1    **Informal urban greenspace: a typology and trilingual systematic review of its role for**

2    **urban residents and trends in the literature**

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17 **Research highlights:**

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19 • Informal urban greenspace (IGS) plays an important role for urban residents.
20 • Majority of articles were published in the USA, UK, Germany and Japan.
21 • Residents preferred a medium level of human influence in IGS.
22 • Material relevant for studying IGS includes books, grey literature and art.
23 • IGS is emerging as a sub-discipline of urban environmental planning and recreation.
24

25

**Abstract**

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.


**Keywords**: wildscape; city; recreation; wasteland; vegetation; landscape


## 1. 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

50 abandoned buildings and infrastructure. Yet much of the research on urban forestry and urban

51 greening focuses on clearly demarcated remnant or formal vegetation assemblages, such as

52 habitat fragments, urban forests and parklands. But conventional park systems can be

53 expensive to maintain, may be unviable in denser built environments, and may ultimately fail

54 to satisfy residents' diverse needs (Byrne et al., 2010). Comparatively less research has

55 addressed the ambiguous, in-between or 'liminal' vegetated spaces found in cities across the

56 world, spaces that Jorgensen and Tylecote call 'ambivalent landscapes' (Jorgensen and

57 Tylecote, 2007).

58

59 Even in the most densely developed metropolises, there are still a multitude of vacant lots,

60 railway sidings, utility easements, corridors between buildings and canal sides that are often

61 overgrown with spontaneous vegetation, which are not coherently managed, and which seem

62 to occupy an uncertain, interstitial niche in the urban matrix (Ward Thompson, 2002). Even

63 backyard gardens and suburban lawns can be liminal. They may be highly manicured,

64 rambling or even overgrown and neglected, depending upon many factors such as feelings of

65 ownership, socio-economic status, identity, cultural beliefs, level of neighbors' surveillance,

66 age and government regulation, among others (Head and Muir, 2006; Trigger and Head,

67 2010).

68

69 Liminal green spaces elicit many questions. Why have they seemingly been neglected by

70 researchers? Are such informal green spaces really temporary and transitory? Might they

71 provide more permanent, but seldom-acknowledged functions for urban residents? If so, what

72 benefits might they confer upon users and non-users, and what problems might they present?

73 How can we formally define and describe them in a way that can be applied globally? What

74 does the literature say about them and their role for urban residents? What trends exist in the

75 literature (temporal trends, spatial patterns, studied space types, methods used, key authors)?

76 To answer these questions, this paper advances a concise, tri-lingual review of 65 peer-

77 reviewed research papers, as well as a summary of pertinent books, on what we call 'informal

78 urban green space', a particular type of liminal green space.

79

80 **2. Liminality and informality: defining informal urban greenspace (IGS)**

81 Recent research by urban researchers such as Seymour and colleagues (2010), Ghosh and

82 Head (2009), and Guitart and colleagues (2012), has noted that urbanization is placing

83 pressure on the ability of formal green space systems to meet residents' recreational,

84 livelihood, sustenance and wellbeing needs. Scholars and practitioners have begun to turn

85 their attention to forgotten or leftover urban spaces to better understand what functions they

86 perform and how they might meet the needs of diverse urban populations (Pyle, 2002; Jonas,

87 2007; Schneekloth, 2007; Jorgensen and Keenan, 2012; Campo, 2013; Kremer et al., 2013).

88 Some of this research has concentrated on formal greening programs, such as the renewal of

89 Los Angeles' alleyways (Seymour et al., 2010) whereas other research has attended to

90 'leftover' spaces that may be used for food production (McLain et al., 2014). The urban

91 agriculture literature, for instance, is replete with examples of informal or liminal spaces,

92 some of which have attained a semi-permanent status while others have vanished as quickly

93 as they appeared (Smit and Nasr 1992). What is common to all of these spaces is uncertainty

94 with regard to land tenure, conservation status, maintenance regimes, use, regulation and

95 legitimacy (McLain et al., 2014). They are liminal spaces.

96

97 The concept of liminality is derived from several disciplines but is salient within the literature

98 of urban geography (Howitt, 2001; Davison, 2008). It refers to a state of 'betweenness',

99 intermediacy, or ambiguity of being – the 'indeterminacy of loose space', as Franck and

100  Stevens call it (2007). Liminal spaces are 'at the margins', characterized by emergence and

101  flux, fluidity and malleability, and are neither segregated nor uncontained (Moran, 2011). For

102  this reason they are often contested.

103

104  To provide guidance and a sense of coherence in the fractured literature on this topic, we

105  draw on a provisional, non-exclusive definition and typology of a form of liminal, quasi-

106  public green spaces we call 'informal urban green space' (IGS). This definition and typology

107  has already been tested in a field survey of IGS quantity and characteristics (citation masked

108  for review). We defined 'informal green space' (IGS) as an explicitly socio-ecological entity,

109  rather than solely cultural or biological. IGS consists of any urban space with a history of

110  strong anthropogenic disturbance that is covered at least partly with non-remnant,

111  spontaneous vegetation (Del Tredici, 2010). It is neither formally recognized by governing

112  institutions or property owners as greenspace designated for agriculture, forestry, gardening,

113  recreation (either as parks or gardens) or for environmental protection (the typical purposes

114  of most greenspace). Nor is the vegetation contained therein managed for any of these by the

115  official owner. Any use for recreational purposes is informal and transitional (e.g.

