban developments at the rural-urban fringe and analyses three regions showing different patterns of urbanisation. Finally, the most important findings are summarised and evaluated in light of relevant policy objectives – not to evaluate the planning policy in the strictest sense, but to identify future challenges for policymakers, urban planners and designers, on local, regional and national scales.

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2. Taming urbanisation: spatial policy in the Netherlands

In the Netherlands, national spatial policy has had great influence on urban developments. To get a better understanding of urban – and suburban – spatial morphology, it is important to have a look at the history of national spatial policy and leading concepts of spatial planning. For over sixty years, Dutch planners and policymakers have strived for more compact forms of urbanisation. The most important objectives of keeping the existing cities compact and avoiding extensive and uncontrolled urban and suburban sprawl were those of protecting nature and recreational areas, limiting the further increase in car use (reducing traffic congestion by reducing commuting distances), decreasing the environmental impact of mobility (less car use, more public transport and bicycle use), and strengthening urban functions in cities (varying from local shops to museums) (e.g. see Bartelds and De Roo 1995; Faludi and Van der Valk 1994; Nabielek et al. 2012). Different strategies to achieve compact urban development have played a prominent role in various Dutch national spatial policy documents. The following passages briefly describe the most important concepts and strategies.

Buffer zones

Already in the years following the Second World War, planners and policymakers feared that cities would grow towards each other, leaving little green space in-between. Therefore, protected buffer zones were introduced in the First National Policy Document on Spatial Planning (1960). These buffer zones restricted urban development in these zones. The first two buffer zones were located between Amsterdam and Haarlem (Spaarnwoude) and between Rotterdam and Delft (Midden-Delfland). Over the following 50 years, the strategy of 'green' restriction zones was extended and further elaborated.

Clustered dispersal

Moreover, the Second and Third National Policy Document on Spatial Planning (Ministry of VROM 1966 and 1978) introduced the concept of 'clustered dispersal' and 'growth centres'. This concept was guided by the idea to limit new urban expansion at the urban fringe by creating new towns that were located at a distance of 10 to 30 kilometres from the bigger cities. Some of these settlements were completely new (e.g. Almere, northeast of Amsterdam) while others were linked to existing small towns or villages (e.g. Zoetermeer, east of The Hague).

Compact city

In the beginning of the 1980s, the concept of 'clustered dispersal' became more and more criticised, as the new towns were dominated by a residential character and showed a lack of urban qualities, such as population density, cultural diversity and mixed functions. Furthermore, big cities such as Amsterdam and Rotterdam were faced with population decline and growing socioeconomic problems. The response to this was a re-orientation on existing big cities that was framed by the concept of the 'compact city'. In this concept, the focus shifted from urban expansion to revitalising and densifying existing urban areas. The aim was to curb suburbanisation and limit new urban development at the urban fringe. The Fourth National Policy Document on Spatial Planning (Ministry of VROM 1988) was based on the concept of the 'compact city'.

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This policy document of 1988, however, did not stop suburbanisation. In the ensuing period, large-scale suburban neighbourhoods (in Dutch called Vinex locations) were planned according to a supplement to the Fourth National Policy Document on Spatial Planning (Ministry of VROM 1991). These residential neighbourhoods were planned in a top-down manner in relatively high densities and good access to public transport. Nevertheless, the sheer scale of developments led to massive urbanisation in some parts of the rural-urban fringe, especially in the Randstad. As a consequence, the population of inner city areas continued to decline (Nabielek 2011). Moreover, the economy was growing strongly and municipalities were developing new commercial zones at the fringes of their cities. However, due to a very restrictive policy concerning retail developments, large out-of-town shopping malls were avoided.

In the subsequent National Policy Document on Spatial Planning (the 'Nota Ruimte', Ministry of VROM 2004), the focus shifted towards urban networks and urban developments on a regional scale. This document set specific goals for so-called concentration areas around greater urban conurbations and 'urban densification' in existing urban areas. Furthermore, valuable green areas were protected by national buffer zones, a national ecological network (EHS) and national parks. However, this document also left more locations for local authorities and the private sector to develop residential and commercial areas.

Liberalisation and decentralisation

The most recent National Policy Document on Spatial Planning SVIR (Ministry of Infrastructure and the Environment 2012) strongly focuses on economic growth and large-scale infrastructural investments. Spatial planning is decentralised to regional and local authorities, and national planning strategies, such as the national buffer zones, urban concentration and densification, have been abolished. The main aims of the liberalisation and decentralisation of planning are to strengthen the urban economy by stimulating so-called agglomeration economies (achieved in larger urban areas) and providing attractive places to live and work, promoting the efficient use of existing infrastructure (e.g. by allowing new urban development near infrastructural nodes), facilitating traffic flows where necessary (by building new roads and new railway connections), and enabling people (both entrepreneurs and residents) to actively participate in urban development. It can be expected that the liberalisation and decentralisation in the spatial policy will accelerate urban development at the rural-urban fringe and possibly beyond, depending on the policy decisions of regional and local planning authorities.

3. Spatial development at the rural-urban fringe in the recent past

The paragraphs above described drivers of urbanisation within the context of Dutch spatial policy. The following section provides an insight into quantitative and qualitative aspects of the developments at the rural-urban fringe. We used two approaches to the urban fringe: a delineated definition to facilitate calculations based on GIS analyses, and a less rigid approach to facilitate qualitative analyses of urbanisation patterns in the region surrounding the city. The qualitative analysis describes seven types of urban developments in close detail. Before turning to the morphological particularities, however, first the results are presented of the quantitative analysis that outlines important land-use changes at the rural-urban fringe in the Netherlands.

Quantitative analysis

In the quantitative analysis, a distinction was made between urban area, rural-urban fringe and countryside, using the definition by Hamers et al. (2009). This definition assumes that the size of the urban fringe depends on the size of the urban area: the larger the existing urban area, the wider the urban fringe. In this quantitative approach, the widest urban fringe in the Netherlands (around the urban area of Amsterdam-Zaandam) is two kilometres wide; the narrowest urban fringe is only a few hundred metres wide. Lucas and Van Oort (1993) use a relatively traditional concentric shell model, while Hamers et al. (2009) also explicitly take the urbanisation near motorway slip roads into account. Finally, the dynamics of the urban fringe are important. Because of urban expansion, the urban fringe has continued to shift outwards, over the years. During the 1996-2003 measurement period, the urban fringe made up 14% of the land area of the Netherlands, compared with 9% in urban area and 77% in countryside. As an example, Figure 1 shows the size of rural-urban fringes in the Rotterdam-The Hague region.

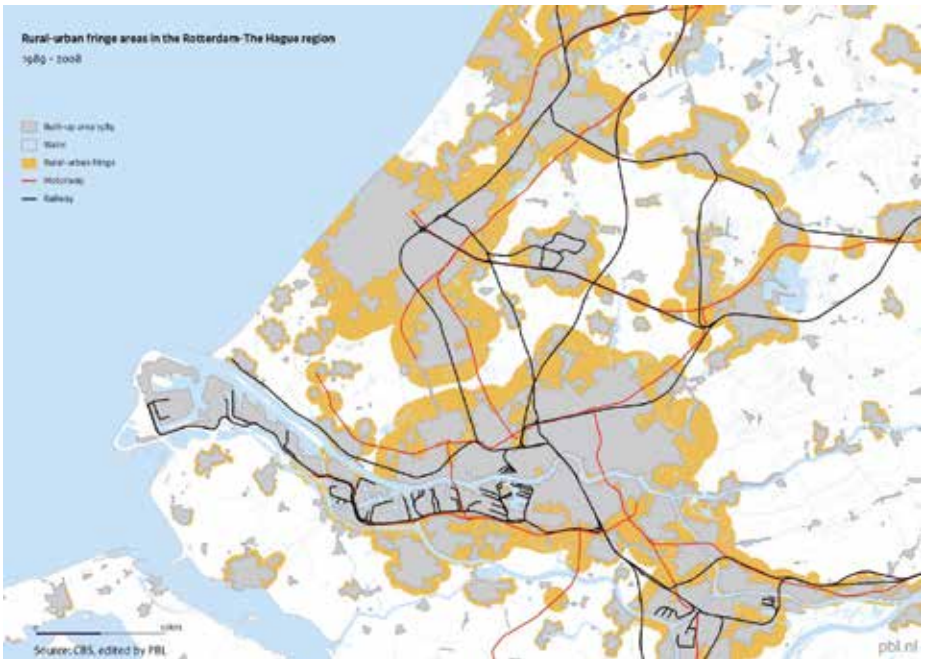

Figure 1
Rural-urban fringe areas in the Rotterdam-The Hague region, according to the definition by Hamers et al. (2009)

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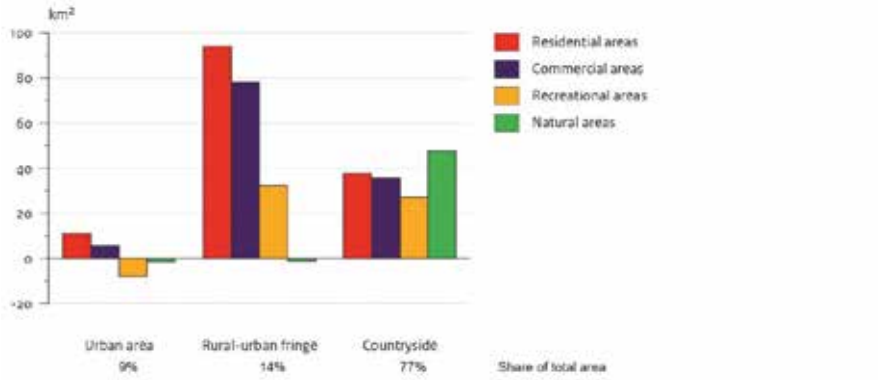

Figure 2
Land-use change in the Netherlands, 1996-2003

A GIS analysis of land-use statistics by Statistics Netherlands (Bodemstatistiek, CBS) was used to compare developments in housing, commerce, recreation and nature, for the three areas mentioned above, over the 1996-2003 period. This comparison showed that the overall majority of developments in housing, commerce and recreation took place in the rural-urban fringe area (see Figure 2). For housing, developments per square kilometre were over 5 times greater than within the urban area, and nearly 14 times greater than in the countryside. Commercial developments led to an eightfold expansion in the rural-urban fringe area compared with the urban area, and were 12 times larger than in the countryside. The area of recreation also increased the most within the rural-urban fringe; per square kilometre with nearly 6.5 times that of recreational areas in the countryside. In the urban area, recreational areas actually decreased. The increase in land use for housing, employment and recreation in the rural-urban fringe occurred at the expense of areas available for nature and especially agriculture (not included in the figure). In itself, development of the varying areas provides no information about numbers of new buildings, densities or building heights. It does, however, clearly show the relatively fast and large-scale urbanisation of the rural-urban fringe. The qualitative analysis provides an elaboration of the different types of urbanisation as is taking place in fringe areas in the Netherlands.

Qualitative analysis: seven types of urban developments at the rural-urban fringe

Figures alone offer an insufficient basis on which to base urbanisation policy for the rural-urban fringe. For this purpose, qualitative insight into the spatial developments is also required. Which land-use functions seek the urban fringe, and which spatial patterns are created as a result? Below, seven characteristic types of urban developments at the rural-urban fringe are presented in detail (see Figure 3): large-scale residential areas (Vinex locations), small-scale residential areas, commercial areas, business parks, retail centres, recreational areas and in-between areas. These development types were selected on the basis of field research and literature studies. The qualitative analysis included urban developments within a larger area than the delineated zone used in the quantitative analysis discussed above.

Large-scale residential areas

Housing is one of the most dominant urban functions at the rural-urban fringe. The residential areas built in recent years primarily consist of large-scale suburban neighbourhoods, planned as part of the supplement to the Fourth Policy Document on Spatial Planning (VROM 1991). Some of these neighbourhoods are intended

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to house more than 30,000 inhabitants. These neighbourhoods either form a new 'edge' of existing concentric cities, or have such an independent position within the urban network that they serve as new centres of a polycentric urban region (Boeijenga and Mensink 2008; Lörzing et al. 2006). A concentration of large-scale residential areas can be found in and around the four largest cities in the Randstad: Amsterdam, Utrecht, The Hague and Rotterdam. Examples of such large-scale residential areas are Ypenburg (The Hague), Carnisselande (Rotterdam), Leidsche Rijn (Utrecht) and Almere Buiten (Almere). Although, generally speaking, there is a wide variety of housing types and styles, these so-called Vinex locations are criticised for their monofunctionality and inflexibility with regard to the future urban transformation task.

Small-scale residential areas

Small-scale residential developments lay scattered along the urban fringe, mostly in the vicinity of small villages and cities. They are predominantly found in more rural areas, such as the region around the city of Groningen. These kinds of residential areas commonly are small neighbourhoods with detached houses. There are also more 'exclusive' residential developments, residential neighbourhoods designed for high-income target groups. These neighbourhoods are characterised by having clear boundaries with surrounding areas (Nabielek 2009) and by distinctive (themed) architecture (Kronberger 2011). In some cases, dwellings are combined with recreational functions (e.g. golf course, harbour).

Commercial areas

In addition to the increase in residential developments, there also has been a strong growth in commercial areas. Between 2000 and 2006, more than one third (about 60 km²) of new developed urban areas was dedicated to commercial and industrial purposes (Ritsema van Eck et al. 2009). Many commercial estates have been developed in the immediate vicinity of motorway junctions and slip roads. They are often located in the left-over areas between motorways and housing areas. The extent and character of such developments have led to severe criticism. On a regional scale, there are complaints about open spaces being 'filled in' (mostly along infrastructure) and about them blurring the contrast between city and countryside. On a local scale, business estates are characterised by a very functional design and a lack of basic urban or architectural qualities (Van der Gaag 2004). Furthermore, business estates without public transport facilities have a negative impact on the environment as they increase traffic and therefore also pollution and carbon emissions. Another problem is the growing number of decaying business estates with vacant plots and empty buildings

Business parks

In recent years, there has been a strong increase in business parks at the rural-urban fringe in the Netherlands. Head offices of national and international companies in the past were mostly located in city centres, but today they are increasingly found along the fringe of big and medium-sized cities and along motorways (Hamers and Nabielek 2006). Compared to commercial areas, the total surface area of these business parks is relatively small. However, they usually have eye-catching structures with high-rise buildings that are visible from far away. Furthermore, most business parks are primarily designed to be accessed by car and, therefore, increase traffic congestion (PBL 2012). Increased car use also has a negative impact on the environment in general and on areas adjacent to those business parks in particular (noise, pollution). Moreover, the construction of new (peripheral) business parks has contributed to a record number of office vacancies in the Netherlands. In 2013, more that 7 million m2 of office space stood vacant, which is 16% of the total office space in the Netherlands (PBL and ASRE 2013).

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Large-scale residential areas (Vinex locations)

Small-scale residential ares

Commercial areas

Business parks

Retail centres

Recreational areas

In-between areas

Figure 3

Seven types of urban developments at the rural-urban fringe.

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Retail centres

Despite the policy restricting retail functions, there has been a considerably growth in retail functions in the rural-urban fringe, in recent times. As mentioned above, restrictive policy on national level has prevented the development of large out-of-town shopping areas. Compared to other European countries, where huge shopping malls can be found on urban peripheries, this is a remarkable achievement of Dutch urban planning policy. However, there has been a significant increase in the number of large furniture and building supply outlets and garden centres at the rural-urban fringe, and especially in the vicinity of motorways (Hamers and Nabielek 2006; Evers and Hamers 2010). In general, such retail areas have a very functional layout. In most cases, public space is poorly designed and dominated by parking areas. Similar to industrial and business parks, they cause environmental pressure by contributing to an increase in traffic.

Recreational areas

As stated above, the land area used for residential and commercial functions at the rural-urban fringe has increased the most. In addition, recreational areas have also been increasing. They may have either a 'red/urban' or a 'green/rural' character. There is a difference between indoor recreational functions (buildings or structures) and outdoor recreational functions. Examples of the first are indoor skiing facilities, thermal baths and multiplex cinemas, whereas the second group includes sports grounds, allotment gardens, natural areas and parks. Indoor facilities are mostly located in the vicinity of motorways and have large parking areas to facilitate the sometimes high concentration of visitors. In the category of outdoor facilities, the growing number of golf courses is particularly striking. Between 1998 and 2006, the total area of golf courses increased from 1,300 to 7,300 hectare (Schuit et al. 2008). The footprint of indoor recreational facilities is much smaller than outdoor recreational functions. However, large and 'stony' buildings and complexes, such as large indoor playgrounds built in open areas can negatively affect the original landscape around the city.

In-between areas

In-between areas are characterised by administrative (municipal borders) and spatial fragmentation. In many cases, large-scale infrastructure cuts through these areas, and new, established, small and large functions lay randomly distributed within them. These fragmented areas can often be found along the urban fringe. They are also characterised by coexisting, different functions that have little in common (Frijters et al. 2004; Hamers and Rutte 2008). These areas have an organic, unplanned layout and public-space quality is mostly poor. In-between areas are, therefore, are often perceived as 'untidy'. On the other hand, these areas offer opportunities for local activities for which there is currently little space in inner cities; for example, ateliers, allotment gardens and sports grounds. In recent years, however, many of these areas have been transformed, among other things, into business parks and other types of commercial areas.

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4. Regional comparison

This section presents an analysis of the morphological patterns of recent urban developments on the rural-urban fringes of three Dutch regions: around Amsterdam, Rotterdam-The Hague and Groningen city. These three regions were selected because they contain different types of urban structures. The Amsterdam region is an example of an urban region in which smaller towns are clustered around a dominant city. The Rotterdam-The Hague region has a polycentric structure, containing two big cities of more or less the same size. Finally, the Groningen region is an example of a monocentric medium-sized city in a rural region. This regional scale provides an impression of the scale, location and spatial patterns of urbanisation at rural-urban fringes. Figures 4 to 6 indicate where urban expansions are compact and where they show a dispersed structure.

Amsterdam region

The city of Amsterdam is a typical example of a compact European city. Together with the surrounding smaller cities, however, it forms a polycentric region in which Amsterdam clearly takes a central and dominant position. The regional map (Figure 4) shows that there has been little urban expansion on the fringe of the city, over the past 20 years.

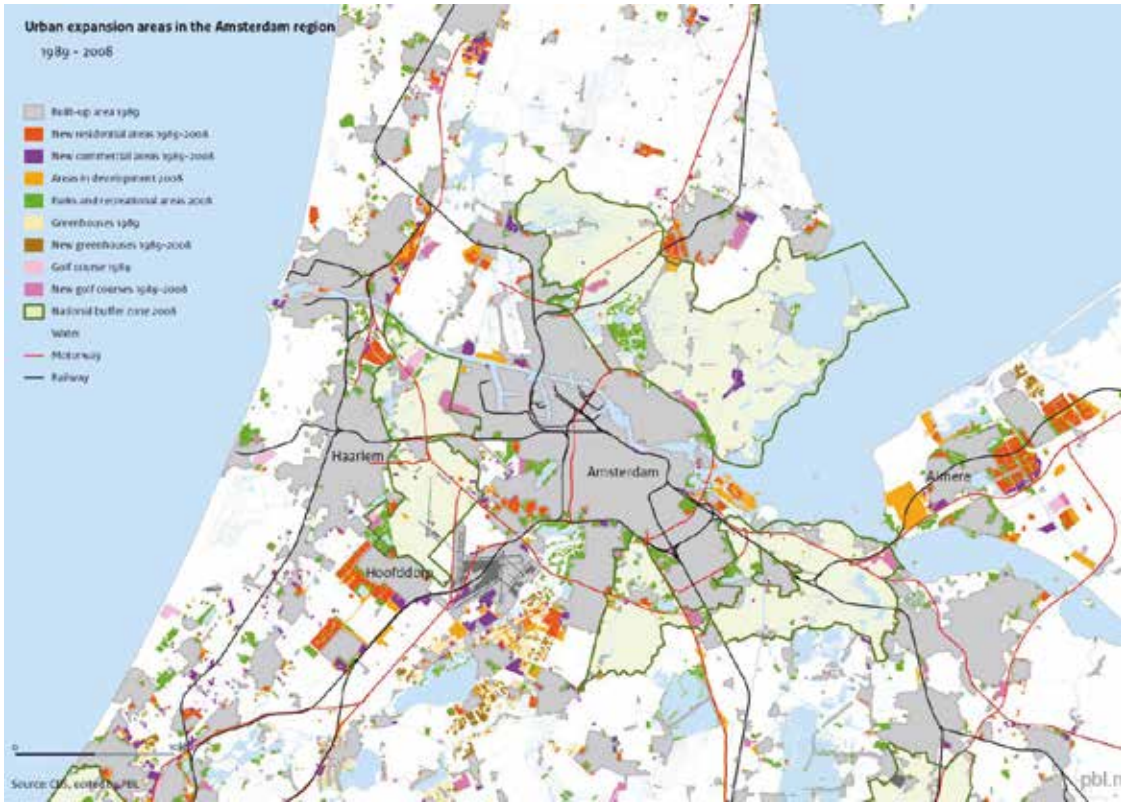

Figure 4
Urban expansion areas, 1989-2008, in the Amsterdam region

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The map shows that Amsterdam is surrounded by green buffer zones that have successfully protected these areas from suburbanisation. Furthermore, in the south of Amsterdam, the airport and the related noise contour have limited possibilities for residential expansion. Surrounding the airport, however, are the strong dynamics of new business locations.

Looking at the urban developments in the Amsterdam region, it can be argued that these are in line with spatial policy ambitions. The city has managed to keep its compact character and the green buffer zones have protected it from fusing with neighbouring cities. However, smaller cities, such as Haarlem, Hoofddorp and Almere, show much larger suburban developments. Because the city of Amsterdam could not expand along its edges, these expansions have shifted towards locations further away from the city. In the south-west of the Amsterdam region, a ring of continuous urbanisation can be seen to emerge between the smaller cities. Moreover, locations at a greater distance from Amsterdam, such as large-scale expansion areas around the new town of Almere (more than 30 kilometres away from Amsterdam), have put serious pressure on the (national and regional) road system. A spatial mismatch between residential locations (e.g. in Almere) and employment locations (primarily in Amsterdam) has increased the number of commuters and has increased the need for large-scale infrastructural investments, both in the railway and motorway systems.

Rotterdam-The Hague region

The Rotterdam-The Hague region can be described as a polycentric urban region with two big cities. With 600,000 inhabitants, Rotterdam is slightly bigger than The Hague (500,000 inhabitants). Smaller cities in this region are Delft, Zoetermeer, Gouda and Dordrecht. Furthermore, the region is characterised by large areas of greenhouses for the production of vegetables and flowers.

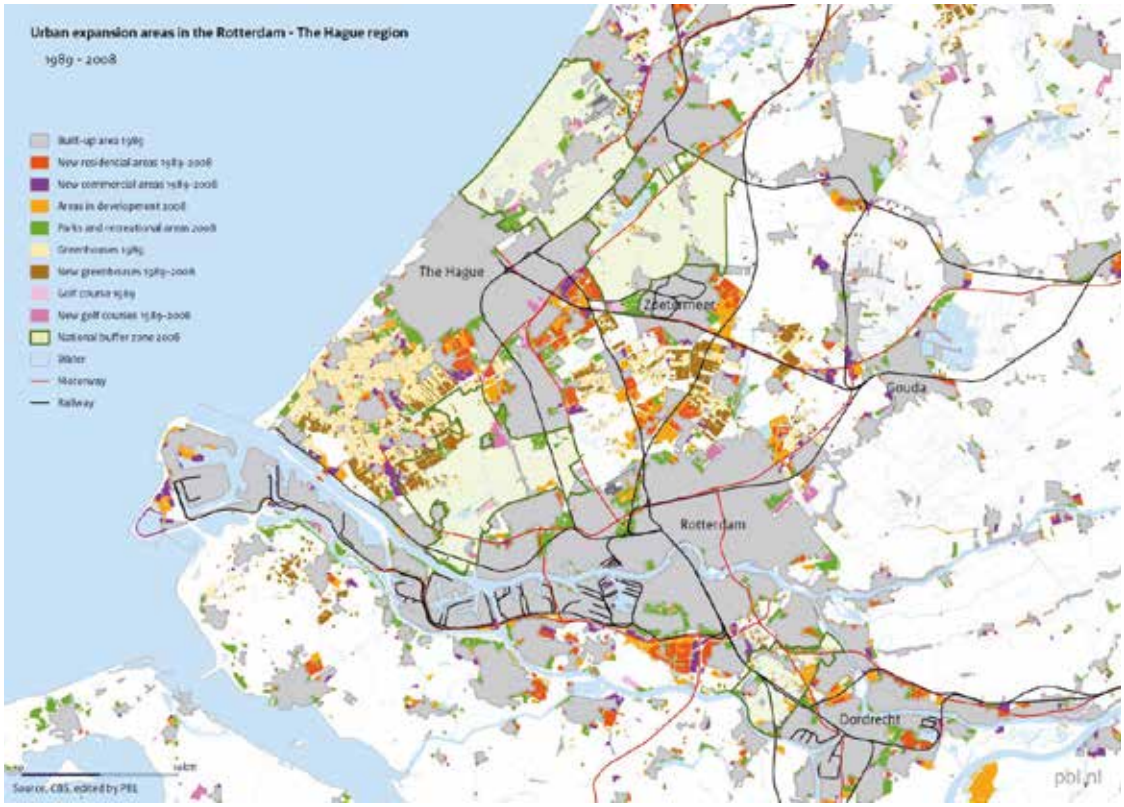

Figure 5
Urban expansion areas, 1989–2008, in the Rotterdam-The Hague region

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The map of urban developments in this region (see Figure 5) shows there has been almost no urbanisation between the cities of Rotterdam and Delft. In this area, the open landscape has been protected by the national buffer zone of Midden-Delfland that was established in 1960. The area between Rotterdam, Zoetermeer and The Hague, on the contrary, shows quite widespread urban developments. These developments are a combination of residential and commercial functions (mostly greenhouses). In these areas, a new regional railway line has been established, connecting Rotterdam to The Hague. New residential neighbourhoods were constructed along this line. This has led to a fragmented morphology: a scattered, widespread urbanisation pattern that is quite unusual for the Netherlands. Furthermore, there have also been a number of new large-scale residential developments in the Rotterdam-The Hague region. These areas are located on the urban fringes of the cities. In Rotterdam and The Hague, large residential Vinex locations were built on the 'other' side of the motorway. In these cases, the motorway forms a strong spatial barrier within the urban structure.

Groningen region

The Groningen urban region has a monocentric structure. Urban expansions in the period between 1989 and 2008 (see Figure 6) were relatively modest (in comparison with the Amsterdam and Rotterdam-The Hague regions) and they are mainly concentrated around the city of Groningen and some surrounding small towns. The majority of peripheral developments consist of new residential neighbourhoods situated concentrically around the historic towns, adjacent to established urban areas. However, the small town of Assen seems to have faced a relatively strong growth in the recent past. In comparison to the size of the existing town, the new development areas on the western and northern side of Assen are relatively large. On the western side, on the other side of the A28 motorway, there is a new residential area (Kloosterveen) and a large golf course. To the east of Assen, the National Landscape Drentsche Aa has prevented urban expansion.

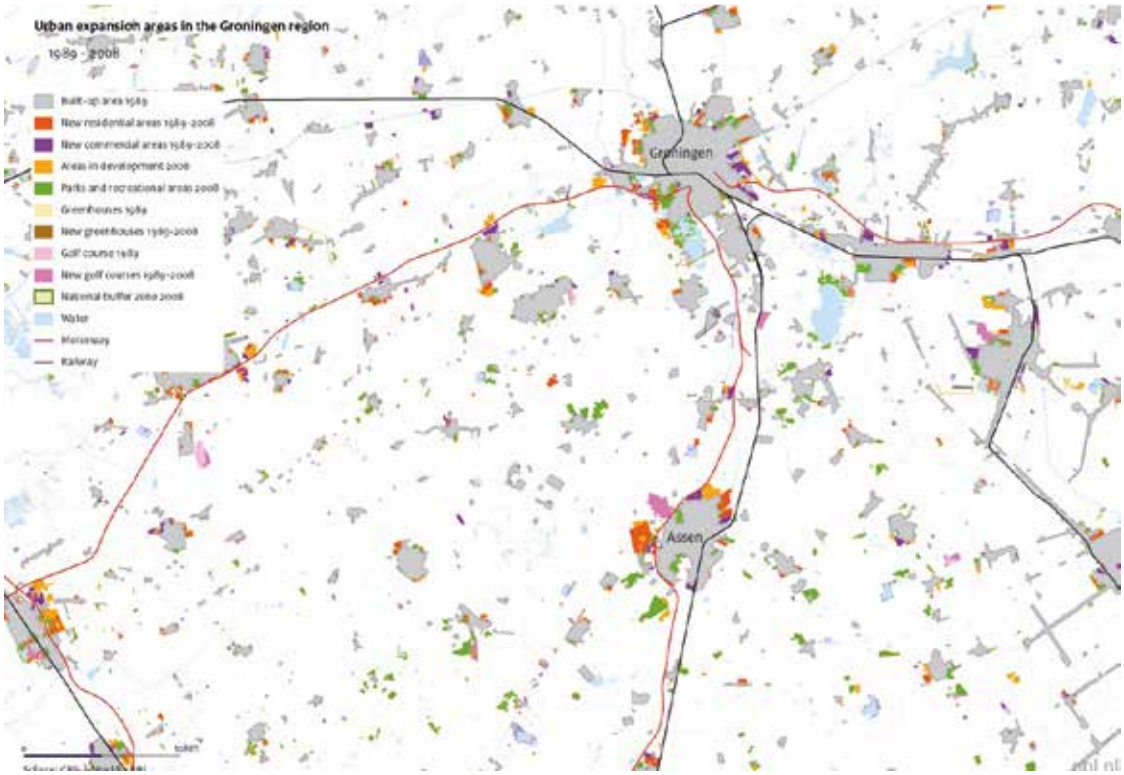

Figure 6
Urban expansion areas, 1989-2008, in the Groningen region

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5. Main findings and evaluation

The maps and figures in this article show the strong growth in urban functions at the rural-urban fringe in the Netherlands. Based on the quantitative and the qualitative analysis, the developments in the fringe areas can be summarised and evaluated in the light of the objectives of the traditional urban compaction policy and the more recent liberalisation and decentralisation of spatial planning in the Netherlands.

The quantitative analysis based on land-use statistics shows that the overall majority of developments in housing, commerce and recreation have taken place at the rural-urban fringe. For housing, for instance, development per square kilometre in the rural-urban fringe area was over 5 times greater than that within the urban area. The area of commercial developments at the rural-urban fringe expanded eightfold compared with those within the urban area. The urbanisation of the rural-urban fringe took place at the expense of space for nature and especially agriculture.

In addition to the quantitative analysis, the maps show the scale and morphological patterns of urban developments along the edges of cities and villages. The maps of the three separate regions show significant regional differences. In more rural areas, such as the region around the city of Groningen, the new urbanisation shows a very compact structure. New urban developments are located adjacent to existing settlements. However, in regions with a more polycentric urban structure, such as the Rotterdam-The Hague region, spaces between cities and villages have filled up with new urban developments that show a much more fragmented morphological character. Urban developments are also found at greater distances from the original urban edges.

