Review

Informal urban greenspace: A typology and trilingual systematic review of its role for urban residents and trends in the literature

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A B S T R A C T

Urban greenspace is vital in fulfilling people's nature needs. Informal urban greenspace (IGS) such as vacant lots, street or railway verges and riverbanks is an often-overlooked part of the natural urban landscape. We lack a formal definition of IGS and a comprehensive review of knowledge about IGS and its role for urban residents. This paper advances a formal definition and typology of IGS that can be applied globally. Based on this definition, a total of 65 peer-reviewed papers in English (57), Japanese (7) and German (1) were reviewed. We analyzed this literature for its temporal trends, spatial patterns, studied IGS types, methods used and key authors, and summarized the individual research papers' findings concerning IGS. Results show IGS plays an important role for urban residents, but also highlight limitations and problems in realizing IGS' full potential. Research papers focused on perception, preferences, value and uses of IGS. Residents could distinguish between formal and informal greenspace. They preferred a medium level of human influence in IGS. The analysis of patterns in the literature reveals: a marked increase in publications in the last 20 years; a strong geographical bias towards the USA; and a lack of multi-type IGS studies including all IGS types. Publications outside of scholarly research papers also make valuable contributions to our understanding of IGS. Our results suggest IGS is emerging as an important sub-discipline of urban greening research.

Introduction

Cities are highly fragmented landscapes. They are comprised of a patchwork of paved and unpaved spaces, built and vacant land, and newly developed and obsolescent and/or abandoned buildings and infrastructure. Yet much of the research on urban forestry and urban greening focuses on clearly demarcated remnant or formal vegetation assemblages, such as habitat fragments, urban forests and parklands. But conventional park systems can be expensive to maintain, may be unviable in denser built environments, and may ultimately fail to satisfy residents' diverse needs (Byrne et al., 2010). Park management authorities widely employ use restrictions and thus limit the recreational potential of parks, for example as a playground for children (Gaster, 1991; Rupprecht, 2009). Comparatively less research has addressed the ambiguous, in-between or 'liminal' vegetated spaces found in cities across the world, spaces that Jorgensen and Tylecote call 'ambivalent landscapes' (Jorgensen and Tylecote, 2007).

Even in the most densely developed metropolises, there are still a multitude of vacant lots, railway sidings, utility easements, corridors between buildings and canal sides that are often overgrown with spontaneous vegetation, which are not coherently managed, and which seem to occupy an uncertain, interstitial niche in the urban matrix (Ward Thompson, 2002). Even backyard gardens and suburban lawns can be liminal. They may be highly manicured, rambling or even overgrown and neglected, depending upon many factors such as feelings of ownership, socio-economic status, identity, cultural beliefs, level of neighbors' surveillance, age and government regulation, among others (Head and Muir, 2006; Trigger and Head, 2010).

Liminal green spaces elicit many questions. Why have they seemingly been neglected by researchers? Are such informal green spaces really temporary and transitory? Might they provide more permanent, but seldom-acknowledged functions for urban residents? If so, what benefits might they confer upon users and non-users, and what problems might they present? How can we formally define and describe them in a way that can be applied globally? What does the literature say about them and their role

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for urban residents? What trends exist in the literature (temporal trends, spatial patterns, studied space types, methods used, key authors)? To answer these questions, this paper advances a concise, tri-lingual review of 65 peer-reviewed research papers, as well as a summary of pertinent books, on what we call 'informal urban green space', a particular type of liminal green space.

Liminality and informality: defining informal urban greenspace (IGS)

Recent research by urban researchers such as Seymour and colleagues (2010), Ghosh and Head (2009), and Guitart and colleagues (2012), has noted that urbanization is placing pressure on the ability of formal green space systems to meet residents' recreational, livelihood, sustenance and wellbeing needs. Scholars and practitioners have begun to turn their attention to forgotten or leftover urban spaces to better understand what functions they perform and how they might meet the needs of diverse urban populations (Pyle, 2002; Jonas, 2007; Schneekloth, 2007; Jorgensen and Keenan, 2012; Campo, 2013; Kremer et al., 2013). Some of this research has concentrated on formal greening programs, such as the renewal of Los Angeles' alleyways (Seymour et al., 2010) whereas other research has attended to 'leftover' spaces that may be used for food production (McLain et al., 2014). The urban agriculture literature, for instance, is replete with examples of informal or liminal spaces, some of which have attained a semi-permanent status while others have vanished as quickly as they appeared (Smit and Nasr, 1992). What is common to all of these spaces is uncertainty with regard to land tenure, conservation status, maintenance regimes, use, regulation and legitimacy (McLain et al., 2014). They are liminal spaces.

The concept of liminality is derived from several disciplines but is salient within the literature of urban geography (Howitt, 2001; Davison, 2008). It refers to a state of 'betweenness', intermediacy, or ambiguity of being – the 'indeterminacy of loose space', as Franck and Stevens call it (2007). Liminal spaces are 'at the margins', characterized by emergence and flux, fluidity and malleability, and are neither segregated nor uncontained (Moran, 2011). For this reason they are often contested.

To provide guidance and a sense of coherence in the fractured literature on this topic, we draw on a provisional, non-exclusive definition and typology of a form of liminal, quasi-public green spaces we call 'informal urban green space' (IGS). This definition and typology has already been tested in a field survey of IGS quantity and characteristics (Rupprecht and Byrne, 2014). We defined 'informal green space' (IGS) as an explicitly socio-ecological entity, rather than solely cultural or biological. IGS consists of any urban space with a history of strong anthropogenic disturbance that is covered at least partly with non-remnant, spontaneous vegetation (Del Tredici, 2010). It is neither formally recognized by governing institutions or property owners as greenspace designated for agriculture, forestry, gardening, recreation (either as parks or gardens) or for environmental protection (the typical purposes of most greenspace). Nor is the vegetation contained therein managed for any of these by the official owner. Any use for recreational purposes is informal and transitional (e.g. unsanctioned verge gardening), taking advantage of the liminal characteristics of IGS. Unlike formal greenspace, human origin and ecological conditions, not management, are the factors influencing IGS the most (Fig. 1).

IGSs differ in their management (e.g. access, vegetation removal, stewardship), land use and site history, their scale and shape, soil characteristics and local urban context. For example, a small brownfield and a vacant lot may be similar in appearance and size, but their different land use history, vegetation removal periods and urban context distinguish them. We identified nine different
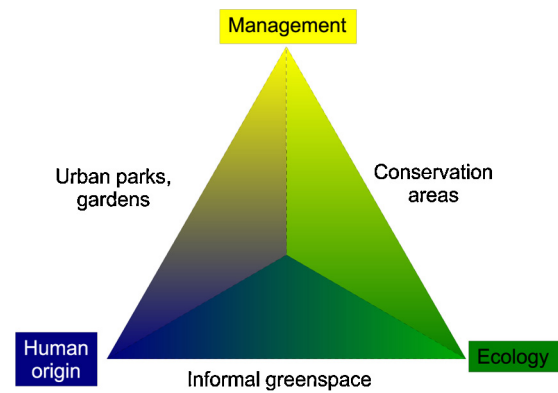

Fig. 1. Comparison of IGS and formal greenspace in terms of influence factor gradients.

subtypes of IGS: street verge, lot, gap, railway, brownfield, waterside, structural, microsite and power line IGS (Table 1 and Fig. 2). The subtypes are not exclusive; thus an IGS may be categorized as multiple subtypes (e.g. street verge and gap). Because this typology recognizes the variety of non-traditional greenspace, it provides a better basis to analyze the implications of IGS for planning and conservation than broad terms such as "wasteland" or "derelict land", and will be used in this systematic review. As mentioned above, the typology has already been applied to survey quantity and characteristics of IGS in a case comparison study (Rupprecht and Byrne, 2014). The distinction between IGS and formal greenspace is not binary, but rather characterized by a gradient of informality: formal recognition as recreational space by the owner provides a criterion to identify a local-government owned vacant lot covered with mowed lawn as IGS, but a low maintenance "wild" private garden as formal greenspace.

