Biophilic urbanism: contributions to holistic urban greening for urban renewal

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Abstract

Purpose

- The purpose of this paper is to consider how biophilic urbanism complements and potentially enhances approaches for the built environment profession to holistically integrate nature into cities. Urban nature - also referred to as urban greening and green infrastructure - has increasingly been considered from many perspectives to address challenges such as population pressures, climate change and resource shortages. Within this context, the authors highlight how "biophilic urbanism" complements and may enhance approaches and efforts for urban greening.

Design/methodology/approach

Full Text

Introduction

In the twenty-first century, humanity faces a range of challenges that are unprecedented in scale and potential consequence. As the extent of climate change and resource shortages become apparent, environmental, social and economic conditions that have underpinned the form and function of our cities and lifestyles appear increasingly unlikely to persist into the future (Hargroves and Smith, 2005). At the same time, a rapidly expanding global population along with urbanisation trends are putting increasing pressure on cities and the systems that support the people who live there (United Nations, 2014).

Around the world, urban areas are being redeveloped to accommodate larger populations, including repurposing former inner city industrial areas for residential and mixed uses; and increasing densities in inner and middle ring suburbs. Ensuring the sustainability and liveability of these redeveloped areas is paramount. Urban infill must mitigate negative impacts of urbanisation, such as increased stormwater runoff; the urban heat island (UHI) effect; and a loss of greenspace. It must also include building resilience to climate change and resource shortage challenges that span heatwaves, increased electricity demand, increased extremes in precipitation, through to reduced food security and increased fuel costs. Simultaneously, considerations for urban liveability and public health and well-being are critical.

Urban nature - also referred to in various built environment disciplines as urban greening and green infrastructure - has been recognised as playing an important role throughout history, with a legacy today in many cities of parks and green space. More recently, the role of urban nature in regulating the urban environment has been considered, particularly within the context of mounting costs and difficulty in providing these same regulatory functions through alternative means. Such regulatory functions include reducing stormwater runoff; mitigating the UHI effect; reducing building energy demand; sequestering carbon and reducing greenhouse gas emissions; improving urban air quality; increasing urban biodiversity; and increasing property values (e.g. Gill *et al.* , 2007; Bolund and Hunhammar, 1999). Embedded within much of this literature is recognition of the importance of nature for holistic human health and well-being. However, applying this knowledge in practice in the design and development of urban areas has only recently begun to gain momentum, in large part due to the disciplinary divide between planners and built environment professionals, and those in health professions (Maller *et al.* , 2006; Srinivasan *et al.* , 2003). Further, there remain barriers to the preservation and creation of urban nature in cities today, such as land-use competition, financial constraints, lack of experience in sustaining nature in built-up areas and complexity associated with engaging multiple stakeholders implicated in urban greening projects (Jim *et al.* , 2010; Williams *et al.* , 2010).

In addition, as urban populations rise and land use competition intensifies; it becomes increasingly difficult to allocate land for urban nature. Forms of urban nature that require substantial ground-level space such as parks, backyards and reserves are only possible under certain circumstances such as when manufacturing plants close or when changes to transportation systems allow land to be repurposed. Within this context, forms of urban nature are required that minimise competition for land, and which provide maximum value for the space that they do occupy.

Methodology

This paper presents research conducted as part of a broader investigation into the mainstreaming of biophilic urbanism (Reeve, 2014). Adopting a qualitative, inductive case study approach, the authors used the following two methods to distil and connect schools of thought and research focused on natural features as a functional feature of urban design: literature review and case study.

Literature review

A literature review provided insight into existing experiences in integrating nature into urban areas to provide health and well-being benefits as well as resilience to impacts of climate change and resource shortages. The review considered peer-reviewed papers, as well as government reports and policies, and industry reports to capture both scholarly investigations into the role of urban nature in providing these liveability and resilience benefits, as well as the as-lived experiences of governments and practitioners in the use of urban nature. In

some cases, information from web sites was also considered, however, any statements or information found was verified where possible in other forms of literature, and an assessment was made regarding the authority of such sources. The review investigated the use of natural features to provide health and well-being benefits, while also mitigating identified challenges associated with climate change and peak oil such as heatwaves; intensified precipitation patterns (including both increased intensity and frequency of rainfall events, as well as increases in periods of low-precipitation); increased building energy demand; loss of biodiversity; oil price vulnerability; and food security. This provided foundational understanding regarding the current state of knowledge regarding the intentional uses of urban nature.