In general, new urban residential areas are rather compact and located close to cities, whereas for new commercial and recreational areas the pattern is more fragmented. Paradoxically, on a local level, urban compaction policy seems quite successful, whereas on regional levels, some local developments add up to traditionally unwanted urban development patterns. In the Rotterdam-The Hague region and the Amsterdam region, national buffer zones have successfully protected certain areas from urbanisation, thereby leaving open spaces between cities. However, concentrations of new urbanisation can be found along the edges of the buffer zones. Furthermore, the maps show that diverse local expansions around bigger and smaller cities have resulted in a contiguous urbanised region. Patterns such as these conflict with urban compaction policy objectives. Although we do not agree with critics (e.g. Bontje 2001) who have argued that the urban compaction policy has not succeeded in countering the deconcentration trend – from an international comparison point of view, few areas in the Netherlands show urban sprawl – we do conclude that certain areas of the Randstad hardly have any distinct compact cities left.

Although it was beyond the scope of this study to determine the extent to which urban functions in fringe areas compete with those in the older parts of cities, on the basis of findings in a variety of other studies, a distinction could be made between commercial functions (e.g. shops and offices) and social and cultural institutions (e.g. museums). It is clear that new business parks, for instance in motorway locations, add to the problem of vacancies in older commercial areas (see e.g. PBL and ASRE 2013). In spite of the liberalisation of spatial planning, in 2012, the national government, provinces and municipalities, together with market parties, signed a covenant to collectively address this problem. Also, it seems clear that, depending on the types of shops, new peripheral shopping centres compete with older local shopping centres in residential areas in cities and/or with shopping areas in city centres. The number of offices and the number of shops have both reached the point of saturation (see e.g. Evers 2011; Evers et al. 2006). On the other hand, some functions in certain parts of city centres, primarily those with a regional public function (e.g. museums), may benefit from the increase in the number of residents in fringe areas, as these areas do not have these facilities themselves. In this field competition does not seem to pose a problem.

From the point of view of more recent liberal urban planning policy, it is important to note that urban growth may help cities to achieve agglomeration economies. For instance, increasing numbers of suppliers and workers entering an area may be beneficial to the economic productivity of an urban region. However,

agglomeration economies are not only about the size of urban areas, but also about densities and amenities. Knowledge spill overs (creativity and innovation), in particular, seem to ask for frequent interactions in relatively dense urban areas (see e.g. Glaeser 2011; Porter 2000; Scott and Storper 2003). As Raspe and Van Dongen (2013) have shown, Dutch cities still lack the densities that characterise many of their counterparts abroad. Based on the character of the urban and suburban expansions observed (such as peripheral business parks and industrial estates), we would argue that fringe areas are unlikely to help increase the density of most urban areas. The maps and the analysis of urban types show that recent urban developments consist of relatively large spatial units with relatively low densities that are functionally and spatially separated from each other. Many recently developed urban areas at the rural-urban fringe are characterised by function separation and single functionality; hardly a creative urban environment, and quite distinct from higher density inner-city locations, where, for example, housing and businesses are located much closer together within the same area.

This 'island-like' structure of distinct and monofunctional spatial entities at the urban fringe can also be evaluated in terms of mobility consequences. From the urban compaction policy as well as a more liberal point of view, these consequences seem to be problematic. Both types of planning aim for a good accessibility of the larger cities. As PBL (2012) has shown, however, urban development in peripheral locations, such as in fringe areas near motorways, results in an increase in traffic along already congested routes. Accessibility would benefit more from building near public transport hubs; road congestion could then decrease and the business case for public transport connections would improve.

Finally, in many cases, urban developments in fringe areas are separated by infrastructural, often large-scale, bundles that create spatial barriers. This results in spatial fragmentation. The barrier effect of infrastructure (as well as of large industrial estates) also limits the possibilities for easy access to the countryside, for example, for recreational purposes. In terms of providing an attractive residential environment – an objective in both the urban compaction and liberal planning policies – additional urban design efforts seem in order, to increase the quality of living in places such as these; for instance, by creating or restoring connections between residential neighbourhoods and green spaces.

6. Planning, design and policy discussion

From the perspective of future spatial planning tasks at the rural-urban fringe, it will be important to anticipate on regional differences due to specific regional developments and conditions. For example, the land-use demand for housing and employment in the northern, south-eastern and south-western part of the country is expected to be much lower than in the western and central parts (primarily the Randstad). Therefore, generic planning concepts appear to be inadequate for steering urbanisation in the desired direction. The recent liberalisation and decentralisation of spatial policy in the Netherlands is in line with this observation. However, it can be expected that the liberalisation will strengthen the trend of an increasingly dispersed urbanisation and will make regional differences even larger. In this context, planning and (re-) designing urban developments at the rural-urban fringe raise some complex planning and design issues on local, regional and national levels.

Challenges on a local level

Considering the local and municipal ambitions to create more sustainable and more liveable urban areas in the future, it is an important challenge to improve the quality of existing and new areas at the rural-urban fringe. In the future, in many urbanised regions in the Netherlands, combinations of urban, recreational and natural programmes will occur, which is a challenge not only for regional and local planning, but also for local design. In light of the characteristics discussed in this article, local authorities, urban planners and designers should develop strategies to create multi-functional areas with shared facilities, improve connections between separated functions and upgrade the identity of locations on the fringe, instead of continuing a 'tabula rasa' approach. Concerning commercial functions that attract large numbers of visitors, such as retail centres and recreational areas, a relevant task would be to improve the quality of their public spaces. And finally, in times of decentralisation and severe budget cuts, it will be necessary to take a closer look at innovative small-scale and bottom-up strategies to enhance the quality of areas at the rural-urban fringe. Lessons can be learned from informal planning and design in in-between areas. There, local and small-scale activities often have a positive effect on the area, for instance, in terms of social participation and a feeling of belonging. Instead of demolition and new construction, a more sustainable approach to urban restructuring and transformation could be to strengthen local identity and place-specific landscape qualities, and involve local stakeholders in the planning and design process (e.g. see PBL and Urhahn Urban Design 2012 for recent best practices).

Challenges on a regional level

Per region, parties must take into account the various urban, recreational and environmental tasks for each municipality. For example, one centre may be faced with a strict landscape protection programme, while another could accommodate urban expansion more easily. To form a clearer image of specific planning and design tasks, spatial needs must be outlined per region, together with conditions for urbanisation and policy and nuisance restrictions. For a region to successfully deal with complex problems in multiple domains (e.g. housing, employment, infrastructure, water management) and take advantage of opportunities where possible, planning will require cooperation on a regional scale. It is advisable to develop an urbanisation strategy for the rural-urban fringe that transcends municipal boundaries, focuses on regional interests and leaves room for sub-regional differences. Within such a framework, smaller projects may then be implemented on a lower scale. Although transcending municipal boundaries, in the past, has proven to be a formidable challenge (competition still seems to be more widespread than collaboration, especially in times of economic crisis), experience with such an approach is currently being gained in various regions of the Netherlands, in terms of long-term strategic planning and (temporarily) changing public-private alliances.

Challenges on a national level

At this moment, it is too early to evaluate the effects of liberalisation and decentralisation of large parts of national spatial planning. Because of the financial and economic crisis, to date, there have been too few construction activities to assess the impact of these policy changes. An important question will be how the increase in dispersed urbanisation has affected the most urbanised regions in the Netherlands, in terms of the economic performance of cities as well as the efficient use of existing infrastructure – both of which are important policy objectives of the current national government. For instance, urban expansion may lead to the desired agglomeration effects, whereas increased urban sprawl may negatively affect various aspects of the environment and quality of living (which is a basis for an attractive business climate), and raise the need for additional investments in new roads (see e.g. Hilbers et al. 2009). One way or another, a balance will have to be struck between a certain 'critical urban mass' needed to achieve the desired level of agglomeration and some form of urban containment that will guarantee desired levels of quality of living (e.g. clean air, close proximity to nature areas), and the efficient use of existing infrastructure. The outcome will differ from region to region, depending on the amount of space needed for urban land use, as well as on regional decisions about where urban development will be allowed to take place: within existing urban areas, at the urban fringe or further out. In a quantitative sense alone, urban planning will be an enormous task (especially in the Randstad). Moreover, in the light of issues such as the loss of open landscapes, the blurring contrast between city and countryside, and poor accessibility of recreational land surrounding urban areas, there is an additional qualitative (planning and design) task that should not be underestimated.

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7. Conclusions

In the past twenty years, there has been a significant increase in urban developments at the rural-urban fringe in the Netherlands. Policymakers, urban planners, landscape designers and architects will have to acknowledge that the rural-urban fringe has become much more than just a peripheral zone. In the context of future quantitative and qualitative planning tasks, the rural-urban fringe requires special attention, not only when planning new areas, but also when redesigning existing ones. Because of specific regional conditions and diverging future land-use demands, it will be important to anticipate on regional differences. On a local level, planners and designers should develop strategies to create multi-functional areas with shared facilities, improve connections between separated functions and upgrade the identity of places at the fringe. Opportunities to involve local stakeholders should be explored. On regional and national levels, sector-based policy for housing, employment, infrastructure, recreation and nature will remain necessary, but an integral spatial policy is also required. Transcending the boundaries between policy dossiers can help cities improve the quality of living and working in urban areas, (re)connect these areas with the surrounding landscape, stimulate economic productivity by increasing densities and enhancing infrastructural connections, and promote the efficient use of existing infrastructure.

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A method for metropolitan landscape characterization; case study Rotterdam

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Abstract

This paper presents a theoretical and methodological framework for a comprehensive landscape characterization, focussing on the largest and most complex urban realm: the metropolitan region. Landscape character has in recent years emerged as a new paradigm to understand, monitor and evaluate cultural landscapes undergoing change. The scope of characterization methods however, is by and large limited to the non-urban realm. In physical terms, the border between the urban and non-urban realms is becoming increasingly diffuse, particularly in metropolitan regions. Metropolitan regions thus conceptually challenge the scope of landscape characterization, as cities can also be understood to be in and of themselves a form of cultural landscape. Moreover, territories where urban and rural realms merge, result in new 'hybrid' types of space that fall outside existing characterization methods. The method developed and presented in this paper is aimed at producing a comprehensive landscape characterization tool for metropolitan regions in order to understand, evaluate and monitor their spatial form. The method developed combines elements from conventional landscape character assessment with urban morphology, mapping, and cluster analyses. The first version of the method was tested using the metropolitan region of Rotterdam and resulted in a preliminary categorization of thirty-six metropolitan landscape types. Twenty-four of the thirty-six types are defined as 'hybrid' or mixed landscape types, which occupy approximately 30% of the territory. Their make-up is determined by formal varying densities of topographic elements, land use categories, and heights. The hybrid landscape types that have emerged as a result of applying this method are of particular interest, as they were not recognized as a specific category by other classification methods. The extent and character of these landscapes is not yet fully understood and therefore not used in the landscape policy forming. The method also reveals a substantial disparity between the assumed threshold of city and countryside in the Rotterdam region, and the one that has resulted from this study. The distribution of hybrid landscape types also shows that patterns of dispersion, diffusion, periphery and fragmentation have exceeded what is considered the peri-urban area of Rotterdam in administrative and planning circles.

Key words

landscape characterisation, metropolitan landscape, hybrid landscape, cluster analyse, landscape type

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1. Introduction

Globalization and the networked society have far-reaching spatial implications, which in turn produce territorial rearrangements of urban regions (Pinzon Cortes, 2009). In recent decades, research into territorial transformations in metropolitan regions arising from these conditions have resulted in a range of new insights from varying perspectives on the form of the territory such as: 'citta diffusa' (Indovina, 1990), 'Tapijtmetropool' (Neutelings, 1994), 'middle landscape' (Rowe, 1991), 'edge city' (Garreau, 1992), 'exopolis' (Soja, 1992), 'Zwischenstad' (Sieverts, 2004) and 'tussenland' (Frijters and RPB, 2004). A common theme in these concepts is the shifting relationship between city and countryside. In contrast to compact homogenous cities, metropolitan regions are characterized by an amorphous patchwork of urban fragments in which the distinction between rural and urban realms is dissolving. According to Castells (2010, p. 2739) "it includes in the same spatial unit urbanized areas and agricultural land, open space and highly dense residential areas [...], it is a multi-centred metropolis that does not correspond to the traditional separation between central cities and their suburbs." In the European context 'dispersed urban regions' can be compared to urban areas with heterogeneous land use and fragmented structure, which is often referred to as Urban Morphological Zone or Urban Metropolitan Area.

The metropolitan region challenges morphological concepts such as 'urban periphery'. The term 'metropolitan' as used in this research broadens the meaning of what is usually understood under urban and peri-urban and includes the entire territory of the city-region, from the dense inner-city tissue and the vast sub-urban up to rural territories. In these areas, processes of urbanization lead to 'hybridization' of landscape. The mixes of industrial, residential, infrastructural, recreational and other kinds of urban tissues which penetrate agricultural or nature areas are characterized by varying densities and forms of built and un-built space which differ markedly from that of compact (historical) urban spaces and open countryside. These hybrids challenge existing categorizations of the spatial disciplines, falling as they do outside both urban and non-urban qualification frameworks. The environmental, social, and economic challenges metropolitan regions face necessitate a comprehensive understanding of the interrelationship of the spatial form of city and countryside. The limitations of existing approaches to characterize and assess metropolitan spatial tissue restrict our comprehension of their physical extent and character and in turn our ability to plan and intervene in them. As conventional methods are not sufficient to understand the complex nature of the metropolitan landscape, a new comprehensive characterization method is needed. The motivation for this research is thus to expand the scope of existing characterization methods to include these metropolitan areas. The paper elaborates on the results of the first implementation of the method in a case study of the Rotterdam metropolitan region.

1.1 Landscape Character Assessment (LCA)

The increasing scale and pace of spatial development affecting European landscapes in general has catalysed attention to methods that can aid in objectively understanding landscapes and help to monitor and manage change. Landscape Character Assessment (LCA) has thus become a key framework in recent years and now serves as a basis for landscape analysis, evaluation, policy development, and design concept development. In the LCA approach, Landscape Character is defined as a distinct, recognizable and consistent pattern of elements that makes one landscape different from another (Swanwick, 2002). Landscape Character is that which makes an area unique (Swanwick, 2002) and can be seen as an expression of the holistic nature of the landscape (Antrop, 2003; Jessel, 2006). The process of characterization involves recognition of areas that have similarities, classifying them and mapping them. One of the most comprehensive and well-documented methods for Landscape Character Assessment can be found in the Guidelines for landscape character assessment developed in 2002 by the Scottish Countryside Agency. The Scottish approach is now widely practiced outside the UK (Swanwick, 2002; Wascher, 2005; Nogué and Sala, 2006; Van Eetvelde et al., 2006; Kim and Pauleit, 2007). The Swanwick guidelines also serve as a basis for the development of this method.

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1.2 Landscape character assessment in metropolitan areas

Although etymologically the term landscape also applies to urban landscapes, most landscape characterization has focussed on cultural, natural or rural landscapes. The European Landscape Convention has broadened the concept of landscape character to include built components in the landscape definition. Nevertheless the tradition of seeing landscape as something outside the cities still dominates the landscape characterization practice and policy making. The intention of the Swanwick Guidelines is to be suitable for the character assessment of both rural and urban landscapes; nevertheless its application in urban landscapes is only just beginning (Swanwick, 2002). As a consequence, in the majority of classifications, urban areas typically remain categorized as one type, termed 'urban area' (as is for instance the case in Dutch classifications). Even in more elaborate classification, such as that prepared for Belgium by Van Eetvelde and Antrop (2009), urban landscapes are subdivided into only three principal categories: urban landscapes, suburban landscapes and industrial and harbour landscapes. Landscape characterization can form an important contribution to understanding urban landscapes, but to date neither landscape character assessment methods nor methods for urban space characterization have been able to sufficiently comprehend and catalogue their complex and composite nature.

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2. Brief overview of classification methods

There are a number of different approaches to landscape typology and systems for landscape classification (Lipský, & Romportl, 2007). As a result, landscape can be categorized according to a wide number of classification variables ranging from climatic, cultural or land use. In the following text we present a short overview of existing methods for landscape classification.

2.1 Landscape classification methods

Depending on which elements are used to define the distinct types, landscape classification methods can be broken down into three main categories (adapted from Berendsen, 2000; Groom, 2005; Nijhuis, & Reitsma, 2011):

- **Biophysical landscape classification**: this category addresses the internal coherence between landscape factors focussed on key-aspects of form and functioning of the natural landscape, such as: soil, geomorphology, climate, vegetation and land cover. The typologies are usually monothematic in nature. European examples include: Geomorphological regions of Europe (Embleton, 1984), Ecological Regions in Europe (Painho and Augusto, 2001), the Soil Atlas of Europe (Jones et al., 2005), Environmental Zones of Europe (Metzger et al., 2005), CORINE Land Cover (Bossard, 2000). National examples include: Soil-based Landscape Typology of the Netherlands (Edelman, 1950; Jongmans et al., 2013), Flora Districts of the Netherlands (Van der Meijden, 1996), Geological Landscape Typology of the Netherlands (TNO, 2009).
- **Anthropic landscape classification**: this category addresses the specific structure and development (genetic succession) of the landscape, focussed on the human influence on the landscape form, such as: agriculture, forestry, recreational uses, mining and infrastructure. The typologies usually combine factors such as soil, climate, management system, historical aspects, and land use dynamics. European examples include: the pan-European landscape typology by Meeus (1988, 1993, 1995), ENVIP-nature map on landscape types (JRC, 2002), European Landscape Classification-LANMAP2 (Mücher and Wascher, 2007; Mücher et al., 2010), and the Map of European Leisure-scapes (Wascher et al., 2008). National examples include: Landscape Typology of the Netherlands (Piket et al., 1987; Visscher 1972; Zonneveld 1985; Berendsen, 2000), Landscape Atlas of Flanders (Antrop et al., 2010; Eetvelde and Antrop, 2003), and the Polder typology of the Netherlands (Steenbergen et al., 2009; Nijhuis and Pouderoijen, 2013).
- **Visual landscape classification**: this category addresses the visual appearance (physiognomy) and human experience of the landscape, focussed on landscape perception and preference exemplified by indicators such as: degree of openness, landscape attractiveness, scenic and aesthetic aspects, visual urbanisation and cluttering. The typologies usually combine formal, visual and psychological aspects of the landscape. Pan-European examples are not available. National examples include: Landscape Attractiveness Map of the Netherlands (Roos-Klein Lankhorst et al., 2002, 2011), Degree of Openness (Dijkstra, 2000; Nijhuis and Reitsma, 2011), Mapping Aesthetic Preference (Sevenant and Antrop, 2010), Visual Urbanization (Van der Hoeven and Nijhuis, 2012).

2.2 Urban space classification methods

There are similarly a number of different approaches to urban space classification and assessment. This overview has no intention to offer an extensive listing of existing methods but reflects on several examples that are relevant for the characterization of metropolitan space. Methods for urban space classification depend on the aims of the study they are implemented in, so they will differ when the city is viewed from different disciplines. Taking into account the type of data used for analyses, techniques implemented, and the ways of representation, two main groups emerge: form-related and function-related classification. Form related classification looks at the patterns and forms of urban elements by studying their morphological character; the representation of these studies is expressed in drawings and maps. Function-related

classifications start from land use, adding statistical data about densities of housing, jobs, inhabitants etc. These methods use computational techniques such as statistical calculations or clustering, and represent the results in the form of maps, which can be either grids or polygons.

- **Form related classification**: within the existing literature, there are two significant lines of studies on urban form. The first corresponds to the tradition of morphological studies, influential in the 1970s and 80s, and the second to more recent studies about the form of the landscape and the territory, which have been conducted since the 1990s (Pinzon Cortes, 2009). For both lines of studies, mapping and drawing are the most used techniques. Urban morphology deals with the knowledge of the logic of form, in this case, urban form. It is studied in several disciplines and involves looking at physical characteristics, structure, relations and transformations of things and their constituent elements. From the existing studies, the main three schools of typo-morphology can be distinguished: British, French and Italian along with studies conducted in the Dutch context (Pinzon Cortes, 2009).
- **Function related classification**: Here we are using two examples: 'Urban Environments' (Stedelijke milieus) Ritsema van Eck et al. (2009) and European Urban Atlas (http://www.eea.europa.eu/data-and-maps/data/urban-atlas). For their classification of 'Urban Environments' Ritsema van Eck et al. used statistical data on land use, density of housing, jobs, shops, percentage of high rise buildings, office and shopping floor areas. They applied a grid of 250 x 250 meters, covering all of the land area of the Netherlands and grouped it into 18 urban environments (and one non-urban environment) using cluster analysis. This was done for 2000 and 2006 using the same categorization so that the changes could be analysed. Another example of the functional analyses is the European Urban Atlas (http://www.eea.europa.eu/data-and-maps/data/urban-atlas), which is providing pan-European comparable land use and land cover data for Large Urban Zones with more than 100.000 inhabitants and uses images from satellites to create reliable and comparable high-resolution maps of urban land. The Urban Atlas has a legend designed to capture urban land use, including low-density urban fabric, and expressing it in a level of continuity with a resolution that is 100 times higher than CORINE land cover. The Urban Atlas provides a far more accurate picture of urban sprawl in the fringe of urban zones. It provides relevant data for analysis related to transport, environment and land use.

2.3 Emerging tools for metropolitan landscape characterization

As we can see from the overview of the landscape classification methods, they focus primarily on non-urban landscapes. Conversely, classification frameworks for urban space generally stop at the city border. Looking specifically at urban and peri-urban landscape classifications, the literature shows very few classifications that treat urban and rural landscape together. The most important exceptions are the landscape typology and characterization for the federal state of Belgium (Van Eetvelde, & Antrop, 2009) and the European Urban Atlas (http://www.eea.europa.eu/data-and-maps/data/urban-atlas). Although those tools can be implemented for metropolitan landscape categorization they are still insufficient for the comprehensive coverage of the variety of hybrid landscape types. Nevertheless they were used as a starting point and inspiration for the development of the new method, which will be described in the following paragraphs.

Tisma, A., van der Velde, R., Nijhuis, S., & Pouderoijen, M. (2013). A method for metropolitan landscape characterization; case study Rotterdam. SPOOL, 1(1). doi:10.7480/spool.2013.1.637

3. A method for the metropolitan landscape characterization

Given the nature of metropolitan territories, the tools and methods presented in paragraphs 2.1 and 2.2 are inadequate for comprehensive metropolitan landscape characterisation. For this research, characterization and classification tools for both rural and urban areas were merged into one new framework. This new framework has been sourced from both urban and landscape fields: morphology and mapping analysis from urban studies, and landscape character assessment from the field of landscape studies.

3.1 Case study area of Rotterdam

The first stages of the method discussed in this paper was developed and tested using the metropolitan region of Rotterdam as a case study. This region is situated in the south of the Randstad conurbation in the Netherlands, the so-called South Wing and is also called Rotterdam-Rijnmond (literally Mouth of the Rhine). It is an official region of the province of South-Holland and consists of 16 municipalities with a total population of approximately 1.3 million.

In order to effectively incorporate the entire metropolitan area, the study area was set as twice the extent of the existing urban area calculated on the basis of existing administrative, planning and geographic border data. The borders of the study area were furthermore set by a rectangular frame measuring 60 km x 30 km. No distinction was made between rural and urban areas, as municipal borders were not used for the calculations.

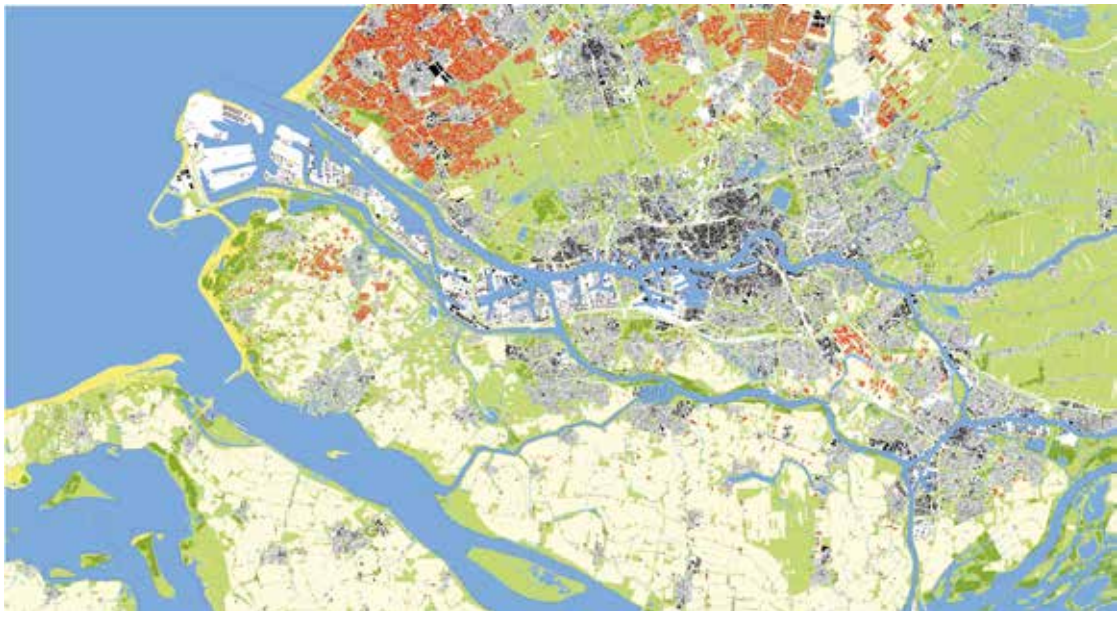

Figure 1
Topographic map of the metropolitan region of Rotterdam

Existing landscape classifications of Rotterdam area show the same lack of comprehensive landscape characterization as most of the other metropolitan regions. For the rural area the Province of South Holland developed a tool for policy-forming based on Area Profiles (Gebiedsprofielen www.zuid-holland.nl/documentenverkenner.htm?Gr=Ruimte&t1naam=Ruimtelijke%20kwaliteit&t2naam=Gebiedsprofielen). The

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Area Profiles are comparable to landscape character types but are again only elaborated for rural areas. As a tool for urban landscape planning the Municipality of Rotterdam uses standard policy instruments such as Masterplan, Green space plan etc. that are only focusing on green spaces such as parks, playgrounds and other usual categores of public urban green spaces (see for instance http://stadsregio.nl/sites/stadsregio.nl/files/pagina-bestanden/RGSP 2011-12-14 RGSP 3.pdf; http://www.rotterdamvooruit.nl: http://www.polderdag-rhoon.nl/uploaded_files/DV_2008 Groenonderzoek Rotterdam Samenvattting.pdf etc.)

3.2 The model of the new method

The proposed model for the new method for metropolitan landscape characterization uses the basic structure of the Landscape character assessment of the Scottish Natural Heritage (2002) as an initial starting point. First their steps of the model focus on desk study on regional scale while the fourth and fifth step concern detailed field study of each of the preliminary developed draft character types.

One of the most important modifications to this model is the addition of mapping/morphology and cluster analysis in step 3 (figure 2). In the following text the five steps of the model will be described, using the case of the Rotterdam metropolitan region. It is important to note that later in this paper we present and discuss the results of the regional scale analyses, which produced the draft character types.

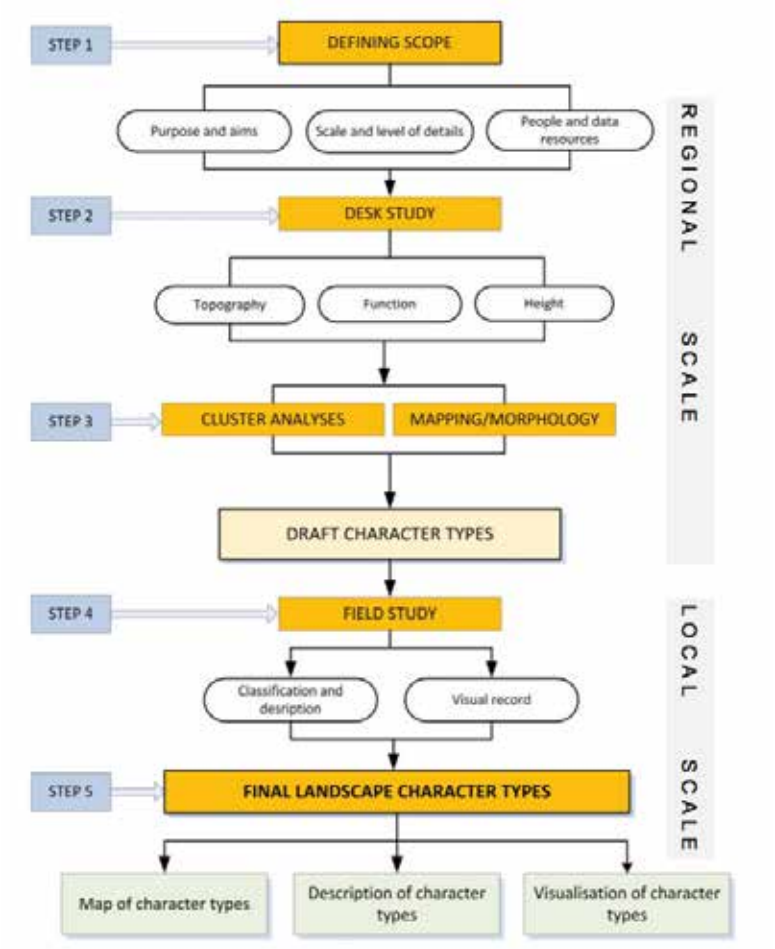

Figure 2
The structure of the Framework for Metropolitan Landscape Characterization

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Step 1. Defining the scope

The first stage of the method involved the definition of the scope of the research, which is explained in the first paragraph. The goal of the classification was to understand the character of heterogeneous metropolitan landscape so that it can be included in the policy forming or monitoring of the changes in these areas. In this stage we decided to work in two scales – regional (step 2 and 3) and local (steps 4 and 5).

Step 2. Desk study

Desk study step involves a selection of elements that will be used to define a first stage spatial categorization, to serve as a basis for landscape character types. The choice of elements can vary because it is very strong related to the purpose of the characterization. The elements can be sourced from various datasets. As the purpose of this research was to focus on the physical and formal landscape characterization, we have decided to work with the datasets that are relevant for this purpose and that are as accurate as possible. Data were sourced from a highly detailed vector topographical database of the Netherlands (TOP10nl, 2011), Land Use Maps (BBG, 2008) and height maps of the Netherlands (Actueel Hoogtebestand Nederland, AHN-1, 1997-2003). The information in the AHN has been derived directly from aerial photos with a high positional accuracy, making it very suitable for statistical and spatial analysis. As original data are developed for the general purposes of various users they needed to be adjusted for the purpose of this landscape characterisation.

TOP10nl has been used to define a first stage categorization of four spatial categories (figure 3): green, blue (water), red (built-up) and grey (infrastructure). As these categories only cover half of the area of the TOP10 and the rest is unclassified – and in order to get 100% coverage of the study area – we reclassified the remaining area into four classes: in-between space residential area (mixed paved and green areas), in-between space business district (mixed paved and green areas), construction sites, and remaining areas. We then celled the layers using a resolution of one metre and made a mosaic of these cells with the dominant value on top, removing any overlapping areas. As a next step we aggregated each category in cells with a resolution of one hundred metres, resulting in eight cell layers with percentages of each of the eight categories (red, green, blue etc.) per hectare.