116  unsanctioned verge gardening), taking advantage of the liminal characteristics of IGS. Unlike

117  formal greenspace, human origin and ecological conditions, not management, are the factors

118  influencing IGS the most (Fig. 1).

119  [Insert Figure 1 here]

120

121  IGSs differ in their management (e.g. access, vegetation removal, stewardship), land use and

122  site history, their scale and shape, soil characteristics and local urban context. For example, a

123  small brownfield and a vacant lot may be similar in appearance and size, but their different

124  land use history, vegetation removal periods and urban context distinguish them. We

125    identified nine different subtypes of IGS: street verge, lot, gap, railway, brownfield,

126    waterside, structural, microsite and power line IGS (Table 1, Fig. 2). The subtypes are not

127    exclusive; thus an IGS may be categorized as multiple subtypes (e.g. street verge and gap).

128    Because this typology recognizes the variety of non-traditional greenspace, it provides a

129    better basis to analyze the implications of IGS for planning and conservation than broad

130    terms such as "wasteland" or "derelict land", and will be used in this systematic review. As

131    mentioned above, the typology has already been applied to survey quantity and

132    characteristics of IGS in a case comparison study (citation masked for review). The

133    distinction between IGS and formal greenspace is not binary, but rather characterized by a

134    gradient of informality: formal recognition as recreational space by the owner provides a

135    criterion to identify a local-government owned vacant lot covered with mowed lawn as IGS,

136    but a low maintenance "wild" private garden as formal greenspace.

[Insert Table 1 here]
[Insert Figure 2 here]

137    The use of the term 'informal greenspace' is not new, but it has thus far not been defined in a

138    way that permits systematic and repeatable research by different scholars. Nicol and Blake

139    (2000) include it in their review on open space but do not differentiate between IGS, as

140    defined in this paper, and space used informally for recreation. Freeman and Buck (2003) and

141    Freeman (2005) provide more detail by naming examples of IGS, but include arguably

142    formal greenspace such as private gardens and provide no clear definition. Other authors use

143    the word "informal" with varying meanings but do not describe the spaces in detail

144    (Tartaglia-Kershaw, 1982; Burgess et al., 1988; Ward Thompson, 2002; Bell and Ward

145    Thompson, 2003; Bjerke et al., 2006; Qviström, 2008; Nichol et al., 2010; Kattwinkel et al.,

146    2011). The terms "urban wildscapes" (Jorgensen and Keenan, 2012) and "urban wilderness"

147    (Konijnendijk, 2012) have also been used to describe liminal spaces similar to IGS. The

148    provisional definition we have provided above aims to offer a basis for future studies of IGS.

149

150    This definition and description explicitly excludes remnant vegetation, parks, ornamental

151    plantings (e.g. flower beds), gardens, secondary-growth urban forests and agricultural areas

152    (fields, rice paddies etc.). Such spaces differ from IGS in how they are recognized, managed

153    and developed; they result from intention by the property owner, whether the vegetation is

154    intentionally planted (e.g. in parks, gardens or second-growth forests) or intentionally

155    preserved (e.g. remnant bushland). Secondary-growth urban forests (rather than, for example,

156    small patches of woody vegetation on a brownfield) represent a borderline case and there is

157    already substantial literature available on these forests, such as the seminal book edited by

158    Kowarik and Körner (2005), parts of which apply to IGS (e.g., Rink and Emmrich, 2005).

159    However, in most cases such forests are recognized for silvicultural or recreational value and

160    thus excluded from the definition of IGS used in this review.

161

162    **3. Methods**

163    We used a systematic review approach following Pickering and Byrne (2013) as the basis for

164    reviewing the existing literature. This method differs from a classic meta-analysis, as the

165    results of the reviewed literature are not used as data for further statistical analysis. Instead,

166    relevant information about peer reviewed published papers is extracted and the review results

167    are used to quickly identify geographic, theoretical and methodological gaps by analyzing

168    trends in the literature (Pickering and Byrne, 2013). One limitation in recent research papers

169    using this approach is the exclusion of non-English literature (Guitart et al., 2012; Roy et al.,

170    2012). The results of our preliminary searches showed that some of the analyzed research

171    papers conducted in Germany, Japan, Switzerland and even Korea were published in German

172  and Japanese rather than English. Given the first author's proficiency in multiple languages,

173  German, Japanese and English publications were included in this review. The preliminary

174  searches also revealed IGS-related research papers published in other languages, such as

175  Spanish (Lopez-Moreno et al., 2003) and Russian (Tikhonova et al., 2002), but these focused

176  on ecological rather than social aspects of IGS. For the same reason, we also excluded 154

177  ecological research papers on IGS in English, Japanese and German. These findings raise

178  serious questions about the potential bias and incompleteness in literature reviews based only

179  on English literature, particularly given reported negative effects of relying on English as the

180  language of science (Ammon, 2001; La Madeleine, 2007; Uzuner, 2008). However, we

181  recognize that in our own review, we have not been able to address papers published in many

182  other languages (e.g. Mandarin, Polish, Spanish etc.) and we take up this point in the

183  conclusion where we call for an extended review in other languages.