Case study

The authors considered six case studies of cities around the world to explore processes through which urban nature was used as a strategic, mainstream measure to build liveability and resilience in urban design and development. Document analysis, semi-structured interviews and direct observation (for three of the case studies) were used to gain insight into the use of urban nature in Berlin (Germany), Chicago (USA), Freiburg (Germany), Portland (USA), Toronto (Canada) and Singapore, and more specifically the factors that appeared significant in each city's transition towards mainstream urban greening.

Documentary evidence for each city included government policies, plans and reports; media reports; secondary analyses of cities (including journal articles, books, film footage, magazine reports); and government and industry web sites. Interviews were conducted with key actors in each city, who were identified as having the potential to reflect on the processes, challenges and systems that influenced the mainstreaming of biophilic urbanism, including government representatives, industry representatives, community leaders and academics that developed and/or reviewed initiatives. For the Berlin case study, which is the focus in this paper, interviews were conducted with two representatives from the Senate Department for Urban Development and Environment; with three representatives from a community advocacy organisation for urban greening; and with two citizens who had played key roles in grassroots urban nature initiatives, as detailed in Table I. An iterative analytical technique of explanation building (Yin, 2009) was used to identify, confirm and refine patterns and a set of factors relating to the mainstreaming process within each city and across the set of case studies.

It is noted that the cities considered did not use the term "biophilic urbanism", and whilst some have begun to adopt the term more recently, others do not. The term imposed by the authors to refer to intentional, formalised urban greening strategies that result in nature being integrated into urban areas as these develop in ways that provide people with regular and beneficial experiences of nature. The findings from this investigation are reported elsewhere (Reeve, 2014), with this paper considering in more detail several processes and outcomes observed in the cities that appear conducive to mainstream urban greening, and provide examples from Berlin.

Results

The biophilia hypothesis provides theoretical basis with potential to explain and enhance health and well-being benefits of urban nature. These benefits have the potential to substantially improve the liveability of dense urban areas, and to provide economic benefits through reduced physical and mental healthcare costs.

The following paragraphs discuss the emergent language of biophilic urbanism, and through a synthesis of literature describe a range of natural features across several scales that concurrently provide both health and well-being benefits as well as broader resilience and sustainability benefits.

Engaging with the language of biophilic urbanism

Kellert and Wilson (1993) suggest that humans have evolved a genetic tendency to prefer natural settings and situations that were important for survival, resulting in "an urge to affiliate with other forms of life" (Wilson, 1984, p. 85). Biophilia is hypothesised to result from "gene-culture coevolution", in which a certain genotype makes it more likely that someone will respond with certain behaviour to a given stimulus (Wilson, 1984, p. 33). If this behavioural response enhances survival and reproductive fitness, then this genotype will spread throughout the population and consequently result in that particular behavioural response becoming more frequent. In this manner, being able to see productive landscapes with the potential to provide for humans' need for food, water and shelter is thought to elicit positive neurological and physiological responses.

Research has found that humans prefer settings with running water, healthy green vegetation and flowers (flowers are often precursors to fruit, and hence a food source). People exhibit positive emotions towards domestic and wild animals, which may reflect a historical predilection towards being near such animals as a food source. Similarly, humans tend to feel at ease with shelter behind them, and an open view in front of them (prospect), enabling them to be at once protected from the elements, and able to see oncoming predators, prey and weather changes (Kellert and Wilson, 1993; Wilson, 1984). The theory of biophilia also includes "biophobia", or negative emotional responses to certain habitats, activities and objects that are potentially hazardous, such as barren landscapes (ice, desert) or predators and dangerous animals (snakes, lions, spiders). This aversion is typically not seen to modern threats, such as guns, swords or cars, suggesting that humans have not yet evolved a psychological response to these (Wilson, 1984).

Research has also found that when humans have experiences of nature, a range of positive neurological, physical and social benefits may result (see Table II). Achieving these benefits has the potential to improve quality of life, and provide direct and indirect financial benefits. This might include reduced health care costs, reduced costs of crime and violence, improved productivity and workplace performance, reduced costs of sick-leave and reduced costs of congestion.