In order to analyse the degree of interspersion of urban and non-urban realms in the metropolitan region, we chose to reduce the spatial categories further to two: 'red' (urban) and 'green' (non-urban). Red comprises all categories of built-up space regardless of whether they are residential or industrial, and glasshouses. Green comprises non-built space, such as forests, heathlands, wetlands, dunes, beaches and recreation parks, as well as agricultural areas, such as orchards, croplands, nurseries, meadows, and urban spaces, such as parks and gardens, cemeteries, sports fields, allotment gardens and verges. Red and green layers were then classified and outputted as black and white morphology maps for visual assessment (table 1).

The second input was the Land Use Map (BBG, 2008). Here we reduced the thirty-eight categories in the dataset to ten: residential, infrastructure, services, industry and offices, functional green, agriculture, glasshouses, nature, water and remaining area. These data has been celled with a resolution of one hundred metres; the value of the largest combined surface of the ten categories has been assigned to the grid cells, resulting in a map with the dominant function per hectare. With the combination of the two input layers the share of green and share of red per land use category have been calculated, and visualised as the two images on the bottom of figure 3.

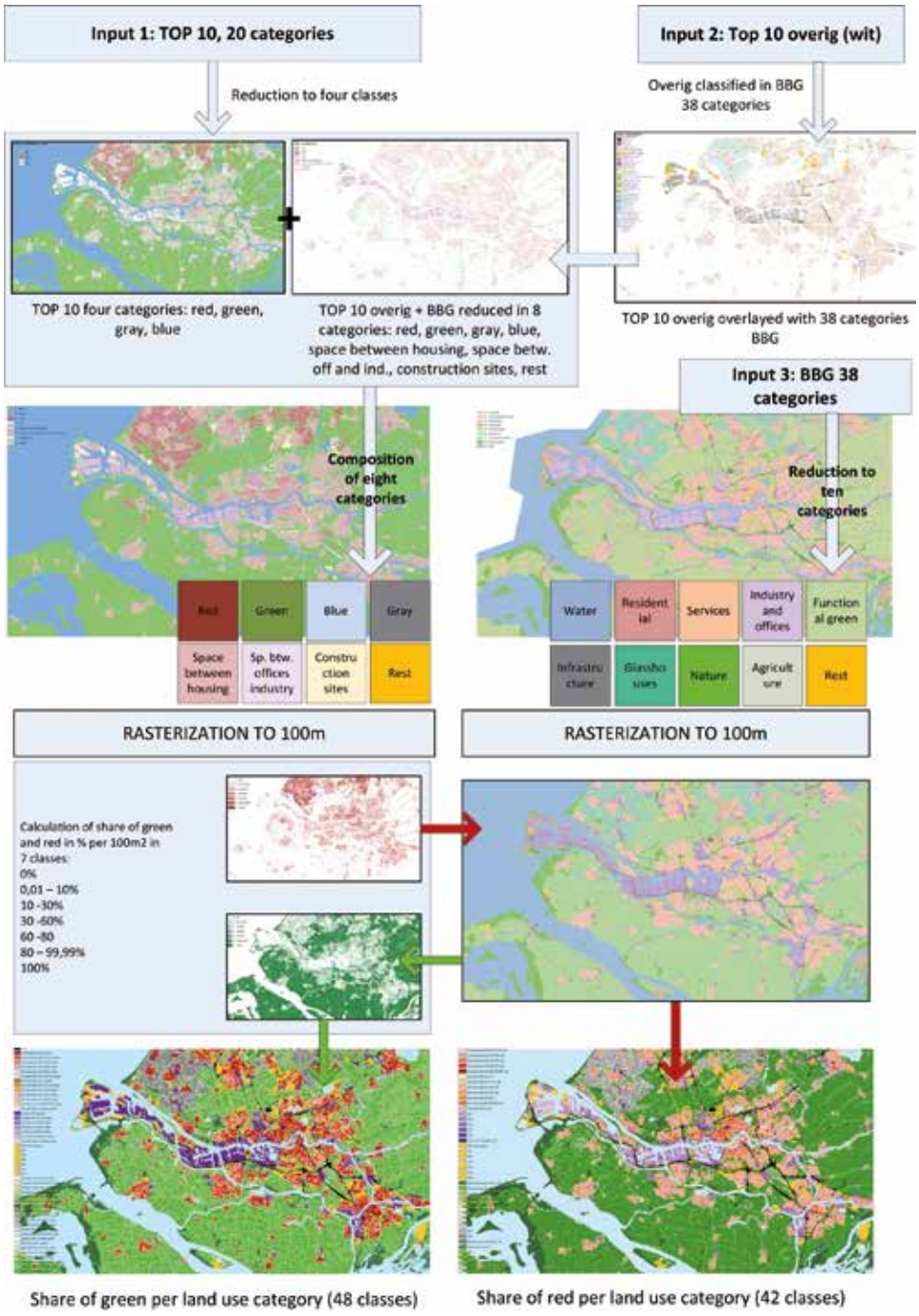

Figure 3
Process of selection and modification of datasets

The third input is the height of topographic elements such as buildings and vegetation. The definition of height in terms of under or above eye-level (1.60 m) addresses the potential of 'being able to see' in a particular situation, and is related to the definition of space by means of spatial boundaries (Nijhuis, & Reitsma, 2011). Space-defining elements are surfaces, screens and volumes that reach above eye level (Thiel, 1961; Curdes, 1993). The actual heights were derived from a high-resolution digital elevation model (DEM), the Actueel Hoogtebestand Nederland (AHN-1, 1997-2003), which is precise to about 15 centimetres per square metre. The DEM's density, distribution and plani-metric accuracy is such that topographic objects

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with a size of two by two metres can be identified clearly and with a maximum deviation of 50 centimetres (AHN, 2010). The model has been supplemented with recent topographic data: the digital topographic map at a scale of 1:10.000 (TOP10nl, 2009). All legend items were selected that were higher than eye-level (including ascending elements, buildings and trees and/or shrubbery) based on the definitions of the Topographical Service of the Land Registry.

Step 3a. Morphology and mapping

Morphology is a well-known method used to study urban form. It involves looking at physical characteristics, structure, relations, patterns and transformations of things and their constituent elements. Mapping is about the "acts of visualizing, conceptualizing, recording, representing and creating spaces graphically" (Cosgrove, 1999). By the evolution of GIS-techniques, application of mapping in the studies of the form of the territory and the landscape became one of the most popular techniques. After we prepared the data we subsequently looked firstly at the patterns of red and green by mapping the distribution of cell percentage categories across the territory. This was followed by the analysis of the percentage of red or green per cell, which was then used to define continuity (more than 80% red or green) or discontinuity (les than 10% of red and green spaces). Following this, the analysis of the share of red and green per land use category gives insights into penetration of red into green space and of green into red space. Discussion of the morphology and mapping analyses of the Rotterdam metropolitan region are presented in paragraph 4.1, 4.2 and 4.3.

Step 3b. Cluster analyses

When there are many layers of spatial information it is difficult to handle them and draw conclusions by simple overlay methods using GIS. Cluster analysis involves grouping a set of elements in such a way that cells in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). It is a common technique for statistical data analysis, used often in landscape analyses for classification (see for instance Ritsema van Eck et al., 2009 and Van Eetvelde and Antrop, 2009) or pattern recognition. In the case of MLC for Rotterdam we have chosen to apply cluster analyses using the same data layers as for the mapping, but adding extra information about heights. This stage of the method resulted in 42 clusters which where afterwards manually regrouped in 36 clusters – draft character types for the metropolitan region of Rotterdam. Discussion of the morphology and mapping analyses of the Rotterdam metropolitan region are presented in paragraph 4.4.

Step 4. Fieldwork

This phase of the method concentrates on the local scale by establishing properties of the character types such as shape, pattern, height, coverage, openness-enclosure, etc. The results of the desk-study analysis are to be verified by doing spot-checks on different typologies to check a) the location and makeup of cells from the TOP10 and BBG, and b) verification of heights. This work is yet to be carried out.

Step 5. Finalization of landscape character types

In this phase the desk-study and fieldwork verification are synthesized in a definitive list of landscape character types. The bulk of the work involves a detailed description of the character types and a visualization of their principal characteristics using diagrams and photos. This work is yet to be carried out.

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4. Discussion

This section discusses the first preliminary findings of the testing of the method on the case of the city-region of Rotterdam. In the following paragraphs we discuss the results of the morphology and percentile analyses (paragraphs 4.1, 4.2, 4.3), followed by the results of the cluster analyses (4.4).

4.1 Morphology of cells using different percentages of red and green

A first outcome of the method is a detailed indication of the pattern of green and red using different percentage categories of red and green per cell. These patterns indicate firstly the degree of hybridization of cells per percentage group, and where these are located, indicating the morphological extent of the merging of urban and rural realms in the study area. Patterns of red and green were analysed by means of the distribution of cells with different percentage of red and green taken from the 1:10.000 map (figure 3).

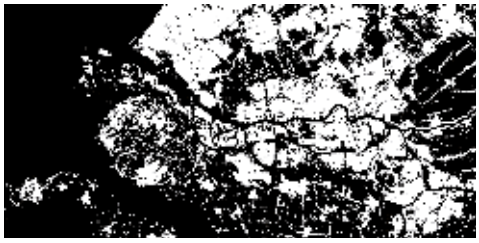
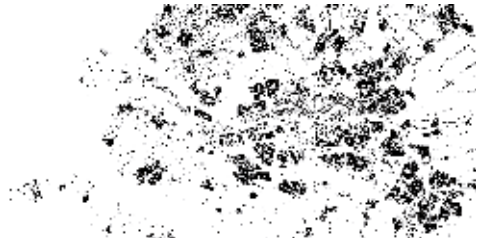
	Morphological patterns of urban and non-urban space in varying percentage groups of 'red' and 'green'	
%	Green	Red
0 %		
	0	Disregarding the water bodies, areas with 0% red-in-cell cells are more extensive than 0% green-in-cell cells.
0.01 - 10 %		
	Low concentrations of green mainly occur in cells in urban areas and glasshouses.	0,01-10% red-in-cell cells are scattered throughout the territory. The patterns of ribbon buildings, villa districts, nature areas and industrial areas are partly visible.
10 - 30 %		
	10-30% green-in-cell cells are scattered throughout urban areas, glasshouses and in large parts of rural areas.	Patterns of 10-30% red-in-cell cells clearly show low-density housing areas on the periphery of Rotterdam, Delft and Dordrecht and other smaller settlements.

Table 1
Morphological patterns of urban and non-urban space in varying percentage groups of 'red' and 'green'.

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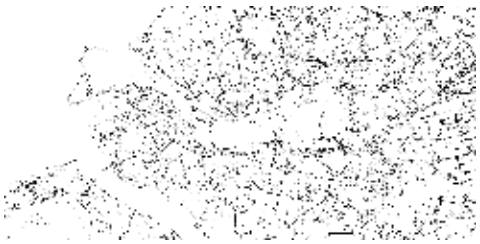
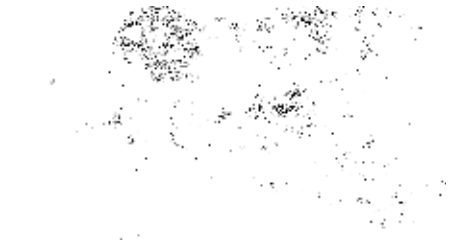
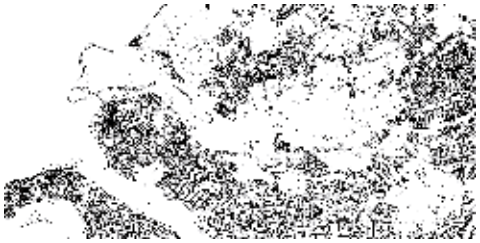
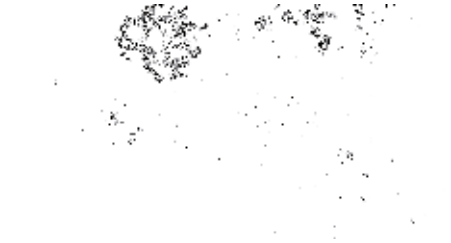
	Morphological patterns of urban and non-urban space in varying percentage groups of 'red' and 'green'	
30 - 60 %		
	30-60% green-in-cell cell patterns indicate a city fringe, and green cells along larger waterways and infrastructure.	Cells occur primarily in the CBD of Rotterdam; glasshouses also dominant.
60 - 80 %		
	60-80% green-in-cell cell patterns indicate a city fringe, and green cells along larger waterways and infrastructure.	Cells indicate the contours of the CBD of Rotterdam; glasshouses also dominant.
80 - 99.99 %		
	Green cells become dominant and indicate patterns of local roads and larger natural areas and forests.	Red cells occur only in glasshouse area.
100 %		
	100% green cells are mainly present in agricultural areas, as well as some forests and natural areas	100% red cells are only present in glasshouse areas.

Table 1
Morphological patterns of urban and non-urban space in varying percentage groups of 'red' and 'green'.

Of note are the extensive variations in patterns of cells depending on which percentage is isolated. Excluding water bodies, 0% green-in-cell cells are limited to glasshouse areas and some downtown urban tissue, while 0% red-in-cell cells still occur in large areas of the territory. These patterns correspond to conventional urban-rural morphology patterns, with a clear spatial definition of urban areas and countryside. This pattern continues in the category 0.01%-10% green-in-cell cells, with low concentrations of green occurring typically in urban areas and glasshouse zones. From this point however, there is a shift in morphology patterning away from typical conditions towards hybrid patterning of built-up and non built-up areas. 0.01%-10% red-in-cell cells for instance, are scattered throughout the territory, including areas on the limits of the study area. This pattern continues up until the 30-60% category, revealing little or no morphological definition of 'city' and 'countryside', aside from low-density residential areas visible in the 10-30% red-in-cell category.

In the 60-80% green-in-cell cell patterns a city fringe begins to appear, along with cells along larger waterways and infrastructure. Nineteenth century urban expansion areas are also revealed in the 60-80% red-in-cell categories. Categories above 80% begin to display the morphological patterns visible in the lower percentage categories, although not as well defined.

The extent of green-in-cell and red-in-cell morphology in the categories between 10% and 80% indicate the degree of heterogeneity and discontinuity of city and countryside in the study area. At the same time, the analysis shows that the study area still has a relatively high percentage of continuous green (80-100%) cells. This is partly, due to the size of the study area frame, but also demonstrates the legacy of the stringent planning culture in the Netherlands which has until recently been able to maintain a relatively distinct division between urban and non-urban realms. In addition, as shown in the absolute percentage distribution maps, areas with no red occupy a much greater area than those with no green. Low concentrations of green-in-cell cells occur mainly in urban areas and glasshouses while low concentrations of red-in-cell cells are scattered throughout the whole area. Additionally, patterns of ribbon development, villa districts, nature areas and industrial areas are partly visible in the 0-10% and 80-99.99% categories.

4.2 Percentile analysis of cells and hybridization

In a graph illustrating the percentages of red or green per cell in the study area (figure 4 / table 2), we can see that the total area of 100% red-in-cell cells is very low (only 0,2%) compared with 20,1% for 100% green-in-cell cells. Cells with some percentage of red however, can be seen to be present throughout the whole area in different densities and concentrations. This penetration of 'red' results in a large amount of 'hybrid' spaces where green and red mix (categories 10 to 80%). This pattern is discussed further in 4.3.

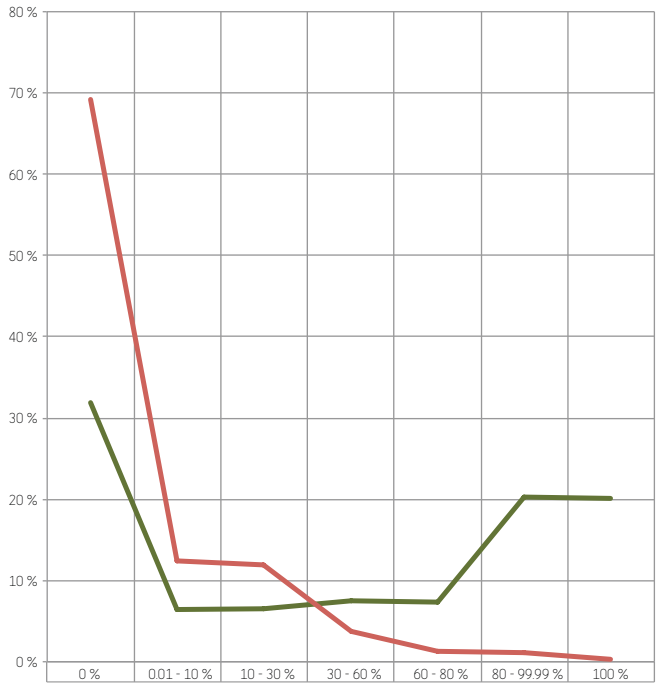


Figure 4
Percentage of green and red cells in the total area of the Metropolitan Region Rotterdam

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Percentage of green and red cells in the total area of the Metropolitan Region Rotterdam							
	0 %	0.01 - 10 %	10 - 30 %	30 - 60 %	60 - 80 %	80 - 99.99 %	*100%*
% of green cells in city region	32	6	7	7	7	20	**20**
% of red cells in city region	69	12	12	4	1	1	**0**

Table 2
Percentage of green and red cells in the total area of the Metropolitan Region Rotterdam

The method of calculation of percentage of green or red per 10.000 m2 cell results in overlapping cells, as each of the cells can have a certain percentage of red or green, which are not complementary. Therefore the combination of the two maps can result in various other images, depending on the questions we want to answer. Figure 5 is one example of these possibilities. It represents a combination of all cells that have both red and green in them, in total 19 categories.

Figure 5
Combinations of all cells that have red and green in them

This map shows the extent of hybridization of red and green in the Rotterdam metropolitan region. These hybrid cells occupy 26% of the study area (figure 6). These results are comparable with the study of Slak and Lee (2003), who have analysed the heterogeneity and homogeneity (the term Slak and Lee use for what is in our paper pattern analyses) of the rural landscapes in France. Their results have shown that the heterogeneity occurs in 35% of the grid cells covering the whole territory of France (in total 15.700 grids). The difference between the methods used in our study and the study of Slak and Lee is that the pattern analyses in our study were done by using expert visual assessment, while in the texture indicator used by Slak and Lee an algorithm is developed to simulate visual perception.

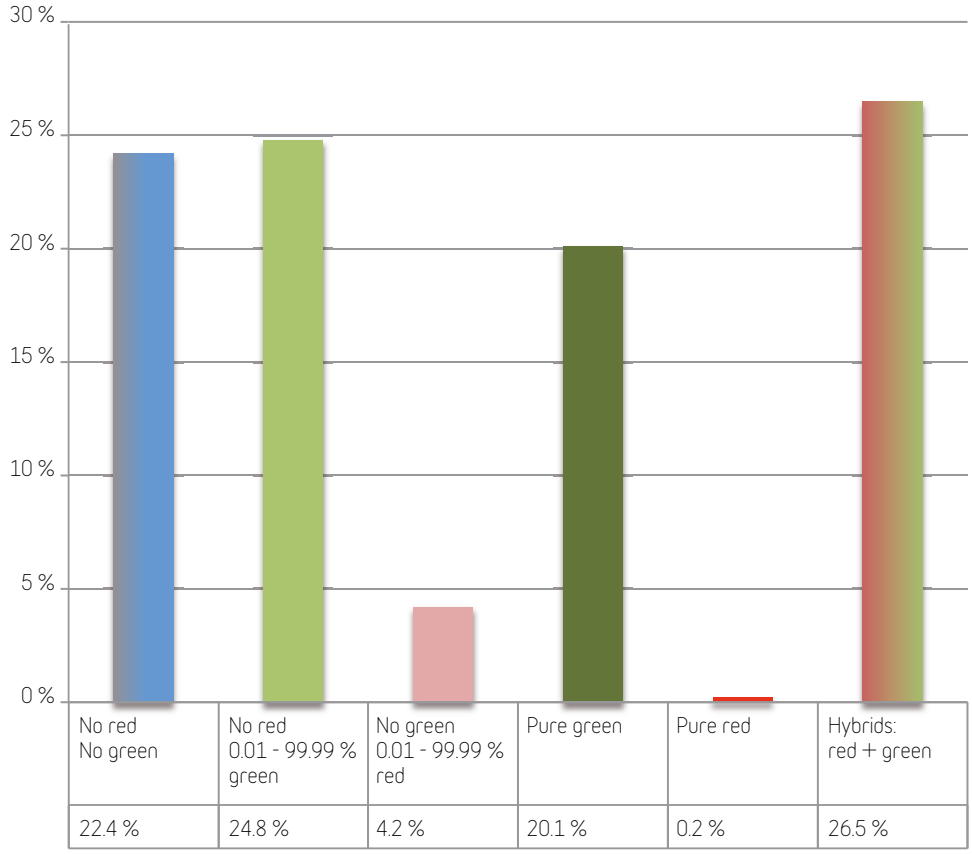

Figure 6
Percentage of hybrid landscapes in the metropolitan area

Figure 6 illustrates that pure red areas are very low qua surface (0,2%) while 'pure green' takes ' takes up 20,1% of the territory. Red areas without any green present are below 5% while green areas without any red are below 24,8%. It is important to note that aside from the large percentage of hybrid landscapes we also detected considerable areas of green space. This pattern originates from agricultural land, which is still a dominant 'green' element that defines the Rotterdam metropolitan region. This is an interesting discovery because the landscape policy evaluation (PBL, 2009) and perception studies (PBL, 2008) argue that the perception of this area as cultural landscape is fragmented by disturbing built-up elements such as industrial, agricultural and infrastructural objects.

4.3 Mix of red and green – hybrid landscapes

We also looked at the share of green and share of red per land-use category. This resulted in the two maps (at the bottom of the figure 3) showing respectively the penetration of red in green space and the penetration of green in red space. The colours representing housing, industry, services, and glasshouses are ordered so as to become darker when less green or more red is present in the cells, and lighter when more green and less red is present in them. In the green categories (functional green, agricultural and nature areas) the colours are ordered the other way around – the more green or the less red they have the darker they are. The image presented on the map 'share of red' appears much darker than the image of 'share of green'. The largest intact dark green colour represents agricultural land with some scattered lighter green elements in it. The darkest colour represents natural areas, which is almost 100% green (contains a very few red cells). For the share of red it was interesting to look at the presence of built-up elements in the

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spaces that are used for leisure and recreation (which we named functional green), nature and agricultural area. Statistics shows that there are no extremely red cells present in these categories, but very low concentrations of red (0,01-10%) are very much present in the whole rural area, mainly in agricultural area and functional green areas, and in very few cases in natural areas.

The image on the map 'share of green' is still very dark, but much lighter than the first one. The agricultural area is not so compact as in the 'red' map anymore, because the pattern of local roads is visible. Dominant green are now only natural areas, but we see a lot of 'hybrid' categories in the city fringe and within urban green spaces. For the share of green it is interesting to look at 'urban' functions such as housing and services, and then at industry and glasshouses. The majority of housing areas and services are in the 'hybrid' category, while the majority of industrial area and glasshouses have a very little amount of green or no green (0-10%). The 'hybrids' can be a mix of different spatial entities and combine various spatial functions.

4.4 Cluster analyses

In the last step of the desk analyses we conducted cluster analyses. For each cluster we had as input eight categories from the Top10 map, ten categories of land use and two categories of height, below and above eye height. The cluster analyses resulted in three variants: 39, 42 and 49 clusters. By looking at the underlying topographic data we concluded that 42 clusters best represent the situation in the Rotterdam metropolitan region. Afterwards we manually adjusted the clusters merging a few that were similar, which resulted in a total of 36 clusters. Looking at the table with the statistic on minimum, average and maximum values and standard deviations for each cluster, we selected those that have more than 80% of all these values as continuous, the rest as discontinuous. Between the discontinuous clusters we noticed the patterns of larger patches and smaller – 'edge' – cells. Finally we can say that there are 12 continuous and 24 discontinuous or 'hybrid' landscape types. Of the discontinuous types half are larger patches and half 'edge' types. Figure 7- 11 list the preliminary character types and their location.

The statistics of the results of the cluster analyses (table 3) shows that almost 70% of the territory of the metropolitan region of Rotterdam is covered by continuous and 30% by discontinuous spatial types. The dominant types in the continuous category are agriculture (26%) and water (24%). None of the discontinuous spatial types shows a particular domination; the most represented types range between 2 and 6%. Those can be found in the mixed low-density residential areas and as edges along the water and next to the smaller roads in agricultural area.

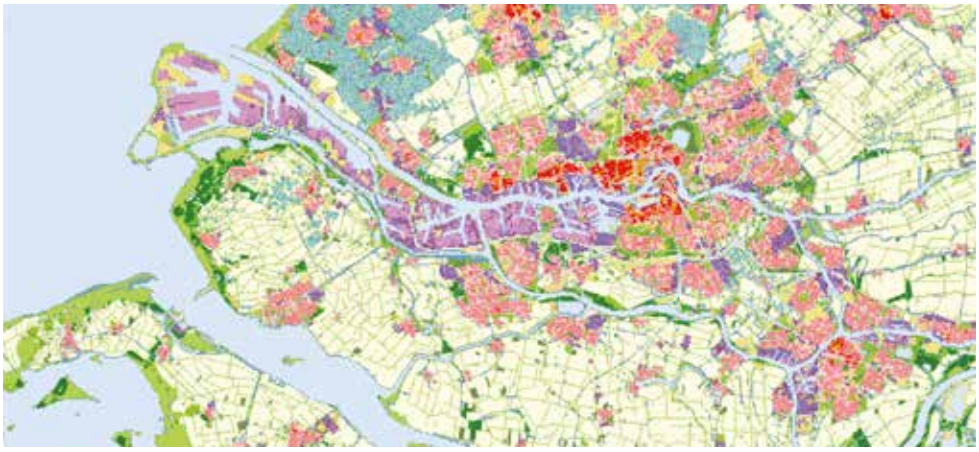

Figure 7
36 Clusters

Tisma, A., van der Velde, R., Nijhuis, S., & Pouderoijen, M. (2013). A method for metropolitan landscape characterization; case study Rotterdam. SPOOL, 1(1). doi:10.7480/spool.2013.1.637

Figure 8
12 Continuous clusters

Figure 9
12 Edge clusters

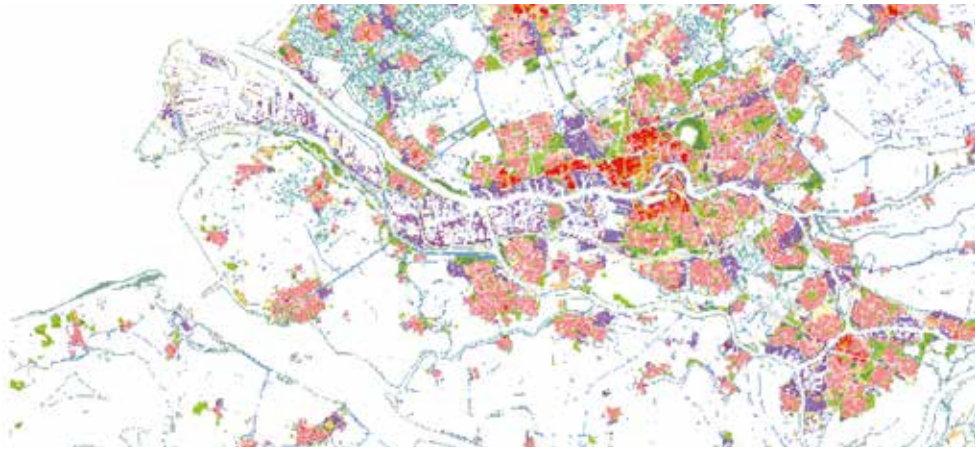

Figure 10
12 Patch clusters

Tisma, A., van der Velde, R., Nijhuis, S., & Pouderoijen, M. (2013). A method for metropolitan landscape characterization; case study Rotterdam. SPOOL, 1(1). doi:10.7480/spool.2013.1.637

Cluster	Preliminary description	%
	Continuous	
10	10 - in-between industrial with some grey, low	1,60
104	104 - 11+26 - glasshouses	1,54
105	105 - 15+23 - construction and remaining, low	0,83
14	14 - agriculture, low	26,14
31	31 - agriculture, with some grey, low	6,90
1	1 - agriculture, with some grey or high red elements	2,97
21	21 - green agriculture, predominantly high	0,49
2	2 - green remaining, low	0,61
29	29 - green nature, mostly low	2,62
22	22 - green nature, mixed high/low	1,13
7	7 - green nature, high (forest)	1,35
103	103 - 9+12+40 - water	24,40
		70,58
	Disontinuous - patch	
39	39 - red residential, in-between residential and grey, mixed high/low	0,68
16	16 - red residential, lots of in-between residential, predominantly low	5,62
27	27 - residential with some in-between, grey and green, predominantly low	2,69
28	28 - buildings, urban services, mixed high/low with grey	0,30
101	101 - 4+18 - services mix	0,58
35	35 - in-between industrial with buildings, predominantly low	1,46
41	41 - red, industry/offices, mixed high/low	0,74
20	20 - functional green (bungalow park)	0,15
38	38 - functional green, mixed high/low with some grey elements (park)	0,85
19	19 - functional green, predominantly low (recreational area, park)	1,98
36	36 - construction green, remaining, predominantly high	0,11
		15,15
	Disontinuous - edge	
3	3 - green residential, grey, predominantly low	0,96
33	33 - in-between industrial with grey infrastructure, green, predominantly low	1,11
37	37 - industry/office water, low	0,50
42	42 - grey with urban services, mostly high	0,41
30	30 - grey infrastructure with surrounding green, mostly low	1,38
106	106 - 17+25 - glasshouses mix	1,20
32	32 - glasshouses with some in-between industrial	1,11
6	6 - blue in green, agricultural areas, some grey, low	2,76
34	34 - green grey, functional green, predominantly low	0,98
24	24 - green grey, infrastructure remaining, low	0,50
102	102 - 8+13 - green/blue edges, low	2,81
5	5 - construction remaining, with some green, grey, low	0,57
		14,28
	TOTAL	100

Table 3

Percentage of landscape type per total area of the urban region of Rotterdam

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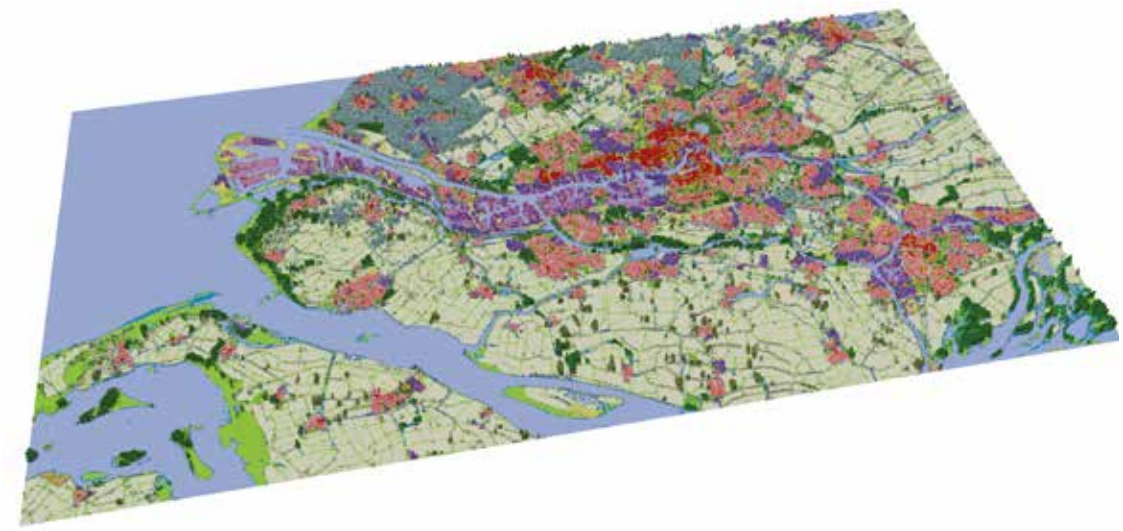

Figure 11
3D visualization

As can be seen from the diagrams presented in this paragraph, mapping and morphology analyses have shown different statistics about the percentage of hybrid landscapes than cluster analyses. This can be explained by the essential difference in the two methods. In the case of mapping the grid cells shown on figure 4 / table 2 contain only red and green elements, while blue (water) and grey (infrastructure) and all of the rest of 16 elements were not taken into analysis. In the cluster analyses all twenty elements play a role in the aggregation of the cells. Nevertheless, each of the two methods has its strengths and weaknesses; it is a combination that makes them stronger. The mapping method simplifies the spatial image and shows how the patterns are distributed in space in a more clear way then clustering. On the other hand mapping lacks in capturing the complexity of each of the cells. Therefore the combination of the two methods gives better insights in the composition, interaction, overlap, fragmentation, and distribution of hybrid cells.