The use of the term 'informal greenspace' is not new, but it has thus far not been defined in a way that permits systematic and repeatable research by different scholars. Nicol and Blake (2000) include it in their review on open space but do not differentiate between IGS, as defined in this paper, and space used informally for recreation. Freeman and Buck (2003) and Freeman (2005) provide more detail by naming examples of IGS, but include arguably formal greenspace such as private gardens and provide no clear definition. Other authors use the word "informal" with varying meanings but do not describe the spaces in detail (Tartaglia-Kershaw, 1982; Burgess et al., 1988; Ward Thompson, 2002; Bell and Ward Thompson, 2003; Bjerke et al., 2006; Qviström, 2008; Nichol et al., 2010; Kattwinkel et al., 2011). The terms "urban wildscapes" (Jorgensen and Keenan, 2012) and "urban wilderness" (Konijnendijk, 2012) have also been used to describe liminal spaces similar to IGS. The provisional definition we have provided above aims to offer a basis for future studies of IGS.

This definition and description explicitly excludes remnant vegetation, parks, ornamental plantings (e.g. flower beds), gardens, secondary-growth urban forests and agricultural areas (fields, rice paddies, etc.). Such spaces differ from IGS in how they are recognized, managed and developed; they result from intention by the property owner, whether the vegetation is intentionally planted (e.g. in parks, gardens or second-growth forests) or intentionally preserved (e.g. remnant bushland). Secondary-growth urban forests (rather than, for example, small patches of woody vegetation on a brownfield) represent a borderline case and there is already substantial literature available on these forests, such as the seminal book edited by Kowarik and Körner (2005), parts of which apply to IGS (e.g., Rink and Emmrich, 2005). However, in most cases such forests are recognized for silvicultural or recreational value and thus excluded from the definition of IGS used in this review.

Table 1
Informal urban greenspace typology (Rupprecht and Byrne, 2014).

IGS	Examples	Description	Management	Form	Substrates
Street verges	Roadside verges, roundabouts, tree rings, informal trails and footpaths	Vegetated area within 5 m from street not in another IGS category; mostly maintained to prevent high and dense vegetation growth other than street trees; public access unrestricted, use restricted	Regular vegetation removal ($\geq$once per month); governmental and private stewardship	Small: <100 m^2, linear	Soil, gravel, stone, concrete, asphalt
Lots	Vacant lots, abandoned lots	Vegetated lot presently not used for residential or commercial purposes; if maintained, usually vegetation removed to ground cover; public access and use restricted	Irregular veg. removal, medium to long removal intervals; private stewardship	Small–medium: <1 ha, block	Soil, gravel, bricks
Gap	Gap between walls or fences	Vegetated area between two walls, fences or at their base; maintenance can be absent or intense; public access and use often restricted	Irregular veg. removal; variable removal intervals; private stewardship	Small: <100 m^2, linear	Soil, gravel
Railway	Rail tracks, verges, stations	Vegetated area within 10 m adjacent to railway tracks not in another IGS category; usually herbicide maintenance to prevent vegetation encroachment on tracks; public access and use mostly restricted	Regular veg. removal (monthly to yearly); corporate or governmental stewardship	Medium–large: >1 ha, linear	Soil, gravel, stone
Brownfields	Landfill, post-use factory grounds, industrial park	Vegetated area presently not used for industrial or commercial purposes; usually no or very infrequent vegetation removal and maintenance; public access and use mostly restricted	Irregular veg. removal, long removal intervals; corporate and governmental stewardship	Medium–large: >1 ha, block	Soil, gravel, concrete, asphalt
Waterside	Rivers, canals, water reservoir edges	Vegetated area within 10 m of water body not in another IGS category; occasional removal of vegetation to maintain flood protection and structural integrity; public access and use often possible with some restrictions	Irregular veg. removal, long removal intervals; governmental stewardship	Small–large: >10 m^2 to >1 ha, linear	Soil, stone, concrete, bricks
Structural	Walls, fences, roofs, buildings	Overgrown human artifacts; often vertical; occasional removal of vegetation to maintain structural integrity; public access and use mostly restricted	Irregular veg. removal, medium to long removal intervals; varying stewardship	Small: <100 m^2, block	Soil, stone, gravel, wood, metal
Microsite	Vegetation in cracks or holes	Vegetation assemblages in cracks, may develop into structural IGS; maintenance can be absent or intense	Irregular veg. removal, variable removal intervals; variable stewardship	Very small: <1 m^2, point	Deposits, soil, stone, concrete
Power line	Power line rights of way	Vegetated corridor under and within 25 m of power lines not in another IGS category; vegetation removed periodically to prevent high growth; public access and use mostly unrestricted	Regular veg. removal (less than yearly); utility or governmental stewardship	Medium–large: >1 ha, linear	Soil

Methods

We used a systematic review approach following Pickering and Byrne (2013) as the basis for reviewing the existing literature. This method differs from a classic meta-analysis, as the results of the reviewed literature are not used as data for further statistical analysis. Instead, relevant information about peer reviewed published papers is extracted and the review results are used to quickly identify geographic, theoretical and methodological gaps by analyzing trends in the literature (Pickering and Byrne, 2013). One limitation in recent research papers using this approach is the exclusion of non-English literature (Guitart et al., 2012; Roy et al., 2012). The results of our preliminary searches showed that some of the analyzed research papers conducted in Germany, Japan, Switzerland and even Korea were published in German and Japanese rather than English. Given the first author's proficiency in multiple languages, German, Japanese and English publications were included in this review. The preliminary searches also revealed IGS-related research papers published in other languages, such as Spanish (Lopez-Moreno et al., 2003) and Russian (Tikhonova et al., 2002), but these focused on ecological rather than social aspects of IGS. For

the same reason, we also excluded 154 ecological research papers on IGS in English, Japanese and German. These findings raise serious questions about the potential bias and incompleteness in literature reviews based only on English literature, particularly given reported negative effects of relying on English as the language of science (Ammon, 2001; La Madeleine, 2007; Uzuner, 2008). However, we recognize that in our own review, we have not been able to address papers published in many other languages (e.g. Mandarin, Polish, Spanish, etc.) and we take up this point in the conclusion where we call for an extended review in other languages.

For this review, we systematically searched five major databases (Web of Knowledge, Scopus, Google Scholar, CiNii and J-STAGE) using Boolean functions to combine search terms, for example "urban AND [all socio-cultural aspect terms with OR functions] AND [IGSvariable]". (For full list of search terms in all three languages see Appendix A). Database searches were performed in early 2011 for the full time frames available, and updated in early 2013 with a repeated search in Web of Knowledge, Scopus and Google Scholar for papers published since the first search. We did not seek to impose a time limit on the search (e.g. 20 years) but it should be noted that not all older papers may be full-text

Fig. 2. Photographs of informal greenspace types following the typology devised in Table 1. (a) Street verge, covered in spontaneous herbal vegetation (Brisbane, Australia); (b) lot, formerly residential with perfunctory access restriction (Tōkyō, Japan), (c) gap, space between three buildings with spont. herbal vegetation used by birds (Sapporo, Japan); (d) railway, annual grass verge between rail track and street; (e) brownfield, spont. vegetated industrial space around abandoned factory (Brisbane); (f) waterside, spont. vegetation on banks and deposits in highly modified river (Nagoya, Japan); (g) structural, spont. vegetation growing out of vertical, porous retaining wall (Tōkyō); (h) microsite, grass growing spont. growing out of crack in the pavement (Nagoya); (i) powerline, vegetated right of way underneath high voltage powerline (Brisbane).

searchable, a limitation that may cause them to be underrepresented. We selected a number of research papers specifically targeting IGS to look for additional potentially relevant publications not returned in the database searches. To be included for the analysis, research papers had to meet one of two inclusion criteria: (1) target either IGS as defined above, or (2) examine a similar human–nature relationship, allowing a partial transfer of the findings to the case of IGS. Research papers were then systematically analyzed for findings on the role of IGS for urban residents, study characteristics of individual research papers (year of publication, location, IGS type, examined aspect of IGS, study methods), and publication trends across all research papers, such as temporal trends, spatial patterns, studied IGS types, methods used, and key authors. Principal and co-authorship was used to identify authors who contributed multiple research papers. Results are presented in tables and figures to efficiently present findings from the large number of research papers, following similar presentation and analysis methods used in recent literature reviews (Garden et al., 2006; Matsuoka and Kaplan, 2008; Roy et al., 2012).

Results and trends in the literature

We found a total of 65 original research papers widely distributed across 31 journals and five edited books. Journals with the most research papers published were *Landscape and Urban Planning*, followed by *Landscape Research, Journal of the Japanese Institute of Landscape Architecture*, then *Urban Forestry & Urban Greening* (Table 2). This suggests a variety of journals and scholars share an interest in this topic.