Building on this body of research into human responses to nature, a set of elements have been evolved to direct urban development in ways that enhance the biophilic benefits they provide, within three categories, being (Browning *et al* ., 2014):

Nature in the Space: considers the presence of nature in various forms, such as plants, water, animals, as well as less direct ways of experiencing nature such as through breezes, sounds and scents. Nature in the Space experiences are enhanced through "meaningful, direct connections with these natural elements, particularly through diversity, movement and multi-sensory interactions".

Nature Analogues: refers to the replication of patterns colours, shapes, textures and materials seen in nature and might include leaf or shell motifs on walls, the use of wood and granite in furniture and the use of geometric patterns commonly seen in nature such as the Fibonacci sequence.

Nature of the Space: takes into account preferences for certain spatial configurations, such as having access to views beyond the immediate surroundings (prospect), as well as a sense of safety from environmental conditions (refuge). Designs that provide a sense of mystery and potential discovery through partially obscuring views or other sensors also stimulate human fascination.

Timothy Beatley (2011) has broadened considerations of biophilic design to consider how this might apply more to cities and urban planning. Beatley encourages looking beyond parks and green spaces to appreciate and celebrate the many forms nature that exists at all scales of the city. This includes highly altered ecosystems and non-endemic species, often at scales and in places that we are unaccustomed to looking. From street trees, to urban bats and possums, to insects flying above us, to the lichen and vines growing spontaneously on infrastructure around us, cities can support surprising amounts of life and biodiversity. In this regard, biophilic urbanism invokes recognition and enhancement of already existing nature in cities, as well as the design and integration of new forms of nature. The central concern for biophilic urbanism is to provide experiences of nature in urban areas that stimulate positive psychological and physiological responses, which may be achieved through strategically inserting nature into the built environment to maximise exposure to this nature; through optimising the design of natural features and the built environment to enhance the benefits they provide; and increasing awareness of and contact with the nature that surrounds people (Beatley, 2011).

In this paper, the authors focus in particular on the aspects of biophilic urbanism relating to the design of natural features (i.e. Nature in the Space), given the ability of these biophilic elements to also deliver environmental system benefits critical to the sustainability and resilience of cities, as described in the following section.

Functional urban nature features at multiple scales

A review of literature reveals much emergent experience with integrating nature into the urban environment; and research from multiple disciplines identifying benefits provided by urban nature, spanning management of stormwater, UHI, and energy demand as well as increasing property values, physical activity, urban amenity, infrastructure longevity and car dependency (see Table III). Building on Beatley's (2011) discussion of the importance of integrating nature across all scales of the urban environment (i.e. building, block, street, neighbourhood, community and region) to ensure urban residents experience nature throughout their daily lives, Table III provides a sample of natural features and examples of the multiple benefits these features have been found within the literature. Critically, many of these benefits have potential to provide resilience to challenges and concerns that may face cities. The biophilic design elements proposed by Browning *et al.* (2014) and principles espoused by Beatley (2011) for the development of biophilic cities may provide avenues by which the design of natural features may be enhanced to maximise their benefits to human health and well-being. The authors suggest that there is a critical nexus between biophilic urbanism and responding to many of the twenty-first century challenges facing cities, and that recognition of the broad range of benefits that natural features can provide can lead to the intentional and strategic incorporation of nature into the urban environment across multiple scales so as to enhance human health and well-being, whilst also providing resilience to urban challenges.

The three scales of natural features presented in Table III are abbreviated from those developed by Beatley (2011). Considering the challenges discussed above regarding land use competition, and disciplinary and stakeholder silos in the urban development process, these scales provide a functional grouping of features

that may assist with the development of policies and programs to direct the use of biophilic elements. There are a number of general considerations and opportunities for each that will influence their use, as follows:

Building scale features are integrated onto, into and around buildings within the boundary of a property parcel. Several considerations are evident, including: the use of these features is likely to be directed by the value perceived by property owners, unless mandatory requirements exist; the full value of natural features do not necessarily accrue to the property owner, with tenants and the broader community also benefiting from these features; as a high proportion of urban land is typically dedicated to buildings and individual lots, the potential for application of these features is high; and that the proximity of these features to infrastructure and people combined with the potential for widespread use is such that these features are likely to provide substantial overall benefits to environmental systems and individuals.