When one wants to create homogenous regions from a classification there are generally a lot of small clusters that must be suppressed. A classical problem dealing with generalizations is to decide where to draw the boundary. In the landscapes where humans manage the land, the borders can show both sharp and gradual transitions between the different landscape types. The common way to display a border is with a sharp boundary that not really corresponds to the real world. To soften the borders, an often-used method is fuzzy sets. Fuzzy sets are sets or classes without sharp boundaries. Fuzziness is considered by many authors (Arnot and Fisher, 2007; Hall and Arnberg, 2002) as a way to handle uncertainty, complexity and vagueness in the class membership of objects. In this perspective the typology resulted in our research needs one more adjustment step to soften the boundaries between the landscape types.

The hypothesis of our research started from the 'dispersed cities' theory with the intention to discover the occurrence of landscape hybridization. As these processes occur in small patches the method for quick scan of large regions had to be sensitive for the small-scale heterogeneities which occur on the 100m pixel level. At this stage of the research we stayed at the crisp classification, which is the product of the cluster analyses. Soft classifications which can be achieved with fuzzy sets were not yet applied in this stage of the research. Whether we will go on with 'fuzzification' in the sense of Hall and Arnberg (2002), will depend on the further applications of the method.

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5. Conclusions

A review of the extent of existing landscape characterization studies shows their scope to be largely limited to non-urban space. Heterogeneous metropolitan landscapes consisting of both urban and rural elements and hybrids of both fall outside existing methods for landscape characterisation.

The research started with the supposition that the existing landscape characterisation methods typically used in European practise are not sufficient to fully understand the landscape character of metropolitan areas. To answer this, we propose a new method for metropolitan landscape characterization which combines tools for rural and urban characterization in one framework.

The first application of the method for Metropolitan Landscape Characterization (MLC) for the study of Rotterdam metropolitan area resulted in thirty-six landscape types, twelve continuous and twenty-four hybrid. Several morphology and mapping analyses have confirmed presupposed fragmentation of traditional urban-rural patterns and diffuse spatial form. Statistical analyses gave additional insight in the extent of these transformations.

The morphology and mapping analyses have shown that the mixed green-red cells in the category of 10% to 80% indicate a large degree of heterogeneity and discontinuity of city and countryside in the study area, pointing to dissolution of periphery, peri-urban and hinterland definition. At the same time, the analysis shows that the study area still has a relatively high percentage of continuous green (non built-up) cells, partly due to the dominance of agriculture, but also demonstrating the legacy of the stringent planning culture in the Netherlands. In addition, as shown in the absolute percentage distribution maps, areas with no red also occupy a much greater area than those with no green. We can rather describe these phenomena in terms of gradation: a gradation of green begins in rural areas and dissolves gradually through the fringe and periphery towards the city centre. At the same time a gradation of 'red' starts from glasshouses and the urban centre of Rotterdam and other cities in this region and gradually dissolves in pure 'green' through peripheral housing districts, and city fringe. At the confluence, a series of hybrid landscapes emerge.

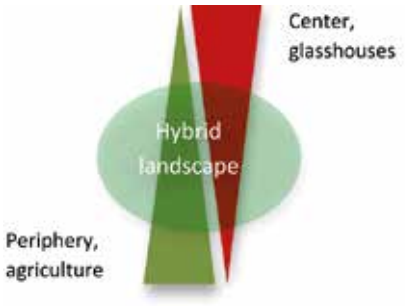

Figure 12
Flow of green in red and red in green

Cluster analysis revealed 24 discontinuous or 'hybrid' types which are new categories not occurring in existing characterization and classification methods described in paragraphs 2 and 3.1. Hybrid landscape types are present throughout the whole of the territory, in different configurations and concentrations covering 30% of the region in the form of larger or smaller patches and edges. Nevertheless, 70% of the area is still occupied by entities of continuous, mostly "green" landscape types. Looking at the results provided by combination of mapping and cluster analyses which we applied in step 3 of the MLC method we can conclude that the method fully satisfies in detection of heterogeneity and dispersal for the large scale regional characterization.

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The results of the study presented in this paper refer to the regional scale and detailed field studies of the preliminary discovered 36 landscape types still need to be done. It is important to recognize and understand the precise physical character of these landscapes, the way they are perceived and valued, and the way they can be used in planning and improvement of the general environmental and living conditions of metropolitan regions.

The characterization of non-urban landscapes is already established tradition in most European countries, but the results of this study indicate a shift of focus needed towards the characterization of hybrid landscapes types in metropolitan regions. The physical amount of space they take up in the metropolitan region of Rotterdam, and most probably in other metropolitan regions, requires more attention, as they can become an important arena of planning, policy and design praxis.

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Landscape assessment in metropolitan areas – developing a visual indicator-based approach

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Abstract

Many studies have addressed landscape preferences in rural settings, identifying key aspects and elements of the visual landscape important for people's appreciation. Information about these characteristics of landscapes has then been used as bases for indicator frameworks linking measurable indicators to landscape aesthetic theory. However, there is a need to expand and develop these frameworks to be relevant for assessment of metropolitan landscapes. Nine key concepts, identified by Tveit et al. (2006) and Ode et al (2008), in existing frameworks for visual landscape assessment (stewardship, naturalness, complexity, imageability, visual scale, historicity, coherence, disturbance and ephemera) are revisited in a metropolitan context, identifying landscape elements and indicators relevant for measuring visual landscape character in metropolitan areas. The study reviews existing evidence of people's landscape preferences relating to urban landscapes and links this knowledge to map-based indicators that can be used by planners and decision-makers responsible for the management and monitoring of landscapes. This paper presents the key concepts in development of a theoretical framework for visual landscape assessment in metropolitan areas.

Key words

Urban landscapes; landscape preferences; landscape assessment; landscape elements; green structure; perception

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1. Introduction

The concept of metropolitan landscape is used to describe the continuum of urban influenced space with a perceived dissolution of the boundaries between urban and rural areas (e.g. Tress and Tress, 2004). In order to appreciate open spaces Van den Brink et al. (2007) argues that "planning in a metropolitan setting should take the broader view, focusing primarily on manifestations and the perception of open spaces, the 'green functions', that fall under the sphere of influence of the metropolis, and looking specifically at the relationship between these functions and the built-up environment" (p. 157). We would therefore argue the need to develop typologies and indicators for the metropolitan landscape including the perception of open space and associated green functions.

Understanding how landscape change affects people's appreciation, health and well-being is high on the political agenda. Many studies have addressed landscape preferences, identifying key aspects and elements of the visual landscape important for people's appreciation. Information about these characteristics of landscapes has then been used as bases for indicator frameworks and tools for planning and policy which are being applied in monitoring and assessment of landscapes, as well as support in decision-making (e.g. Botequilha Leitao & Ahern, 2002; Botequilha Leitão, Miller, Ahern, & McGarigal, 2006). Through exploring the conceptual common ground between landscape aesthetics and other landscape qualities, indicator frameworks can provide a starting point for landscape assessment encompassing multiple landscape qualities (Fry, Tveit, Ode, & Velarde, 2009). However, such frameworks have been developed primarily in rural contexts (e.g. Ode, Tveit, & Fry, 2008), and as the majority of the population is living in urban areas, there is a need to expand and develop these frameworks to be relevant for assessment of metropolitan landscapes.

The VisuLands framework (Ode et al., 2008; Tveit, Ode, & Fry, 2006) was developed for assessment of landscape visual character. The framework is based on a literature review of landscape aesthetic theory and identifies nine key concepts describing visual landscapes; stewardship, naturalness, complexity, imageability, visual scale, historicity, coherence, disturbance and ephemera (See definitions in Table 2). The hierarchical framework links attributes of different landscape aspects, and currently used indicators of visual landscapes back to their theoretical basis, stressing the importance of a comprehensive and transparent approach to visual landscape assessment.

The VisuLands framework was developed in a rural or countryside context. The present study revisits the VisuLands framework, identifying landscape elements and indicators relevant for measuring visual landscape character in metropolitan areas. The study reviews existing evidence of people's landscape preferences relating to urban landscapes and links this knowledge to map-based indicators that can be used by planners and decision-makers responsible for the management and monitoring of landscapes. The study presents how visual character and quality can be assessed in a transparent and comprehensive manner in metropolitan landscapes.

2. Methods

We conducted a literature review, searching Web of Knowledge using key words such as 'landscape', 'urban', 'metropolitan', 'perception' and 'preferences'. We identified a wide range of articles. Based on their title, abstract and key words, a first selection of 149 papers was done. These papers were revised, through which the final selection of papers to be included in this review was made. This resulted in 42 papers being included in the final analysis. Many of the reviewed papers addressed recreation or other type of use of urban landscapes, and restorative potential of urban landscapes. The final selection included articles dealing with preferences for urban landscapes per se, identifying aspects, characteristics or elements of the urban landscape important for preference. Several of the 42 articles included in the final selection also addressed use or restoration in relation to preference. The papers were analysed assessing the landscape aspects and elements found to be of importance for landscape preference in the urban setting. The findings were classified according to nine visual concepts: stewardship, naturalness, complexity, imageability, visual scale, historicity, coherence, disturbance and ephemera, in order to assess which of these key concepts of landscape visual character that apply also in the urban context. In addition, we included safety as a separate aspect in the analysis, as this has been identified as an important factor for preference in the urban setting (Asakawa, Yoshida, & Yabe, 2004; Gobster & Westphal, 2004; Jorgensen & Anthopoulou, 2007; Jorgensen, Hitchmough, & Calvert, 2002).

The review includes different urban landscapes, with varying degrees of green cover, although focussing on the urban green structure. These include urban green structure, residential neighbourhoods, streetscapes, historical and modern townscapes as well as zones surrounding buildings such as corporate campus or hospital grounds. Urban green structure ranges from pocket parks and other small and large parks, gardens and greenery in residential areas to greenways including riverine vegetation and urban woodlands.

Author	Specific focus	Natural-ness	Ste-wardship	Cohe-rence	Distur-bance	Visual Scale	Com-plexity	Histori-city	Imagea-bility	Ephe-mera	Safety
Volker & Kistemann, 2013	River zone, water	•		•	•	•		•	•	•	•
Peckham et al., 2013	Urban forest, trees	•	•		•		•	•		•	•
Zhang et al., 2013	Parks	•		•		•	•	•	•		•
Cengiz et al., 2012	Urban green structure	•	•			•					•
Dallimer et al., 2012	Urban green structure	•				•	•			•	
Eroglu et al., 2012	Plants									•	
Heyman, 2012	Urban woodland	•			•						
Hofmann et al., 2012	Parks and urban derelict land	•	•			•		•			
Kil et al., 2012	Wildland-urban interface	•						•	•	•	
Nikunen & Korpela, 2012	Nightscapes, lighting	•			•						•
Han et al., 2011	Streetscapes	•						•		•	
Heyman et al., 2011	Urban forest					•					
White & Gatersleben, 2011	Green roofs and façades	•	•				•				
Zhang & Lin, 2011	Streetscapes	•		•	•	•	•		•		•
Zheng et al., 2011	Residential landscapes	•	•								
Caspersen & Olafsson, 2010	Urban green structure	•		•		•		•			
Foltete & Piombini, 2010	Pedestrian routes	•				•	•				
Qureshi et al., 2010	Parks	•	•			•			•		•
Van den Berg & Van Winsum-Westra, 2010	Allotment gardens	•	•								
Lee et al., 2009	Urban sidewalk landscapes	•				•					
Bulut & Yilmaz, 2008	Historic town landscape	•		•			•	•	•		
Bjerke et al., 2006	Urban park landscape					•					
Ellis et al., 2006	Residential neighborhoods	•									
Helfand et al., 2006	Residential yards	•									
Jim & Chen, 2006	Parks										
Sullivan & Lovell, 2006	Streetscapes	•									
Özgüner & Kendle 2006	Parks	•	•							•	
Galindo & Hidalgo 2005	Urban	•	•	•	•	•	•	•			
Asakawa et al., 2004	Stream corridors	•							•		•
Gobster & Westphal, 2004	River corridor greenway	•	•			•					•
Kaplan & Austin, 2004	Residential neighborhoods	•	•								
Todorova et al., 2004	Streetscapes	•							•	•	•
Vogt & Marans, 2004	Residential neighborhoods	•				•					
Van Herzele & Wiedemann, 2003	Urban green space	•				•		•			
Roovers et al., 2002	Urban woodland	•				•	•				
Herzog & Chernick, 2000	Urban and natural settings		•			•					
Schaumann & Salisbury, 1998	Stream corridors	•									
Palmer, 1997	Towns	•									
Gobster, 1995	Green ways	•	•								
Sullivan, 1994	Residential neighborhoods	•				•			•		
Kennedy & Zube, 1991	Urban desert vegetation	•									

Table 1

Overview of key concepts, authors and specific focus

Concept	Definition (from Tveit et al. 2006)	Dimensions in an urban context	Potential indicator
Naturalness	Closeness to a preconceived natural state	Wilderness Wild/Ecological Lush and abundant Native vegetation Undisturbed nature	Amount of water Amount of vegetation Amount of native vegetation Diversity of plant species Presence of wildlife Presence of dead wood
Stewardship	The presence of a sense of order and human care through active management which contributes to a perceived accordance to an 'ideal' situation.	Well-kept Cared for Maintenance Neatness Clean Manicured Formality Artificial	
Coherence	A reflection of the unity of a scene, where coherence may be enhanced through repeating patterns of colour and texture but also correspondence with natural conditions and surrounding.	Harmony Peace Coherence vegetation and natural landscape Harmony with surrounding built up areas Correspondence with their "style"?	
Disturbance	A lack of contextual fit and coherence, where elements (related to constructions and interventions) deviate from the context.	Negative human impact Noise	Presence/amount of features such as: golf course, construction work, wheel-tracks, forestry, litter, graffiti, electric poles, wires and transformers Noise level
Visual scale	The perceptual units that reflect the experience of landscape rooms, visibility and openness	Openness and vastness/Defined areas Being in an area – not feeling boundary Visibility Ground topography View Panoramic views and scenery	Vegetation density and structure Canopy closure Size of open space Amount of visual obstacles such as walls, shrub, hedges, fences and gates Amount of viewpoint
Complexity	The diversity and richness of landscape elements and features, their interspersion as well as the grain size of the landscape.	Diversity Variety	Variety of urban green areas Variation in topography Variation in forest species and structure Diversity of elements Perceived species richness (wildlife and plant) Perceived habitat richness Diversity in pattern, colour, style and textures
Historicity	Reflects the visual presence of time layers and the amount, condition and diversity of cultural elements.	Traditional Cultural history Heritage architecture	Presence of historical buildings Presence of old and archaic trees
Imageability	Imageability stands for the qualities of a landscape present in totality or through elements; landmarks and special features, both natural and cultural, making the landscape create a strong visual image in the observer, and making landscapes distinguishable and memorable.	Uniqueness/Scenery Orientation points Landmarks	Amount of land marks Amount of orientation points Amount of elements such as garden ornaments, public art, fountains, flower design
Ephemera	The presence of elements changing with season and weather.	Seasonal change Plant composition Wildlife Flowering and wiltering Wind	Amount of flowering plants/bushes
Safety		Security/Crowding Personal safety Safety connected to sense of care Visibility Traffic separation	Vegetation density Presence of lights Presence of water Amount of roads with different level of traffic

Table 2
Overview of key concepts and their definitions, dimensions and indicators

3. A framework for visual landscape assessment in the urban context

The results of the review are presented below and summarised in Table 1 and 2 using the framework presented in Tveit et al. (2006).

Naturalness

Most of the papers in the review identify naturalness as an important characteristic that urban green space contributes with in a metropolitan area and the concept is identified as a strong contributor to preference as well as health benefits (e.g. Ellis, Lee, & Kweon, 2006; Kaplan, Austin, & Kaplan, 2004; Palmer, 1997; Sullivan, 1994; Sullivan & Lovell, 2006; Van Herzele & Wiedemann, 2003; Vogt & Marans, 2004). It's a concept that is identified for a wide range of green spaces including urban sidewalks (Lee, Jang, Wang, & Namgung, 2009) and streetscapes (Todorova, Asakawa, & Aikoh, 2004). A main defining aspect is the presence of vegetation (e.g. Cengiz, Cengiz, & Bekci, 2012; Foltete & Piombini, 2010) which makes a contrast to the surrounding built up area (e.g. Barnhart 1998). Several researchers address to what degree urban green space could be described as wild or wilderness (e.g. Caspersen & Olafsson, 2010; Van den Berg & Van Winsum-Westra, 2010; Zheng, Zhang, & Chen, 2011). Others address naturalness in relation to park styles, e.g. naturalistic style in contrast to a more formal or manicured type of urban green space (e.g. Van den Berg & Van Winsum-Westra, 2010).

An important element of naturalness is natural vegetation (Han, Joo, Kim, & Oh, 2011; Helfand, Sik Park, Nassauer, & Kosek, 2006; Kil, Stein, Holland, & Anderson, 2012; Nikunen & Korpela, 2012; Peckham, Duinker, & Ordóñez, 2013), species richness (e.g. Dallimer et al., 2012; Hofmann, Westermann, Kowarik, & Van der Meer, 2012; Qureshi, Breuste, & Lindley, 2010), tree and shrub coverage (Ellis et al., 2006); structure and presence of understorey (Heyman, 2012; Roovers, Hermy, & Gulinck, 2002), water (e.g. Heyman, 2012; Nordh, Alalouch, & Hartig, 2011; Voelker & Kistemann, 2013), but also the lack of human activity (e.g. Schaumann & Salisbury, 1998).

Another important aspect of naturalness is the associated wildlife (Gobster & Westphal, 2004; Kil et al., 2012; Özgüner & Kendle, 2006; Qureshi et al., 2010) and the richness of different type of habitat (e.g. Dallimer et al., 2012).

Stewardship

The concept of stewardship implies that the landscape appears cared for (Hands & Brown, 2002; Herzog & Chernick, 2000; Özgüner & Kendle, 2006; Peckham et al., 2013) being well-kept (Cengiz et al., 2012; Zheng et al., 2011), maintained (Gobster, 1995; Hofmann et al., 2012; Shroeder, 1990), clean (e.g. Gobster & Westphal, 2004; Qureshi et al., 2010; Zheng et al., 2011); looking nice (R. Kaplan et al., 2004).

The appearance of stewardship has been found to relate to preference and particularly tranquility (e.g. Herzog & Chernick, 2000) as well as enhancing acceptance for ecological restoration (e.g. Hands & Brown, 2002).

The concept could also be seen as being associated with formal parks which includes flowerbeds and hedges (e.g. Hofmann et al., 2012; Qureshi et al., 2010), straight and manicured (e.g. Van den Berg & Van Winsum-Westra, 2010). A key term used in this context is artificial, as opposed to natural (e.g. Hofmann et al., 2012; Zheng et al., 2011).

Coherence

For urban green structure several different contexts are identified in relation to coherence. These include the surrounding built up environment (Voelker & Kistemann, 2013), the surrounding landscape (Caspersen & Olafsson, 2010; Hua Zhang, Chen, Sun, & Bao, 2013; Heng Zhang & Lin, 2011) but also the correspondence to the style of the green area (Özgüner & Kendle, 2006). Several authors stress the importance of harmony (e.g. Voelker & Kistemann, 2013; Heng Zhang & Lin, 2011).

Disturbance

Disturbance deals with what detracts from preference and is in this context not just visual but can also be noise (Voelker & Kistemann, 2013).

The concept of disturbance is often linked opposite to naturalness, where a high level of disturbance could be argued to decrease the sense of naturalness (e.g. Peckham et al., 2013). Human impact increases the impression of disturbance (Heyman, 2012; Heng Zhang & Lin, 2011). Here it is mostly design and addition of human elements that are not fitting in the landscape context, which could include buildings and roads (Voelker & Kistemann, 2013).

Visual scale

In the context of urban green structure visual scale is mostly focusing on openness and vastness as opposite to closedness (Heyman, 2012; Qureshi et al., 2010; Voelker & Kistemann, 2013; Vogt & Marans, 2004; Heng Zhang & Lin, 2011). Important for preference is the sense to be in a park or forest (Van Herzele & Wiedemann, 2003) but also to have spatially defined areas (Sullivan, 1994).

Another important aspect linked to openness is visibility, relating to what degree we could see through an area (Cengiz et al., 2012), which is often related to tree and shrub density (E. Heyman, Gunnarsson, Stenseke, Henningsson, & Tim, 2011; Hofmann et al., 2012) or tree cover (Dallimer et al., 2012; Hofmann et al., 2012). Limiting the visibility are also visual obstacles such as walls, hedge, fences, gates (Foltete & Piombini, 2010). Within the urban green structure several authors stress the importance of views and specifically panoramic and scenic views (Caspersen & Olafsson, 2010; Qureshi et al., 2010).

The concept of visual scale is closely linked to safety (Herzog & Chernick, 2000; Jorgensen et al., 2002) but also our ability to move and to recreational activity (Bjerke, Ostdahl, Thrane, & Strumse, 2006).

Complexity

Complexity deals with the diversity and variety of urban forests and green space (Özgüner & Kendle, 2006; Peckham et al., 2013), often with the implication that a diversity of types provides us with places for different types of activities.

Several papers highlight the importance of diversity of man-made elements (Foltete & Piombini, 2010; Heng Zhang & Lin, 2011) as well as plant species and habitat richness (e.g. Dallimer et al., 2012; Roovers et al., 2002; Hua Zhang et al., 2013) in relation to preference and use. But complexity is also discussed in relation to pattern, colour, style and texture (Hands & Brown, 2002; White & Gatersleben, 2011; Heng Zhang & Lin, 2011).

Historicity

Historicity is discussed as important for providing a sense of continuity as well as for sense of place and traditions (e.g. Bulut & Yilmaz, 2008; Caspersen & Olafsson, 2010; Han et al., 2011; Van Herzele & Wiedemann, 2003), where an opposing concept mentioned is artificiality (e.g. Hofmann et al., 2012).

Several of the papers highlight the importance of historical buildings and artifacts (e.g. Kil et al., 2012; Voelker & Kistemann, 2013) for providing an historical context for the area while old and archaic trees are seen as important for providing continuity (e.g. Peckham et al., 2013; Hua Zhang et al., 2013).

Imageability

The concept of imageability focuses on the uniqueness and the sense of place, with several authors identifying it as an important contributor to preference (e.g. Voelker & Kistemann, 2013; Hua Zhang et al., 2013). Contributing elements in the urban green space context includes different types of garden ornaments (Qureshi et al., 2010; Hua Zhang et al., 2013), historical elements (Kil et al., 2012), public art (Heng Zhang & Lin, 2011). Another aspect of this concept is provision of landmarks which helps both for orientation and making the place more memorable (e.g. Voelker & Kistemann, 2013).

Ephemera

Seasonal change is part of urban green structure and several papers highlight this as an important aspect (e.g. Eroglu, Muderrisoglu, & Kesim, 2012; Han et al., 2011; Todorova et al., 2004; Voelker & Kistemann, 2013). An important aspect of seasonal change is the associated wildlife (e.g. Dallimer et al., 2012; Kil et al., 2012).

Ephemera could also refer to other type of changes, such as those related to weather, were the effect of wind is specifically identified as important (e.g. Peckham et al., 2013; Voelker & Kistemann, 2013).

Safety

Several of the reviewed papers identify safety as an important factor for landscape preference in the urban setting (Asakawa et al., 2004; Cengiz et al., 2012; Green, 1999; Herzog & Kutzli, 2002; Jorgensen et al., 2002; Nikunen & Korpela, 2012; Peckham et al., 2013; Qureshi et al., 2010; Shroeder, 1990; Todorova et al., 2004; Voelker & Kistemann, 2013; Hua Zhang et al., 2013; Heng Zhang & Lin, 2011). Some papers report a relationship between density of vegetation and visibility and feeling of safety. If the vegetation becomes too dense, it can hinder visibility and overview of potential dangers, which can induce feelings of unsafety in parks and other urban green areas (Jorgensen et al., 2002; Shroeder, 1990; Hua Zhang et al., 2013). Also related to visibility, lighting is identified by other researchers as important for perceived safety (Herzog & Flynn-Smith, 2001; Nikunen & Korpela, 2012; Qureshi et al., 2010).

Other aspects of safety relate to the sense of care and maintenance. Sense of care and maintenance have a positive impact on perceived safety, while litter and waste, graffiti, lack of maintenance and lack of care can have a negative impact (Gobster & Westphal, 2004; Peckham et al., 2013; Shroeder, 1990). These connections between stewardship and safety seem to be particularly pronounced in the urban context. It also has to do with the presence and activities of other people, which has been found to affect preference (Green, 1999; Nordh et al., 2011; Voelker & Kistemann, 2013).

Another aspect of safety particularly relevant in the urban context is safety in terms of dangers connected with traffic. Preference for settings where pedestrians are physically separated from traffic through park design has been reported (e.g. Todorova et al., 2004)

Tveit, M., & Ode Sang, A. (2014). Landscape assessment in metropolitan areas – developing a visual indicator-based approach. SPOOL, 1(1). doi:10.7480/spool.2013.1.641

4. Discussion of landscape perception and preference in the metropolitan context

Our review regarding landscape preferences in the metropolitan context has revealed that the key concepts describing visual landscape character in the rural context, apply in the metropolitan context as well. However, despite many of the same terms used to describe rural landscapes also apply to metropolitan landscapes, in terms of people's perception, some of the concepts seem to be perceived and defined rather differently in the metropolitan context.

The clearest example is naturalness, which in a rural setting is often related to a perceived natural state, as wilderness, as unmanaged and undisturbed vegetation (R. Kaplan & Kaplan, 1989; Ode et al., 2008; Purcell & Lamb, 1998). The results from this review show that in the metropolitan context, all vegetation is perceived as naturalness, as the contrast to the urban grey is so distinct. As in the rural context, presence of several vegetation layers and vegetation density adds to perceived naturalness (Bjerke et al., 2006). Whereas in the rural context there can be an opposite relationship between perceived naturalness and perceived stewardship (Nassauer, 1995; Ode et al., 2008), this seems less pronounced and less relevant in the metropolitan context. Management of vegetation in the urban context seems not to be at the cost of perceived naturalness in the way expected from the rural context. Rather, our analyses suggest that in the metropolitan setting the concept of stewardship relates to sense of care and order through signs of maintenance and structure, and through absence of litter and graffiti.

In our review both naturalness and stewardship were found to be strongly connected to perceived safety. Naturalness in terms of dense understory and dense vegetation in general lowers the perceived safety, while all signs of management, both regarding vegetation and general maintenance of parks and other green spaces increase perceived safety (Bjerke et al., 2006; Jorgensen et al., 2002; Schroeder & Green, 1985). Another concept closely related to perceived safety is visual scale. Openness and visibility is a prerequisite to detect danger, and this seems to be a strong element of preference in the metropolitan context. Visual scale is also related to vegetation density and thus to naturalness and stewardship as described above. In the metropolitan context, the openness and visibility is often limited compared with the countryside. The need to get overview, however, seems more pronounced in the metropolitan context, which is also related to presence of other people in most urban settings.

Disturbance and coherence are seen as opposite characteristics in landscape perception (Bell, 1999; R. Kaplan & Kaplan, 1989; Ode et al., 2008). The results from this review suggest that this is the case in the metropolitan context as well as in the countryside. However, as perceived disturbance is very dependent on context, this is inevitably perceived differently in the metropolitan setting than in the rural setting. In an otherwise natural setting, any man-made object may be perceived as disturbing. As the metropolitan context is dominated by man-made objects, it takes more to be perceived as disturbance here. However, inside parks and other green spaces, it seems that coherence is an important quality, which is negatively affected by disturbing objects. Other people may also be perceived as disturbance, particularly in situations with crowding.

Our analyses show that historicity, imageability and ephemera are positively perceived characteristics also in the metropolitan context. Historicity in the metropolitan landscape is related both to the city itself, historical buildings and heritage architecture, historical sites and cultural heritage elements (e.g. Coeterier, 2002). The green structure itself can be a historical landscape, such as in the case of historical gardens and parks, or the green structure can hold presence of specific man-made or natural elements which provide continuity and historical links. Strongly linked to historicity is imageability. Imageability comes from the elements or characteristics of the landscape that provide uniqueness and make it particularly memorable. In the metropolitan setting, many such elements will be linked simultaneously to historicity, although modern architecture, art work and park structure can also enhance imageability.

Ephemera are changes with season or weather (Litton, 1972; Tveit et al., 2006). This review suggests that in the metropolitan setting, and in designed landscapes, ephemeral effects are often sought after through the use of vegetation and water elements. This adds constant change and complexity to the scenery through the seasons, which contributes positively to landscape perception. We found that imageability and ephemera were not always explicitly addressed in the included studies, although implicitly valued as effects.

The review has shown that in the metropolitan setting, as much as in the rural setting, complexity works on several levels. There is the overall city level and its diversity of different types of green areas. Then there are different degrees of complexity within the different parts of the urban green structure. For a specific park there could be different sub areas, and for the specific forest stand or plantation there could be different levels of complexity in structure and composition. Then there is complexity at the level of richness and diversity of different landscape elements, natural as well as man-made. The relationship between complexity and preference, however, is complex and depends both on content and context. Complexity can make a landscape more interesting and provide opportunities for exploration on the one hand, but on the other hand an overly complex landscape can be perceived as chaotic (R. Kaplan & Kaplan, 1989). Perceive complexity is also seen as strongly related to perceived coherence (Ode, Hagerhall, & Sang, 2010)

This review has shown that the literature regarding perception and preferences for metropolitan landscapes and their elements and characteristics are very much related to use. The concern that urban green structure must fulfil the requirements for different purposes of use is high from a policy and planning perspective. Green structure should provide low threshold areas for physical activity (e.g. Cohen, McKenzie, & Sehgal, 2007; Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Floyd, Spengler, Maddock, Gobster, & Suau, 2008), possibility for restoration and otherwise be attractive for recreation for urban dwellers (e.g. Hansmann, Hug, & Seeland, 2007; H. Nordh, Hartig, Hagerhall, & Fry, 2009b). It should also provide the city with other ecosystem services such as local climate control, habitat for urban living species and help absorb precipitation to avoid excess run-off (Bolund & Hunhammar, 1999; Marcotullio & Boyle, 2003). Information about which elements and characteristics are important for the different functions is a prerequisite for integrated landscape management in the urban context, and there is a need to develop integrated frameworks including integrated landscape indicators suitable to encompass several landscape functions.

