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)

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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.

References

Antrop, M. (2004). Landscape change and the urbanization process in Europe. Landscape and Urban Planning, 67(1-4), 9-26.

Appleton, J. (1975). The experience of landscape. New York, NY: John Wiley and Sons.

Asakawa, S., Yoshida, K., & Yabe, K. (2004). Perceptions of urban stream corridors within the greenway system of Sapporo, Japan. Landscape and Urban Planning, 68(2-3), 167-182.

Barnhart, S. K., et al. (1998). Behaviour and outdoor setting preferences at a psychiatric hospital. Landscape and Urban Planning, 42(2–4), 147-156.

Bell, S. (1999). Landscape: pattern, perception and process. London, United Kingdom: E & FN Spon.

Bjerke, T., Ostdahl, T., Thrane, C., & Strumse, E. (2006). Vegetation density of urban parks and perceived appropriateness for recreation. Urban Forestry & Urban Greening, 5(1), 35-44. doi: 10.1016/j.ufug.2006.01.006

Bolund, P., & Hunhammar, S. (1999). Ecosystem services in urban areas. Ecological Economics, 29(2), 293-301.

Botequilha Leitao, A., & Ahern, J. (2002). Applying landscape ecological concepts and metrics in sustainable landscape planning. Landscape and Urban Planning, 59(2), 65-93.

Botequilha Leitão, A., Miller, J., Ahern, J., & McGarigal, K. (2006). Measuring landscapes. Washington, DC: Island Press.

Bulut, Z., & Yilmaz, H. (2008). Determination of landscape beauties through visual quality assessment method: a case study for Kemaliye (Erzincan/Turkey). Environmental Monitoring and Assessment, 141(1-3), 121-129. doi: 10.1007/s10661-007-9882-0

Caspersen, O. H., & Olafsson, A. S. (2010). Recreational mapping and planning for enlargement of the green structure in greater Copenhagen. Urban Forestry & Urban Greening, 9(2), 101-112. doi: 10.1016/j.ufug.2009.06.007

Cengiz, C., Cengiz, B., & Bekci, B. (2012). Environmental quality analysis for sustainable urban public green spaces management in Bartm, Turkey. Journal of Food Agriculture & Environment, 10(3-4), 938-946.

Coeterier, J. F. (2002). Lay people's evaluation of historic sites. Landscape and Urban Planning, 59(2), 111-123.

Cohen, D., McKenzie, T. L., & Sehgal, A. (2007). Contribution of Public Parks to Physical Activity. American Journal of Public Health, 97(3), 509-514.

Council of Europe. (2003). Presentation of the European Landscape Convention. Strasbourg: Council of Europe.

Dallimer, M., Irvine, K. N., Skinner, A. M. J., Davies, Z. G., Rouquette, J. R., Maltby, L. L., et al. (2012). Biodiversity and the Feel-Good Factor: Understanding Associations between Self-Reported Human Well-being and Species Richness. Bioscience, 62(1), 47-55. doi: 10.1525/bio.2012.62.1.9

Déjeant-Pons, M. (2006). The European Landscape Convention. Landscape Research, 31(4), 363-384. doi: 10.1080/01426390601004343

Ding, D., Sallis, J. F., Kerr, J., Lee, S., & Rosenberg, D. E. (2011). Neighborhood Environment and Physical Activity Among Youth: A Review. American Journal of Preventive Medicine, 41(4), 442-455. doi: 10.1016/j.amepre.2011.06.036

Ellaway, A., Macintyre, S., & Bonnefoy, X. (2005). Graffiti, greenery, and obesity in adults:secondary analysis of European cross sectional survey. British Medical Journal, 331, 611-612.

Ellis, C. D., Lee, S.-W., & Kweon, B.-S. (2006). Retail land use, neighborhood satisfaction and the urban forest: an investigation into the moderating and mediating effects of trees and shrubs. Landscape and Urban Planning, 74(1), 70-78. doi: 10.1016/j.landurbplan.2004.10.004

Eroglu, E., Muderrisoglu, H., & Kesim, G. A. (2012). The effect of seasonal change of plants compositions on visual perception. Journal of Environmental Engineering and Landscape Management, 20(3), 196-205. doi: 10.3846/16486897.2011.646007

Floyd, M. F., Spengler, J. O., Maddock, J. E., Gobster, P. H., & Suau, L. J. (2008). Park-Based Physical Activity in Diverse Communities of Two U.S. Cities: An Observational Study. American Journal of Preventive Medicine, 34(4), 299-305. doi: 10.1016/j.amepre.2008.01.009

Foltete, J.-C., & Piombini, A. (2010). Deviations in pedestrian itineraries in urban areas: a method to assess the role of environmental factors. Environment and Planning B-Planning & Design, 37(4), 723-739. doi: 10.1068/b35015

Fry, G., Tveit, M. S., Ode, Å., & Velarde, M. D. (2009). The ecology of visual landscapes: Exploring the conceptual common ground of visual and ecological landscape indicators. Ecological Indicators, 9(5), 933-947.