Street-scale features lie beyond the boundary of individual property parcels at the scale of a street. Several general considerations are evident, including: these spaces are typically publically owned; the potential use of street-scale features is high, given the proportion of urban space dedicated to streets and roads; these features need to that allow for (and potentially enhance) other activities that occur in these spaces, such as car, bicycle and pedestrian traffic, access by emergency and service vehicles, parking, underground and overhead services, and in the case of pocket parks, potential property development.

City-scale features are larger than a suburban block or urban street. These features are generally few in number, and where public access is provided, are accessible to all city residents. These features can also traverse a city. Several considerations are evident, including: features are large in size and difficult to retrofit into already developed urban areas other than in major land-use change situations; city-scale features generally have lower technical and engineering design requirements, as these may be less connected to urban infrastructure and other land uses; features may provide opportunities for recreation, nature-based experiences and biodiversity conservation not possible at the building or city-scale due to the size of individual features and separation from the built environment.

Discussion

Building on the synthesis of literature regarding the benefits of urban nature, and how such benefits might be achieved within dense urban environments, the following paragraphs discuss how incorporating perspectives from biophilic urbanism might shape urban design in practice. This discussion draws on the case study analysis of the six cities, with the Berlin case study used here to provide examples. It is suggested that the following processes and outcomes observed in the case study cities are supportive of biophilic urbanism and a broader agenda of strategic urban greening:

consideration of multiple forms of urban nature, in particular those that are compatible with urban consolidation, across multiple scales (i.e. building, street and city-scales);

consideration throughout the design process of how to optimise the health and well-being benefits of natural features, in addition to other environmental system benefits;

the use of integrated, multi-disciplinary, multi-departmental approaches to the inclusion and design of urban nature features, through increased recognition of the multiple values provided by urban nature that are of relevance to a variety of stakeholders and government departments; and

increased support and funding for urban nature features through recognition of the economic value provided by natural features, and the opportunity to decrease spending for the provision of environmental services.

These processes and outcomes are discussed in the following paragraphs.

Use of integrated forms of nature across multiple scales

Multiple forms of urban nature across spatial scales provide a continuity and diversity of nature experiences in urban environments; ensuring people have visual and physical access to nature. As highlighted in Table III, this range of features across spatial scales can lead to a wide range of sustainability and resilience benefits. For instance, building and street-scale features provide greater opportunities for stormwater and UHI management, due to being integrated into and around infrastructure and the potential for a larger number of these features to exist. City-scale features, however, provide potential refuge for biodiversity and opportunities for recreation that are less viable with smaller, more integrated features. As has been the case in Berlin, strategies to develop natural features at these three scales is also critical given the challenges and opportunities associated with doing so at each of these scales.

Urban greening in Berlin is primarily driven by a suite of policy and legislative measures, which largely derive from the Federal and Berlin Nature Conservation Acts. The Landscape Programme (LaPro) is based on these Acts and takes a high-level view of development in the city and seeks to address fundamental issues relating to urban planning such as the provision of recreational and green space, preservation of ecological value and balancing density with liveability (Berlin Senate, n.d.a). The LaPro is fundamentally concerned with the preservation of ecology and ecosystem function, as well as landscape amenity and providing for experiences of nature throughout the urban area (Berliner Vorschriften Informations System, 2013). This is achieved through mechanisms applied across scales, as discussed below.

At the building scale, the Berlin Biotope Area Factor (BAF) directs the integration of nature into properties (within BAF regulated zones), by requiring a set proportion of each site to be "ecologically effective surface area". Proportions are set according to the land use and the property location, and property owners are able to determine how to meet these requirements through the use of features such as green roofs, green walls, raised bed gardens and permeable pavement. These features are weighted according to their ecological value, with greater weighting given to vegetated features, and those that provide hydrological, air quality and biodiversity benefits. The BAF is enacted as properties are redeveloped and ensures that as properties in the densest part of Berlin are renovated and redeveloped, they become greener (Berlin Senate, 1990). This complements the Courtyard Greening Programme, which ran from 1983 to 1996 and provided moderate financial assistance for retrofitting green roofs, green facades and courtyard greenery to residential properties resulting in 54 hectares of greened courtyards and roofs (Kazmierczak and Carter, 2010).