Table 2
Journals containing most IGS papers.

Journals containing two or more papers	Number of papers	Percent of papers[a] (%)
Landscape and Urban Planning	16	24.6
Landscape Research	6	9.2
Journal of the Japanese Institute of Landscape Architecture	4	6.2
Urban Forestry & Urban Greening	3	4.6
Journal of Environmental Psychology	2	3.1
Papers on Environmental Information Science	2	3.1
Society & Natural Resources	2	3.1

[a] Percentage does not add up to 100% as only journals with most papers are shown.

Table 3
Common studied aspects in papers on IGS' role for urban residents.

Studied aspect	Number of papers	Percent of papers[a] (%)
Perception (cultural, social, etc.)	18	28.6
Preference (general, visual, cultural, etc.)	17	27.0
Use (actual, potential, children's, etc.)	12	19.0
Value (cultural, educational, etc.)	8	12.7

[a] Percentage does not add up to 100% as only most common categories are shown.

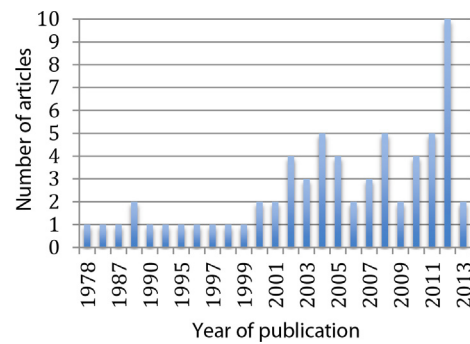**Fig. 3.** Publication history of papers on IGS' role for urban residents.

Role of IGS for urban residents

The findings of this systematic review are presented in a summary of the four main aspects examined by the research papers (perception, preferences, value and use of IGS, see Table 3). Additionally, two tables show the research papers' year of publication, location, IGS type, examined aspect of IGS and study methods (Appendix B), and the individual research papers' findings in regard to IGS (Appendix C). We discuss the main findings and their implications after summarizing the results and examining trends in the literature.

Researchers report that residents perceive a diversity of IGS aspects, such as its naturalness, use, maintenance, safety and access (Asakawa et al., 2004; Gobster and Westphal, 2004). Residents can distinguish between formal and informal greenspace (Talbot et al., 1987; Özgüner and Kendle, 2006). Residents also recognize problems and benefits of IGS – benefits not always recognized by authorities (Pincetl and Gearin, 2005; Platt, 2012). However, perception differed among resident groups: residents with little nature contact experience (e.g., those living in high-rise apartments in newly developed areas) show less nature affinity than those with extensive nature contact experience (Sawaki and Kamihogi, 1995).

Research has found that residents have preferences for characteristics distinguishing IGS from formal greenspace, namely naturalness (including trees, water, water quality, a degree of wilderness, less grooming than in formal greenspace), diversity and mystery (Herzog, 1989; House and Fordham, 1997; Gobster and Westphal, 2004; Chon and Shafer, 2009). But residents also prefer a certain level of maintenance (a "tended" look, cleanliness), accessibility, usability and being familiar with the appearance (Nassauer et al., 2001; Todorova et al., 2004; Chon and Shafer, 2009; Rall and Haase, 2011; Zhao et al., 2012). Those characteristics which residents dislike were uniformity, artificial modification, high formality, no modification and too mature vegetation (Kadono, 1996; Yokohari et al., 2004). Residents thus cherish the special features of IGS, but prefer spaces that show a certain (not too low or too high) level of human influence. However, preferences differ between individuals, seasons and different groups (such as laypersons and professionals, adults and children) (Rink and Emmrich, 2005; Hofmann et al., 2012).

The literature has also identified several ways IGS can be valuable. IGS can provide recreational value and improve daily life by adding urban greenspace area (Kelcey, 1978; Hayashi et al., 1999; Aristimuño, 2002). It can also provide emotional benefits by inspiring residents and connecting humans' natural and cultural selves (Jorgensen and Tylecote, 2007). It serves children as a personal special place, gives them the chance to challenge themselves and to experience nature (Pyle, 2002; Platt, 2012). IGS may also be valuable in shrinking cities (Rink and Emmrich, 2005; Mathey and Rink, 2010; Rall and Haase, 2011), as an alternative to classic conservation areas (Rink and Emmrich, 2005), and as a challenge to our consensus of what space is supposed to be (Verschelden et al.,

2012). Researchers emphasize that IGS has much potential which remains untapped.

While scholarly papers show the significant future potential of IGS, they also reported that residents already use IGS for numerous activities, such as child play, dog walks, fishing, encountering strangers, gardening, shortcuts, relaxation, enjoying nature, sea contact, angling, sunbathing, jogging and barbecues (Talbot et al., 1987; Kim et al., 2002; Lachmund, 2003; Qviström, 2008; Foster and Sandberg, 2010; Rall and Haase, 2011; Hunter and Brown, 2012; Brighenti and Mattiucci, 2013; Unt et al., 2013). Children, minorities, migrants and homeless people were mentioned as frequent users of IGS (Pyle, 2002; Platt, 2012; Brighenti and Mattiucci, 2013). We will discuss these findings in more detail after examining trends in the literature.

Temporal trends in the literature

The number of socio-cultural research papers has risen over the last 20 years (Fig. 3), with over 75% of all research papers published since 2002. While interest in the recreational potential of IGS was discussed in 1978 (Kelcey), many earlier research papers only include IGS as one example or type among those studied (Talbot et al., 1987; Asakawa, 1990). A reason for the increasing interest may be the ongoing urbanization, the growing percentage of humans living in cities (UN-HABITAT, 2012), and problems this presents (e.g. nature-deficit disorder, Louv, 2008) – a point we return to in the discussion.

Spatial and linguistic patterns in the literature

The geographic distribution of study areas shows a heavy bias towards four countries: the USA (20 papers, 30.8%), Japan (15 papers, 23.1%), the UK (eight papers, 12.3%), and Germany (eight papers, 12.3%) (Fig. 4). But few research papers compare different cultural and governmental contexts. Papers from countries with increasing research output, such as China, are notably rare. Non-English papers (eight papers, 12.3%) were mostly comprised of Japanese papers (seven papers, 10.8%), with their study areas being Japan (six papers, 9.5%) and Korea (one paper, 1.6%). Only one paper was written in German (1.6% of all papers and 12.5% of papers whose study area was Germany).

Target IGS types

The distribution of research papers per type of space examined shows a clear focus on waterside IGS and multi-IGS-type papers (19 papers, 30.2% both, Fig. 5). The large number of multi-IGS-type papers may be the result of papers discussing IGS in general rather than a specific type – papers were classified as multi-IGS type if two or more IGS types were studied. Even in these papers, however, comparisons between different IGS types were rare. Literature on
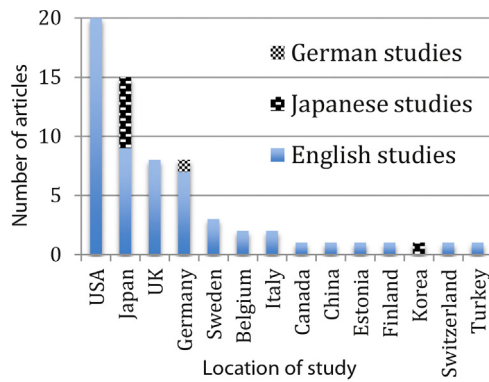
Fig. 4. Geographic and linguistic distribution of papers on IGS' role for urban residents.

Table 4
Methods used in papers on IGS' role for urban residents.

Methods used	Number of papers	Percent of papers[a] (%)
Survey (e.g. mail-back questionnaire)	30	47.6
Photography (e.g. photo survey, photomontage)	27	42.9
Interviews (e.g. semi-structured i.)	11	17.5
Literature review	9	14.3
Case study	6	9.5
Case comparison	3	4.8
Focus groups	3	4.8
Observation (incl. participant observation)	3	4.8

[a] Percentage does not add up to 100% as papers may use more than one method.

microsite, gap, structural, and powerline IGS types is scarce, possibly because of methodological challenges they present (e.g. size, abundance).