5. Conclusion

We have found that some of the key concepts related to landscape perception have other connotations in the metropolitan context. This is particularly the case for naturalness, stewardship and disturbance. Landscape elements that may be perceived as disturbing or unnatural in a rural setting may 'blend in' in the metropolitan highly man-made context. Similarly, highly managed vegetation which would be linked to stewardship in the countryside, would contribute to perceived naturalness in the metropolitan setting. Several studies stress the importance of naturalness. However there is a lack of any operational terms for how to evaluate the degree of naturalness, both in relation to degree of contrast to the built up context as well as the naturalness within the green structure. This lack of operational terms specific to encompass metropolitan landscape perception needs to be addressed for all the different concepts of landscape perception described in this study. We would therefore recommend a cautious use of already available indicator frameworks in the metropolitan setting. There is further need for a more systematic research exploring the tentative indicators proposed in Table 2, focusing on how different elements and qualities relates to landscape perception and preference. Future development and application of indicator-based frameworks for landscape assessment in the metropolitan context also need to keep strong links to the theoretical basis of the understanding of how people perceive landscapes. With cautious development and application indicator-based approaches can be a valuable tool for assessment, planning and management of landscapes in metropolitan landscapes.

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Understanding the whole city as landscape. A multivariate approach to urban landscape morphology

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Abstract

The European Landscape Convention implies a requirement for signatory states to identify their urban landscapes which goes beyond the traditional focus on individual parks and green spaces and the links between them. Landscape ecological approaches can provide a useful model for identifying urban landscape types across a whole territory, but the variables relevant for urban landscapes are very different to those usually addressing rural areas. This paper presents an approach for classifying the urban landscape of Vienna that was developed in a research project funded by the Austrian Ministry for Transport, Innovation and Technology: 'Urban Fabric and Microclimate Response'. Nine landscape types and a number of sub-types were defined, using a multivariate statistical approach which takes into account both morphological and urban climate related variables. Although the variables were selected to objectively reflect the factors that could best represent the urban climatic characteristics of the urban landscape, the results also provided a widely plausible representation of the structure of the city's landscapes. Selected examples of the landscape types that were defined in this way were used both to simulate current microclimatic conditions and also to model the effects of possible climatic amelioration measures. Finally the paper looks forward to developing a more general-purpose urban landscape typology that allows investigating a much broader complex of urban landscape functions.

Key words

urban landscape; urban morphology; landscape classification; urban landscape typology; multivariate statistics

1. Introduction

An increasing hierarchy of levels of organisation can be identified within different fields of scientific endeavour. In the field of botany, one important jump in scale took place between the study of the flora – the occurrence and distribution of plant species within a particular geographic area, and the study of vegetation – which grew out of the realisation that particular species tend to occur in relatively constant groupings, and that these tend to map on to geomorphological patterns and the distribution of soil types (e.g. Braun-Blanquet, 1932).

A further critical step up the ladder of organisation levels in the landscape field took place with the systematic application of vegetation ecological methods at the landscape scale, in particular in the context of the definition of 'land classes' for Great Britain (e.g. Bunce et al, 1996). This approach has been applied to the whole area of Great Britain. However, because it was always intended primarily as a means of structuring ecological surveys, urban areas were excluded from the classification and left 'white', or at best were all lumped together as one homogenous urban class. Studies which have built on this tradition at the European level (e.g. Mücher et al, 2003) have similarly treated 'urban' as a single, undifferentiated landscape type. Other European level approaches to looking at land use within a consistent framework have not really addressed the issue of resolving the inner structure of urban areas. Instead the focus has been more on delineating the edges of towns and cities from both a structural and a functional point of view, e.g. with the definition of Urban Morphological Zones – UMZs (European Environment Agency, 2006) or Functional Urban Areas (Espon, 2007).

Within urban areas, the landscape tradition has, at best, taken a 'patchy' view of towns and cities. While rural areas are generally considered to be 'all landscape', albeit with embedded buildings and structures, the landscape focus on urban areas is generally directed primarily at parks, public gardens and other 'classic' open spaces such as squares. Although other mono-functional green spaces such as allotment sites, sports grounds, cemeteries or outdoor swimming baths are frequently also considered as part of the urban landscape, in all cases attention has tended to concentrate on a series of isolated 'green' spaces within the wider urban fabric.

This view of the landscapes of urban areas is frequently complemented by attempts to identify and create links and connections, both between these individual green spaces and between these and the surrounding rural landscape. Classic 'point' green spaces are thus joined by linear features such as green links, green wedges and green corridors. Together these 'points' and 'lines' helped to fill out the landscape view of urban areas, but the intervening matrix of the urban fabric, which accounts for the great majority of urban areas remained largely excluded from the 'urban landscape'.

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This article will first discuss the larger context that is provided by the European Landscape Convention (which celebrates in 2014 the tenth anniversary of its coming into force), and the 'Urban Fabric and Microclimate Response' project in which the results were produced. Next, it describes the methodology, based on the definition of urban landscape units, and the selection of attributes and variables with which the urban landscape types of Vienna are defined. The article outlines briefly the main spatial characteristics of the Austrian capital which serves as case-study. This is followed by the presentation of the urban landscape classification that was the outcome of the research: the urban structure of Vienna, and the overall pattern of urban landscape types. The landscape types form the basis for simulating the microclimate. The article closes off with discussion and conclusions.

2. Context

Urban implications of the European Landscape Convention

The European Landscape Convention, ELC (Council of Europe, 2000), defines the whole territory of the signatory states as landscape, and thereby explicitly includes urban areas. But the Convention does something else very important too: it calls upon signatory states to identify their landscapes, and explicitly includes urban and peri-urban landscapes, in addition to the 'natural' and 'rural' ones (ELC Article 2).

Taking the Convention seriously requires doing more than simply divide the territory into four classes to correspond to the above four landscape 'types'; and in the case of most signatory states detailed landscape classifications have been or are being prepared. These generally break down the rural and natural landscape into a series of landscape types, which are described in terms of their landscape character, but have little to say about urban or peri-urban landscapes (Swanwick, 2002). As a result there is clearly a need for an analogous approach to urban areas which identifies urban landscape types in a territorially comprehensive manner.

While landscape ecology inspired approaches, such as those pioneered by Bunce, can provide important inspiration and methodological models for addressing the urban landscape, it is clearly evident that the natural ecological structure of the landscape is significantly 'overwritten' by the patterns of built development during the urbanisation process, and its role in towns and cities must, as a result, be considerably diminished. If we accept this, then it is necessary to take a holistic approach and consider the urban landscape as a phenomenon which includes the buildings and structures that now 'obscure' the underlying landscape structure, as well as the open spaces.

In a possible response to these considerations, the idea of 'landscape urbanism' (Waldheim, 2006), with its implied promise to apply landscape ideas to the whole city, might appear to present itself as the answer for which the discipline has been waiting. But despite the enthusiasm with which this rather nebulous concept has been taken up by many architects and urban designers, there remain a lot of question marks as to what it actually represents and how helpful it actually is. Thompson's critical analysis of the claims of landscape urbanism provides an excellent overview of the issues involved (Thompson, 2012). Its shortcomings are particularly overt with regard to its potential for the treatment of existing towns and cities: its 'blindness to pre-existing structures, urban ecologies and morphological patterns' is even pointed out by one of the contributors to the seminal Landscape Urbanism text (Shane, 2006).

If, instead, one continues with the vegetation science analogy, urban landscapes might be considered as being analogous to what ecologists describe as azonal vegetation types (e.g. Breckle, 2002, p. 73). Here one specific eco-factor (such as water in the case of riverine ecosystems or altitude in the case of alpine ecosystems) over-rides the local environmental conditions to impose a consistent form of vegetation that ignores other environmental boundaries. In the case of urban landscapes it can be said to be the interaction of built fabric and open space structure that is critical for understanding the city as an urban landscape, and not the traditionally studied ecological factors. Such configurations tend to be consistent across most towns and cities, largely irrespective of their (bio)geographical location. Urban areas in general can therefore be seen as an azonal landscape type, but approaches to defining the finer sub-division of this broader type need to be developed, not least to fulfil the requirements of the European Landscape Convention 'to identify (urban) landscapes' at a resolution which is more meaningful from a planning perspective. Some interesting local examples already exist of attempts to map the urban structure or the urban biotopes of particular cities, but these tend to be based on narrower land use designations and not on broader landscape considerations (e.g. the Berlin Environmental Atlas). Other approaches aim to classify urban areas from an urban ecological point of view based on land use and land cover mosaics (e.g. Pauleit and Breuste, 2011).

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The Urban Fabric and Microclimate Response project

The idea that different urban landscape types will have different microclimatic characteristics, which will affect the way in which they react to climate change and affords different potentials for the amelioration of the effects of global warming, provided the impetus to develop an urban landscape typology for the city of Vienna as the first stage of a study into the impacts of global warming on urban microclimate.

The study 'Urban Fabric and Microclimate Response – Assessment and Design Improvement' is part of the Austrian Climate Research Programme (ACRP) and took place in the thematic area 'understanding the climate system and consequences of climate change'. The ACRP-programme was funded by the Klima- und Energiefonds, of the Austrian Ministry for Transport, Innovation and Technology. Stiles et al. (2014) published the outcomes of the project in an extensive final report consisting of eight chapters written in the German language, supplemented by a summary report that was published both in German and English.

Before developing the typology, it was necessary to operationalise the concept of urban landscape in a manner that was relevant for the purposes of the project. The purpose of developing a typological approach as a starting point, was to be able to identify the various landscape types within the city boundaries, in terms of the factors which were likely to have an impact on the urban climate, and to be subsequently able to make specific recommendations for climate adaption measures tailored to the specific urban landscape types in question. While the typology had to make sense both in the context of Vienna's urban structure and in relation to the factors which are likely to influence the urban climate, it was clearly also desirable to develop an approach which could also have a wider applicability to other aspects of the urban landscape and to urban areas in general. It offers the possibility of, for example, undertaking future comparative studies of the landscapes of different European cities.

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3. Method

Definition of urban landscape units

In order to be able to collect the relevant data to characterise and map urban landscapes, it was necessary first to decide on appropriate units and a scale for the study. Some studies have made use of land use maps as a basis for defining urban landscape units – the Berlin Environmental Atlas (Berlin, 2002) is a good example of this approach – but this was felt to be unsatisfactory, as landscapes are by their nature characterised by consistent mixes of different land use types and are not made up of mono-functional areas. The analogy of vegetation mapping is useful here: vegetation types can be seen as a level of organisation below that of landscapes, and these do not consist of species monocultures but of characteristic and repeated mixtures of groups of species. Much the same can be said for urban landscapes, which can be thought of as characteristic combinations of land use, built fabric and open space structure. Note: this is in stark contrast to most approaches to landscapes in rural areas, which tend to be primarily defined in terms of their 'natural' characteristics such as geology, soils, hydrology, vegetation etc. Sampling vegetation is typically undertaken using sample quadrats within which the percentage cover of the different species, together with relevant environmental data are recorded. These commonly range from one metre square for grassland vegetation to considerably larger plots for sampling forest areas. This approach has already been successfully scaled up and adapted to the landscape scale, most notably in the context of the definition of 'land classes' for Great Britain (e.g. Bunce et al, 1996). The land classes were defined by sampling land use and environmental information at a scale of 1 x 1 km across the British Isles, whereby urban areas were specifically excluded from the study, which was intended primarily as a means of structuring ecological surveys. While the UK land classification provides a valuable model for the overall approach of developing an urban landscape typology, the scale of the landscape units and the environmental and land use data used needed to be reviewed and adapted for the Vienna study.

For a number of reasons it was decided that a one quarter kilometre square quadrant (500 x 500 metres) would be the most appropriate scale at which to collect the information. To some extent the size of the landscape unit will always be a compromise between practicality and ideal optima. The size of the unit must make sense in the context of the study area as a whole and the granularity of the landscapes it contains, but it also needs to reflect the level of internal diversity to be expected. Furthermore, as landscapes are 'areas as perceived by people' the human scale and perspective was also a consideration. However, the importance of practicality cannot be underestimated, and a simple square grid could not be more straightforward and easier to work with. Seen from the scale of the city as a whole, an individual landscape unit of 500 metres by 500 metres, giving it an area of 25 hectares, allowed a sufficiently fine scale to be represented within the texture of the urban fabric of a city which has an overall area of 415 km², while at the same time giving a manageable overall number of landscape units within the city boundaries. Viewed from the perspective of an individual quarter kilometre square quadrant, the level of detail which could be resolved allowed individual streets, open spaces, land parcels and the buildings and open spaces within them to be easily identified and mapped. This was important, as the ultimate purpose of the study was to focus on making recommendations for ameliorating the impacts of climate change for the main urban landscape types identified, based on simulations of specific interventions in the open space structure, and these needed to be implemented at the level of the individual street or plot. Consequently, identifying the typical patterns of land use and open space which are characteristic of each urban landscape type was an important precondition for the second phase of the study. Finally, the idea of neighbourhood as expressed by 'easy walking distance' is also approximately embodied within a quadrant of 500 x 500 metres, which can be traversed on foot in about five minutes. This means that, whatever the diversity of its internal structure, it can be considered as an urban landscape unit that can be easily perceived by a person moving within it at the pedestrian scale.

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Selection of attributes and variables with which to define urban landscape types

It is important to bear in mind that the purpose of this study was to look at the relationship between urban fabric and microclimate, in order to be able to make recommendations regarding the possibilities for the mitigation of the impacts of climate change. The classification was therefore not intended primarily to be a general purpose one, but one which would generate an urban landscape typology that was influenced by factors affecting urban climate and microclimate. A wide range of variables reflecting six main groups of attributes was initially considered. These were:

- (Micro)Climatic factors
- Topography
- Land use
- Buildings and structures
- Roads and streets
- Open spaces

The availability of data in a suitable and sufficiently detailed digital form for the city as a whole was clearly also an essential practical precondition to be considered, as was the need to limit the possible variables to a practicable number. The above were simplified down to four groups of attributes, which were agreed on as the basis for generating the typology. Each was represented by a number of key variables. Data relating to the following variables were collected for each of 1458 quadrants which were located fully within the city's administrative boundaries :

- (Micro)Climatic factors
  - Severity of winters (average number of days with average minus temperatures)
  - Summer warmth (average number of days with average temperatures > 20°C)
  - Summer days (average number of days with max temp > 25°C)
  - Hot days (average number of days with max temp > 30°C)
  - Hot nights (average number of days where min temp did not fall below 20°C)
  - Annual precipitation (in mm)
- Topography
  - Absolute altitude (at centre of quadrant in metres)
  - Difference between the highest and lowest point in each quadrant (in metres)
  - Vertical position relative to neighbouring quadrants (in metres)
  - Average slope gradient (in degrees)
  - Average aspect of slope (in degrees)
- Open spaces
  - Proportion of impermeable surfaces (as a percentage)
  - Proportion of vegetation per quadrant according to height classes
  - < 0.5 m (grass and perennials)
  - 0.5 – 3.5 m (shrubs and small trees)
  - 3.5 – 15 m (e.g. street trees)
  - > 15 m (individual specimen trees)
  - Proportion of water surface per quadrant (as a percentage)
  - Vegetation shadow at 3 times of day on June 21st (as a percentage)
- Buildings and structures
  - Proportion of quadrant built up (as a percentage)
  - Median building height (in metres)
  - Roughness (building height difference in metres)
  - Length of external facades (in metres)
  - Length of internal facades (in metres)
  - Length of external facades where distance to street is > 5 metres (metres)
  - Main orientation of streets in relation the main prevailing winds (NE-SW and E-W)
  - Area shaded by buildings at 3 different times of day on 21.6. (mid-summer) and 21.12 (mid-winter) (as a percentage)

These data were computed for each of the quadrants which lay entirely within the city boundaries. Subsequently a factor analysis was carried out in order to ascertain which of these variables were potentially correlated with one another. This resulted in a simplification to nine significant factors: one for climate, two for topography, three for open spaces and three for buildings and structures (see Fig 1.).

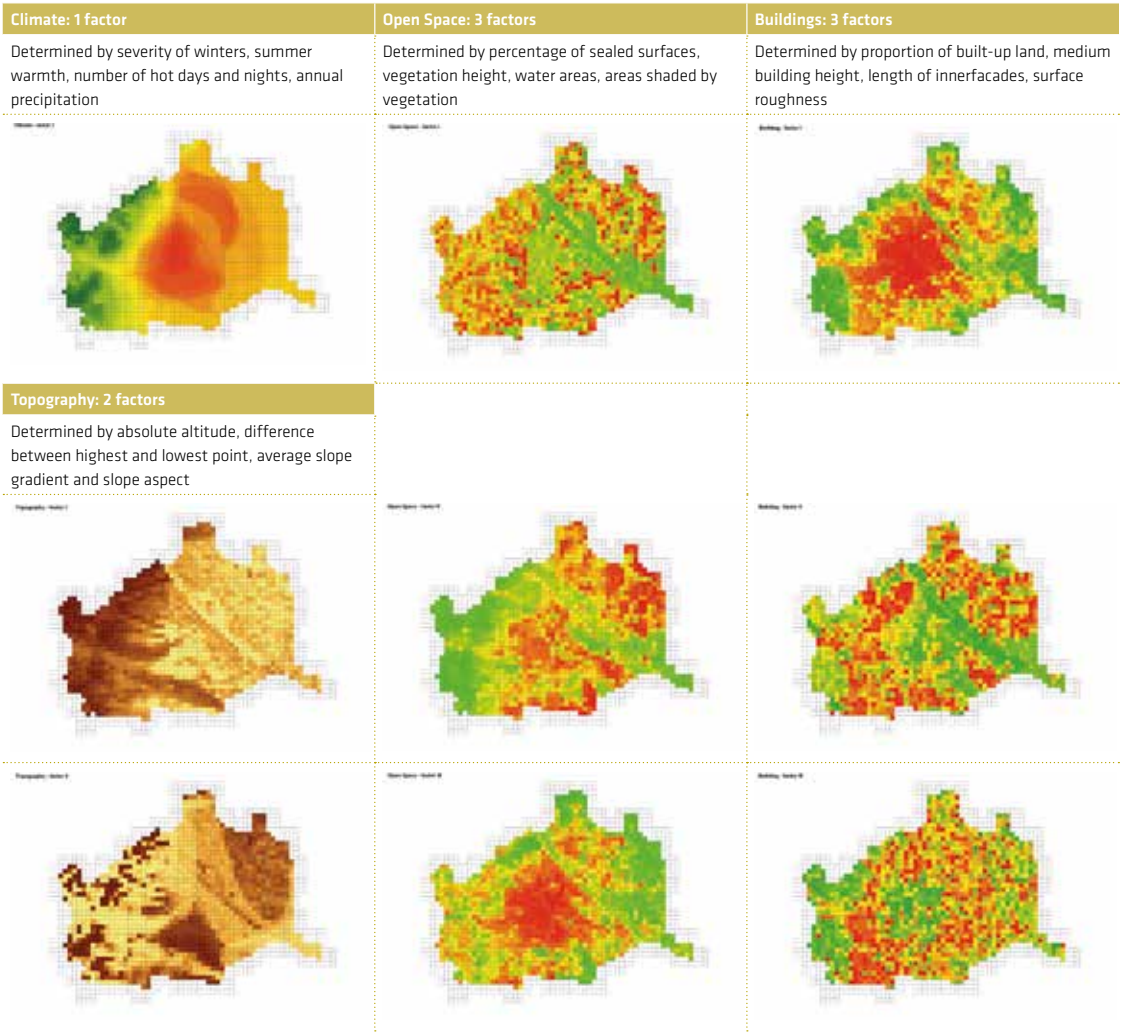

Figure 1
Results of factor analysis for the selected variables.

Finally an iterative two step cluster analysis was carried out, as a result of which the nine variables which had been identified by the factor analysis were grouped to place each of the quadrants considered into one of nine different clusters, each of which represented a different urban landscape type (urban fabric – to use the terminology of the project in question). Plotted on the map of Vienna they gave the picture seen in Figure 2. For someone who is familiar with the urban structure of Vienna, the result is immediately recognisable and convincing.

Stiles, R., Gasienica-Wawrytko, B., Hagen, K., Trimmel, H., Loibl, W., Tötzer, T., Köstl, M., Pauleit, S., Schirmann, A., & Feilmayr, W. (2014). Understanding the whole city as landscape. A multivariate approach to urban landscape morphology. SPOOL, 1(1).

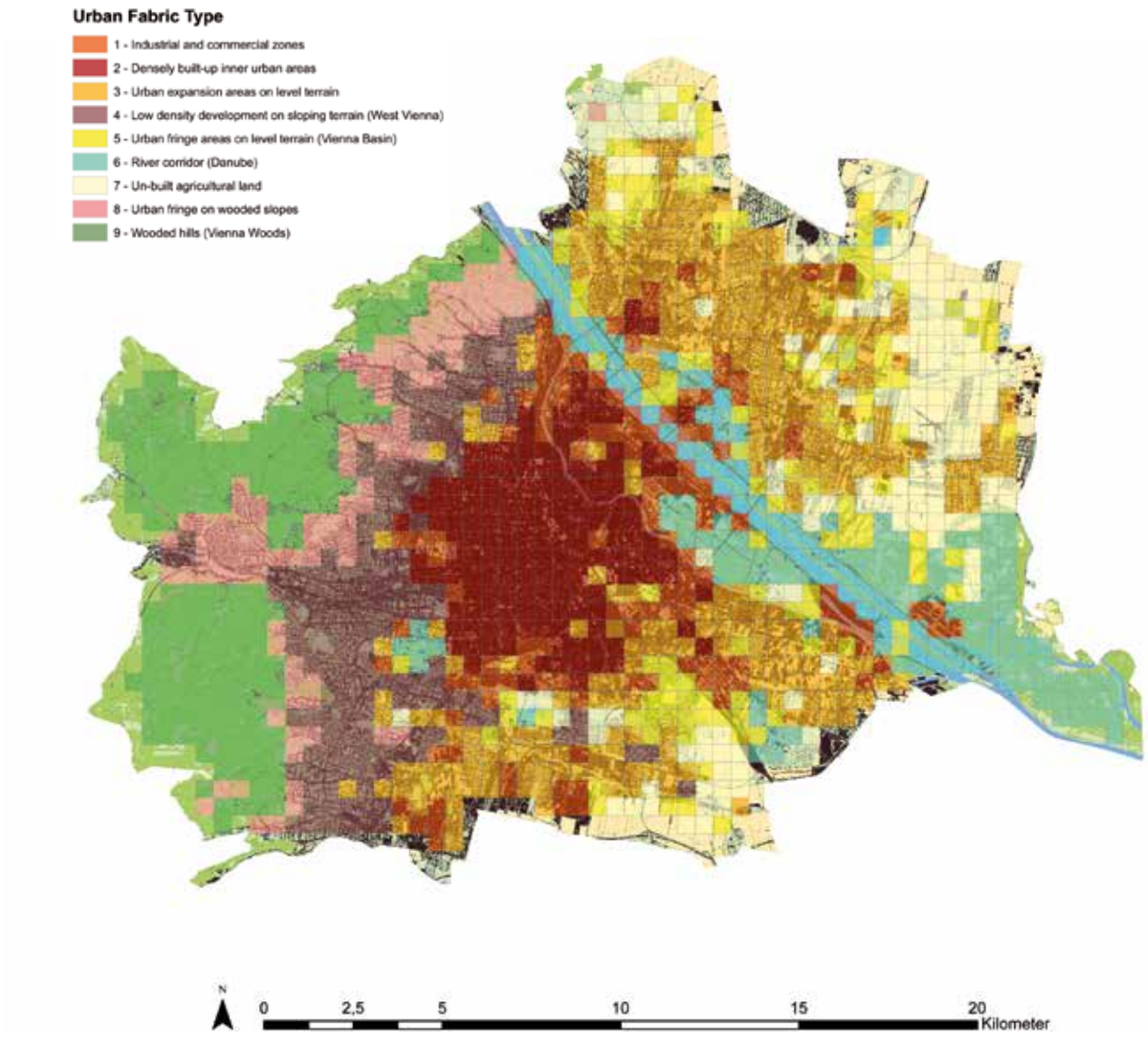

Figure 2

Distribution of the nine main urban landscape types identified for Vienna.

Stiles, R., Gasienica-Wawrytko, B., Hagen, K., Trimmel, H., Loibl, W., Tötzer, T., Köstl, M., Pauleit, S., Schirmann, A., & Feilmayr, W. (2014). Understanding the whole city as landscape. A multivariate approach to urban landscape morphology. SPOOL, 1(1).

The urban structure of Vienna

The selection of attributes and variables on which the classification of the 500 x 500 m quadrants was based was done solely on an objective basis. Variables were selected to represent the factors which were felt to be those which would best reflect and influence the microclimate of the urban area. If the approach was to be convincing for a wider lay public, however, it was also important that the resulting urban landscape classes and their geographic distribution looked subjectively 'right' and appeared to reflect the overall urban morphology of the city which was familiar to its residents and politicians.

According to Article 2 of the European Landscape Convention 'Landscape means an area as perceived by people […]' This can perhaps in part be interpreted as emphasising the importance of generating a landscape classification which is ideally broadly in tune with the overall perceptions of the general public. Vienna is a relatively compact city, which in fact has a very clear and easily recognisable 'image' in the sense of Kevin Lynch (Lynch, 1960).

The city's administrative boundaries roughly describe an ellipse broader in the east-west direction than in the north-south direction. This is cut through by the corridor of the Danube, which runs roughly from the centre of the northern boundary in a south-easterly direction, dissecting the city into two parts. To the north and east of the river lies about one third of the land area, which is broadly flat, while to the south and west of the Danube the remaining two thirds of the city include the historic core and the highland of the Vienna Woods which fringe the city along its western and north-western borders. Within this 'natural' landscape structure the development of the city has radiated out from a point close to the centroid of the city boundary, which lies to the southwest of the Danube. From there, on the southwest side of the river, the city has grown outwards in broadly concentric circles, with the oldest and densest development in the centre and increasingly low density and low rise building towards the edges. The north-east side of the Danube, which did not become part of the city until after 1918, has a different and much more patchy urban form comprising a series of former village centres interspersed with an infill of housing developments dating for the most part from the 1960s onwards. This area still has the greatest 'expansion' potential for the city and is also characterised by significant areas of remaining agricultural land, largely in the form of arable fields. Finally, the Danube corridor widens out towards the south-eastern edge of the city to form extensive riparian woodlands, which are part of the Danube National Park.

Stiles, R., Gasienica-Wawrytko, B., Hagen, K., Trimmel, H., Loibl, W., Tötzer, T., Köstl, M., Pauleit, S., Schirmann, A., & Feilmayr, W. (2014). Understanding the whole city as landscape. A multivariate approach to urban landscape morphology. SPOOL, 1(1).

4. Results

The overall pattern of the resulting urban landscape classification (urban fabric types)

Figure 2 illustrates the outcome of the cluster analysis of the nine variables. The fact that it resulted in nine landscape types is a coincidence, but – as noted above – the way in which these nine landscape (or urban fabric) types are distributed within the boundaries of the city does indeed appear to capture the structure of the city, as described above, in a familiar and recognisable pattern. The western fringe of the Vienna Woods is clearly to be seen in the form of urban fabric type 9, coloured in green (where urban development is essentially absent), while the other main natural feature, the Danube corridor (class 6), also cuts familiarly across the city from northwest to southeast, broadening out to form the National Park in the southeast. The concentric structure of the built form is also clearly visible, with the dense urban core (class 2), picked out in dark red, grading out through brown, while the rings of less dense development can be seen as a dark brown (class 4) and a pink (class 8) band. Between these two groups of urban landscapes one can recognise three other classes whose distribution is slightly more difficult to interpret: dark orange (class 1), scattered broadly around the main urban core, pale orange (class 3), more recently built up areas to the east of the Danube, and to the south of the urban core, yellow (class 5), individual areas on the edges of this newer development; and finally the beige quadrants (class 7) represent the remaining areas of broadly open agricultural land to the east and south of the city.

While this pattern provided a good reflection of the familiar urban structure, and the granularity of the 25 ha quadrants respects the distribution of the landscape (urban morphology) types in an acceptable manner, it was felt that there was perhaps scope for further refinement in the context of three of the classes identified. As a result a second cluster analysis using the same method, preceded by a factor analysis, was undertaken on the three classes in question. The inner urban core (class 2), accounting for some 10% of the overall area of the city, appeared to have a coverage of an area which in fact was felt to be more heterogeneous in terms of its built form and open space patterns, than the classification currently suggested. The relatively diffuse area (class 3), broadly representing the more recent post-war development across the Danube and to the south of the old urban core, accounted for some 19% of the city, and also appeared to be a candidate for further refinement, as did the overall smaller but also diverse Danube corridor class (11% of the city), which included both the river corridor itself as well as parts of the surrounding land.

The results of this further analysis are shown in Figure 3, and the nine new sub-classes generating clearly indicate that the further subdivision of these three urban fabric types also results in a better resolution of the structure of the urban landscape. Two of these classes: 2 (urban core) and 3 (post-war development), were also seen as representing the more critical areas of the city in terms of the potential impacts of climate change, both from the point of view of the density of their built structure and, partly as a consequence, the number of residents likely to be affected. The former class 2 was broken down into sub-classes 2a, 2b and 2c. Sub-class 2a corresponded to the dense perimeter block development of the late 19th century on sloping terrain, sub-class 2b identified less dense areas of development with more open space mainly to the north and south of the main urban core, while sub-class 2c was left as representing the historic old city centre with its mediaeval street pattern. Class 3 was further refined to distinguish the main areas of post-war new development to the east and the south of the old city (3a), as well as older former village centres within this (3b) and some scattered quadrants west of the Danube with single family homes on the slopes of the Vienna Woods (3c). The last class subjected to the secondary cluster analysis, the landscapes of the Danube corridor, was able to be sub-divided clearly into two main well-recognisable sub-classes and a third which was harder to characterise and which accounted for only 10% of the cluster. The two main sub-classes (each accounting for more than 40% of the area) comprised the riparian woodlands of the National Park (6a - the 'Lobau'), and the meadows to the west of the Danube (6c - the 'Prater').