At the street-scale, an emphasis on street tree planting has existed since most were destroyed during Second World War (Berlin Senate, n.d. d), with 2 million of funding recently provided for street tree planting despite very substantial budget restrictions (IR1). An innovative policy in Berlin that allows for temporary uses of vacant land has led to a large number of community orientated green spaces at this scale (Hansen, 2015), including in particular community gardens. This policy in large part reflects a social movement that was already occurring of citizens making beneficial use of underutilised land in this way, which had previously been resisted by the government, however recognition of the benefit this provides has resulted in this new approach (IR2).

At a city-scale, large green space and parks are frequently funded using offset funds from developers who are unable to meet their obligation for nature and landscape conservation under the LaPro. The 5.5-hectare Nordbahnhof Park is one such example, which occupies land that formerly housed a railway station destroyed in Second World War and parts of the Berlin Wall (Berlin Senate, n.d.c). Other major green space in Berlin similarly takes advantage of transport infrastructure that has become obsolete, including, for example the NaturPark Schöneberger Südgelände, which has a mix of vegetation and habitat types in what was formerly the Tempelhof railway yard (Berlin Tourismus and Kongress, n.d.a); and the Tempelhof Park where a large, central green space (predominately grassed) takes advantage of the now obsolete airport (Berlin Tourismus and Kongress GmbH, n.d.b). In addition, as part of the action programme for the Berlin-Agenda, 20 linear green parks are being developed throughout Berlin, providing a network of around 550 km of walkways, promenades and urban spaces. They link to several other parks and green spaces, and encourage active transport throughout the city (Berlin Senate, n.d. d).

Optimising the value of urban nature features

Given land use constraints and competing economic priorities challenging urban greening today, designing natural features to enhance the multi-functional benefits they provide can assist to justify these features economically and ensure maximum value is gained from space dedicated to these features. Poorly defined objectives for green space and a reliance on standard-based approaches that focus predominantly on the amount of land required to be dedicated to green space are noted to result in poor quality parks and open space that are not widely used (Byrne and Sipe, 2010; Byrne *et al.* , 2010), offering limited value to the community. Increasing recognition of the role of natural features in beneficially regulating various environmental systems in urban areas, such as the hydrological system and urban climate, is driving investment in, and the design of, natural features in many cities (e.g. United States Environmental Protection Agency (US EPA), 2010). Biophilic urbanism offers additional design guidance for maximising the contribution of these features to human health and well-being, and a framework for potentially justifying investments in natural features. The cities investigated all had explicit recognition of the multiple benefits provided by urban nature in their policies and programs that encouraged their use, and furthermore invested in research and demonstration of natural features to optimise their value and develop innovative ways of integrating nature into the built environment.

Berlin's Land Use Plan, LaPro, Landscape Strategy and Climate Change Strategies all recognise the multiple benefits that urban nature provides, and see the integration of nature into the fabric of the city as a strategy to enhance liveability, improve environmental function, respond to climate change and protect the city's water supply (Berlin Senate, 2011a, b, n.d.a). These strategies are strongly informed by Berlin's Environmental Atlas, which provides spatially enabled data relating to the quality of the soil, water, air, climate, land use, traffic, noise and energy for the entire urban area of Berlin, as well as the distribution of greenspace, open space, street trees, biotopes and bird populations. The Atlas also provides policy-relevant details such as the causes and effects of pollution and how these are related to urban features (Berlin Senate, n.d.e). To provide an example, this data has underpinned the city's Climate Change Strategy and in particular the use of urban nature, with green space and natural features throughout the city evaluated for the cooling benefit they provide, alongside evaluations of urban infrastructure including buildings and transport features and how these impact on the urban climate and climate change more generally. These analyses have led to data-based recommendations to manage urban temperatures and mitigate impacts of climate change, such as identifying optimal designs and locations for cooling and air quality management (Berlin Senate, n.d.f).

Integrated approaches to urban greening

The creation and maintenance of urban nature in cities is frequently regarded as an environmental management issue, with responsibilities for this residing within environmental departments, and/or parks and wildlife departments. Cities that use natural features as intentional and functional components of the urban landscape to provide a suite of benefits were found to engage a wide range of government departments as well as non-government stakeholders to design, fund, create and maintain natural features. Integrated approaches were also found to be necessary as the development of many natural features requires collaboration between multiple stakeholders and government departments, such as those responsible for urban planning, building approvals, transport, environmental management and parks and wildlife.