Main aspects studied

Published papers targeted a number of different aspects, with perception (18 papers, 28.6%) and preference (17 papers, 27%) being the most prevalent (Table 3). Perception papers examined which factors (e.g. recreational use, participation) influence landscape perception (Asakawa et al., 2004), and what differences exist in perception between user groups (e.g. children, adults, students, caregivers) (Mori et al., 2005; Rink and Emmrich, 2005). Preference papers covered, among others, aspects of visual preference (Akbar et al., 2003) and cultural preference (Lossau and Winter, 2011). IGS use papers could largely be divided into those on potential use (Hayashi et al., 1999) and actual use (e.g. by children) (Platt, 2012). The diversity of examined aspects of human–nature interaction are an indicator for the complexity of the topic, ranging from preference (Todorova et al., 2002; White and Gatersleben, 2011) and perception (Yamashita, 2002; Gobster and Westphal, 2004) to less studied topics such as willingness to coexist with nature (Sawaki and Kamihogi, 1995), biodiversity experience (Gyllin and Grahn, 2005) and the role of vacant lots as vegetable gardens (Kim et al., 2002).

Methods used

The most popular methods used were surveys (30 papers, 47.6%) and photography (27 papers, 42.9%, Table 4). Reasons for their popularity may include the flexibility surveys offer in collecting qualitative, quantitative and socio-demographic data, as well as the large role visual impression plays in perceiving and evaluating scenery. The in-depth analysis (Table 4) shows the full variety of methods authors employed. Mixed methods were popular, and many research papers use a variety of

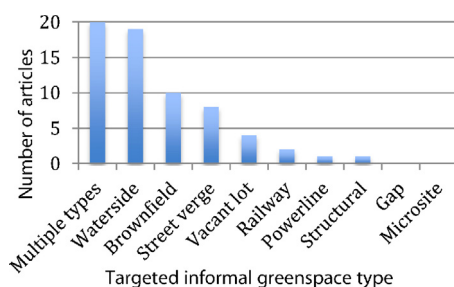**Fig. 5.** Distribution of papers on IGS' role for urban residents by targeted IGS type.

questionnaire-based surveys (Akbar et al., 2003; Asakawa et al., 2004), often combined with photographs (Herzog, 1989; Kaplan, 2007) or photo-manipulation (Mori et al., 2005; Sullivan and Lovell, 2006). Other papers use interviews, focus groups and participant observation (Rink and Emmrich, 2005; Lossau and Winter, 2011), case studies (Lisberg Jensen and Ouis, 2008), case comparison studies (Foster and Sandberg, 2010) or linguistic methods (Nakamura et al., 2000; Gyllin and Grahn, 2005). Participatory research methods (e.g. map-making) and GIS-based methods are still comparatively rare, possibly because of the higher time commitment and technological proficiency they require.

Key authors

Several scholars have contributed multiple research papers. Asakawa, who included vacant lots in a study on greenery and residents' satisfaction (Asakawa, 1990) also investigated how urban stream corridors are perceived (Asakawa et al., 2004) and co-authored papers on waterside IGS (Lee and Asakawa, 1992) as well as street verge vegetation design (Todorova et al., 2004; Mori et al., 2005). Kaplan studied preference for nature near workplaces (finding a desire for "wild" nature) (Kaplan, 2007). She has also co-authored IGS-related papers on nature perception and functions with Talbot and Kaplan (1984) and Talbot et al. (1987), and contributed to a review of people's needs that includes papers on IGS (Matsuoka and Kaplan, 2008). Özgüner examined attitudes towards naturalistic versus designed landscapes, finding a preference for informality (Özgüner and Kendle, 2006) and a waterside IGS restoration project in Turkey (Özgüner et al., 2012). Rink focused on social perceptions and acceptance of "wasteland" and "wilderness" (Rink and Emmrich, 2005; Rink and Herbst, 2011), and has co-authored a book chapter on socio-ecological aspects of urban wastelands and biodiversity (Mathey and Rink, 2010). Sullivan studied verges (Sullivan and Lovell, 2006) and waterside IGS in the form of agricultural buffers on the urban fringe (Sullivan et al., 2004). Sullivan also co-authored a paper on waterside IGS perception (Kenwick et al., 2009). Jorgensen has examined theoretical aspects and the significance of IGS (Jorgensen and Tylecote, 2007), and contributed in the form of an edited book (Jorgensen and Keenan, 2012) which we will discuss below.

Discussion

IGS appears to play an important role for urban residents, whose relationship with IGS is very complex and sometimes contradictory. The perceived vacancy of the spaces can mask their natural or cultural history (Corbin, 2003) and can be negatively interpreted as emptiness and dereliction (Ruelle et al., 2012). On the other hand, freedom of movement, discovery and wildness are also mentioned

as associations (Home et al., 2010). A subjective lack of purpose can also mean a freedom from purpose, following Franck and Stevens' 'indeterminacy of loose space' (2007). The creativity users of IGS demonstrate through a large variety of informal activities from nature contact to recreation (Unt et al., 2013) and food production (Kim et al., 2002) speaks for the benefits of urban space without prescribed use.

The disapproval of one group of residents may result in unilateral action for 'improvement' or removal of IGS that denies another group of residents valued opportunities. For example, the literature suggests vacant lots are predominantly evaluated negatively (Corbin, 2003), which may lead to their removal. Yet such lots provide children with the chance for discovery and the challenge of "secret nature" (Pyle, 2002). This has implications for the diversity of recreation needs and the insufficiency of formal greenspace (Byrne and Sipe, 2010). Realizing the potential of IGS for urban residents therefore requires negotiation between diverging perceptions, preferences, values and goals of users.

Not only do the study topics and methods scholars have employed show that IGS is a diverse and rich area of study, but the character and results of the research they found (Appendices B and C) also reveal the complexity underlying the human–nature relationship in urban areas. Similar to the potential of IGS for other living beings (Hard, 2001), one key theme in the literature is the benefits such spaces have to offer to humans. Scholars report health, mental and social benefits provided by vegetable garden space (Kim et al., 2002), play space, and improved greenspace accessibility (Kelcey, 1978). Researchers have also found opportunities for nature exploration and walking (Talbot et al., 1987), and new design possibilities, as well as a source of inspiration for a new aesthetic combining natural and industrial elements (Rink and Herbst, 2011). A limitation of the literature on IGS benefits is the lack of quantitative studies examining how widely IGS is used and appreciated.

But many scholars also report that much of this potential is not used because it is often not recognized, accepted or accessible (Asakawa, 1990; Hayashi et al., 1999; Rink and Emmrich, 2005; Rink and Herbst, 2011) – another key theme in the literature. They find that similar spaces such as matured greenways may indeed be viewed negatively and associated with crime (Talbot and Kaplan, 1984; Yokohari et al., 2004). Some authors attribute this finding to negative cultural associations with vacancy (Corbin, 2003) and explain how human perception and experience configures what is seen and recognized as green space (Lossau and Winter, 2011). This does not imply urban residents have a simple preconception of nature: research shows how residents distinguish between different types of greenspace (Talbot et al., 1987; Özgüner and Kendle, 2006) and emphasize how much importance is placed on this relationship with nature (House and Fordham, 1997; Gao and Asami, 2007; Matsuoka and Kaplan, 2008) and its complex interactions of perceptions, preferences, attitudes and needs (Sawaki and Kamihogi, 1995; Yamashita, 2002; Asakawa et al., 2004; Gobster and Westphal, 2004; Matsuoka and Kaplan, 2008). Scholars have shown that these aspects vary among different user groups (Byrne and Sipe, 2010). What this suggests is that planning should acknowledge the need for diversity in urban greenspace by providing for a variety of uses (e.g. playground, golf course, cultural events) (Kadono, 1996) and take into account conservation, social and cultural aspects (Aristimuño, 2002). That said, the scarcity of ways to overcome the challenges in using the potential of IGS represents a serious gap in the literature.

Research has found that informal greenspace may not address the needs of some adults (as discussed above). But a key finding is that children have their own needs and perceive their environment differently from adults (Ammon, 2001; Yamashita, 2002; La Madeleine, 2007; Uzuner, 2008). Research with children shows they seem to accept and use informal greenspace willingly (Rink and Emmrich, 2005; Rink and Herbst, 2011; Platt, 2012), although its existence and important role as secret, personal and special places for children are threatened by urban development and restrictions in children's freedom of movement (Pyle, 2002). Pyle (2002) contrasts his own extensive neighborhood and informal greenspace explorations with the example of a child confined to the cul-de-sac it lives in, due to parental concerns for safety, and the resulting loss of experience.