184

185  For this review, we systematically searched five major databases (Web of Knowledge,

186  Scopus, Google Scholar, CiNii and J-STAGE) using Boolean functions to combine search

187  terms, for example "urban AND [all socio-cultural aspect terms with OR functions] AND

188  [IGSvariable]". (For full list of search terms in all three languages see Appendix A).

189  Database searches were performed in early 2011 for the full time frames available, and

190  updated in early 2013 with a repeated search in Web of Knowledge, Scopus and Google

191  Scholar for papers published since the first search. We did not seek to impose a time limit on

192  the search (e.g. 20 years) but it should be noted that not all older papers may be full-text

193  searchable, a limitation that may cause them to be underrepresented. We selected a number of

194  research papers specifically targeting IGS to look for additional potentially relevant

195  publications not returned in the database searches. To be included for the analysis, research

196  papers had to meet one of two inclusion criteria: (1) target either IGS as defined above, or (2)

197    examine a similar human-nature relationship, allowing a partial transfer of the findings to the

198    case of IGS. Research papers were then systematically analyzed for findings on the role of

199    IGS for urban residents, study characteristics of individual research papers (year of

200    publication, location, IGS type, examined aspect of IGS, study methods), and publication

201    trends across all research papers, such as temporal trends, spatial patterns, studied IGS types,

202    methods used, and key authors. Principal and co-authorship was used to identify authors who

203    contributed multiple research papers. Results are presented in tables and figures to efficiently

204    present findings from the large number of research papers, following similar presentation and

205    analysis methods used in recent literature reviews (Garden et al., 2006; Matsuoka and

206    Kaplan, 2008; Roy et al., 2012).

207

208        **4. Results and trends in the literature**

209    We found a total of 65 original research papers widely distributed across 31 journals and five

210    edited books. Journals with the most research papers published were *Landscape and Urban*

211    *Planning*, followed by *Landscape Research*, *Journal of the Japanese Institute of Landscape*

212    *Architecture*, then *Urban Forestry & Urban Greening* (Table 2). This suggests a variety of

213    journals and scholars share an interest in this topic.

214    [Insert Table 2 here]

215

216    **Role of IGS for urban residents**

217    The findings of this systematic review are presented in a summary of the four main aspects

218    examined by the research papers (perception, preferences, value and use of IGS, see Table 3).

219    Additionally, two tables show the research papers' year of publication, location, IGS type,

220    examined aspect of IGS and study methods (Appendix B), and the individual research

221  papers' findings in regard to IGS (Appendix C). We discuss the main findings and their

222  implications after summarizing the results and examining trends in the literature.

223

224  Researchers report that residents perceive a diversity of IGS aspects, such as its naturalness,

225  use, maintenance, safety and access (Asakawa et al., 2004; Gobster and Westphal, 2004).

226  Residents can distinguish between formal and informal greenspace (Talbot et al., 1987;

227  Özgüner and Kendle, 2006). Residents also recognize problems and benefits of IGS –

228  benefits not always recognized by authorities (Pincetl and Gearin, 2005; Platt, 2012).

229  However, perception differed among resident groups: residents with little nature contact

230  experience (e.g., those living in high-rise apartments in newly developed areas) show less

231  nature affinity than those with extensive nature contact experience (Sawaki and Kamihogi,

232  1995).

233

234  Research has found that residents have preferences for characteristics distinguishing IGS

235  from formal greenspace, namely naturalness (including trees, water, water quality, a degree

236  of wilderness, less grooming than in formal greenspace), diversity and mystery (Herzog,

237  1989; House and Fordham, 1997; Gobster and Westphal, 2004; Chon and Shafer, 2009). But

238  residents also prefer a certain level of maintenance (a "tended" look, cleanliness),

239  accessibility, usability and being familiar with the appearance (Nassauer et al., 2001;

240  Todorova et al., 2004; Chon and Shafer, 2009; Rall and Haase, 2011; Zhao et al., 2012).

241  Those characteristics which residents dislike were uniformity, artificial modification, high

242  formality, no modification and too mature vegetation (Kadono, 1996; Yokohari et al., 2004).

243  Residents thus cherish the special features of IGS, but prefer spaces that show a certain (not

244  too low or too high) level of human influence. However, preferences differ between

245  individuals, seasons and different groups (such as laypersons and professionals, adults and

246  children) (Rink and Emmrich, 2005; Hofmann et al., 2012).

247

248  The literature has also identified several ways IGS can be valuable. IGS can provide

249  recreational value and improve daily life by adding urban greenspace area (Kelcey, 1978;

250  Hayashi et al., 1999; Aristimuño, 2002). It can also provide emotional benefits by inspiring

251  residents and connecting humans' natural and cultural selves (Jorgensen and Tylecote, 2007).

252  It serves children as a personal special place, gives them the chance to challenge themselves

253  and to experience nature (Pyle, 2002; Platt, 2012). IGS may also be valuable in shrinking

254  cities (Rink and Emmrich, 2005; Mathey and Rink, 2010; Rall and Haase, 2011), as an

255  alternative to classic conservation areas (Rink and Emmrich, 2005), and as a challenge to our

256  consensus of what space is supposed to be (Verschelden et al., 2012). Researchers emphasize

257  that IGS has much potential which remains untapped.