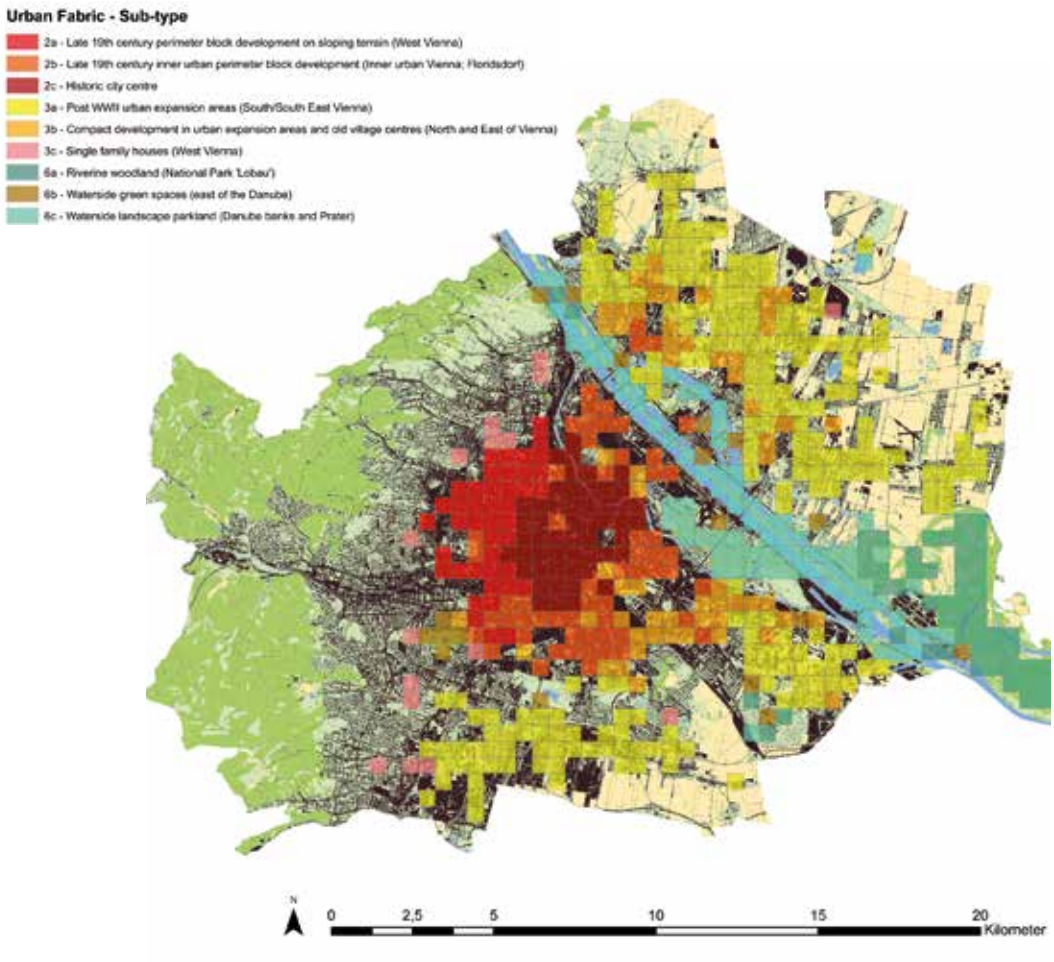

Figure 3
Further sub-division of urban landscape types 2, 3 and 6

Thus at the level of the city as a whole, the pattern of landscape types (urban fabric types) resulting from the classification was the outcome of a multivariate statistical procedure which aggregated the data felt to be objectively important to provide the best reflection of the factors likely to influence the urban climate. At the same time, however, the resulting pattern also presented a subjectively plausible representation of the widely perceived structure of Vienna's urban landscape. The next phase of the study was to look 'within' the individual urban fabric types and to characterise them in terms of their typical urban fabric and open space patterns.

Characterising the urban landscape types as a basis for simulating the microclimate

Generating an urban landscape typology is, of course, not an end in itself, but a means of better understanding various aspects of the way in which the urban landscape functions. As mentioned above, the purpose of generating the nine urban fabric types and the nine sub-types in the context of this project, 'Urban Fabric and Microclimate', was to provide a basis for considering both their existing and potential performance in microclimatic terms. This is being undertaken using the ENVI_met software package, developed by Michael Bruse and his team at the University of Mainz (Bruse, 2004). It is not proposed to go into this issue in detail here, except to demonstrate the way in which typical example quadrants of the main urban fabric (landscape) types have been identified and used to model their microclimatic characteristics.

The first step was to take the whole population of the urban landscape (fabric) types regarded as having both the most potential problems with regard to climate change and the most potential for its amelioration, and to identify 'typical' individual quadrants in each case. This was followed with a series of simulations of different aspects, both the current microclimatic conditions, including wind speed, potential air temperature, mean radiant temperature and relative humidity, as well as the perceived thermal comfort (predicted mean vote - PMV). These were modelled both for the status quo situation as well as for the evaluation of the potential impacts of a range of possible amelioration measures (see Figure 4).

Figure 4
Microclimate simulations for a sample quadrant from landscape sub-class 2b.

To identify a sample of 'typical' examples from each of the key urban fabric classes, a series of random samples were selected from each of the classes in question, the number of which depended on the overall proportion of each class within the urban landscape as a whole. These were then described in terms of their characteristic open space structure, with reference to GIS-information from a number of datasets that had not previously been available at the time the urban fabric (landscape) types had been generated. These datasets related to the actual land use, biotope monitoring data and the detailed topographic plan of the city. This information was coordinated with the corresponding aerial photographs, and a series of six examples of urban fabric (landscape) types were selected, which represented two of the main urban landscape types and four of the sub-types (see Figure 5).

Figure 5
Selected 'typical' quadrants representing two urban fabric types and four sub-types.

A total of 15 open space structures were identified across the six sample quadrants. These were found to occur in characteristic amounts and combinations in each of the urban fabric types represented by the selected sample quadrants. Having simulated a range of status quo microclimate conditions for the six typical examples of the urban landscape types identified, a series of specific micro-climatic amelioration measures were then proposed for each of the urban landscape types in question and their impacts were again simulated using ENVI_met. The measures concerned included different combinations of strategic tree planting in particular streets which had been identified as critical, the retrofitting of green roofs, as well as measures to reduce the areas of sealed surface within important areas, and to increase the vegetation cover in inner courtyards. An example of the approach taken is illustrated in Figure 6.

On the basis of the results of the simulations, specific packages of micro-climatic amelioration measures were proposed for the six urban landscape types investigated; each set of measures was prioritised and tailored to the specific conditions represented by the landscape types in question. As the urban landscape typology rather than the micro-climatic aspects of the study are the main focus of this paper, the proposed amelioration measures will not be elaborated upon in more detail here. Instead, it can be instructive to reflect critically on how effective the approach has been and to consider what future improvements may be valuable.

Urban fabric (landscape) type 2a - Quadrant 723		
Aerial photo	**Noteworthy existing issues**	**ENVI-MET Input file**
	• Hernalser Gürtel (central boulevard) cooler than the surroundings despite its extreme width • Higher relative humidity in areas of unsealed surfaces or vegetated courtyards • Inner courtyards of the perimeter block development with limited areas of sealed surfaces are effective as cooling areas • Closed courtyards with sealed surfaces heat up significantly (e.g. School courtyard to the east of the Gürtel) • Streets running East-West cause the greatest problems during the hottest part of the day	 

Figure 6
Input data for simulation of different climate change amelioration measures.

Stiles, R., Gasienica-Wawrytko, B., Hagen, K., Trimmel, H., Loibl, W., Tötzer, T., Köstl, M., Pauleit, S., Schirmann, A., & Feilmayr, W. (2014). Understanding the whole city as landscape. A multivariate approach to urban landscape morphology. SPOOL, 1(1).

5. Discussion and outlook: Structure and function of the urban landscape

There is an implicit assumption behind the work of all planners and designers: this is not that 'form follows function' in the words of Mies van der Rohe, but that 'structure enables and indeed promotes function'. The ultimate goal of all planners and designers is, of course, to optimise the long term functioning of the environment, but they only have indirect means to pursue this goal by adjusting the structure (design, configuration, spatial organisation etc.). This suggests that in constructing an approach to define urban landscape typologies that seek to meet multi-purpose objectives, it might be preferable to separate factors which are relevant from a structural point of view from those influencing the wide range of functions that the urban landscape can potentially carry out.

The basis for the generation of the urban landscape typology that has been presented here, took the form of a hybrid between more general aspects of structure (e.g. buildings and structures and topography) and specific aspects of function in relation to variables relating to urban microclimate (e.g. annual precipitation, severity of winters). Despite this, the resulting urban landscape typology is one which seems to closely reflect the perceived morphology of the city.

The close relationship between the urban landscape (fabric) typology generated and wider characteristics of the urban landscape which were not initially used to generate the typology was illustrated by the way in which the selected 'typical' quadrants, that were chosen to represent the six landscape types to be investigated further, could also be described in terms of other characteristic open space features, such as different types of streets, courtyards, squares and green spaces, as well as other open areas including railway corridors and agricultural land. By making use of additional data sets that provided information on both vegetation types and on the general topographical features of the city, it was possible to identify combinations of types of open space and vegetation patterns which were typical for the urban landscape (fabric) types in question, thereby suggesting that the urban landscape types can also have a predictive potential. This also opens up the future possibility of this and other relevant information being integrated into the process of generating the initial landscape typology, which in turn begs the question as to what form such 'relevant' information might take.

Given the relationship between landscape structure and function alluded to above, any approach which aims to further develop and improve upon the typology described here, would ideally focus on identifying urban morphological features, represented by combinations of indicators for built structure and open space patterns, which can act as proxies for a much broader range of possible urban landscape functions than just those of influencing the urban (micro)climate considered here. Three broad groups of urban landscape functions can be identified: social and societal, structural and symbolic and biological and ecological. Ameliorating the micro-climate belongs to the last group, but – depending on how one breaks them down – it can be regarded as only one of some 12 possible functions, ranging from stormwater management and facilitating social contact to establishing a sense of place sense of place (Stiles, 2010). It can be surmised that many of these at least, might be represented by urban morphological proxies as expressed by characteristics of built structure and open spaces. This will in turn define the need to both identify these wider functions and to operationalise them in terms of possible elements of the urban landscape structure which can help to enable and promote them.

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6. Conclusions

The authors place the outcomes of the 'Urban Fabric and Microclimate Response' project in the framework of the European Landscape convention. By doing so, they stress the need for a new approach for the development of typologies that describe cities as urban landscapes. The typology that was developed in the 'Urban Fabric and Microclimate Response' project should be read as such a new urban landscape typology. It considers a large number of indicators including aspects of climate as well as topography, built-up area and open space.

Data feeding these indicators was gathered for quadrants of 500 x 500 metres in the Austrian city of Vienna. A multivariate statistical procedure was used to treat the data. This resulted in a pattern of nine urban landscape types. The outcome provides the best reflection of the factors likely to influence the urban climate. At the same time the pattern presents a subjectively plausible representation of the widely perceived structure of Vienna's urban landscape.

A range of microclimate conditions was simulated for typical examples of the Vienna urban landscape types. Based on this a series of specific micro-climatic amelioration measures were then proposed for each of the urban landscape types in question and their impacts were again simulated using ENVI_met. On the basis of the results of the simulations, specific packages of micro-climatic amelioration measures were proposed for the six urban landscape types investigated; each set of measures was prioritised and tailored to the specific conditions represented by the landscape types in question.

One important finding was that the microclimate conditions showed a high level of variation between the different urban fabric types but also within individual quadrants across relatively small distances.

While the approach that was developed in the 'Urban Fabric and Microclimate Response' project has been successful and has both met the needs of providing the basis for microclimatic simulations as well as what may be seen as a proof of concept of generating an urban landscape typology, it also leaves open considerable potential for refining the approach to the generation of more 'general purpose' urban landscape typologies based on the morphological structure of the urban landscape.

Finally, if this potential is to be realised to the full extent, then it is important that the typologies identified are not just the result of 'local' patterns, but types which can be recognised within a larger context, and ideally with international validity.

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Powerful and large regional authorities are needed to preserve green open space for urban agglomerations

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Abstract

Identification and assessment of strategies for the conservation and multifunctional development of green open space in the urban fringe of European urban regions is a challenge to both the academic and the real life world. Within the EU funded research project PLUREL – Peri-urban land use relationships – 'Strategies and sustainability assessment tools for urban rural linkages', we developed a methodology for international comparison of regional strategies that considers the policy context at supra-regional level. This methodology helped to explain the reported impacts of strategies. For this we further elaborated the theoretical concept of policy arrangements and policy dimensions by Van Tatenhove et al. (2000) and Arts et al. (2006). Strategies and policy contexts referred to are from Montpellier Agglomeration, a formal coalition of now 31 municipalities, Leipzig-Halle region, a functional urban region (FUR) with governance coalitions around green open space preservation strategies, and Hangzhou in China, a very large city with hierarchical formal government. Results showed how the means of influence from different government levels can complement and reinforce each other and raise the effectiveness of the strategies. A combination of hierarchical government with a horizontal coalition between local authorities covering the full FUR can be very effective for managing the land use developments in the urban fringe, even when private business, CSOs or other NGOs are not included in the coalition. Supra-regional authorities do not have to possess the land resources, but setting the Rules of the Game is a powerful means of influence to coerce local municipalities to preserve green open space in the urban fringe.

Key words

governance, green open space, urban fringe, urban region, policy evaluation, policy regime, spatial concept, multifunctional development, international comparison

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1. Introduction

Urban growth has increased pressure on green open space globally and especially in the urban fringe. For the EU, it has been predicted that peri-urban areas will grow four times faster than the urban cores for the coming decades (Nilsson et al., 2013). Peri-urbanisation causes, among other things, the loss and degradation of valuable natural areas and farmland alike and it leads to an increase of traffic due to low density development patterns (SCATTER 2004). On the other hand, carefully planned and managed green areas in the urban fringe can link the city with the countryside to provide multiple benefits such as opportunities for recreation, supply of local food, clean air and fresh water, and spaces for management of stormwater and biological wastes from urban areas. Therefore, urban containment by adopting a compact city strategy needs to be broadened into regional perspectives to steer peri-urbanisation in a sustainable manner so that benefits can be reaped while negative impacts are minimised.

Main policy challenges in the urban fringe which are an impediment to the development of sustainable land use systems are in particular the lack of coordination between adjacent local authorities, interference between different national and EU-level sectoral and regional policies, and implementation deficits of sector-based strategies. (Nilsson et al, 2013).

While there is an increasing body of research on the causes of urban sprawl and peri-urbanisation (e.g. Champion, 1999; Caruso, 2001; SCATTER 2004; EEA 2006; Couch et al., 2007; Bruegman, 2008), little is known on suitable strategies for more sustainable development of land use systems in the peri-urban, and specifically the conservation and multifunctional development of green open space. To reduce this gap was one of the main aims of the research project PLUREL funded by the EU (Piorr et al., 2011; Nilsson et al., 2013). In the project, overall six European and one Chinese case study regions were chosen for comparative analysis.

In Europe, different policy, legal and spatial planning families can be identified (Newman & Thornley, 1996; CEC 1997; CULTPLAN 2007; Knieling and Othengrafen, 2009; Tosics, 2013). These contextual differences are considered as complications for comparing and drawing policy lessons between regions. In this paper, we compare the governance in three urban regions from France, Germany and China. These governance cases present the two ideal types of multi-governance according to Hooghe and Marks (2003): general purpose jurisdictions with non-intersecting borders and where each next sub-level is nested within the previous level (Hangzhou); governance addressed at particular tasks or problems, not comprehensive (Leipzig-Halle region); and a mix of these two ideal types (Montpellier Agglomeration) where hierarchical government is combined with horizontal coalitions between local authorities. Thus we discuss the different scales and levels to which Termeer et al. (2010) refer as complicating the study of governance: the institutional, jurisdictional and spatial scales.

2. Comparison between strategies under different policy regimes

As central concept we used the 'strategy', a designed course of action that an actor makes to achieve his goals, employing certain means of influence. The concept assumes a unity of decision making and actions, which can be a single actor, but also a group of actors organized in a regional authority, sharing objectives and means of action, governed by a decision making body. The selected strategies were developed by regional actors to preserve green open space in the urban fringe. Since green open space often forms the border area between different local authorities, the regional authorities were chosen as central unit of decision-making. The definition of a strategy fitted more comprehensive policies but also policies for

actions concerned with one specific theme, which made it apt for the comparison of the different types of governance.

To describe the means of influence employed in the regional strategies within the supra-regional policy context, we adopted the Policy Arrangements Approach (PAA). The PAA was initially developed to depict structural political changes. Van Tatenhove et al. (2000) and Arts et al. (2006) defined it as the temporary stabilization of the content and organisation of a policy domain. They described and analysed the design of the environmental policy domain with the aid of four dimensions: rules of the games; resources; actors and their coalitions; and discourse. The first three represent the organization of environmental policy, with organizations as social systems comprising sets of agents that are nested in structures of rules and resources (Giddens 1984). The second aspect of the policy arrangement concept, substance, operates through so-called 'policy discourse' (see also Dryzek, 1997; Hajer, 1997 in Van Tatenhove et al., 2000). These four different dimensions allowed us to describe both the policy context and the means of influence employed in the strategies. We assumed that the supra-regional policy context together with the means of influence used in the strategy, influences the land use decisions of actors at the subordinate levels. In line with the definitions of Van Tatenhove and Arts we theoretically consider the supra-regional context as temporary stable, against the background of which regional strategies perform, adding up their influence.

While the PAA provided a theoretical framework it still needed to be operationalized for comparative assessment of the strategies in the selected case studies. Inspired by Van Gossum's evaluation of governance capacity and his use of a 4-point Likert scale (Van Gossum et al., 2011) we explored ways to quantify – even though in relative terms – the influence that a strategy exerts as a result of the means it employs. From the study of the about 20 regional strategies the main constituents or elements were identified. We categorized these constituents under each of the policy dimensions. When all types of constituents were used by a regional strategy we attributed the maximum number of points to the strategy. If the strategy did forsake on a constituent we looked whether the supra-regional policy context did make up for it. Thus, the supra-regional policy context completed the picture into that of the full policy arrangement in support of the objective(s) of the strategies.

Figure 2 visualizes the scoring system for the regional strategies. With each extra constituent the length of the arrow for a specific policy dimension increases, i.e. each point that has been scored adds a next segment to the arrow. The figure shows how much a dimension adds up to the power or influence of the strategy over land use actors at the sub-ordinate levels. In the following we specify these constituents of each of the four main policy dimensions.

Rules of the game

These define the ways actors should behave, and consist in legislation, regulations, legitimate norms, how issues might be raised, policies formulated or decisions made. In general, actors constantly draw upon rules that provide them with guidelines to act properly and legitimately. These can also be informal rules, especially cultural norms for what is accepted or appropriate behaviour. To give further practical significance to this dimension we examined whether a strategy was embedded in legislation (1 point), in a binding land use - or zoning plan (1 point) and culturally embedded (see under 'Policy discourses' how this criterion was applied) (1 point).

Resources

The allocation of power over land (1 point) and the mobilization of financial resources (1 point) are central to explain how agents maintain and transform their environment. The type of landownership and the availability of land resources for expanding urban settlements co-determine land development. Knowledge is the third source of influence (1 point), providing actors with the insight how to best achieve their objectives. When the case studies reported that the knowledge resource was deliberately strengthened by the strategy, we considered this an extra source of influence of the strategy.

Policy coalitions

A policy arrangement can also be characterized by certain groups of actors who share resources or interpretation of a policy and policy goals and who mobilize to reach those goals. Some actors strategically form alliances with other influential partners in order to complement their own means of influence with those of the other. In agreement with the two ideal types of governance by Hooghe and Marks (2003) we distinguished three types of coalitions: of regional governments with higher or lower level governments (vertical governance, between nested levels, ideal type I) (1 point); between neighbouring governments (horizontal governance) (1 point); with the public, NGOs or private partners for thematic actions (multi-actor governance) (ideal type II) (1 point).

Policy discourses

A policy discourse refers to 'a specific ensemble of ideas, concepts, and categorisations that are produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities' (Hajer, 1995: 44 in Arts and Van Tatenhove, 2005, 6). This 'naming and framing' of issues forms the basis for the design of policies. The concept 'discourse' was earlier elaborated upon by Foucault (1971). He describes 'discourse' as a spirit of the age. When such dominant societal discourses provided tailwind to the policy discourse, we considered this as cultural embedding of the strategy under the dimension 'Rules of the game'.

In our study we used the concept of discourse only to briefly characterise the communication of arguments and objectives of a strategy as a way to obtain consent or support from the public or other parties (1 point). When in addition a spatial concept was used to visualize an issue we gave this dimension an extra point. Spatial visions can work as a means of influence, as already suggested by Auclair (2003, p. 63) and as indirectly acknowledged by Vervoort (2011) when warning against the influence of oversimplified visions of reality entailed in spatial representations.

Impact assessment

Table 1 shows the conceptual relation between a strategy and its effectiveness. The impacts of the different strategies were assessed by both practitioners and researchers in each case study region, based on a set of criteria (Aalbers and Van Dijk, 2008 PDF). Since they contain inherent uncertainties in time and space no final conclusions on the outcomes can be made. Instead, indicative findings based upon observations from the case study research will be presented which may then be related to the characteristics of each strategy.

Rules	Embedding of a strategy in legislation (L)	Laid down in binding land use -/local - or zoning plan (Z)	Cultural embedding (C)
Resources	Financial resources (F)	Land resources (L)	Special attention to raising the level of knowledge and expertise of the human resources (K)
Coalition	Vertically with governments at higher or lower level (V)	Horizontally with neighbouring governments (H)	With multiple types of actors, e.g. members of the public, private parties (MA)
Discourse	In words actively used by the actor to raise awareness and support for the strategy from other parties (W)	In visualized form, actively used by the actor to raise awareness and support for the strategy among other parties (V)	

Table 1
Constituent means of influence of the different dimensions that make the strategies powerful

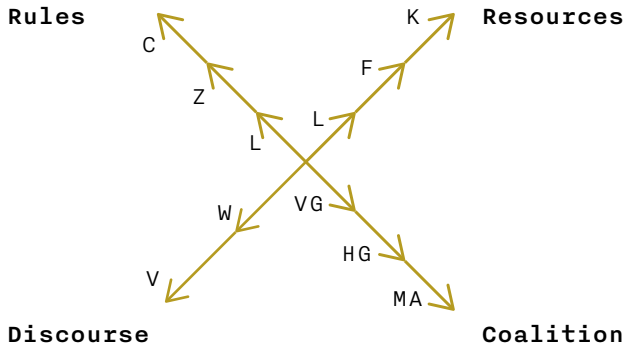

Figure 1
Visual representation, the arrows depicting the relative strength that the strategy obtains from each constituent policy dimension or type of means of influence. With each extra constituent the related arrow increases with an extra segment. Capitals refer to table 1.

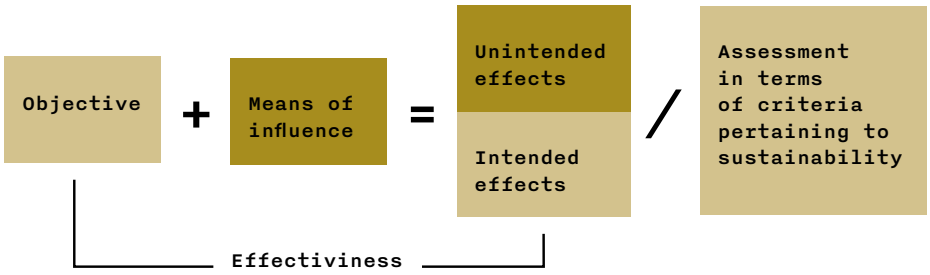

Figure 2
A strategy, effects, effectiveness and assessment

Material:

Six case study regions were chosen, reflecting different geographic settings, urban regional types and dynamics of growth and shrinkage. In addition, one Chinese case study was included to explore peri-urbanisation in a very different policy context.

Based on identification of the most pressing issues for conservation and sustainable development of open spaces in the peri-urban in workshops, five different types of strategies were examined in the case studies (Aalbers and Eckerberg, 2013). These were strategies for:

- Comprehensive land use planning at the regional level
- Strengthening agriculture in the urban fringe
- Protecting biodiversity areas at risk
- Reducing housing and business building pressure
- Integrating tourism and recreation in development.

The data were collected by desk study of policy documents from regional and higher level, of plans, maps and statistics. We did field visits, semi-structured interviews and panel discussions. The strategies were described by regional research teams and reviewed by actors from within the regions and state level. Researchers and practitioners also formulated the impact assessment criteria and assessed the strategies, distinguishing between processes and outcomes. For this paper we selected three case studies and overall four strategies.

3. The three regions and their regional strategies

The following analysis is based on Buyck et al. 2008 (PDF), 2009 (PDF (2010)), Bauer 2009, Sinn et al. 2008 (PDF), Jianjun et al. 2008 (PDF) and grounded in a joint analytical framework and a joint assessment framework (Aalbers and Van Dijk 2008a. b).

Montpellier Agglomeration, France and the Scheme for Territorial Cohesion

Figure 3
Montpellier is the capital of Languedoc-Roussillon in the south of France. Since the 1980s it developed from a quiet town, mainly based on the wine industry, into a strong economic centre based on high tech industries and services. Since then it experienced strong population growth. In 2005, the Montpellier urban region counted 450,000 inhabitants. This growth led to widespread urban sprawl and erosion of the regional landscapes. Concerned policy-makers adopted in 2006 the 'Scheme for territorial cohesion'. The photograph shows recent housing development alongside the lagoon. (Springer Verlag)

Policy-makers in Montpellier had become increasingly concerned with the urban sprawl and the erosion of the regional landscapes. In 2006 they adopted the 'Scheme for Territorial Cohesion'. This scheme changed the way spatial development was conceived. The scheme was accompanied with the delegation of significant parts of planning powers from the municipal level to that of the newly formed Association of Montpellier Agglomeration. Today this Association consists of 31 municipalities.

The Scheme for Territorial Cohesion and rating of this strategy and its policy environment (9/10)

National law obliged municipalities to associate with other municipalities, and consequently the Association of Montpellier Agglomeration was formed. It coordinates planning procedures related to economic development, spatial planning and transport through the Scheme. All local plans and decisions on municipal housing and urban mobility, site developments and housing standards need to comply with the Scheme. Important instruments of the Scheme are the setting of minimum housing densities for new urban extensions, a spatial framework for natural and agricultural areas where development is strongly restricted

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and setting of clear boundaries for urban development at the urban fringe. In addition, different types of land pre-emption rights strengthen public control over development. A score of 2 out of 3 was assigned to the Scheme for the policy dimension Rules of the Game as it is clearly embedded into legislation and it is a binding plan for the municipalities. No information was available on its cultural embedding.

Montpellier Agglomeration obtains resources for development and execution of the Scheme from local taxes on land, buildings and economic activities, and national and European funding. The Association also advises and provides competent staff to the municipalities in order to develop local plans. Means and skills are dedicated to communicate the Scheme and make it accepted and shared by the citizens of Montpellier Agglomeration. As the Scheme is well resourced in terms of finances, knowledge and human resources, and can control land resources through its cooperation with the Department, it scored 3 out of 3 for the policy dimension of resources.

The Scheme is developed by the Association of Montpellier Agglomeration, a horizontal coalition of now 31 municipalities. Also vertically the Association forms a coalition, i.e. with the Département where both national state officers (e.g. from the Ministry of Agriculture) and the local governments are represented in the Conseil Général to protect farmland in peri-urban areas and to promote environmental issues. An opposing policy coalition includes developers and landowners, with other state authorities supportive of economic development. Farmers, though key stakeholders in the peri-urban areas of Montpellier, are not organized nor involved in these coalitions despite being the biggest landowners. Neither are the NGOs and CSOs. The public is consulted through public enquiry and formally represented through the elected politicians in the Association's Council and through the Association's Economic and Social Council. Thus the implementation of the Scheme takes place only in coalition with governments at higher and lower level and with neighbouring governments. The Scheme scored 2 out of 3 for the dimension of coalitions.

In the Scheme, discourses of territorial cohesion and sustainable development are predominating. In particular, landscape quality is promoted as a vector for sustainable development, a new idea in French thinking on the subject. It served as an integrative concept allowing actors to converge on the idea of preservation, linking between the urban and peri-urban territory. Simultaneously, demographic growth is appreciated as source for economic growth. The 'shared city' – hinting at social relationships – and the 'thrifty city' – preserving resources, identity and heritage – are other concepts that complement these discourses. Use of collective transportation is considered as a lever of urban development. It is concluded, that the Scheme promoted and actively used discourses both in word and in the form of a spatial i.e. landscape vision in order to raise awareness and create support for the strategy among other parties. A value of 2 out of 2 was assigned to the Scheme for the dimension of discourses.

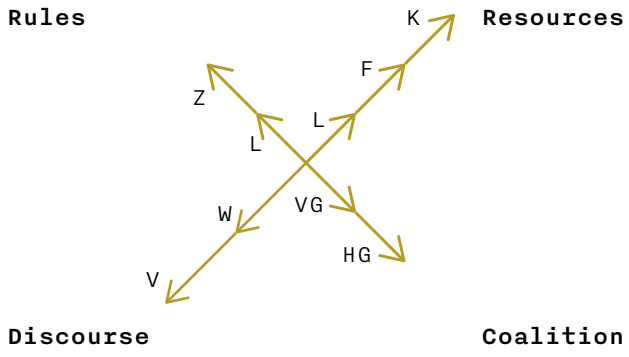

Figure 4
Policy dimensions of the Scheme of Territorial Cohesion

Impact of the Scheme for Territorial Cohesion in terms of management of green open space

Case study practitioners and researchers concluded that the Scheme performs very well. The shared learning process of developing and executing the Scheme has led to a considerable mind opening and joint vision among the local authorities and even among citizens. Local politicians both in speech and actions adhere to the Scheme and it stimulated the Agglomeration to spread development in a more sustainable manner. In combination with the landscape discourse the position of agriculture in the urban fringe is strengthened and increase of land prices is limited. The strategy restricts free riding behaviour of local authorities. However, it is problematic that the FUR (the urban core and its surrounding commuting rings) is not entirely contained in the scheme and that urban development leapfrogs over the jurisdictional boundaries of the Association.

3.1 Leipzig-Halle region, Germany and the strategies of The Green Corridors and Parthe Floodplain protection

Figure 5
(photo by D. Haase)

Figure 6
Leipzig-Halle is a polycentric region of approximately 1 million inhabitants and 4,390 km2. The City of Leipzig (2010: 511,000 inhabitants) is an urban centre challenged by shrinkage due to outmigration and decline in the urban fringe. Although the population has declined over the last decades, urban land has increased. Therefore, Leipzig's surroundings, which belong to the most productive agricultural areas in Germany, are under pressure. The photograph 2 shows the recent urbanization and photograph 3 shows the perforated city centre where a brownfield has been replaced with pocket park and playing ground. (photo by S. Pauleit)

The Green Corridors strategy and its rating (7/10)

The Green Corridors strategy aims to link urban and peri-urban open spaces for ecological and recreational functions. These areas should be kept free of development and disruptive land uses (RPA Western Saxony 2008). The corridors are included in the Regional Plan, which provides the framework for further plans at lower levels such as the municipal land use plans. The plan is adopted by the Regional Association, which consists of a coalition of mayors, district administrators and other authorities. Its elected planning board prepares the plans for the general assembly of the Association. We attributed 2 out of 3 points for the Rules of the game: for the embedding in legislation and in a binding land use plan. No data were available on cultural embedding.

The corridors restrict urban development. This may lead to conflicts with municipalities, as – without compensation – the Green Corridors can constrain local economic development. Regional development funding is only available indirectly through informal instruments such as the Green Ring around Leipzig-Halle where the development of walking and cycling paths and education is funded. The strategy obtained no points on the Resources dimension.

Plan making involves stakeholder participation of local authorities, organisations for inter-municipal cooperation and nature NGOs. Public involvement occurs at the occasion of the presentation of the draft plan twice, before it becomes statutory within the Regional Plan of Western Saxony. The strategy obtained 3 points for Coalitions.

The strategy builds on the discourse of the floodplain forests that are highly valued by the public. This contributes to branding of the Green Corridors and awareness raising. The Green Corridors concept is easily understandable and convincing. For its Discourses, both in words and in the form of a spatial vision the Green Corridors scored 2 points.