Gardsjord, H., Tveit, M., & Nordh, H. Promoting youth's physical activity through park design – linking theory and practice in a public health perspective. Landscape Research. doi: 10.1080/01426397.2013.793764

Gobster, P. H. (1995). Aldo Leopold's "Ecological Esthetic": Integrating Esthetic and Biodiversity Values. Journal of Forestry, 93, 6-10.

Gobster, P. H., & Westphal, L. M. (2004). The human dimensions of urban greenways: planning for recreation and related experiences. Landscape and Urban Planning, 68(2-3), 147-165.

Grahn, P., & Stigsdotter, U. A. (2003). Landscape planning and stress. Urban Forestry & Urban Greening, 2(1), 1-18.

Green, R. (1999). Meaning and form in community perception of town character. Journal of Environmental Psychology, 19(4), 311-329. doi: 10.1006/jevp.1999.0143

Han, M.-H., Joo, M.-K., Kim, J.-T., & Oh, Y.-K. (2011). Seasonal Preferences and Interactions of Visual/Auditory Elements of Streetscape in Namwon City, Korea. Indoor and Built Environment, 20(1), 162-170. doi: 10.1177/1420326x10394481

Hands, D. E., & Brown, R. D. (2002). Enhancing visual preference of ecological rehabilitation sites. Landscape and Urban Planning, 58, 57-70.

Hansmann, R., Hug, S.-M., & Seeland, K. (2007). Restoration and stress relief through physical activities in forests and parks. Urban Forestry & Urban Greening, 6(4), 213-225.

Helfand, G. E., Sik Park, J., Nassauer, J. I., & Kosek, S. (2006). The economics of native plants in residential landscape designs. Landscape and Urban Planning, 78(3), 229-240. doi: 10.1016/j.landurbplan.2005.08.001

Herzog, T. R., & Chernick, K. K. (2000). Tranquility and danger in urban and natural settings. Journal of Environmental Psychology, 20(1), 29-39. doi: 10.1006/jevp.1999.0151

Herzog, T. R., & Flynn-Smith, J. A. (2001). Preference and perceived danger as a function of the perceived curvature, length, and width of urban alleys. Environment and Behavior, 33(5), 653-666. doi: 10.1177/00139160121973179

Herzog, T. R., & Kutzli, G. E. (2002). Preference and perceived danger in field/forest settings. Environment and Behavior, 34(6), 819-835.

Heyman, E., Gunnarsson, B., Stenseke, M., Henningsson, S., & Tim, G. (2011). Openness as a key-variable for analysis of management trade-offs in urban woodlands. Urban Forestry & Urban Greening, 10(4), 281-293. doi: 10.1016/j.ufug.2011.07.003

Heyman, E. (2012). Analysing recreational values and management effects in an urban forest with the visitor-employed photography method. Urban Forestry & Urban Greening, 11(3), 267-277. doi: 10.1016/j.ufug.2012.02.003

Hofmann, M., Westermann, J. R., Kowarik, I., & Van der Meer, E. (2012). Perceptions of parks and urban derelict land by landscape planners and residents. Urban Forestry & Urban Greening, 11(3), 303-312. doi: 10.1016/j.ufug.2012.04.001