Researchers have also found that disparities between urban nature and inherited images of ideal nature show that issues of perception and social construction of nature expectations are not limited to adults (Dove et al., 2000). This has wide-ranging implications. Because urban areas are becoming the main source of nature contact for many humans, they are probably influencing nature conservation efforts even outside of cities (Dunn et al., 2006; Millard, 2010). Some studies have found that users may place high importance on the usability of IGS, viewing urban wilderness conservation areas as off limits to humans (Rink and Herbst, 2011). This suggests that the literature still lacks a detailed understanding of the human–nature relationship underlying residents' interaction with IGS.

This limited understanding of IGS is reflected in the trends we found in the literature. These trends may be explained by a number of reasons. We recognize that the scarcity of research papers we found from countries such as China, could be attributed to the limited number of languages used for this review. The linguistic distribution of the Japan-based papers – showing two distinct groups of Japanese and English papers (six papers published in Japanese, 40% of studies conducted in Japan) was different from the distribution of papers from Germany. The use of English in papers describing studies conducted in Germany and Japan may be explained by the fact that the results are potentially relevant to all researchers in this field, regardless of their location. The pattern of targeted IGS types showed many studies examined multiple IGS types and waterside IGS, but only a few looked at gap, powerline and microsite IGS. Additionally, railway and structural IGS papers were also rare – a serious limitation of the literature. However, research papers have examined the development of abandoned rail tracks into recreation trails ("rails-to-trails") and associated land use conflicts between proponents and opposing local land owners (Turco et al., 1998; Hawthorne et al., 2008).

Researchers have used a variety of methods to understand various aspects of human–IGS interaction. These include map surveys in which the participants express their relationship with the local area by drawing on maps (Aristimuño, 2002) as well as participant photography and on-site description of the environment (Yamashita, 2002). Such methods enable the researcher to engage participants actively in the research process. Even though participant photography methods are still uncommon (two papers, 3%), researchers using these methods have been able to report fascinating results. Yamashita (2002) used the photo-projective method and asked Japanese adults and elementary school fifth/sixth-graders to take pictures of their neighborhood's river environment, then add voice and written notes. He was able to show that children and adults perceive the river landscape and water in different ways – for children, water in the landscape attracted more attention, and its quality was more important than flow rate. Platt's use of the diary-interview/diary-photography method to examine American 10–12 year olds perception of public space helped him to discover that the children sometimes prefer vacant lots and sidewalks over parks for safety reasons (2012). Many papers also combine methods from multiple fields such as geography, planning and psychology (Almazán et al., 2012; Unt et al., 2013). But discussion of IGS and its role for urban residents is not limited to peer-reviewed journal papers.

IGS in (edited) books

There is a variety of books and edited books on IGS, which represent an important part of the literature. Gilbert's book "The Ecology of Urban Ecosystems" (1989) is an early example. It examined the ecological characteristics of urban commons, railway lines, roads and rivers, but also discussed human-wildlife interaction (pp. 311–317). Three recent books provide additional insights into the socio-ecological aspects of IGS. Jorgensen and Keenan's edited book (2012) "Urban Wildscapes" makes a valuable contribution by addressing relatively unexplored areas such as IGS in China and using rarely employed methods such as the analysis of children's literature. Hobbs et al.'s edited book (2013) "Novel Ecosystems" discusses not only ecological implications, but also includes nine chapters investigating aspects of the human–nature relationship (e.g. public engagement, children's use). Campo's intricate study of an "abandoned" Brooklyn waterfront shows what potential IGS can hold when embraced by the local community (2013). He found this liminal space provided, for a limited time, space for a variety of activities, from skateboarding and swimming to fishing and contemplation.

While not as methodologically rigorous, books such as "Natural History of Vacant Lots" (Vessel and Wong, 1987) illustrate an effort of scholars to engage with the public. Writers have also collected findings from the academic literature and combined it with research and interviews to produce books like "The Unofficial Countryside" (Mabey, 2010, first published in 1973), the "Rambunctious Garden" (Marris, 2011) and "London's Lost Rivers" (Talling, 2011). These works discuss the origin, character and role of some IGS types (e.g. brownfields, vacant lots, waterside IGS). Talling (2011) includes historic IGS no longer existing – a gap in the scholarly literature on IGS, and a topic linked to the concept of solastalgia (Albrecht et al., 2007), or feeling of loss when remembering a place from childhood. These works highlight some important aspects of IGS for urban residents, but our knowledge of IGS is still limited, and as we have shown in this review, research has been piecemeal. We lack a comprehensive research agenda on IGS.

Directions for future research

This review has identified gaps in our knowledge of IGS regarding three main aspects: (i) the geographic distribution of research; (ii) knowledge about specific, understudied types of IGS; and (iii) thus far underused methods of research (e.g. participatory methods, international comparisons, cross-cultural studies, studies combining socio-ecological aspects). Four countries, the USA, the UK, Germany and Japan, dominate the research on IGS (although we acknowledge our language limitations, which we discuss below). We still know very little about IGS in Africa, South America, South-East Asia, the Middle East, India, China or Australia. The geographical bias in the literature places limitations on cross-cultural meta-analyses, but international case comparison studies are also rare. These gaps are important because the types of greenspace may vary in different places, especially with cultural variations, and more cross-cultural research is required. However, it is important to note that this review only examined the available literature in English, German and Japanese. As mentioned above, our search found Spanish and Russian research papers on IGS. A review of literature on IGS these languages, Chinese, French, Polish and other languages would likely advance our understanding of IGS.

This literature review has revealed that scholars know little about gap and microsite IGS. The area of an individual site may be much smaller than that of a vacant lot or brownfield IGS, potentially presenting significant methodological challenges (Rupprecht and Byrne, 2014). Given the fragmented nature of urban landscapes, it is likely that a high number of such spaces exist within cities. Similar

to gaps and microsites, other less-studied IGS types (e.g., structural, powerline and railway IGS) are often absent in multi-type studies. The typology in this paper has sought to provide a basis for future comprehensive comparison studies of all IGS types.

In addition to including all IGS types, future studies on the social aspects of IGS should draw upon a broader array of research methods. User surveys have dominated the research to date. While they are certainly convenient ways of receiving feedback from IGS users or residents, they may mask rich details that can emerge from qualitative research. Photography is an obvious choice when examining an object most often experienced visually, but it too has limitations such as potential bias introduced if the photographer is not the participant. Ethnographic methods such as participant observation and collaborative map-making, or technology-based geographical information system (GIS)-enhanced analysis methods have only been used in very few cases. Mixed methods research may provide other insights (e.g., a deeper understanding of how urban residents think about and interact with IGS). Potential effects of IGS on children's health also warrant attention, given the finding that just having a view of greenspace may be important for physical and mental health (Taylor et al., 2002). A comprehensive study comparing the quantity of each IGS type present in different cities would represent a valuable starting point for a global IGS mapping initiative, and could be combined with quantitative survey of residents' interaction with IGS. The role of IGS for urban residents should be clarified by examining residents' perception, actual use, and reasons for use of IGS, whether residents have a history of using IGS as children, and potential links to their attitude towards urban nature. An international cross-cultural case comparison study of these topics would not only advance our understanding of IGS considerably, but would also provide valuable insights for urban conservation, planning and potential future use of IGS.

Conclusion

This review has systematically analyzed peer-reviewed research literature in English, Japanese and German on a type of liminal space, a group of quasi-public green spaces termed 'informal urban green spaces', to understand what role they play for urban residents. An increase in publications over the last 20 years suggests IGS is an emerging topic in urban greening research. Important gaps in the literature include: the scarcity of IGS studies outside of the USA, Europe and Japan, as well as the lack of studies on microsite, gap, structural, and powerline IGS types. Key themes emerging from the literature include: the health, mental and social benefits of IGS; difficulties in realizing potential IGS benefits due to recognition, acceptance and access issues; and differing perception of IGS between resident groups (e.g. children and adults). Key methods used include surveys and photography, but participatory, GIS-augmented and mixed methods remain scarce. The liminality of IGS poses a challenge for scholars and urban planners. Ambiguity, informality and malleability allow IGS to perform functions formal green space cannot, but at the same time leave IGS vulnerable to being contested politically, legally and aesthetically. The gaps in the literature on this topic suggests that what we understand about the human-IGS interaction may be outweighed by what we do not know. While this review has examined the literature on IGS in English, German and Japanese, a future review of literature in other languages may be a valuable step in filling some gaps in our knowledge about IGS.