258

259  While scholarly papers show the significant future potential of IGS, they also reported that

260  residents already use IGS for numerous activities, such as child play, dog walks, fishing,

261  encountering strangers, gardening, shortcuts, relaxation, enjoying nature, sea contact,

262  angling, sunbathing, jogging and barbecues (Talbot et al., 1987; Kim et al., 2002; Lachmund,

263  2003; Qviström, 2008; Foster and Sandberg, 2010; Rall and Haase, 2011; Hunter and Brown,

264  2012; Brighenti and Mattiucci, 2013; Unt et al., 2013). Children, minorities, migrants and

265  homeless people were mentioned as frequent users of IGS (Pyle, 2002; Platt, 2012; Brighenti

266  and Mattiucci, 2013). We will discuss these findings in more detail after examining trends in

267  the literature.

268

269

270 **Temporal trends in the literature**

271 The number of socio-cultural research papers has risen over the last 20 years (Fig. 3), with

272 over 75% of all research papers published since 2002. While interest in the recreational

273 potential of IGS was discussed in 1978 (Kelcey), many earlier research papers only include

274 IGS as one example or type among those studied (Talbot et al., 1987; Asakawa, 1990). A

275 reason for the increasing interest may be the ongoing urbanization, the growing percentage of

276 humans living in cities (UN-HABITAT, 2012), and problems this presents (e.g. nature-deficit

277 disorder, Louv, 2008) – a point we return to in the discussion.

278 [Insert Figure 3 here]

279

280 **Spatial and linguistic patterns in the literature**

281 The geographic distribution of study areas shows a heavy bias towards four countries: the

282 USA (20 papers, 30.8%), Japan (15 papers, 23.1%), the UK (eight papers, 12.3%), and

283 Germany (eight papers, 12.3%) (Fig. 4). But few research papers compare different cultural

284 and governmental contexts. Papers from countries with increasing research output, such as

285 China, are notably rare. Non-English papers (eight papers, 12.3%) were mostly comprised of

286 Japanese papers (seven papers, 10.8%), with their study areas being Japan (six papers, 9.5%)

287 and Korea (one paper, 1.6%). Only one paper was written in German (1.6% of all papers and

288 12.5% of papers whose study area was Germany).

[Insert Figure 4 here]

289

290 **Target IGS types**

291 The distribution of research papers per type of space examined shows a clear focus on

292 waterside IGS and multi-IGS-type papers (19 papers, 30.2% both, Fig. 5). The large number

293 of multi-IGS-type papers may be the result of papers discussing IGS in general rather than a

294 specific type – papers were classified as multi-IGS type if two or more IGS types were

295    studied. Even in these papers, however, comparisons between different IGS types were rare.

296    Literature on microsite, gap, structural, and powerline IGS types is scarce, possibly because

297    of methodological challenges they present (e.g. size, abundance).

     [Insert Figure 5 here]

298    **Main aspects studied**

299    Published papers targeted a number of different aspects, with perception (18 papers, 28.6%)

300    and preference (17 papers, 27%) being the most prevalent (Table 3). Perception papers

301    examined which factors (e.g. recreational use, participation) influence landscape perception

302    (Asakawa et al., 2004), and what differences exist in perception between user groups (e.g.

303    children, adults, students, caregivers) (Mori et al., 2005; Rink and Emmrich, 2005).

304    Preference papers covered, among others, aspects of visual preference (Akbar et al., 2003)

305    and cultural preference (Lossau and Winter, 2011). IGS use papers could largely be divided

306    into those on potential use (Hayashi et al., 1999) and actual use (e.g. by children) (Platt,

307    2012). The diversity of examined aspects of human-nature interaction are an indicator for the

308    complexity of the topic, ranging from preference (Todorova et al., 2002; White and

309    Gatersleben, 2011) and perception (Yamashita, 2002; Gobster and Westphal, 2004) to less

310    studied topics such as willingness to coexist with nature (Sawaki and Kamihogi, 1995),

311    biodiversity experience (Gyllin and Grahn, 2005) and the role of vacant lots as vegetable

312    gardens (Kim et al., 2002).

313    [Insert Table 3 here]

314

315    **Methods used**

316    The most popular methods used were surveys (30 papers, 47.6%) and photography (27

317    papers, 42.9%, Table 4). Reasons for their popularity may include the flexibility surveys offer

318    in collecting qualitative, quantitative and socio-demographic data, as well as the large role

319    visual impression plays in perceiving and evaluating scenery. The in-depth analysis (Table 4)

320    shows the full variety of methods authors employed. Mixed methods were popular, and many

321    research papers use a variety of questionnaire-based surveys (Akbar et al., 2003; Asakawa et

322    al., 2004), often combined with photographs (Herzog, 1989; Kaplan, 2007) or photo-

323    manipulation (Mori et al., 2005; Sullivan and Lovell, 2006). Other papers use interviews,

324    focus groups and participant observation (Rink and Emmrich, 2005; Lossau and Winter,

325    2011), case studies (Lisberg Jensen and Ouis, 2008), case comparison studies (Foster and

326    Sandberg, 2010) or linguistic methods (Nakamura et al., 2000; Gyllin and Grahn, 2005).

327    Participatory research methods (e.g. map-making) and GIS-based methods are still

328    comparatively rare, possibly because of the higher time commitment and technological

329    proficiency they require.