Jim, C.Y. & Chen, W.Y. (2006). Perception and attitude toward urban green spaces in Guangzhou (China). Environmental Management 38, 338-349.
Jorgensen, A., Hitchmough, J., & Calvert, T. (2002). Woodland spaces and edges: their impact on perception of safety and preference. Landscape and Urban Planning, 60(3), 135-150.
Jorgensen, A., & Anthopoulou, A. (2007). Enjoyment and fear in urban woodlands - Does age make a difference? Urban Forestry & Urban Greening, 6(4), 267-278.
Kaczynski, A. T., & Henderson, K. A. (2007). Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation. Leisure Sciences: An Interdisciplinary Journal, 29(4), 315 - 354.
Kaplan, S., & Kaplan, R. (1982). Cognition and Environment: Functioning in an Uncertain World. New York, NY: Praeger.
Kaplan, R., & Kaplan, S. (1989). The experience of nature; a psychological perspective. Cambridge, United Kingdom: Cambridge University Press.
Kaplan, R., Austin, M. E., & Kaplan, S. (2004). Open Space Communities: Resident Perceptions, Nature Benefits, and Problems with Terminology. Journal of the American Planning Association, 70(3), 300-312. doi: 10.1080/01944360408976380
Kennedy, C.B., Zube, E.H. (1991). Attitudes towards vegetation in a desert urban forest: creating sense of place. Journal of Arboriculture 17, 159-166.
Kil, N., Stein, T. V., Holland, S. M., & Anderson, D. H. (2012). Understanding place meanings in planning and managing the wildland-urban interface: The case of Florida trail hikers. Landscape and Urban Planning, 107(4), 370-379. doi: 10.1016/j.landurbplan.2012.07.004
Kira, K. (2006). "The only place to go and be in the city": women talk about exercise, being outdoors, and the meanings of a large urban park. Health & Place, 12(4), 631-643.
Lee, B. J., Jang, T. Y., Wang, W., & Namgung, M. (2009). Design Criteria for an Urban Sidewalk Landscape Considering Emotional Perception. Journal of Urban Planning and Development-Asce, 135(4), 133-140. doi: 10.1061/(asce)up.1943-5444.0000013
Litton, R. B. (1972). Aesthetic Dimensions of the Landscape. In J. V. Krutilla (Ed.), Natural Environments: Studies in theoretical and applied analysis (pp. 262-291). Baltimore, Maryland: John Hopkins University Press.
Maas, J., & Verheij, R. A. (2007). Are health benefits of physical activity in natural environments used in primary care by general practitioners in The Netherlands? Urban Forestry & Urban Greening, 6(4), 227-233.
Marcotullio, P. J., & Boyle, G. (2003). Defining an Ecosystem Approach to Urban Management and Policy Development UNU/IAS Report. Tokyo, Japan: United Nations University.
Nassauer, J. I. (1995). Messy ecosystems, orderly frames. Landscape Journal, 14, 161-170.
Nikunen, H., & Korpela, K. M. (2012). The effects of scene contents and focus of light on perceived restorativeness, fear and preference in nightscapes. Journal of Environmental Planning and Management, 55(4), 453-468. doi: 10.1080/09640568.2011.608548
Nordh, H., Hartig, T., Hagerhall, C. M., & Fry, G. (2009a). Components of small urban parks that predict the possibility for restoration. Urban Forestry & Urban Greening, 8(4), 225-235.
Nordh, H., Hartig, T., Hagerhall, C. M., & Fry, G. (2009b). Components of small urban parks that predict the possibility for restoration. Urban Forestry & Urban Greening, 8(4), 225-235. doi: 10.1016/j.ufug.2009.06.003
Nordh, H., Alalouch, C., & Hartig, T. (2011). Assessing restorative components of small urban parks using conjoint methodology. Urban Forestry & Urban Greening, 10(2), 95-103. doi: 10.1016/j.ufug.2010.12.003
Ode, Å., Tveit, M., & Fry, G. (2008). Capturing Landscape Visual Character Using Indicators: Touching Base with Landscape Aesthetic Theory. Landscape Research, 33(1), 89-118.
Ode, Å., Hagerhall, C. M., & Sang, N. (2010). Analysing Visual Landscape Complexity: Theory and Application. Landscape Research, 35(1), 111-131.
Özgüner, H., & Kendle, A. D. (2006). Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK). Landscape and Urban Planning, 00074(00002), 139-158.
Palmer, J. F. (1997). Stability of landscape perceptions in the face of landscape change. Landscape and Urban Planning, 37(1-2), 109.
Peckham, S. C., Duinker, P. N., & Ordóñez, C. (2013). Urban forest values in Canada: Views of citizens in Calgary and Halifax. Urban Forestry & Urban Greening, 12(2), 154-162. doi: 10.1016/j.ufug.2013.01.001
Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. International Journal of Environmental Health Research, 15(5), 319-337. doi: 10.1080/09603120500155963
Purcell, A. T., & Lamb, R. J. (1998). Preference and naturalness: An ecological approach. Landscape and Urban Planning, 42, 57-66.
Qureshi, S., Breuste, J. H., & Lindley, S. J. (2010). Green Space Functionality Along an Urban Gradient in Karachi, Pakistan: A Socio-Ecological Study. Human Ecology, 38(2), 283-294. doi: 10.1007/s10745-010-9303-9
Roovers, P., Hermy, M., & Gulinck, H. (2002). Visitor profile, perceptions and expectations in forests from a gradient of increasing urbanisation in central Belgium. Landscape and Urban Planning, 59(3), 129-145.
Schaumann, S., & Salisbury, S. (1998). Restoring nature in the city: Puget Sound experiences. Landscape Urban Planning, 42, 287-295.
Schroeder, H. W., & Green, T. L. (1985). Public preference for tree density in municipal parks. Journal of Arboriculture, 11(9), 272-277.
Schroeder, H. W. (1990). Perceptions and preferences of urban forest users. Journal of Arboriculture, 16(3), 58-61.
Ståhle, A. (2007). Sociotope mapping. Exploring public open space and its multiple use values in urban and landscape planning practice. Nordic Journal of Architectural Research, 19(4), 59-71.
Stigsdotter, U. K., & Grahn, P. Stressed individuals and preferences for activities and environmental characteristics in green spaces. Urban Forestry & Urban Greening, 10(4), 295-304.
Sullivan, W. C. (1994). Perceptions of the rural-urban fringe - citizen preferences for natural and developed settings. Landscape and Urban Planning, 29(2-3), 85-101. doi: 10.1016/0169-2046(94)90020-5
Sullivan, W. C., & Lovell, S. T. (2006). Improving the visual quality of commercial development at the rural-urban fringe. Landscape and Urban Planning, 77(1-2), 152-166. doi: 10.1016/j.landurbplan.2005.01.008
Todorova, A., Asakawa, S., & Aikoh, T. (2004). Preferences for and attitudes towards street flowers and trees in Sapporo, Japan. Landscape and Urban Planning, 69(4), 403-416. doi: 10.1016/j.landurbplan.2003.11.001
Tress, G., Tress, B., Harms, B., Smeets, P. , & Van der Valk, A. (Eds.) (2004). Planning Metropolitan Landscapes - Concepts, Demands, Approaches. Wageningen, Netherlands: Alterra.
Tveit, M., Ode, Å., & Fry, G. (2006). Key concepts in a framework for analysing visual landscape character. Landscape Research, 31(3), 229-256.
Ulrich, R. S. (1983). Aesthetic and Affective Response to the Natural Environment. In I. Altman & J. F. Wohlwill (Eds.), Behavior and the Natural Environment (pp. 85-125). New York, NY: Plenum Press.
Ulrich, R. S. (1986). Human responses to vegetation and landscapes. Landscape and Urban Planning, 13, 29-44.

Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), The Biophilia Hypothesis (pp. pp 73 - 137). Washington, D.C.: Island Press/Shearwater Books.
Van de Voorde, T., Jacquet, W., & Canters, F. (2011). Mapping form and function in urban areas: An approach based on urban metrics and continuous impervious surface data. Landscape and Urban Planning, 102(3), 143-155. doi: 10.1016/j.landurbplan.2011.03.017
Van den Berg, A. E., & Van Winsum-Westra, M. (2010). Manicured, romantic, or wild? The relation between need for structure and preferences for garden styles. Urban Forestry & Urban Greening, 9(3), 179-186.
Van den Brink, A., Van der Valk, A., & Van Dijk, T. (2007). Planning and the Challenges of the Metropolitan Landscape: Innovation in the Netherlands. International Planning Studies, 11, 147-165.
Van Herzele, A., & Wiedemann, T. (2003). A monitoring tool for the provision of accessible and attractive urban green spaces. Landscape and Urban Planning, 63(2), 109-126.
Voelker, S., & Kistemann, T. (2013). "I'm always entirely happy when I'm here!" Urban blue enhancing human health and well-being in Cologne and Dusseldorf, Germany. Social Science & Medicine, 78, 113-124. doi: 10.1016/j.socscimed.2012.09.047
Vogt, C. A., & Marans, R. W. (2004). Natural resources and open space in the residential decision process: a study of recent movers to fringe counties in southeast Michigan. Landscape and Urban Planning, 69(2–3), 255-269. doi: 10.1016/j.landurbplan.2003.07.006
White, E. V., & Gatersleben, B. (2011). Greenery on residential buildings: Does it affect preferences and perceptions of beauty? Journal of Environmental Psychology, 31(1), 89-98. doi: 10.1016/j.jenvp.2010.11.002
Zhang, H., & Lin, S.-H. (2011). Affective appraisal of residents and visual elements in the neighborhood: A case study in an established suburban community. Landscape and Urban Planning, 101(1), 11-21. doi: 10.1016/j.landurbplan.2010.12.010
Zhang, H., Chen, B., Sun, Z., & Bao, Z. (2013). Landscape perception and recreation needs in urban green space in Fuyang, Hangzhou, China. Urban Forestry & Urban Greening, 12(1), 44-52. doi: 10.1016/j.ufug.2012.11.001
Zheng, B., Zhang, Y., & Chen, J. (2011). Preference to home landscape: wildness or neatness? Landscape and Urban Planning, 99(1), 1-8. doi: 10.1016/j.landurbplan.2010.08.006

316 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