Acknowledgements

Appendix A.

Search terms used in English, Japanese and German.

English	Japanese	German
IGSVariable		
Ruderal	荒地 (arechi)	ruderal
Railway	鉄道 (tetsudō)	Eisenbahn
Vacant lot	空き地 (akichi)	leeres Grundstück
Abandoned lot	空き地 (akichi)	verlassenes Grundstück
Walls	壁 (kabe)	Mauer, Wall
Street/road verges	道の端 (michi no hashi)	Straßenrand, Straßengraben
Curbside	舗道の縁石 (hodō no enseki)	Straßenrand
Wasteland	荒地、荒野 (kōya)	Ödland, Brache
Brownfield	工場跡地 (kōjōatochi), ブラウンフィールド	Industriebrache, Brache, Braunfeld
Landfill	埋立地 (umetatechi)	Deponie, Müllhalde
Industrial park	工業団地 (kōgyōdanchi)	Industriepark
Corridor	回廊 (kairō)	Korridor, Schneise
Power line	電線 (densen)	Hochspannungsleitung, Stromleitung
Riverbank	川岸 (kawagishi)	Flussufer
Buildings	建物 (tatemono)	Gebäude
Road swales	–	Straßengraben
Trails, foot paths	路 (michi)	Weg, Pfad, Fusspfad, Trampelpfad
Wilderness	荒野, 自然 (shizen)	Wildniss
Spontaneous vegetation	自然発生植生 (jihatsutekishokusei)	Spontane vegetation
Novel ecosystem	新興生態系 (shinkōseitaikei)	Neue Ökosysteme
Riparian	河岸 (kawagishi), 川岸、水辺 (suihen)	Ufer...
Socio-cultural aspects		
Landscape	景観 (keikan)	Landschaft
Greenspace	緑地 (ryokuchi)	Grünflächen
Perception	認識 (ninshiki), 意識 (ishiki)	Wahrnehmung
Value	価値観 (kachikan)	Werte
Attitude	態度 (taido)	Einstellung
Opinion	意見 (iken)	Meinung
Preference	選好 (senkō)	Präferenz
Relationship	関係 (kankei)	Beziehung

Appendix B.

Year of publication, location, IGS type studied, research focus, and method of papers on IGS' role for urban residents.

First author	Year	Country	Study area	IGS type	Examined	Method
Akbar	2003	UK	Multiple	Street verge	Visual preference	Survey
Almazán	2012	Japan	Tokyo	Structural	Visual impression	Mapping, photography
Aristimuno	2002	Japan	Kobe	Multiple	Landscape cognition	Map survey
Asakawa	1990	Japan	Sapporo	Multiple	Satisfaction	Survey
Asakawa	2004	Japan	Sapporo	Waterside	Perception	Survey
Brighenti	2013	Italy	Trento	Waterside	Role as public space	Case study, observation
Bryson	2012	USA	Spokane	Brownfield	Redevelopment issues	Case study
Chon	2009	USA	Houston	Street verge	Aesthetic responses	Photos, virtual tour, survey
Corbin	2003	USA	–	Vacant lot	Perception, value	Literature review
Dove	2000	UK	–	Waterside	Perception	Photo survey
Foster	2010	Canada	Toronto	Multiple	Values, attitudes	Case comparison
Gao	2007	Japan	Tokyo, Kitakyushu	Multiple	Preferences and land price effects	Photo, survey, land price analysis
Gobster	2004	USA	Chicago	Waterside	Perception of several aspects	Focus groups, survey, interviews
Gyllin	2005	Sweden	Multiple	Railway	Biodiversity experience	Survey, semantic model
Hard	2001	Germany	–	Multiple	Interaction with spontaneous ruderal vegetation	Literature review
Hayashi	1999	Japan	Matsudo	Vacant lot	Potential use	Field survey
Herzog	1989	USA	Grand Rapids	Multiple	Preference	Photo survey
Hofmann	2012	Germany	Berlin	Multiple	Visual preference	Photo survey
Home	2010	Switzerland	Zurich	Multiple	Cultural and biological evaluation determinants	Photos, interviews, Kelly's repertory grid
House	1997	UK	Eton Wick	Waterside	Preference	Survey
Hunter	2012	USA	Ann Arbor	Street verge	Use, social contagion	Field survey, GIS analysis
Jorgensen	2007	UK	–	Multiple	Role of urban landscape	Literature review
Kadono	1996	Japan	Tokyo	Waterside	Perception, use	User survey
Kaplan	2007	USA	Ann Arbor	Street verge	Landscape preferences	Photo survey, survey
Kelcey	1978	UK	Multiple	Multiple	Potential greenspace value	Field survey
Kenwick	2009	USA	Multiple	Waterside	Landscape preferences	Photo survey, survey

First author	Year	Country	Study area	IGS type	Examined	Method
Kim	2002	Korea	Iisan	Vacant lot	Actual and potential use	Field survey, User survey
Lachmund	2003	Germany	Multiple	Multiple	Historic scientific use	Literature review
Lafortezza	2008	Italy	Bari	Brownfield	Visual preference	Photomontage, survey
Lee	1992	Japan	Sapporo	Waterside	Perception	Survey
Lisberg Jensen	2008	Sweden	Malmö	Brownfield	History, cultural ideology	Case study, observation, interviews, discourse analysis
Lossau	2011	Germany	Berlin	Brownfield	Cultural perception, representation	Case comparison, interviews, participant observation
Mathey	2010	Germany	–	Multiple	Social perception, acceptance	Literature review
Matsuoka	2008	USA	–	Multiple	Preference, needs	Literature review
Millard	2010	UK	–	Multiple	Cultural perception	Literature review
Mizukami	2008	Japan	Kyoto	Waterside	Perception	Photo survey
Mori	2005	Japan	Sapporo	Street verge	Perception, preference	Photo simulation
Nakamura	2000	Japan	Multiple	Waterside	Perception	Photo, video, semantic differential
Nassauer	2001	USA	–	Waterside	Cultural values	Literature review
Özgüner	2006	UK	Sheffield	Waterside	Attitudes toward naturalistic and designed landscapes	Photos, survey
Özgüner	2012	Turkey	Isparta	Waterside	Perception	Survey, before/after comparison
Pincetl	2005	USA	Los Angeles	Multiple	Opinion, use	Focus groups, photos
Platt	2012	USA	Milwaukee	Multiple	Children's use	Diary-interview, diary-photography
Pyle	2002	USA	–	Vacant lot	Role for children	Literature review
Qviström	2012	Sweden	Multiple	Railway	Historical transformation	Case study
Rall	2011	Germany	Leipzig	Brownfield	Perception and sustainability indicators	Field survey, survey, interviews
Rink	2005	Germany	Leipzig	Brownfield	Perception and values	Photos, interviews, focus groups
Rink	2011	Germany	–	Multiple	Social context, educational value	Literature review
Ruelle	2012	Belgium	Multiple	Brownfield	Landscape preference	Case comparison, survey
Sawaki	1995	Japan	Kobe	Multiple	Coexistence with nature	Survey
Schaumann	1998	USA	Puget Sound	Waterside	Visual preference	Photomanipulation, Survey
Simcox	1989	USA	Tucson	Waterside	Value orientations	Photos, survey, interviews
Soini	2011	Finland	Helsinki	Powerline	Perception	Survey
Sullivan	2004	USA	Champaign-Urbana	Waterside	Attitudes towards agricultural buffers	Photomontage, survey
Sullivan	2006	USA	–	Street verge	Visual preference	Photomanipulation, Survey
Talbot	1984	USA	Detroit	Multiple	Preference	Photo survey
Talbot	1987	USA	Ann Arbor	Brownfield	Use and value	Photo, survey
Todorova	2004	Japan	Sapporo	Street verge	Vegetation preferences	Photomontage, survey
Unt	2013	Estonia	Tallinn	Brownfield	Informal use, aesthetics	Case study, interviews, policy analysis
Verschelden	2012	Belgium	Multiple	Brownfield	Role for community art	Case studies
Wagner	2008	USA	Ames	Waterside	Values	Interviews, survey
White	2011	UK	–	Multiple	Vegetation preferences	Photomontage, survey, interview
Yamashita	2002	Japan	Tanushimaru	Waterside	Perception, evaluation	Photo-projective method
Yokohari	2004	Japan	Tsukuba	Street verge	Fear of crime	Survey
Zhao	2012	China	Xuzhou	Waterside	Aesthetic preference	Photo survey

Appendix C.