330    [Insert Table 4 here]

331

332    **Key authors**

333    Several scholars have contributed multiple research papers. Asakawa, who included vacant

334    lots in a study on greenery and residents' satisfaction (Asakawa, 1990) also investigated how

335    urban stream corridors are perceived (Asakawa et al., 2004) and co-authored papers on

336    waterside IGS (Lee and Asakawa, 1992) as well as street verge vegetation design (Todorova

337    et al., 2004; Mori et al., 2005). Kaplan studied preference for nature near workplaces (finding

338    a desire for "wild" nature) (Kaplan, 2007). She has also co-authored IGS-related papers on

339    nature perception and functions with Talbot (1984; 1987), and contributed to a review of

340    people's needs that includes papers on IGS (Matsuoka and Kaplan, 2008). Özgüner examined

341    attitudes towards naturalistic versus designed landscapes, finding a preference for informality

342    (Özgüner and Kendle, 2006) and a waterside IGS restoration project in Turkey (Özgüner et

343    al., 2012). Rink focused on social perceptions and acceptance of "wasteland" and

344 "wilderness" (Rink and Emmrich, 2005; Rink and Herbst, 2011), and has co-authored a book

345 chapter on socio-ecological aspects of urban wastelands and biodiversity (Mathey and Rink,

346 2010). Sullivan studied verges (Sullivan and Lovell, 2006) and waterside IGS in the form of

347 agricultural buffers on the urban fringe(Sullivan et al., 2004). Sullivan also co-authored a

348 paper on waterside IGS perception(Kenwick et al., 2009). Jorgensen has examined theoretical

349 aspects and the significance of IGS (Jorgensen and Tylecote, 2007), and contributed in the

350 form of an edited book (Jorgensen and Keenan, 2012) which we will discuss below.

351

352    **5.  Discussion**

353 IGS appears to play an important role for urban residents, whose relationship with IGS is

354 very complex and sometimes contradictory. The perceived vacancy of the spaces can mask

355 their natural or cultural history (Corbin, 2003) and can be negatively interpreted as emptiness

356 and dereliction (Ruelle et al., 2012). On the other hand, freedom of movement, discovery and

357 wildness are also mentioned as associations (Home et al., 2010). A subjective lack of purpose

358 can also mean a freedom from purpose, following Franck and Stevens' 'indeterminacy of

359 loose space' (2007). The creativity users of IGS demonstrate through a large variety of

360 informal activities from nature contact to recreation (Unt et al., 2013) and food production

361 (Kim et al., 2002) speaks for the benefits of urban space without prescribed use.

362

363 The disapproval of one group of residents may result in unilateral action for 'improvement'

364 or removal of IGS that denies another group of residents valued opportunities. For example,

365 the literature suggests vacant lots are predominantly evaluated negatively(Corbin, 2003),

366 which may lead to their removal. Yet such lots provide children with the chance for

367 discovery and the challenge of "secret nature" (Pyle, 2002). This has implications for the

368 diversity of recreation needs and the insufficiency of formal greenspace (Byrne and Sipe,

369    2010). Realizing the potential of IGS for urban residents therefore requires negotiation

370    between diverging perceptions, preferences, values and goals of users.

371

372    Not only do the study topics and methods scholars have employed show that IGS is a diverse

373    and rich area of study, but the character and results of the research they found (Appendices B,

374    C) also reveal the complexity underlying the human-nature relationship in urban areas.

375    Similar to the potential of IGS for other living beings (Hard, 2001), one key theme in the

376    literature is the benefits such spaces have to offer to humans. Scholars report health, mental

377    and social benefits provided by vegetable garden space (Kim et al., 2002), play space, and

378    improved greenspace accessibility (Kelcey, 1978; 2000). Researchers have also found

379    opportunities for nature exploration and walking (Talbot et al., 1987; 2003), and new design

380    possibilities, as well as a source of inspiration for a new aesthetic combining natural and

381    industrial elements (Rink and Herbst, 2011). A limitation of the literature on IGS benefits is

382    the lack of quantitative studies examining how widely IGS is used and appreciated.

383

384    But many scholars also report that much of this potential is not used because it is often not

385    recognized, accepted or accessible (Asakawa, 1990; Hayashi et al., 1999; Rink and Emmrich,

386    2005; Rink and Herbst, 2011) – another key theme in the literature. They find that similar

387    spaces such as matured greenways may indeed be viewed negatively and associated with

388    crime (Talbot and Kaplan, 1984; Yokohari et al., 2004). Some authors attribute this finding to

389    negative cultural associations with vacancy (Corbin, 2003; 2005) and explain how human

390    perception and experience configures what is seen and recognized as green space (Lossau and

391    Winter, 2011). This does not imply urban residents have a simple preconception of nature:

392    research shows how residents distinguish between different types of greenspace (Talbot et al.,

393    1987; Özgüner and Kendle, 2006) and emphasize how much importance is placed on this

394  relationship with nature (House and Fordham, 1997; Gao and Asami, 2007; Matsuoka and

395  Kaplan, 2008) and its complex interactions of perceptions, preferences, attitudes and needs

396  (Sawaki and Kamihogi, 1995; Yamashita, 2002; Asakawa et al., 2004; Gobster and Westphal,

397  2004; Matsuoka and Kaplan, 2008). Scholars have shown that these aspects vary among

398  different user groups (Byrne and Sipe, 2010). What this suggests is that planning should

399  acknowledge the need for diversity in urban greenspace by providing for a variety of uses

400  (e.g. playground, golf course, cultural events) (Kadono, 1996) and take into account

401  conservation, social and cultural aspects (Aristimuño, 2002). That said, the scarcity of ways

402  to overcome the challenges in using the potential of IGS represents a serious gap in the

403  literature.