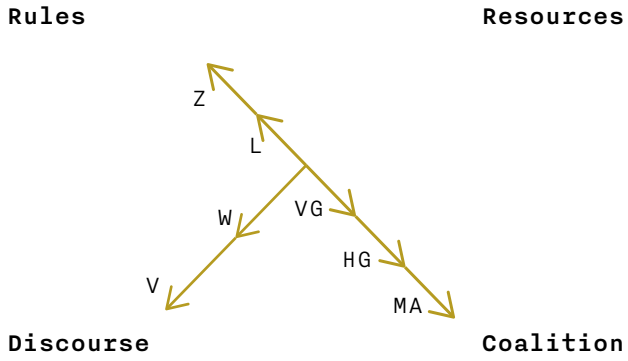

Figure 7
Policy dimensions of the Strategy of The Green Corridors according to the Regional Plan for Western Saxony.

Impact of the strategy of the Green Corridors

Investors seem to be capable of developing pressure against the Green Corridors. For example, building permits have been granted in the Northern Leipzig Green Corridor. Nevertheless the strategy contributes to preserving valuable landscape identity and natural habitats and agricultural land uses. However, the distribution of costs and benefits of the strategy is unbalanced between the core city and its neighbouring municipalities: while everyone profits from attractive surroundings, the development options of peri-urban communities are constrained. In particular in the context of population shrinkage, municipalities emphasise investments in urban development and compete for residents and business with other municipalities, thus menacing the preservation of the Green Corridors, a strategy that does not come with resources of its own.

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Strategy for Inter-municipal Cooperation Parthe Floodplain protection and rating (8/10)

This second strategy on green open space in the Leipzig-Halle region is developed by an inter-municipal coalition between the municipalities of Leipzig, Taucha and Borsdorf in the peri-urban area north and north-east of Leipzig that was formed in 1992 to preserve the Parthe Floodplain and its riparian forests. The agreements of the Parthe floodplain coalition are binding for these municipalities by contract. The strategy is implemented into their preparatory land use plans. For Rules of the game: the strategy scored only 1 point, which was for its embedding in a binding land use plan. On cultural embedding no data were available.

Measures taken by the Parthe floodplain coalition are funded by the municipalities and the State on a project basis. Financial resources are also obtained from the Green Ring budget of the city of Leipzig, thus linking the planning and implementation of these two important approaches to the development of green space networks in the region. Land is made available by pooling compensation areas. The coalition shares professional personnel in landscape planning. The strategy obtained 3 points for Resources. Landowners like farmers are involved in the coalition as well. By the involvement of these landowners the strategy indirectly arranges for influence on the land resources. Cooperation also occurs with the tourist association, local inns, NGOs in the field of nature conservation, and neighbouring municipalities. Coalitions: The strategy obtained 2 out of 3 points: 1 for horizontal and 1 for multi-actor governance.

'Parthe Floodplain protection' and 'Green in between' are the main discourses. These are combined with activities such as art exhibitions along the river to link parks and green spaces. For instance, there is a permanent exhibition on the floodplain's flora and fauna, guided excursions for schools, guided walks e.g. for bird watching, as well as recommendations for individual excursions. There is a clear spatial entity: the Parthe floodplain, which is synchronised with the Green Ring Strategy of Leipzig. The strategy's aims are tangible, like constructing cycling paths. Participating local authorities are constantly reminded of the importance of natural and landscape values for quality of life and as a soft location factor for investors. A value of 2 was attributed to Discourses, they are there in words and in the form of a spatial vision

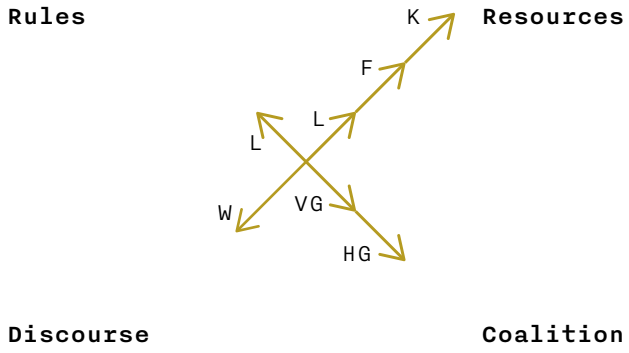

Figure 8
Policy dimensions of the Strategy for inter-municipal cooperation in Parthe Floodplain protection

Impact of Parthe floodplain cooperation

The recreational and nature conservation value of the area are enhanced by the projects implemented through the Parthe floodplain cooperation. However, there are no means of enforcement and decisions are based on consensus. Generally, commercial development in the floodplains is not prevented and the Parthe floodplain cooperation restricts itself to measures concerned with landscape while overall land use decisions are left at the discretion of the individual local authorities. Despite this limitation, the strategy is considered successful by local interviewees for the time being, while its sustainability in the long term is not secured and depends on the effectiveness of the strategy in the eyes of the participants. Agreements on division of costs between the local authorities are important for its legitimacy.

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3.2 Region of Hangzou City, China and Xixi wetland strategy

Figure 9

Hangzhou region is one of China's three economic powerhouses. The densely populated region of 16,596 km2 is undergoing extremely rapid and large-scale urban development. Between 2001-2005 the population grew with an average 5 % per year in the city proper of Hangzhou. Its current population of 4.4 million inhabitants is expected to peak in 2030 when it will have reached 6.7 million inhabitants. Growth concentrates in the urban cores and the surrounding peri-urban areas. The photograph shows the recent urbanization and Xixi on the foreground. (photo by S. Pauleit)

Hangzhou is the political, economic and cultural centre of Zhejiang province, and the second largest city after Shanghai in this region. Urban planning in Hangzhou City is still considered mainly from an economic perspective whereby its main task is to provide the corresponding spatial allocation for independently developed economic plans (Spiekermann et al., 2013).

Local governments are under pressure to sell land, especially in peri-urban areas, as a major revenue that stays locally to make investments into infrastructure (Ding and Song, 2009). Inefficient use of land and land speculation further fuel urban land expansion leading to the loss of most valuable farmland and nature areas. One of the strategies employed by the City of Hangzhou in this context of extreme population growth is to protect and restore green open spaces in Xixi, a wetland area in the West Lake district of Hangzhou city. Historically, the area was renowned for its scenery and natural wetlands. However, most of the wetlands were destroyed due to strong and uncoordinated urbanisation processes in the 1990s. In an attempt to reverse the process, China's first national wetland park was established in 2005 with a total surface area of 10 km2.

Rating of Xixi wetland strategy and its wider policy environment

The Hangzhou region represents the ideal type I governance in terms of Hooghe and Marks' (2003) classification of governance, where the lower level government institutions are nested within those of higher level. The lower-level governments should obey higher ones. In practice, higher-level governments always impact and intervene in local businesses. The strategy of Hangzhou city for Xixi area combines landscape and ecosystem restoration, tourism and recreation with development of up-market housing areas. West Lake district administration, hierarchically a level right below Hangzhou municipality administration, applies to Xixi area. Detailed regulatory planning was conducted by Hangzhou municipality. The New Town of Jiangcun in Xixi is developed according to a comprehensive town development plan including the development of supporting infrastructures (Spiekermann et al., 2013). For Rules of the Game

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we attributed 2 points for respectively embedding in legislation and in a binding land use plan. On cultural embedding no data were available. As was the case in Xixi, the state can requisition collective-owned land for public purposes and compensate farmers in China. Land is then leased to private investors and land use rights can be sold on the land market.

In total, 2,500 rural households involving 13,000 farmers were removed from the protected area and resettled into new residential areas nearby (Spiekermann et al., 2013). The expropriated farmers were reimbursed with new homes and compensation ground but they cannot continue to be farmers. Compensation rates were reported to be high in Hangzhou by Chinese standards, since land prices are also high. However, the rates were far below the value of the land when sold for commercial development (Spiekermann et al., 2013) 2 out of 3 points are given for Resources. On knowledge and expertise no data were available. There is a strong competition between the city and adjacent towns, as well as between districts and villages at the next lower levels of the planning hierarchy to attract investments. They compete rather than forming alliances. Coalitions with other then governmental actors involved in the Xixi-Wetland strategy could not be observed. The Municipality and Real Estate Developers cooperate and there is cooperation with tourist business, universities, research institutes and invited experts. But these are not forms of coalitions in the political sense to acquire influence over developments. A value of only one point out of 3 was given for Coalitions, for vertical governance.

In Hangzhou region the challenge is to reconcile three competing discourses on 'land-use efficiency', 'social harmony' and the 'ecological city' expressed in the planning documents. However, these themes in terms of substantive orientation are not used as political discourses to invite partners to support the discourse and add up to the political influence of a coalition. At the level of Xixi-wetland strategy: the strategy has adopted a win-win principle of commercial development during the protection process as well as environment protection during the development process. It uses the identity of the historical landscape in vicinity of residential areas to improve the image of the area and its attractiveness to potential up-market residents. Various events are used to reinforce the park's image as a scenic area and to educate the public about wetland protection. The strategy is also meant to ease tourist pressure in other parts of Hangzhou, namely the famous West Lake area. The political meaning of a discourse does however not apply to the Chinese cases. The government does not engage in governance approaches with discourses to create coalitions for joint strategies. The government alone decides. (Discourses: Score 0/2).

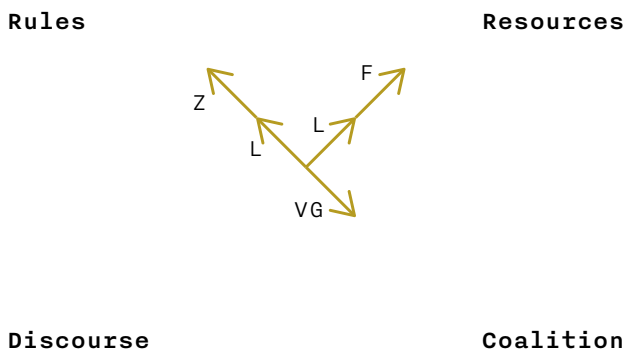

Figure 10
Policy dimensions of the Xixi-Wetland strategy.

Impact of Xixi-Wetland strategy

In the past the important wetland ecosystem was reduced from 60 km2 to small and degraded remnants. This process came to a halt and has been partly reversed. Xixi area now represents the highest quality of life

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area in China attractive to up-market residents, bringing development opportunities and benefits to local people. The branding of recreation and tourism has created opportunities for private business and positioned New Jiangcun Town as tourism service base and as service base for Zhejiang University. The urbanization of farmland has not only led to a loss of eco-environment quality but also to social losses. Farmers, though reimbursed for the expropriation of their land, have no competitive skills at the labour market. They are only to a limited extent employed in garden development and management. They are the vulnerable group in this process.

4. Explaining performances of the strategies

The main aim of this study was to compare the performance of strategies for preservation and sustainable development of green open spaces in peri-urban areas between countries under different policy regimes. The concept of policy arrangements was adopted for this purpose and further operationalized by developing a simple scoring system.

The approach allowed to identify differences between the three regions and the four strategies analysed. The highest overall score was achieved by the Scheme of the Montpellier Agglomeration (8 out of a total of 10 points). Only for multi-actor governance and cultural embedding the strategy did not score. Simultaneously the Scheme was considered very successful by the case study researchers (Jarrige et al., 2013). The complementarity between regional and supra-regional governments in terms of means of influence over local municipalities, which are all in support of the objectives of the Scheme, can explain the success of the strategy in steering urban development towards preferred locations. The Association of the Agglomeration has become the most powerful government body, even more powerful than Montpellier city. It is a sign of this strength that the Association now consists of directly elected politicians. Involvement of the public and business was limited to public enquiry and representation in the Social and Economic Council, on the other hand. However, this did not seem to hamper the success of the Scheme.

Compared to the Parthe Floodplain coalition and the Green Corridor strategy, the stronger impact of the Scheme can be explained by its strong vertical governmental adding up of legal, land and financial policy dimensions aimed at preserving green open space. Both the Scheme of Montpellier and the strategies in the Leipzig-Halle region promote the landscape discourse, putting green open space central as a resource for both urban and rural development.

The reference by the regional planning association for the Green Corridors to the discourse of the Strategy for the Floodplains of Parthe river helps to gain support for the Green Corridors from the public. The case study researchers named this ‘synergy’, which we can interpret as complementarity between strategies in a same region, or making use of the means of influence of another strategy.

The absence of farmers in the Parthe Floodplain coalition may, like in the Montpellier Agglomeration case, be an explanatory factor for the negative developments for the farming sector in the region. We expect that a wider coalition, involving other types of actors than the governmental ones only, can contribute to better care of the interests of these actor groups.

The Green Corridors strategy obtained a score of 7 out of 10, being weak on financial and land resources. On knowledge and human resources no data were available. Funds can be obtained indirectly via regional development funding, but this financial support of Green Corridors is not sufficient to release the pressure from industrial/commercial investors, in particular under the conditions of a shrinking population. On the other hand, the Scheme comes with the financial resources and this might explain a great deal of the difference in success between the two.

The Parthe floodplain cooperation strategy is also not equipped with lasting financial resources and competences, for land use planning are still in the hand of the individual municipalities. However, the strategy creates synergies in terms of sharing qualified personnel and providing services in the field of landscape conservation and management, project management and application for funding, involving non-governmental organizations and business. The floodplains are valued by the general public, which can be explained by the constant reminding of its nature values, the discourse that accompanies the strategy. However, resilience of the strategy and protection of the Parthe Floodplain are not ensured due to the absence of embedding of the strategy in legislation. The consensus base and contractual agreements do not seem sufficient. Moreover, the Parthe floodplain did not form a coalition with higher-level government and lacks integration. In comparison, the Scheme of Montpellier Agglomeration is embedded in a multilevel hierarchical government, which seems to make it more influential and to coerce spatial integration between sectors

European partners in the PLUREL project were amazed by the radical approach taken for wetland restoration in Xixi enabled by the top-down planning of Hangzhou government. The displacement of the urban core of Hangzhou city to the other side of the river is another striking example of the power of Hangzhou government (Spiekermann et al., 2013). These outcomes are impressive. The protection and restoration of the wetland area will provide long-term benefits to the strongly growing city region. The successful (ab) use of the rules deprived farmers from their traditional livelihood, but provided Hangzhou City with the necessary land to promote polycentric development. Financial resources were invested, paying relatively high compensation rates to farmers, to reduce negative consequences for them. Yet, European partners wondered whether another model for development should have been adopted to integrate part of the farmers in the wetland park with ecological farming, instead of creating a museum like landscape. Certainly, the win-win discourse contributed to the integration of environmental and economic development standards but it was not politically used to increase influence by allying with other groups.

For Hangzhou, the circular economy provides for financial sources whereas Parthe Floodplain is weak in this respect. It might contribute to resilience of the Xixi strategy, compared to uncertainty of success of the Parthe Floodplain strategy for the long term.

Aalbers, C., & Pauleit, S. (2013). Powerful and large regional authorities are needed to preserve green open space for urban agglomerations. SPOOL, 1(1). doi:10.7480/spool.2013.1.629

5. Conclusions

European research on governance of environmental problems faces a scientific challenge when practitioners from different member states of the EU ask for comparison between case studies from different regions. Various attempts have been made to distinguish between planning families, landscapes and/or cultures for this purpose. Yet, also approaches are required for analysis of strategies that are employed in the various political and cultural contexts. We propose that the adoption and further elaboration of the policy arrangements approach (Van Tatenhove et al., 2000, Arts et al., 2006) can contribute to social learning in the field of land use policies for preserving green open spaces in the peri-urban. We used the concept to both describe the wider policy environment and the regional strategies and explain their influence at the level of municipalities.

The approach used in this research allows identifying the actors, rules, resources and discourses to influence land use decisions at different levels (e.g. regions, state). This all makes the concept suitable for comparative research of strategies for spatial planning between countries with different policy regimes where these means of influence are often differently spread between government levels.

The distinction of different constituents per dimension and their rating allowed to express differences in strengths of each policy dimension between the strategies. Of course, the scores had mainly illustrative meaning. However, they facilitated comparison between and understanding of the different and often complex approaches to governance adopted in the case studies. In particular, they allowed to explain the performance of regional strategies and how this was influenced by the horizontal or vertical adding up of policy dimensions.

The PLUREL case study research was designed to find out which modes of governance and communication between the relevant parties across different levels of decision-making are effective to develop sustainable land use systems in the peri-urban. The Montpellier case showed that the horizontal and vertical coalition/ cooperation between governments and adoption of a Scheme for Territorial Cohesion, following a tight web of rules and regulations has effectively limited sprawl and steered urban development, even though coalitions between governments and CSOs, NGOs or business were absent. These groups are just informed by competent communication officers. Also in the Leipzig case the Green Corridors were in fact imposed by the Saxon state. Again this linkage between government levels, where the higher level or wider policy environment is very meaningful in steering land use developments at the regional and sub-ordinate level.

The results stress the importance of a governmental way of planning in which the Rules of the Game are finely tuned towards control of land use developments and with coalitions between governments that tap the jurisdictional powers of the different governmental levels. They do not have to possess the land resources. National law and policies should coerce such coalitions at the level of the FUR and enable these coalitions to acquire the necessary financial resources. Moreover, we recommend a comprehensive plan at the level of the FUR for managing the land use development of the urban fringe and its green areas as binding guidance to lower level zoning plans. It can coerce integration between sectors as seen in the Montpellier case in relation to green open space: it enables spatial and substantive linkages between housing, infrastructure, sources of economic growth and creates win-win situations in relation to green open space. Importantly, awareness among the public is raised.

In terms of substance of the strategies and wider context different discourses were developed and purposely combined to gain influence, inform the public or raise awareness. In particular in the Montpellier case the discourse on landscape as a central vector for sustainable development proved to provide common ground for parties with otherwise conflicting interests. While discourses thus need to be considered as an important dimension of strategies for protecting and developing multifunctional landscapes in peri-urban regions, the case studies also show that resources and means of enforcement are required, to effectively protect green areas.

Based on the above studies we are tempted to say that the misfit between environmental problems and governance scale concerning urban growth and the preservation of ecosystems is rather a result of inadequate policy in real life – such as the Agglomeration of Montpellier not covering the FUR – and not a result of failing knowledge. With the increase of daily commuting distances, the FUR increases and with it the size of the area for which regional cooperation between local municipalities is needed. Therefore, new municipalities should join the regional authority. This demands a flexibility that cannot easily be achieved, considering the vested interests of established authorities.

We showed how the concept of policy dimensions can be further related to actions that are well known to practitioners: legislation, establishing procedures, investing budget, attracting personnel with specific skills, using visualisations of plans and attractive writings to promote policies. The approach is rather practical and easy, provided that the necessary data are collected. This makes the concept of policy dimensions meaningful to bridge a communicative gap between theory and practice, a gap that is mentioned by Kok and Veldkamp in 2010. The policy dimensions pay attention to the institutional, jurisdictional and spatial scales at the different levels, as shown in the case studies, and provide insight in the complexity of governance, for which Termeer et al. (2010) suggest new knowledge is required. We suggest further experimentation with a rating approach to explain impacts, to compare and to ultimately suggest policy improvements in practice.

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Metropolitan Gardens – gardens in the interstices of the metropolitan tissue

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Abstract

The heterogeneity of the contemporary metropolitan landscape has led to a multiplicity of intermediate spaces, in between and within the different tissues of the metropolitan landscape. These interstices can provide favourable conditions to be transformed into gardens. What design instruments can be discovered for these gardens to address the characteristics of the interstice? And what is the value of doing so? In this essay three contemporary examples are compared, which explicitly address the different metropolitan landscapes in which they are located. Paley Park (New York, USA) is a transformation of an interstice within a dense urban tissue; the Crazannes Garden (Crazannes, FR) creates a point of contact between motorway and rural landscape, and the Reflection Garden (Seattle, USA) addresses the inclusion of what used to be the hinterland into the metropolitan realm, which has so little physical impact that the interstitial space between the urban fragments constitutes practically the entire surface. The gardens are compared focusing on the landscape, the metropolitan condition of their situation, and the formal, spatial and visual transformation of the context in the composition of the garden. From the case studies one can conclude that gardens can define specific places in a generic metropolitan landscape, employing several design tools: centring, enclosing and highlighting a specific selection of existing landscape qualities.

Key words

interstice; interstitial garden; landscape architecture; garden; metropolitan landscape; place

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1. Introduction

In the course of history the garden evolved into many forms, opening up to the outside world, more and more following the growing awareness of landscape, but remaining defined spaces as expressions of a specific location in the landscape. From the perspective of landscape architecture, gardens are expressions of landscape, territorial representations that, in the words of Monique Mosser and Georges Teyssot, are constructed in situ 'on the interface of architecture and topography.' They can be defined as the most condensed unities in which the historical, functional and spatial complexity of the landscape manifests itself (Mosser and Teyssot, 1991, p. 8; Marot, 2003, p. 10-11; Hunt, 1996) (Figure 1). Two apparently diverging reflections on the expression of landscape could converge in the contemporary garden: the notion of place and the transformation of the landscape into a metropolitan landscape.

Figure 1
Garden as an expression of cultural and natural landscape: Villa Medici (Michelozzo di Bartolomeo, 1458-1462; photograph Peter Bolhuis).

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Contemporary discourse on 'place' is informed strongly by philosophical and sociological theories. It tends to refer to personal knowledge and sensitivities, past experiences – in other words, to relational concepts on the personal history of the individual with the place (e.g. Relph, 1976; Tuan, 1977; Norberg-Schulz, 1980) – or to cultural and social relationships (e.g. De Certeau, 1984; Hayden, 1995). In these theories the user is central, not the physical place. Without rejecting these views, in order to move from theory towards the discovery of design instruments, this article has a more physical geographical lens, with a focus on the physical, spatial component of the place, referring to a set of characteristics inherent to a geographical location, which can be perceived as a whole (e.g. Sauer, 1925; May, 1970). Central is not the experience, the user, but that which is experienced, that which can be created, the physical component of the equation. To be able to distinguish a place, as the geographer Joseph May pointed out, place has a 'perceptual unity', that is, its characteristics make it perceivable as a coherent unit, different from its surroundings (1970). Place is specific.

The second reflection of significance here is its defining quality as a dynamic system in continuous transformation. Parallel to the way place is addressed in this article, and complementary to many contemporary theories on landscape, I will focus on the geographical component of landscape, the changing spatial conditions. Over the past century a symbiotic relationship between city and landscape has grown, leading to what has been defined as the metropolitan landscape. As Steenbergen and Reh phrased it:

Seen from the perspective of landscape architecture, the term refers to the spatial relationship between two different systems, namely on one hand that of nature and the agricultural landscape each with its own topography, spatial form and visual structure, over against the spatial system of the city, which in turn has its own structure and morphology. Their interaction, and points where they penetrate each other, lead to various intermediate spatial forms.(Steenbergen and Reh, 2011, pp. 15-17)

Gardens are representations of this landscape in all its complexity, suggesting that also the metropolitan landscape needs to be recognised and addressed in the garden. What new landscape architectural conditions for making gardens arise from the metropolitan landscape and how can they be expressed in their design?

Depending on how the metropolis is defined, multiple views are possible, ranging from the social, economic and environmental aspects of large urban regions (Rowe, 1992; Sieverts, 1997) or network urbanism (Dupuy, 2008), to landscape ecological conditions (Forman, 2008) to the spatial aspects of the urban landscape (Steenbergen and Reh, 2011) and landscape infrastructures as armatures for urban development (Waldheim et al., 2006; Czerniak and Hargreaves, 2007). To what extent landscape, in the sense of a permanent underlying substructure, visual, physical and conceptual open space, and as a conceptual and instrumental 'vehicle' of nature, has a bearing on the resolution of metropolitan problems is the broader aim of these inquiries. In many of these theories a specific notion crops up, which seems to hold keys for the design of gardens: the interstice, a spatial consequence of metropolitan developments, which many different metropolitan landscapes, conditions or concepts have in common.

This paper explores how new centralities (places) are generated in the placeless interstice, focusing on the small scale of the everyday landscape, and addressing the interstices within and between the different tissues and fragments that constitute the metropolitan landscape.

2. The garden in the evolving metropolis

Garden and metropolis have a long history of symbiosis. The spatial coherence between city and landscape determines the nature of the metropolis, which may be considered as a city that has gradually opened up to the landscape, on all scales and in different forms over a long period of time. With every step in the development a new repertoire of landscape architectonic typologies forges the relationship of city and landscape. In the contemporary metropolis as a carpet of urban and landscape fragments we see the interstice as the intermediate emerge.

As Steenbergen has analysed in his essay "Metropolitan Footprints", metropolitan development took place in different stages (Steenbergen, 2008, pp. 114-115). The nuclear medieval city can be viewed as an artefact placed against the background of the non-city, determined by the way it is distinguished, separated from its environs. Enclosed gardens formed the stepping-stones in the functional relationship of the city with the open landscape and with nature. From the Renaissance onwards, the landscape territory of the city was opened up architecturally. In the course of the 19th century the city perimeter gradually dissolved, opening up the city to the surrounding landscape. The modern city expanded into the landscape, opening up the urban perimeter with the urban park as a colonisation model. Each step came about using a new repertoire of landscape-architectonic typologies. In the early 20th-century garden city, public green appeared as 'interim space' and remedy for the increasingly inaccessible landscape. The green belt was a last effort at keeping the city organised and the landscape accessible.

When, as a result of the continuous process of urban expansion and transformation, the entire territory ultimately disintegrates and the city becomes poly-nuclear, the difference between city and landscape vanishes. The last stage of the metropolitan process until now can therefore be described as the disappearance of the distinction between city and landscape. City and landscape are united in an unlimited urban field of hybrid intermediate forms. Explosive population growth, changes in economic activities, and the growth of transport and communication in the last half century has made the change from a city in the landscape to the city as a landscape of fragments primarily a contemporary development.

The current 'metropolis' is not a spatially defined artefact, in contrast to the territorially limited city of the middle ages. Where the traditional city is based on a commitment to continuity and composition, to order as an unbroken continuity consisting of distinguishable, yet inseparable parts, in metropolitan territories one can rather speak of a spatial and temporal continuity, undefined and unbounded, characterised by flexible and dynamic relationships (Van der Velde and De Wit, 2009, p. 56).

This hybrid landscape provides favourable conditions for the re-emergence of the garden. The size of the garden finds an easy fit in the many interstices that are left between the different programmatic entities, following the loosening up of the compositional logic of the traditional city. The concept of the interstice as a property of the metropolis was described 16 years ago in the book Zwischenstadt, in which Thomas Sieverts coined the notion of the 'in-between city' (Sieverts, 1997). This notion highlights the interstice as the new urban realm, extended green areas, which tend to form the (unplanned) core of new urban developments, a new urban pattern. If addressed and cultivated these interstices can yield valuable tools for addressing the metropolis.

The link between the marginal space and the garden was made by the French philosopher Louis Marin, in his essay on the Jardin de Julie, the fictional garden in Rousseau's La Nouvelle Héloïse (1761). Marin compared the garden to what in French is called the Rue Traversière – the road that runs across. In other words, the garden is viewed as a disjointed place, a spatial configuration that eludes normative expectations as far as function and direction are concerned. The garden can be viewed as a traverse, cutting across the theories and practices of contemporary urbanism involving 'green spaces' and 'natural' leisure resorts in the post-industrial city: "You who construct gardens, no longer make parks, or green spaces; make margins. Do not make leisure and game terrains; make places of jouissance" (Marin, 1992, p. 87).

3. Interstices in metropolitan landscapes

The following analysis is based on Buyck et al. 2008 (PDF), 2009 (PDF (2010)), Bauer 2009, Sinn et al. The aforementioned concept of the interstice as a property of the metropolis is related to the view of the metropolitan landscape as a carpet of fragments, as for example Neutelings put forward in his analysis of the transformation of the urban fringe of The Hague. Here he likened the metropolitan territory to a carpet of urban fragments, devoid of compositional form (Neutelings, 1989). The continuity and compositional logic of the city seems to have been replaced by a contiguity of elements and networks that are not necessarily matching, resulting in a spatial structure full of holes and fringes. These interstices are undefined residual spaces, spaces we see but hardly register, with no apparent meaning or function.

The relation of different metropolitan conditions to the underlying landscape has led to different types of metropolitan fabric, each with their own distinct physical determinants. Three types of interstice can be discovered. First there is the interstice within the metropolitan tissue. The derelict sites of torn-down buildings, traffic islands, medians, widening of the pavement, and unkempt plantations can be gathered under this type of interstitial space. A second type of interstice appears when one metropolitan landscape intersects the other, most clearly visible where the large, sweeping course of motorways or railways, informed by the physical laws of speed, cuts through the fine urban or rural tissue. A third type is when the metropolitan developments are projected on an existing landscape, but hardly leave a visible trace, leading to a transparent 'carpet,' with the interstitial space not as a residual fragment, but as all-encompassing surface (Figure 2).

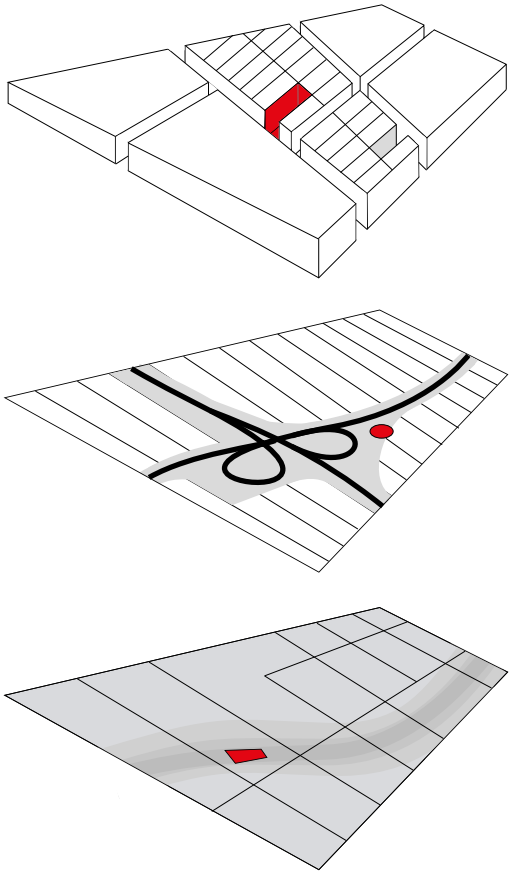

Figure 2
Interstitial gardens reacting on three types of interstitial space (The grey areas mark the interstitial space; the gardens are indicated in red).

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4. Three interstitial gardens

In order to research design means and components with which 'interstitial gardens' might address the metropolitan landscape, three examples of gardens in highly different (spatial) metropolitan contexts are compared. The case studies focus on the specific type of metropolitan landscape and the position of the interstice in this, and on the formal, spatial and visual transformation of the context in the composition of the garden.

The first example, Paley Park, was designed in the dense tissue of the skyscraper metropolis of Manhattan. The design is basically a transformation of an interstice within the urban tissue. The second example, the Crazannes Garden, is connected to the territory generated by the flows of infrastructure. The design addresses the relation of the motorway and the existing landscape. Urban sprawl is a well-known phenomenon, leading in many cases to a suburbanisation, but in more extreme examples, as in the third case study, the Reflection Garden near Seattle, to a metropolitan landscape, which is virtually invisible. The garden exposes the incorporation of the underlying landscape within the metropolitan landscape.

A comparison between the gardens is made possible by describing each one, using the same components: the type of metropolitan landscape and their position herein, the design history, their composition and the relationship between the garden and interstice.