In Berlin, integrated planning is facilitated through the structure of the Senate, with the Senate Department for Urban Development and the Environment housing agencies responsible for building, planning, housing, traffic, environment and monuments. As a consequence, key policies and strategies that affect urban development and urban greening, including the LaPro, Land Use Plan, Climate Change Strategy, Landscape Strategy, Urban Development Concept 2030 and Biodiversity Strategy are developed with consideration for these policy areas. The arrangement of urban planners, landscape planners and nature conservationists sitting within this same Senate department has facilitated the close alignment between Berlin's Land Use Plan and LaPro - an arrangement credited with ensuring that urban development in the city considers green space requirements as an integral starting point, rather than an external afterthought (IR2; Hansen, 2015). An integrated view of urban greening is also clearly evident within these policies and strategies, with the multiple benefits of nature explicitly acknowledged spanning, for example food supply, raw material provision, water supply, air quality improvement, biodiversity and habitat provision, carbon sequestration, climate management, tourism and economic development, cultural and spiritual benefits, recreation, physical and mental health benefits (Kabisch, 2015).

Increased financial and policy support for urban nature features

Explicit consideration of the benefits urban nature can provide, and the deliberate design of nature to optimise these benefits, can lead to increased financial and policy support for urban greening and enable their more widespread use. This has been evident, for example, throughout the USA, where recognition of the stormwater management benefits of "green infrastructure" and the degree to which this could reduce requirements for more costly grey infrastructure to address combined sewer overflows has led to substantial budget allocations for the vegetated features (US EPA, 2010). Given the substantial proportion of government expenditure typically allocated to public health, the opportunity to explicitly recognise the health and well-being benefits of natural features, and to design them in order to maximise these benefits, has potential to expand budgetary allocations.

Berlin's financial difficulties have resulted in very substantial budget cuts to all departments, with budgets for urban greening not immune (Kabisch, 2015). These were reduced by 60 per cent over ten years, with similar cuts to the boroughs affecting maintenance of existing green space, as well as the development of neighbourhood plans needed to enact the BAF (IR2). Senate staff emphasised that these cuts did not reflect a lack of recognition of the value of urban nature, and indeed recent budget increases for urban greening - albeit marginal - resulted from the holistic communication of the benefits of urban nature and landscape planning through the Landscape Strategy (IR1, IR2). These budget cuts sit within a broader context of a substantial suite of policy measures and programmes that have resulted in a comprehensive legislative framework

directing urban greening, with many costs shared with the private sector. These policies and programmes are reflective of widespread acknowledgement of the multiple values of urban nature, which persist today as evidenced by the overwhelming support for the StEPKlima and its strong focus on urban greening as a response to climate change amongst city planners, politicians and citizens (UN-Habitat, 2012).

Conclusion

Experiences of mainstreaming the use of integrated urban nature suggest holistic approaches to urban greening that recognise the diverse benefits of natural features can lead to processes and outcomes supportive of comprehensive, strategic and formalised urban greening approaches. These can result in natural features delivering health and well-being benefits as well as a range of sustainability and resilience benefits to cities.

As an emerging field, biophilic urbanism draws on theoretical propositions of an innate affiliation with nature to propose design elements and planning approaches to enhance the holistic health and well-being benefits of urban environments. These may assist built environment professionals and planners in efforts to address liveability and health and well-being concerns in urban areas, and to optimise the benefits provided by natural features. The inclusion of biophilic urbanism design principles may complement holistic approaches, in particular through; encouraging the use of natural features across various scales of the urban environment; optimising the design of features so as to obtain multiple benefits; using integrated, multi-disciplinary and multi-departmental processes in policy development and the design and development of features; and securing financing for urban greening based on recognition of the multiple values it provides.

As the field is clearly emergent, alongside a number of other fields that direct the use of urban nature, the ongoing challenge for all such approaches to urban development is to transition from an *ad hoc* , champion-based approach to integrated nature, to one in which this is a mainstream aspect of urban development. Further work is needed to more clearly address critical issues, such as gaining economic recognition of the diverse benefits of urban nature in decision making processes; gaining technical knowledge necessary to develop engineered, integrated forms of nature; integrating local horticultural knowledge into natural feature design and development process to enhance survival rates and functionality; addressing barriers within planning and approval processes; and overcoming institutional resistance.

Table I Berlin interview respondents

[Image omitted: See PDF]

Table II Health and well-being benefits of nature

[Image omitted: See PDF]

Table III Biophilic features and their scales

[Image omitted: See PDF]

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