404

405  Research has found that informal greenspace may not address the needs of some adults (as

406  discussed above). But a key finding is that children have their own needs and perceive their

407  environment differently from adults (Ammon, 2001; Yamashita, 2002; La Madeleine, 2007;

408  Uzuner, 2008). Research with children shows they seem to accept and use informal

409  greenspace willingly (Rink and Emmrich, 2005; Rink and Herbst, 2011; Platt, 2012),

410  although its existence and important role as secret, personal and special places for children

411  are threatened by urban development and restrictions in children's freedom of movement

412  (Pyle, 2002). Pyle (2002) contrasts his own extensive neighborhood and informal greenspace

413  explorations with the example of a child confined to the cul-de-sac it lives in, due to parental

414  concerns for safety, and the resulting loss of experience.

415

416  Researchers have also found that disparities between urban nature and inherited images of

417  ideal nature show that issues of perception and social construction of nature expectations are

418  not limited to adults (Dove et al., 2000). This has wide-ranging implications. Because urban

419 areas are becoming the main source of nature contact for many humans, they are probably

420 influencing nature conservation efforts even outside of cities (Dunn et al., 2006; Millard,

421 2010). Some studies have found that users may place high importance on the usability of

422 IGS, viewing urban wilderness conservation areas as off limits to humans (Rink and Herbst,

423 2011). This suggests that the literature still lacks a detailed understanding of the human-

424 nature relationship underlying residents' interaction with IGS.

425

426 This limited understanding of IGS is reflected in the trends we found in the literature. These

427 trends may be explained by a number of reasons. We recognize that the scarcity of research

428 papers we found from countries such as China, could be attributed to the limited number of

429 languages used for this review. The linguistic distribution of the Japan-based papers –

430 showing two distinct groups of Japanese and English papers (six papers published in

431 Japanese, 40% of studies conducted in Japan) was different from the distribution of papers

432 from Germany. The use of English in papers describing studies conducted in Germany and

433 Japan may be explained by the fact that the results are potentially relevant to all researchers

434 in this field, regardless of their location. The pattern of targeted IGS types showed many

435 studies examined multiple IGS types and waterside IGS, but only a few looked at gap,

436 powerline and microsite IGS. Additionally, railway and structural IGS papers were also rare

437 – a serious limitation of the literature. However, research papers have examined the

438 development of abandoned rail tracks into recreation trails ("rails-to-trails") and associated

439 land use conflicts between proponents and opposing local land owners (Turco et al., 1998;

440 Hawthorne et al., 2008).

441

442 Researchers have used a variety of methods to understand various aspects of human-IGS

443 interaction. These include map surveys in which the participants express their relationship

444    with the local area by drawing on maps (Aristimuño, 2002) as well as participant

445    photography and on-site description of the environment (Yamashita, 2002). Such methods

446    enable the researcher to engage participants actively in the research process. Even though

447    participant photography methods are still uncommon (two papers, 3%), researchers using

448    these methods have been able to report fascinating results. Yamashita (2002) used the photo-

449    projective method and asked Japanese adults and elementary school fifth/sixth-graders to take

450    pictures of their neighborhood's river environment, then add voice and written notes. He was

451    able to show that children and adults perceive the river landscape and water in different ways

452    – for children, water in the landscape attracted more attention, and its quality was more

453    important than flow rate. Platt's use of the diary-interview/diary-photography method to

454    examine American 10-12 year olds perception of public space helped him to discover that the

455    children sometimes prefer vacant lots and sidewalks over parks for safety reasons (2012).

456    Many papers also combine methods from multiple fields such as geography, planning and

457    psychology (Almazán et al., 2012; Unt et al., 2013). But discussion of IGS and its role for

458    urban residents is not limited to peer-reviewed journal papers.

459

460    **IGS in (edited) books**

461    There is a variety of books and edited books on IGS, which represent an important part of the

462    literature. Gilbert's book "The Ecology of Urban Ecosystems" (1989) is an early example. It

463    examined the ecological characteristics of urban commons, railway lines, roads and rivers,

464    but also discussed human-wildlife interaction (p.311-317). Three recent books provide

465    additional insights into the socio-ecological aspects of IGS. Jorgensen and Keenan's edited

466    book (2012) "Urban Wildscapes" makes a valuable contribution by addressing relatively

467    unexplored areas such as IGS in China and using rarely employed methods such as the

468    analysis of children's literature. Hobbs, Higgs and Hall's edited book (2013) "Novel

469    Ecosystems" discusses not only ecological implications, but also includes nine chapters

470    investigating aspects of the human-nature relationship (e.g. public engagement, children's

471    use). Campo's intricate study of an "abandoned" Brooklyn waterfront shows what potential

472    IGS can hold when embraced by the local community (2013). He found this liminal space

473    provided, for a limited time, space for a variety of activities, from skateboarding and

474    swimming to fishing and contemplation.