4.1 Paley Park, an urban void in the skyscraper metropolis

4.1.1 Metropolitan landscape: skyscraper metropolis

Of the many notions of metropolis, still the most iconic one is the 'great city': a central city with the power to attract people, great in size, and accumulating key economic activities. In that sense New York, or more precisely Manhattan, is the archetypal metropolitan landscape: "Manhattanism is the one urbanistic ideology that has fed, from its conception, on the splendors and miseries of the metropolitan condition – hyper-density – without once losing its faith in it as the basis for a desirable modern culture. Manhattan's architecture is a paradigm for the exploitation of congestion", as Rem Koolhaas wrote in his seminal eulogy for Manhattan, Delirious New York (Koolhaas, 1994, p. 10).

In the second half of the 19th century America transformed rapidly from an agrarian into an urban society. New York started to grow fast, channelled by the extension plan of 1811, a grid of building blocks of 50 by 200 metres, extending over the island of Manhattan. The narrow blocks gave developers no choice but to build upward, unleashing the grid's unlimited potential for growth. The invention of the skyscraper is the core of the success of New York as a metropolis. In his analysis of the metropolis, in the sense of 'great cities' or super-cities, the geographer Emrys Jones commented on the enormous impact of the office block as the focus of activity (Jones, 1990, p. 91). The Manhattan skyline proclaims its complete commitment to the technology, which has produced the greatest massing of buildings ever seen, and to the economic system that enabled it (Figure 3).

Figure 3
Skyscraper metropolis

4.1.2 Urban interstice

The Manhattan plan does not provide for public open space; to remove land from the market was clearly seen as a waste of a profit-producing resource. With exceptions like Central park and Bryant Park, the only open space outside the streets can be found within the blocks. A shifting constellation of unbuilt spaces – basically nothing more than empty building sites – emerged as an unplanned consequence of the lay out. Even in Midtown, the most densely built part of Manhattan, these open spaces are myriad.

In a condition of density, the landscape horizon, the reference to nature, and the connection to the underlying landscape are hard to find. The remaining open spaces are the interstices in the urban tissue, obtaining their definition from the buildings that surround it (Figure 4).

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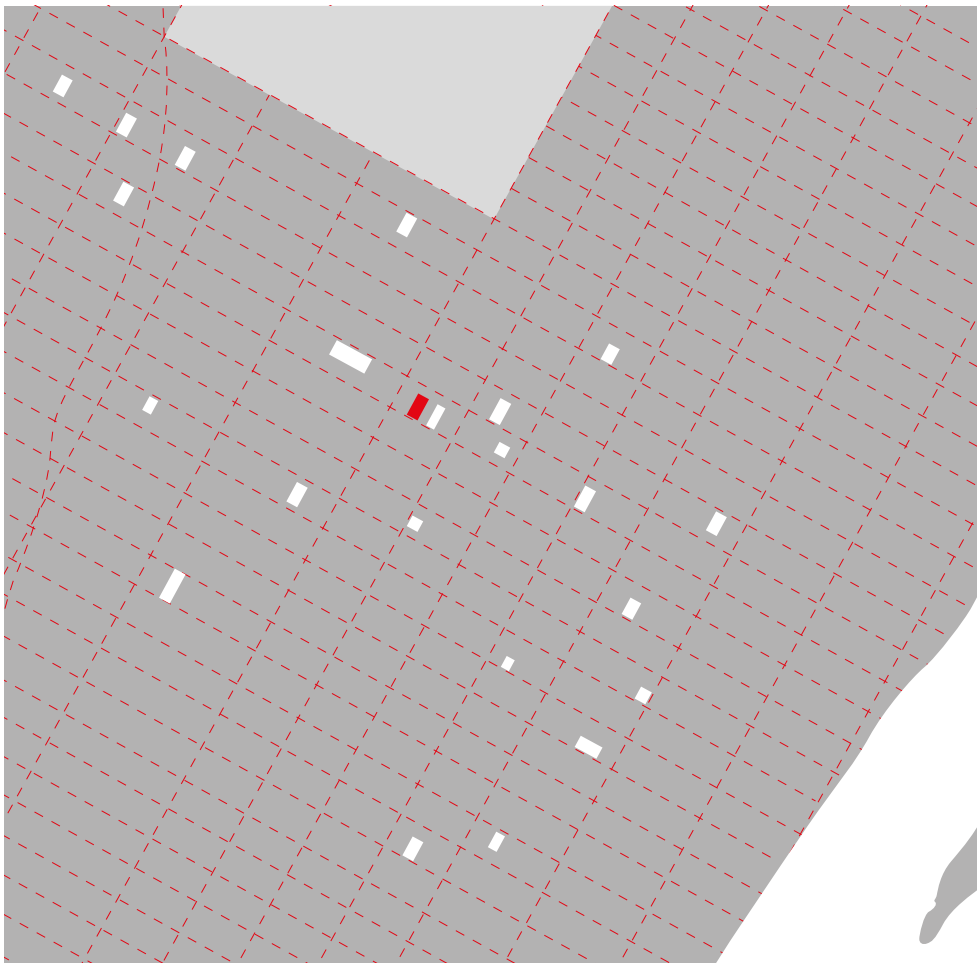

Figure 4
The dense tissue of Manhattan has many interstices, the size of a building lot. In Paley Park one of these interstices has been transformed into a public garden.

4.1.3 Design history of Paley Park

In 1967 landscape architect Robert Zion made a design for a public garden on an empty lot at 56th Street. It was a speculative design, meant as the prototype for a new kind of public space, as a critique against the then officially determined minimum size for urban parks of 12,000 square metres. Zion argued for a system of 'parklets', running throughout commercial areas, one for every midtown block. They would be public gardens for the inner city, the size of a building lot. He described the location as "a part of space removed from the flow of traffic (including pedestrian traffic), enclosed, protected and sheltered from noise. Preferably it is a space between buildings, benefiting from the shelter of neighboring structures; the type of space which is now most commonly used as parking lot" (Zion and Breen, 1963, unpaginated). The proposal was picked up by William Paley, who decided to build a public garden on the vacant site he had just bought, to commemorate his father, and asked Zion to design it.

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4.1.4 Composition

Zion added several composition elements, emphasising form, size and position of the interstice: a double flight of stairs, ivy clad walls – formalising the outer walls of the neighbouring buildings – a tree canopy – blocking the view and negotiating the absence of sky – and a water wall at the far end of the space. Thus the interstice was transformed from a residual space into an independent, architectural space. A linear spatial sequence, elaborated in a widening and narrowing of space, changes in height levels, and vertical objects as attractor of the view – the water wall – or as disperser of movement – the field of trees – makes the transition between the continuous movement of the streets and the enclosure of the interior space within the building block. Interlaced with the axial sequence is an organisation around the open central space (Figure 5).

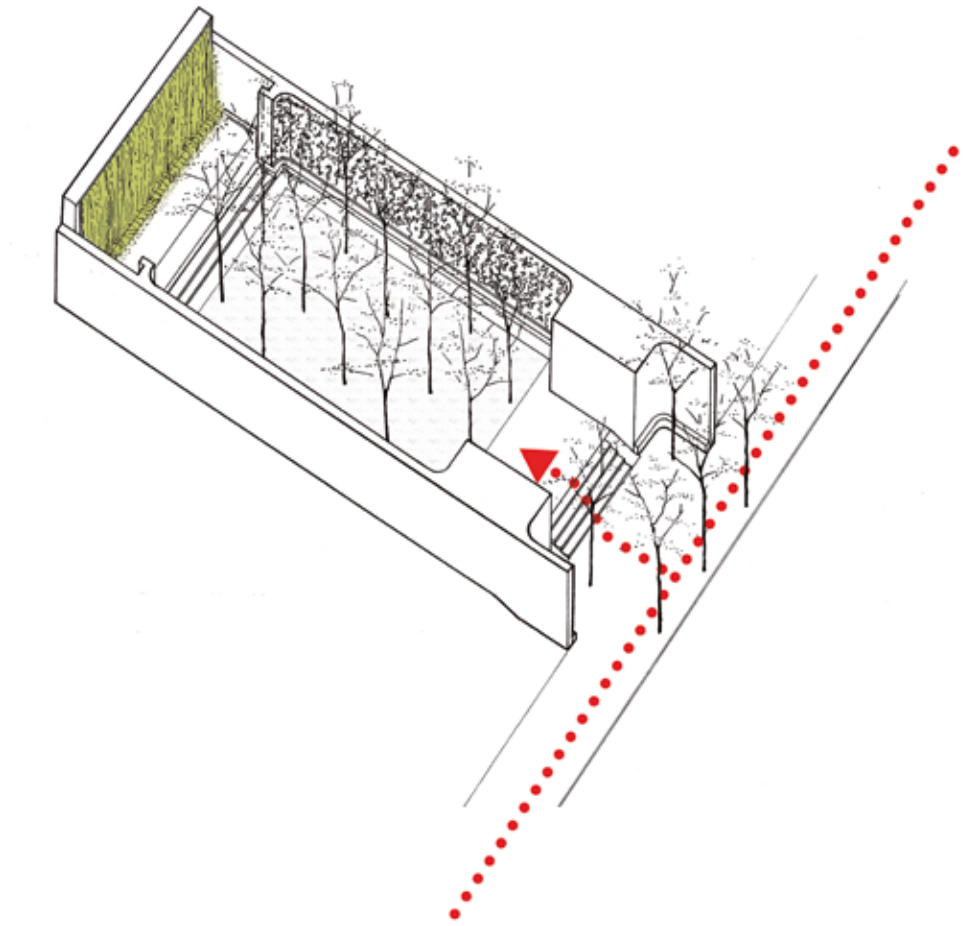

Figure 5
The composition of Paley Park is a concentric organisation around the open central space, combined with a spatial sequence from street to water wall.

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4.1.5 Garden and interstice

While exposing the urban interstice as an autonomous space, at the same time the garden refers to the underlying landscape, defining a specific place within Manhattan. The island of Manhattan was originally a landscape of forests, streams and rocks. Its rugged, glacially formed topography was planed flat in the course of the city's development. In the garden the water wall, the field of trees and ivy-clad walls create the image of a mountain canyon, in a narrative reference to the disappeared landscape, feeding the topographical memory of the city. Where the falling water hits the pool, a shimmering horizontal line forms an internal, urban horizon, replacing the landscape horizon (Figure 6). The interstitial space, here defined as a counterform of the building mass, is transformed into a landscape architectonic space: the urban void, where the nature reference adds meaning to the space.

Figure 6
The spatial qualities of the interstice are elaborated, and in the resulting space a narrative reference to the vanished landscape has been created.

4.2. The Crazannes Garden, counterpoint of the flowscape metropolis

4.2.1 Metropolitan landscape: flowscape

Originally an integral part of the urban fabric, over time the landscape of infrastructure has become a self-sufficient entity, spreading out beyond the urban fabric, as well as taking up ever more physical space and becoming visually dominant. The movements of car, tram, train or airplane determine the basic landscape form and three-dimensionality of metropolitan infrastructure – a space of flows. Whereas the urban and the cultural landscape have always closely followed the natural morphology, resulting in a close-knitted unity, the technical demands of the motorway create a geometry of its own, informed by the physical laws of speed.

The flowscape was introduced to the rural region at the mouth of the Charente River in western France when a new motorway, the A837 was built in 1992, forming a new link in the already dense European motorway network. The region has had an urban imprint for a long time. Two towns, Saintes and Rochefort, owe their origins to the river, but they remained isolated towns until the building of the railway in the 19th century. Only in the early 20th century the towns were connected by a national road, which soon became heavily burdened with traffic. The A837 was built to relieve the national road (Figure 7). Intersecting the morphology of the natural landscape and skimming the edges of the towns, the new motorway generated a territory of fly-overs and exits, road reservations, parallel back roads, planting, low wide embankments and generic commercial developments.

Figure 7
Flowscape metropolis: the A837 intersects the natural landscape.

4.2.2 Flowscape interstice

Where the infrastructural landscape cuts through the morphology of the existing landscape, large gaps appear, residual areas, which are geometrically and spatially undefined. Partly these areas are determined by the demands and the reservations of the motorway, partly because the patterns of the existing landscape are cut off unfavourably (Figure 8).

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Figure 8
The Aire de Crazannes fills the interstice between the motorway and the quarry landscape; the Crazannes Garden connects the interstice to the quarry.

4.2.3 Design history of the Aire de Crazannes

During the first surveys for the passage of the A837, the ASF (Société des Autoroutes du Sud de la France) noticed a rocky outcropping, revealing a vast zone of old quarries filled with rubble and earth. Only the last one exploited, the Crazannes Quarry, was left when still open. It was decided to avoid the old quarries and exploit the limestone outcropping to extract aggregates for the construction of the road. The artist Bernard Lassus, advisor on a national landscape policy for motorways, was asked to design two aires (rest areas) for the motorway, one in each direction. One of them is the Aire de Crazannes. It was positioned in the interstice between the motorway and the Crazannes Quarry, which would be opened up to visitors who would stop at the aire. The interstice was densely planted with trees, with two gardens pushed away as far as possible from the motorway, touching the edge of the quarry.

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4.2.4 Composition

The road is curved into two loops, with a turning radius designed for slow-driving cars looking for a parking space. The perimeter defines the form of the gardens: the road, followed by a range of seams, and a circular arcade around a central lawn. The arcade is a transition space between exterior (both the motorway and the quarry landscape) and the interior space of the lawn. At the edge of the forest a second, crescent-shaped arcade connects the garden to the forest and to the quarry, giving direction to a walking route (Figure 9).

The invitation to take a walk discloses the landscape, with the neutral space of the circular garden functioning as an 'airlock' between the linear visual space of motorway and the meandering spatial sequence of the quarry, where the earthy smell, the stark contrasts of light and shadow, the rocks and the abundant plants give a distinctive sense of place.

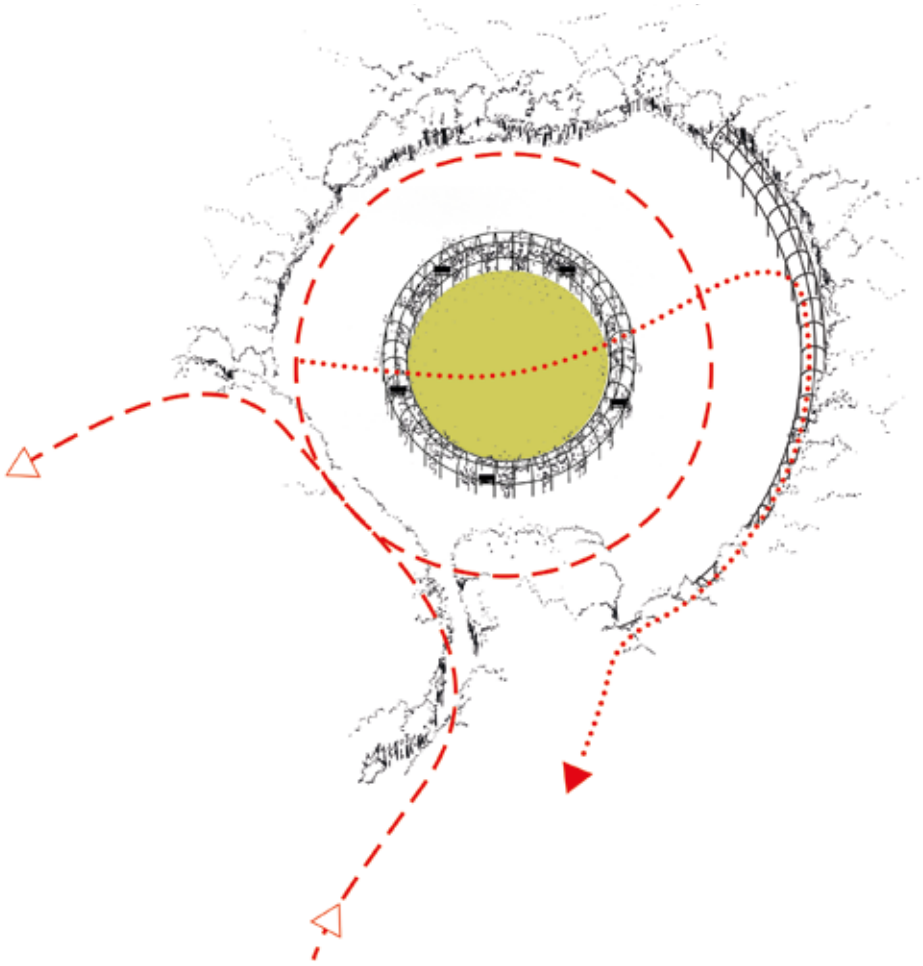

Figure 9
The circular form of the Crazannes Garden is derived from the geometry of the road. The resulting space functions as an interface between the movement on the road and the landscape walk.

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4.2.5 Garden and interstice

While the aire as a whole fills the triangular interstice between road and quarry, the gardens are precisely positioned at the edge, connecting the interstice – which was informed by the motorway – to the quarry. Connecting the world of speed and the world of 'standstill', the garden also connects the different realms of perception: the visual of the motorway and the multisensory in the quarry. In contrast to Paley Park, the Crazannes Garden is no destination, no point of standstill, but a momentary intermission in an otherwise continuous movement, remaining aside. It can be considered to be 'crossways' to the linear dynamic of the flowscape: disjointed from the fluent motorway system, from conventional and utilitarian constraints, but at the same time integral to the spatial and visual structure. In its introvert spatial form, in its quietness and its nature image, it is the opposite from the motorway system, but at the same time it is derived from its very form, like the eye of a hurricane.

Figure 10
The Crazannes Garden is a neutral space, with its surrounding arcade inviting the traveller to make the transition from motorway to the local landscape.

4.3. The Reflection Garden, sublimating nature in the invisible metropolis

4.3.1 Metropolitan landscape: invisible metropolis

The American sociologist Melvin Webber argues that technology, allowing for freedom of movement and free access to information, has enabled us to live in a world, where an urban way of life can be enjoyed without living in the confines of the city. Urbanity is no longer the exclusive trait of the city dweller; those living in what used to be the hinterland can be the most urbane of men (Webber, 1964, p. 89). Greater freedom of movement has loosened the urban fabric, and activities have become more scattered. In this

'urban realm' the notion of hinterland has disappeared. The hinterland has been, by definition, a place demarcated by interaction with a centre. "Today, when highly specialised communicators are to be found in what is called the hinterland, the basis for the definition dissipates" (Webber, 1964, p. 143). What is hinterland and what is centre becomes, at best, but a difference in magnitudes of information flow and of volumes of activity.

The Seattle metropolitan area, rather than a centralised metropolis dominated by Seattle's downtown core, is a dispersed metropolis with several cores of urbanity. The urban pattern is informed by several major river systems. High mountain ranges make extensive expansion to the east and to the west impossible, but the many islands in the Puget Sound in between the mountains have developed into a nebulous suburban area. A net of bridges and ferries interconnects the islands. Bainbridge Island, being the closest to Seattle, has become an increasingly affluent bedroom community of Seattle. The densely forested and thinly populated community on Bainbridge Island owes its existence, not to farmers or lumberjacks, as it used to, but to people commuting to Seattle on a daily basis.

None of the Puget Sound islands can be called Seattle's hinterland. Rather, all of them are integral with the entire metropolitan realm. The participants in the different networks, who live in the central business district of Seattle and those in the forests of Bainbridge Island, are the same. The level of prosperity is high, and technical innovation is so advanced that agglomeration has become less important; there is no necessary correlation between where people live and where they work. Location, not agglomeration, becomes the inducement for settlement, and location, in the case of Puget Sound, is defined by pristine lakes and forests. Arcadia, the original antithesis of the city, has become the metropolis (Figure 11).

Figure 11
Invisible metropolis: Bainbridge Island still has the spatial structure of the original natural forest.

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4.3.2 Interstice

Thus it is that, within this metropolitan area, not the urban programme, but the natural landscape determines the physical and spatial structure. The urban programme takes up hardly any physical space, and the residual space between the almost negligible urban fragments constitutes all but the entire surface.

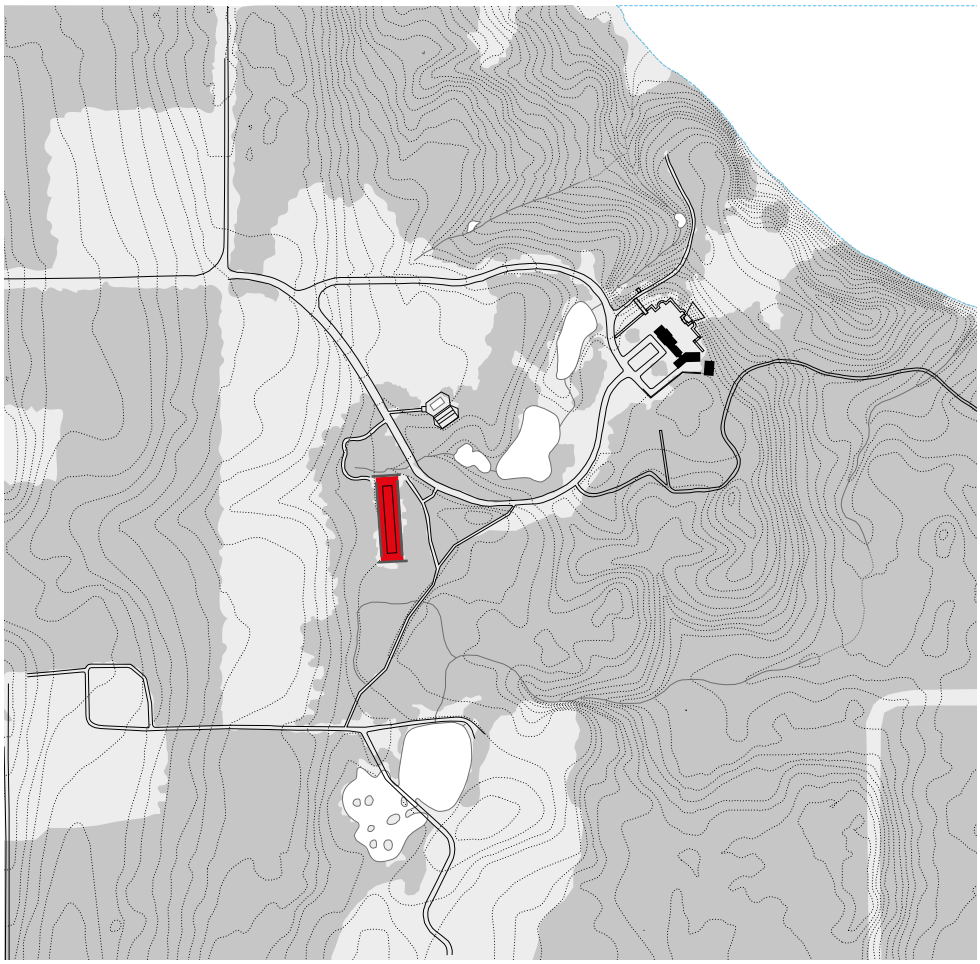

Figure 12
The Reflection Garden landscape layer is positioned at a strategic location in the landscape.

4.3.3 Design history of the Reflection Garden

In 1951 Prentice Bloedel, a wealthy Seattle-based timber baron, purchased a property on Bainbridge Island, where he created a country house, the Bloedel Reserve. After his death it was transformed into a public arboretum and nature reserve. The Bloedels, members of the elite, representing an extension of urban values in its fine architecture, artificial landscape, and sophisticated society, can be viewed as the forerunners of the metropolitan developments on the island. It took the Bloedels some decades to transform the original hunting lodge into the estate it now is. The Reflection Garden, created between 1969 and 1971 by the landscape architect Richard Haag, completed the composition. The garden ignores the classical composition of the estate – arranged around a central axis perpendicular to the shore of Puget Sound – and instead follows the basic form of the natural landscape.

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4.3.4 Composition

The Reflection Garden is positioned at a strategic location, making the underlying landscape layer visible. Within its boundaries the hidden quality of the site – the groundwater - is displayed, specified and magnified. A site was chosen where the groundwater almost touches the surface, and then excavated to water-bearing sandy soil for maximum flow of ground water. The site reflects the fold left by the last glacier to retreat from the land about 15.000 years ago, leaving a pattern of ridges and folds, hardly visible at the surface. But it does reflect in the ground water table, made visible by the garden. A high hedge frames the garden, clipped into a fixed plane on the inside, turning the garden into an architectural room, but free growing on the outside, blending in with the forest. Lawn, hedge and forest form a sharply defined sequence of layers, organised around the open central space of the pool. From the open space of the garden the spatial qualities and the scale of the landscape become visible. The integration of garden space – enclosure – and landscape space determines the layout of the garden.

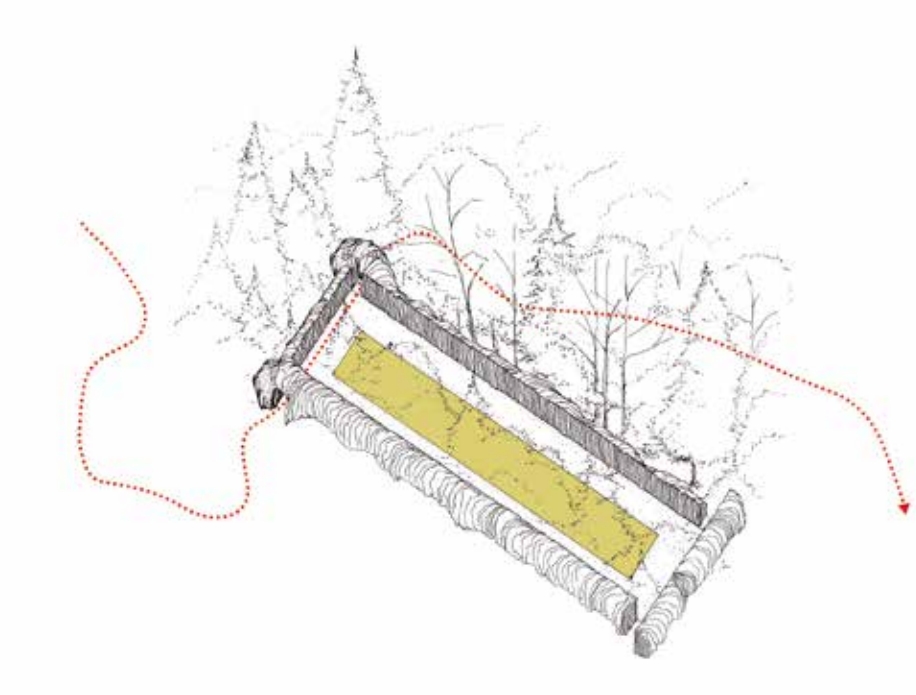

Figure 13
The Reflection Garden exposes the underground water system and the landscape space of the forest.

4.3.5 Garden and interstice

In the invisible metropolis, the interstice – the residual space between metropolitan developments – is omnipresent, which makes its relation to the metropolitan developments hard to read. The garden condenses the qualities of the landscape in a single space. The restrained image contrasts with the image of dramatic indigenous wilderness. Thus the garden is bound to the landscape (derived from it), and at the same time it is essentially an 'other space', contrary to its surroundings, "in such a way as to suspect, neutralize, or invent the set of relations that they happen to designate, mirror or reflect", as Michel Foucault wrote (1967, p. 352). With this garden a perceivable, but disjointed space is created within the forest landscape. The garden exposes – by reconciling the urbane garden and the wilderness within one space – the incorporation of the natural landscape within the metropolitan landscape. Marking a place and illuminating its landscape qualities, unlocks the non-urban landscape and includes it into the urban realm.

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Figure 14
Creating a place in the ubiquitous forest landscape.

4.4 Emerging strategies and tools

The interstices that appear in the instable and dynamic metropolitan landscape, with its continuously changing spatial conditions, are plausible habitats for new gardens. Whereas different metropolitan conditions ask for different landscape architectural transformations, these specific situations can provide possible reasons to be transformed into gardens. Expressing what is local and particular, interstitial gardens can provide reference points in a landscape that becomes ever more undefined and globalised.

The landscape image in the garden gives meaning to the leftover space: as a representation of the original landscape, disappeared under metropolitan developments, as a portal to the surrounding landscape, or as a 'looking glass' to what is hidden underground. The marginal space is exploited: what is a margin in the urban tissue becomes a centralised space once inside; what is closed off from the public gaze, becomes an opening onto the landscape. The quality of 'outside' – outside the real space of society, outside daily life, outside the generic reality of the metropolis, outside the physical surroundings – can be discovered in the cracks of the metropolitan tissue. This quality can become a garden when it is transformed into perceivable space, when – to refer once more to the image of the carpet – the hole in the carpet of fragments is transformed into a looking glass to the landscape layer underneath.

The examples give different elaborations of the transformation of residual spaces into defined places. An interstice, which already has an inherent spatial frame, can be architecturally elaborated, spatially organising the internal space around an open centre. The geometry of the motorway can be exploited to frame a centre, a moment of standstill, functioning as a portal inviting to investigate the surrounding landscape. A specific place in the landscape can be spatially framed.

Three design tools or strategies to define place, can be discovered in all three case studies: magnifying, enclosing, and centring. A specific selection of existing landscape qualities is taken in and magnified, highlighted. This selection is set apart by the enclosure, the most basic action of defining space, creating

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an inside as opposed to an outside, or a specific place as opposed to a generic context. In interplay with the enclosure, the organisation around an open centre is the spatial representation of locational awareness and is elaborated as a concentric spatial layering. Whereas the metropolitan landscape can be described as a layering and contiguity of different spatial conditions next to and on top of each other, centring in contrast, demarcates a specific place. The centre creates a focus on the landscape, and, as Bernard Lassus wrote, "where a landscape appears, we are already in a place" (1998, p. 77).

The opportunity interstitial gardens offers for the metropolis, is not that they create a core for emerging urban fabrics, structuring the metropolitan landscape or that they give a solution for large-scale metropolitan issues, but that they can function as places outside, juxtaposing their metropolitan context by emphasising specific locations, and reflecting the landscape from the margins of the metropolitan tissue.

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5. Conclusion: metropolitan landscape and place

Over the past century a symbiotic relationship between city and landscape has grown, leading to what can be called the metropolitan landscape, a non-geographical complex system, replacing the city tied to the idea of place. A 'placeless geography', lacking both diverse landscapes and significant places, seems to have replaced the localism and variety of places. However, the metropolis is not as placeless as it might seem to be. The experience of place can be found in specific locations.

Interstices, marginal spaces, which have no apparent function in the metropolis, give the opportunity to open up to hidden qualities 'underneath' the metropolitan tissue, qualities that can be defined as place, if they can be perceived as such. Place is an expression of the inherent qualities of the landscape itself, of a particular and specific part of space, and of that what may occupy that space. But the qualities of place only become meaningful if they can be experienced, if the location is perceivable as an articulate ensemble. An architectonic transformation of leftover spaces into gardens can make the qualities of place perceivable, as a physical, visual form, giving the place its own order and expressing geographical experience.

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Toute la famille alla hier dîner à Chillou..... on se promena le long de la digue.... Mons.r le Bailli.... vint répondre Mad.e de Volma d'en lui offrir son bras. Pour le prendre elle me remet Marcellin, il court à moi, j'accours à lui.... l'infâme fait un faux pas, le pied lui manque, il tombe dans l'eau. Je pousse un cri perçant;... Mad.e se retourne, voit son fils pris comme un rat, et s'élance après lui..... on n'avait là ni gens ni bateau, il fallut du temps pour les retirer.