Summary of findings of papers on IGS' role for urban residents.

First author	Year	IGS type	Examined	Main findings
Akbar	2003	Street verges	Visual preference	Verge vegetation perceived as drab but important; preference for variety of vegetation types, colorful herbs and trees over short-cut lawn; no willingness to pay more
Almazán	2012	Structural	Visual impression	Vertical greenspace overlooked in standard greenspace area analyses; small greenery plays most important role in creating a general sense of greenery in the area; street width has influence on likelihood of informal use by residents as plant pot space
Aristimuño	2002	Multiple	Landscape cognition	Perception and perception intensity are influenced by residence length; residents identify areas with recreational and conservation value even if they are degraded; rivers and nature-culture zones (temple grounds) play an important role for residents' daily life and identity
Asakawa	1990	Multiple	Satisfaction	Vacant lots are important part of vegetation cover but do not raise satisfaction; park greenery and greenery in housing lots strongly affect satisfaction; park greenery important for recreation, natural space greenery for nature contact and landscape; building cover and tree cover ratio can explain most variance and are important indices

First author	Year	IGS type	Examined	Main findings
Asakawa	2004	Waterside	Perception	Recreational use, participation, nature and scenery, sanitary maintenance, and water safety are important factors of stream perception; respondents fell into the three groups passive, recreation oriented and participation interested; streams should be enhanced ecologically, have a recreational circulation system and be integrated using local natural and cultural characteristics
Brighenti	2013	Waterside	Role as public space	Loose, largely unplanned and unequipped territory shows diverse use; danger of planning hubris leading to creation of domesticated and formalized space; use includes informal trails, dog walks, child play, fishing, encountering strangers; minority and migrant population among most active users; shelter and temporary residence for displaced, homeless people
Bryson	2012	Brownfield	Redevelopment issues	Brownfield redevelopment can solve but also create environmental justice problems (e.g. gentrification); residents appreciate site remediation and possible positive effects (e.g. lower crime rate, increase of community amenities) but are wary of gentrification effects (e.g. no affordable housing, rising property taxes, displacement); policymakers, planners and developers tend to celebrate positive effects while ignoring negative externalities; gentrification as a result of environmental remediation is also an environmental justice issue
Chon	2009	Street verges	Aesthetic responses	Maintenance, distinctiveness, naturalness, pleasantness and arousal represent five cognitive and affective dimensions of aesthetic response; all are positive predictors of greenway likeability
Corbin	2003	Vacant lot	Perception, value	Declaration of vacancy erases important dimensions of a site, such as natural history or characteristics, cultural history or meanings, systems whose functional purpose is not recognized; different approaches to vacancy offer ways to overcome negative cultural associations
Dove	2000	Waterside	Perception	Children have stereotypical images of rivers, typically with clean water, banks surrounded by vegetation, and located in the countryside; such images can prevent the recognition of other examples in different settings
Foster	2010	Multiple	Values, attitudes	Invasive species can serve important functions for local ecosystems and for human communities, are often compatible with recreational interests and can help restore human-made wastelands; naturalization efforts are ecologically sensitive and costly, often benefiting wealthy rather than poor neighborhoods
Gao	2007	Multiple	Preferences and land price effects	Greenery of walls, trees and open pedestrian space as well as the visual quality increase land prices
Gobster	2004	Waterside	Perception of several aspects	Cleanliness, naturalness, aesthetics, safety, access, and appropriateness of development are important dimensions of greenway perception and use; they show a rich variation among stakeholders and greenway areas
Gyllin	2005	Railway	Biodiversity experience	Experienced biological diversity is associated with words representing species richness, environments with a character of wilderness or nature, and variation; it is not necessarily associated with a positive experience; areas containing spontaneous vegetation and water obtained higher biodiversity index scores than did areas characterized by a short-cut lawn and more uniform vegetation
Hard	2001	Multiple	Interaction with spontaneous ruderal vegetation	Discussion of city nature must recognize different types of nature; current management is deeply flawed; IGS should be kept free from administrative intervention, including protection
Hayashi	1999	Vacant lot	Potential use	Vacant lot area is similar to that of parks; almost half are fenced off; rate of fenced off lots increases with urbanization; many will not be used in the near future and could be used as park alternatives
Herzog	1989	Multiple	Preference	Coherence, mystery and nature are positive predictors of preference; photos categorized as Tended Nature are liked most, old buildings least
Hofmann	2012	Multiple	Visual preference	Canopy closure was most important classification criterion for residents, artificiality for landscape planners; landscape planners preferred rather natural areas with low accessibility and high species richness, residents preferred formal parks; residents generally accept urban derelict land as recreational areas if a minimum of maintenance and accessibility is provided
Home	2010	Multiple	Cultural and biological evaluation determinants	Landscape preferences are based on separate cultural and biological modes of assessment; brownfield-type photo associated with freedom of movement, discovery, wildness
House	1997	Waterside	Preference	Respondents value river highly; preference for naturalness and diversity rather than uniformity and human interference; willingness to risk flood damage to avoid damaging impacts on local landscape, amenity and wildlife
Hunter	2012	Street verges	Use, social contagion	11% of surveyed properties had "easement garden" in privately managed public space; likeliness of holding such a garden influenced by similar gardens in vicinity, indicating social contagion is in play
Jorgensen	2007	Multiple	Role of urban landscape	Important in terms of their physical functions and as a means of unlocking imaginative truths and questions about the human condition; harbor post-modern wilderness; evolving landscapes which re-connect human natural-cultural selves in the context of urban existence
Kadono	1996	Waterside	Perception, use	Human behavior and perception of riverfront differs by area and local setting; construction of uniform facilities never provides proper solution; varying preferences: conservation without artificial modification, more parks and playgrounds, no golf courses, accessible river fronts for traditional cultural activities
Kaplan	2007	Street verges	Landscape preferences	Preference for large trees and prairie-like, less groomed settings; parking lots receive low preference ratings regardless of scale and settings, pointing to a need to reduce car dependency
Kelcey	1978	Multiple	Potential greenspace value	Derelict land, railways, rivers and canals constitute much of the scarce urban greenspace; large potential but in need of much improvement, which is linked to attitudes and philosophy of community, politicians, planners, etc.