475

476    While not as methodologically rigorous, books such as "Natural History of Vacant Lots"

477    (Vessel and Wong, 1987) illustrate an effort of scholars to engage with the public. Writers

478    have also collected findings from the academic literature and combined it with research and

479    interviews to produce books like "The Unofficial Countryside" (Mabey, 2010, first published

480    in 1973), the "Rambunctious Garden" (Marris, 2011) and "London's Lost Rivers" (Talling,

481    2011). These works discuss the origin, character and role of some IGS types (e.g.

482    brownfields, vacant lots, waterside IGS). Talling (2011) includes historic IGS no longer

483    existing – a gap in the scholarly literature on IGS, and a topic linked to the concept of

484    solastalgia (Albrecht et al., 2007), or feeling of loss when remembering a place from

485    childhood. These works highlight some important aspects of IGS for urban residents, but our

486    knowledge of IGS is still limited, and as we have shown in this review, research has been

487    piecemeal. We lack a comprehensive research agenda on IGS.

488

489    **Directions for future research**

490    This review has identified gaps in our knowledge of IGS regarding three main aspects: (i) the

491    geographic distribution of research; (ii) knowledge about specific, understudied types of IGS;

492    and (iii) thus far underused methods of research (e.g. participatory methods, international

493    comparisons, cross-cultural studies, studies combining socio-ecological aspects). Four

494    countries, the USA, the UK, Germany and Japan, dominate the research on IGS (although we

495    acknowledge our language limitations, which we discuss below). We still know very little

496    about IGS in Africa, South America, South-East Asia, the Middle East, India, China or

497    Australia. The geographical bias in the literature places limitations on cross-cultural meta-

498    analyses, but international case comparison studies are also rare. These gaps are important

499    because the types of greenspace may vary in different places, especially with cultural

500    variations, and more cross-cultural research is required. However, it is important to note that

501    this review only examined the available literature in English, German and Japanese. As

502    mentioned above, our search found Spanish and Russian research papers on IGS. A review of

503    literature on IGS these languages, Chinese, French, Polish and other languages would likely

504    advance our understanding of IGS.

505

506    This literature review has revealed that scholars know little about gap and microsite IGS. The

507    area of an individual site may be much smaller than that of a vacant lot or brownfield IGS,

508    potentially presenting significant methodological challenges (citation masked for review).

509    Given the fragmented nature of urban landscapes, it is likely that a high number of such

510    spaces exist within cities. Similar to gaps and microsites, other less-studied IGS types (e.g.,

511    structural, powerline and railway IGS) are often absent in multi-type studies. The typology in

512    this paper has sought to provide a basis for future comprehensive comparison studies of all

513    IGS types.

514

515    In addition to including all IGS types, future studies on the social aspects of IGS should draw

516    upon a broader array of research methods. User surveys have dominated the research to date.

517    While they are certainly convenient ways of receiving feedback from IGS users or residents,

518    they may mask rich details that can emerge from qualitative research. Photography is an

519    obvious choice when examining an object most often experienced visually, but it too has

520    limitations such as potential bias introduced if the photographer is not the participant.

521    Ethnographic methods such as participant observation and collaborative map-making, or

522    technology-based geographical information system (GIS)-enhanced analysis methods have

523    only been used in very few cases. Mixed methods research may provide other insights (e.g., a

524    deeper understanding of how urban residents think about and interact with IGS). Potential

525    effects of IGS on children's health also warrant attention, given the finding that just having a

526    view of greenspace may be important for physical and mental health (Taylor et al., 2002). A

527    comprehensive study comparing the quantity of each IGS type present in different cities

528    would represent a valuable starting point for a global IGS mapping initiative, and could be

529    combined with quantitative survey of residents' interaction with IGS. The role of IGS for

530    urban residents should be clarified by examining residents' perception, actual use, and

531    reasons for use of IGS, whether residents have a history of using IGS as children, and

532    potential links to their attitude towards urban nature. An international cross-cultural case

533    comparison study of these topics would not only advance our understanding of IGS

534    considerably, but would also provide valuable insights for urban conservation, planning and

535    potential future use of IGS.

536

537    **Conclusion**

538    This review has systematically analyzed peer-reviewed research literature in English,

539    Japanese and German on a type of liminal space, a group of quasi-public green spaces termed

540    'informal urban green spaces', to understand what role they play for urban residents. An

541    increase in publications over the last 20 years suggests IGS is an emerging topic in urban

542    greening research. Important gaps in the literature include: the scarcity of IGS studies outside

543    of the USA, Europe and Japan, as well as the lack of studies on microsite, gap, structural, and

544     powerline IGS types. Key themes emerging from the literature include: the health, mental and

545     social benefits of IGS; difficulties in realizing potential IGS benefits due to recognition,

546     acceptance and access issues; and differing perception of IGS between resident groups (e.g.

547     children and adults). Key methods used include surveys and photography, but participatory,

548     GIS-augmented and mixed methods remain scarce. The liminality of IGS poses a challenge

549     for scholars and urban planners. Ambiguity, informality and malleability allow IGS to

550     perform functions formal green space cannot, but at the same time leave IGS vulnerable to

551     being contested politically, legally and aesthetically. The gaps in the literature on this topic

552     suggests that what we understand about the human-IGS interaction may be outweighed by

553     what we do not know. While this review has examined the literature on IGS in English,

554     German and Japanese, a future review of literature in other languages may be a valuable step

555     in filling some gaps in our knowledge about IGS.

556

25

557    **Acknowledgements**

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**List of Tables**

**Table 1 Informal urban greenspace typology**

| IGS | Examples | Description | Management | Form | Substrates |
|---|---|---|---|---|---|
| Street verges | Roadside verges, roundabouts, tree rings, informal trails and footpaths | Vegetated area within 5m 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 (>= once per month); governmental and private stewardship | Small: <100m$^2$, 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: <1ha, 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: <100m$^2$, linear | Soil, gravel |
| Railway | Rail tracks, verges, stations | Vegetated area within 10m 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: >1ha, linear | Soil, gravel, stone |
| Brown fields | 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: >1ha, block | Soil, gravel, concrete, asphalt |
| Waterside | Rivers, canals, water reservoir edges | Vegetated area within 10m 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: >10m$^2$ to >1ha, 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: <100m$^2$, 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: <1m$^2$, point | Deposits, soil, stone, conrete |
| Power line | Power line rights of way | Vegetated corridor under and within 25m 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: >1ha, linear | Soil |

**Table 2 Journals containing most IGS papers**

| Journals containing two or more papers | Number of papers | Percent of papers* |
|---|---|---|
| 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% |

* 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* |
|---|---|---|
| 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% |

* Percentage does not add up to 100% as only most common categories are shown

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

| Methods used | Number of papers | Percent of papers* |
|---|---|---|
| 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% |

* Percentage does not add up to 100% as papers may use more than one method

**List of Appendices**

Appendix A – Search terms used in English, Japanese and German
Appendix B – Year of publication, location, IGS type studied, research focus, and method of papers on IGS' role for urban residents
Appendix C – Summary of findings of papers on IGS' role for urban residents

**Appendix A – Search terms used in English, Japanese and German**

| English | Japanese | German |
|---|---|---|
| *IGSVariable* | | |
| ruderal | (arechi) | ruderal |
| railway | (tetsudō) | Eisenbahn |
| vacant lot | (akichi) | leeres Grundstück |
| abandoned lot | (akichi) | verlassenes Grundstück |
| walls | (kabe) | Mauer, Wall |
| street/ road verges | (michi no hashi) | Straßenrand, Straßengraben |
| curbside | (hodō no enseki) | Straßenrand |
| wasteland | (kōya) | Ödland, Brache |
| brownfield | (kōjōatochi), | Industriebrache, Brache, Braunfeld |
| landfill | (umetatechi) | Deponie, Müllhalde |
| industrial park | (kōgyōdanchi) | Industriepark |
| corridor | (kairō) | Korridor, Schneise |
| power line | (densen) | Hochspannungsleitung, Stromleitung |
| riverbank | (kawagishi) | Flussufer |
| buildings | (tatemono) | Gebäude |
| road swales | | Straßengraben |
| trails, foot paths | (michi) | Weg, Pfad, Fusspfad, Trampelpfad |
| wilderness | , (shizen) | Wildniss |
| spontaneous vegetation | (jihatsutekishokusei) | Spontane vegetation |
| novel ecosystem | (shinkōseitaikei) | Neue Ökosysteme |
| riparian | (kawagishi), (suihen) | Ufer... |
| *Socio-cultural aspects* | | |
| landscape | (keikan) | Landschaft |
| greenspace | (ryokuchi) | Grünflächen |
| perception | (ninshiki), (ishiki) | Wahrnehmung |
| value | (kachikan) | Werte |
| attitude | (taido) | Einstellung |
| opinion | (iken) | Meinung |
| preference | (senkō) | Präferenz |
| relationship | (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 |
| 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 |
| 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 |

| First author | Year | IGS type | Examined | Main findings |
|---|---|---|---|---|
| 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 |

| First author | Year | IGS type | Examined | Main findings |
|---|---|---|---|---|
| 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. |
| 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 1400m with focus on 500m 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 |

| First author | Year | IGS type | Examined | Main findings |
|---|---|---|---|---|
| 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 |
| 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; |

| First author | Year | IGS type | Examined | Main findings |
|---|---|---|---|---|
| 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 |

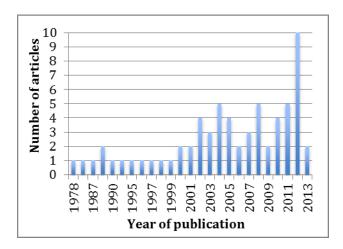| First author | Year | IGS type | Examined | Main findings |
|---|---|---|---|---|
| Verschelden | 2012 | Brownfield | Role for community art | Spaces are manifestations of changing dynamics in the city, have potential for challenging consensus, supporting learning processes and democratic moments by 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 |

**List of Figures**

Rupprecht & Byrne, Figure 3



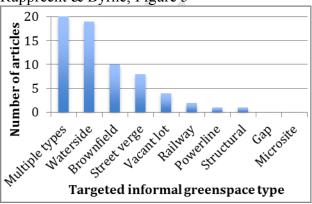Rupprecht & Byrne, Figure 4



Rupprecht & Byrne, Figure 5

Management

Urban parks, gardens

Conservation areas

Human origin

Informal greenspace

Ecology