First author	Year	IGS type	Examined	Main findings
Kenwick	2009	Waterside	Landscape preferences	Residents and planners prefer riparian buffers with trees and meandering streams
Kim	2002	Vacant lot	Actual and potential use	Vacant lots used as vegetable gardens provide multiple benefits; need for planning of such space in new development areas
Lachmund	2003	Multiple	Historic scientific use	Botanical studies of World War II bomb sites played large role in development of ecological and political thinking about ruderal sites
Lafortezza	2008	Brownfield	Visual preference	Rehabilitation alternatives more ecologically functional for forest bird species dispersal and also more visually preferable; differences in user groups and residence location
Lee	1992	Waterside	Perception	Greenery recalled as familiar is full of variety, consisting of different parks, private gardens and large scale greenery; distance to greenery limited to 1400 m with focus on 500 m core; large scale greenery more influence; percentage of greenery recalled influenced by cognition, frequency of use and type of greenery; assessment correlations are river and cleanliness, windbreak and pleasantness and safety, park and activeness
Lisberg Jensen	2008	Brownfield	History, cultural ideology	Place both natural and cultural; transition from industrial area to wasteland to enclave of nature; complex interaction with society including conflicts
Lossau	2011	Brownfield	Cultural perception, representation	Concepts of useful, beautiful and sensitive nature exist and play a crucial role in decisions of how city space is used; urban ecology is challenged by the social construction of nature and must deal with the arising complexity and questions
Mathey	2010	Multiple	Social perception, acceptance	Wasteland provides new biodiversity possibilities but poses acceptance problems; translation of ecological patterns into cultural language is required; spontaneous vegetation can become a design element; wasteland can solve problems in shrinking cities; wasteland is not perceived as wilderness as wilderness is seen as non-existent in cities
Matsuoka	2008	Multiple	Preference, needs	Strong support for the important role nearby natural environments play in human well-being; urban nature contact areas meet needs in a unique manner; urban residents worldwide express a desire for contact with nature and each other, attractive environments, places in which to recreate and play, privacy, a more active role in the design of their community, and a sense of community identity; beneficial space types are diverse
Millard	2010	Multiple	Cultural perception	Interactions between culture and urban biodiversity constitute a two-way complex of influences and drivers; urban biodiversity is the first and main contact that an increasingly large proportion of the world population has with biodiversity generally, and is therefore the key in shaping perceptions and attitudes to the natural world
Mizukami	2008	Waterside	Perception	Artificial and natural elements of urban riverscapes conflict with each other;
Mori	2005	Street verges	Perception, preference	Street intercept plantings increased comprehensive ratings and silence ratings for both user groups; sense of relief response differed between students and curators
Nakamura	2000	Waterside	Perception	Fluctuation in the evaluation, seasonal and individual differences are important sources for knowledge on river design
Nassauer	2001	Waterside	Cultural values	Riparian design can be novel in its ecological effects but should be sufficiently familiar in appearance to correspond with cultural values and thus be accepted
Özgüner	2006	Waterside	Attitudes toward naturalistic and designed landscapes	Public can distinguish between naturalistic and designed landscapes, appreciates both types and derives similar and different benefits; perceives natural areas as opposite of formal in a parks context and opposite of built-up in a city-wide context; both types of natural areas are preferred for different reasons
Özgüner	2012	Waterside	Perception	Restoration of derelict lands increases the value of such areas for people and enhances their uses for recreational purposes in urban areas; restoration of derelict and unused urban areas and preservation as green spaces is recommended
Pincetl	2005	Multiple	Opinion, use	Non-traditional greening not recognized by authorities; benefit recognized by residents; residents actively seek alternatives
Platt	2012	Multiple	Children's use	Children prefer informal spaces like vacant lots and sidewalks over parks; parks are perceived as dangerous, being frequented by gangs, posing the risk of violence, kidnapping, being shot; abundance of these alternative spaces ease children's access; vacant lots are perceived as having both negative and positive aspects; children see informal spaces as ripe for play rather than blight
Pyle	2002	Vacant lot	Role for children	Vacant lots play important role for children as place of nature experience and personal special place; dominant negative evaluation threatens existence of vacant lots; secret nature provides challenges; steps recommended to preserve existence for children's benefit
Qviström	2012	Railway	Historical transformation	Breakdown of site history and transformation from railway to ruin to green space provides vital background information; approach taking into account complex use history (e.g. fields, beaches, mining, allotment gardens, reserve) rather than limited goal of recreation or wildlife space favored; no clear boundaries between former function era and ruin phase
Rall	2011	Brownfield	Perception and sustainability indicators	Interim use brownfields scored higher than recently demolished brownfield sites; greater usage than other types, especially by men; uses include taking shortcuts, relaxation, enjoying nature and dog walks; desired improvements include seating and better maintenance; knowledge about interim use strategy is poor and sites are not recognized as intervention result; increased communication recommended; potential for shrinking cities
Rink	2005	Brownfield	Perception and values	Urban wilderness areas highly valuable to and accepted by children; used by some adults; other urban inhabitants need help to perceive such space as valuable; potential for shrinking cities; role in planning still small due to its focus on designed green; alternative to classic conservation areas

First author	Year	IGS type	Examined	Main findings
Rink	2011	Multiple	Social context, educational value	Urban wilderness must be useful; shutting out people for conservation leads to total rejection; urban nature distinct from ex-urban nature; biodiversity not recognized by residents and irrelevant for use; attractiveness cannot be exclusively derived from naturalness; inherited images of parks and designed green conflict with notions of urban wilderness; uncontrolled urban wilderness cannot be used as a planning strategy, as it intensifies negative impressions of dilapidation, especially in shrinking cities;
Ruelle	2012	Brownfield	Landscape preference	Perceived landscape quality influences community evaluation of regeneration schemes; preference of some community groups for post-industrial aesthetics; all brownfields are used to some degree, regardless of quality; emptiness and dereliction dominate as negative evaluation, but notions of quietness and nostalgia are also expressed; even well-regenerated sites are perceived as having maintenance issues
Sawaki	1995	Multiple	Coexistence with nature	Residents differ in their willingness to coexist with nature; some animals are liked, others disliked; species vary in their perceived appropriate habitat zones; some residents want to live more separately from nature; prolonged nature contact fosters preference
Schaumann	1998	Waterside	Visual preference	Expert opinion does not correlate with layperson choices; evaluation of scenic quality is not the same as understanding human behavior in our habitat; refined scenes are preferred over rough ones; majority of observed behaviors toward urban streams is negative
Simcox	1989	Waterside	Value orientations	Positive value orientations toward preservation of noncommodity amenities including wildlife habitat, riparian vegetation, open space, and scenic landscapes; encroachment of urban development into natural settings is weakening open space values and fostering attitudes that are tolerant of increased development; preservation of noncommodity landscape amenities may be impossible once urban development begins
Soini	2011	Powerline	Perception	Transmission lines generally perceived as negative landscape elements, both when long-established and when new; perceptions among the residents were heterogeneous; heterogeneity explained with environmental attitudes and leisure activities as well as knowledge and land ownership
Sullivan	2004	Waterside	Attitudes towards agricultural buffers	Support for buffers, with approval of basic buffers over three times that of the no buffer conditions and even greater approval for extensive buffers; farmers, academics, and residents agreed on their approval for the basic buffers over no buffers, but differed with respect to the extensive buffers
Sullivan	2006	Street verges	Visual preference	Nature plays an important role in the aesthetics of developed settings at the rural–urban fringe; trees in particular can be used to improve visual quality
Talbot	1984	Multiple	Preference	Well-maintained areas incorporating built features were preferred over more untouched and densely wooded areas, which were often associated with fears of physical danger; residents placed a very high value on their opportunities to enjoy the outdoors; few differences in preferences or in value perceptions due to demographic characteristics
Talbot	1987	Brownfield	Use and value	Residents use, highly value and distinguish between different types of green and open spaces according to needs; physical size related to preference for own territory but not for public open space; "scrubby area" valued for knowledge of its existence, used for nature pursuits
Todorova	2004	Street verges	Vegetation preferences	Trees have a great influence on preference of street vegetation; under trees, low and ordered compositions of brightly colored flowers were the most preferred; flowers were seen as contributing to the aesthetic quality of a street and having a positive influence on psychological well-being
Unt	2013	Brownfield	Informal use, aesthetics	Unenforced ownership makes it de facto public space; used for place for sea contact, angling, swimming, sunbathing, child play, jogging, barbecue, etc.; chosen by visitors for variety of possible activities, as urban wilderness to gain a sublime experience, disturbing quality of presence of decay, living open-air museum of landscape and culture; fear factor (risk of injury, polluted water, etc.) not an issue; representation of empty space on maps not reflecting reality
Verschelden	2012	Brownfield	Role for community art	Spaces are manifestations of changing dynamics in the city, have potential for challenging consensus, supporting learning processes and democratic moments by acting as space for community art
Wagner	2008	Waterside	Values	Broad and complex valuation structure with both differences and similarities identified between stakeholder groups and technical assumptions; visual attractiveness was an important function, but water quality enhancement and wildlife habitat were more frequently identified; riparian buffers may be socially acceptable if their appearance is understood as necessary in supporting functions valued by the community
White	2011	Multiple	Vegetation preferences	Houses with some types of building-integrated vegetation were significantly more preferred, beautiful, restorative, and had a more positive affective quality than those without; ivy facade and meadow roof rated highest; building-integrated vegetation would be a valuable addition to the urban environment
Yamashita	2002	Waterside	Perception, evaluation	For adult viewers, appropriate arrangements of mid- to long-distance elements and dynamic aspects of water should become more significant in landscape planning; for pre-pubertal children as main users of the environment, planners need to focus more on short-distance elements including water, especially on its quality
Yokohari	2004	Street verges	Fear of crime	Mature vegetation along greenways is part of town history but is increasingly regarded as a cause of fear of crime due to changes in society and thus closely trimmed and cut; planning re-evaluation should aim for a balance between ecology and safety through citizen participation in the planning process
Zhao	2012	Waterside	Aesthetic preference	River accessibility and number of colors are positive predictors for aesthetic preference of urban rivers; wood diversity index and plants on water are negative ones; positive correlation between aesthetic preferences also for types of bank and degree of wilderness; negative correlation with buildings

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