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Defining greenspace: Multiple uses across multiple disciplines

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HIGHLIGHTS

- Most publications reviewed fail to define what is meant by the term greenspace.
- Of those that do provide a definition, six different definition types are identified.
- Two broad interpretations are used: a) greenspace as synonomous with nature; and.
- b) greenspace as explicitly urban vegetation.
- Recommend a definition is required that is both qualitative and quantitative.

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ABSTRACT

Greenspace research has been driven by an emerging interest in the impact that biodiversity and ecosystem function has on life in urban areas. Studies from multiple disciplines across the life, physical and social sciences investigate the interactions with or within greenspace, creating a wide range of potentially related, but disparate findings. In order to understand whether these unconnected findings might be integrated, it is important to be able to make comparisons and build meta-analyses. In a review of journal articles about greenspace, we found that less than half of the 125 journal articles reviewed defined what greenspace was in their study; although many articles implied a definition. In those that provided a definition, we identified two overarching interpretations of greenspace using six different definition types. Perhaps arising from how the term has been lexicalized, this suggests that researchers do not have the same understanding of greenspace and limits the ability of researchers to draw meaning from multiple contexts or create syntheses. Rather than suggest a single, prescriptive understanding of greenspace, we propose that researchers construct a definition of greenspace for the context of their research that utilises both qualitative and quantitative aspects.

1. Introduction

Greenspace is usually, but not always, comprised of vegetation and associated with natural elements. There has been growing interest in greenspace research due to evidence that nature positively impacts human wellbeing (Frumkin, 2013; Taylor & Hochuli, 2015). This research is relevant to a range of disciplines, including the health and medical sciences, urban design and planning, ecology, and a number of social sciences. While single discipline studies are important, greenspace research will not progress without considering the findings of multiple components, such as social and ecological aspects, due to the complexity of how they integrate (Alberti, 2008). This is particularly relevant in cities, where social and ecological components, including greenspaces, are under pressures associated with urbanization. There are two potential ways to achieve research across multiple elements. First, multidisciplinary investigations consider multiple components. For example, ecology 'in' cities typically involves research from one discipline, such as investigating the diversity and abundance of birds along a rural-urban gradient, but the ecology 'of' cities incorporates multiple disciplines and takes a multi-scale approach (McDonnell, 2012), such as investigating the diversity and abundance of birds in multiple land cover types that represent a rural-urban gradient across an entire city to inform urban planning and management (e.g., Catterall, 2009). Urban ecology has embraced the ecology 'of' cities as a multidisciplinary way to integrate various aspects of the hybrid urban environment. The second way forward for research of multiple components is to make comparative assessments of studies. Comparative studies might include meta-analysis, or syntheses of

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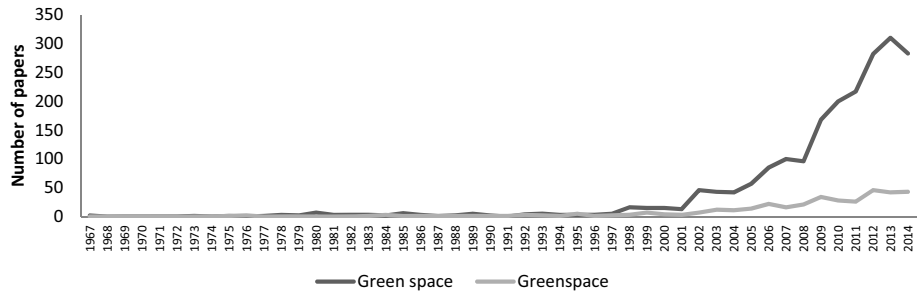

Fig. 1. Publications about greenspace have increased since the turn of the century.

existing studies (McDonnell & Hahs, 2009). In order to understand the variation of greenspace across the world, being able to perform comparative research is important (Niemelä, 2014). In order to be able to compare findings, similar definitions and data are required (McDonnell & Hahs, 2009) (for example, McCrorie, Fenton, & Ellaway, 2014).

Disciplines have different objectives and use different methodologies, and this can result in different meanings (McDonnell, 2012). Without ensuring that common terms are rigorously defined, it is likely that there will be a lack of consensus in how they are used. This has been found to be the case with the term, 'urban' (McIntyre, Knowles-Yánez, & Hope, 2000). Furthermore, tacit assumptions are often used in lieu of definitions in various disciplines' literature. Providing a clear and considered definition of key terms is critical for researchers, otherwise they risk relying on idiosyncratic personal interpretations of generalized terms (Pickett, Cadenasso, McDonnell, & Burch, 2009). Such individual interpretations might be acceptable for limited or single discipline studies (Pickett et al., 2009), but it is impossible to undertake multidisciplinary research or perform comparative studies without quantified descriptions of key terms (McIntyre et al., 2000). For example, a human-dominated ecosystem might be considered *urban*, but without quantification, the term *urban* lacks qualitative and quantitative detail that detracts from its usefulness, suggesting instead a lack of rigor on the part of the researchers (McIntyre et al., 2000). It is critical to provide a meaningful operational definition in order for the research to progress (Hochuli, Christie, & Lomov, 2009), particularly when multiple aspects are involved. In addition to progressing academic research, policies are at risk of becoming redundant when terms are inadequately defined. If a country or region has a policy of, for example, 7 acres of greenspace per 1000 residents (Ambrey & Fleming, 2014) because the greenspace is intended to improve the lives of residents, then the greenspace may not be fulfilling the desired function if it is degraded or if it comprises artificial elements. So in order to ensure policy decision-making remains relevant, operational definitions must be provided that can be interpreted by all sectors. By meaningful operational definitions, we mean that a term should be qualified and quantified where possible. This is more likely to increase understanding across multiple disciplines and research contexts.

Some of the varying interpretations may be related to how terms develop and become lexicalized. Historically, greenspace has been used as two words, *green* and *space*, where the adjective green describes the space. For example, in a paper concerning trees mitigating air pollution, green space is defined as "land covered with some form of vegetation" (Warren, 1973). The author was right to qualify that the vegetation of interest was trees, as otherwise, a 'green space' conforming with the definition provided (i.e., vegetated land) may not be as relevant to the pollution mitigation aspects. Another valid use of the term is "green space bipropellant" (Kang, Jang, & Kwon, 2016), however it does not refer to vegetated land. Instead, it refers to an environmentally-friendly form of space propulsion (Kang et al., 2016). *Greenspace* is a compound that, unlike a noun phrase such as *purple shirt*, has a distinct meaning (Verhoeven & van Huyssteen, 2013), such as *whiteboard*, which is not just a board that is white, but an erasable board that is used with markers for presentations. While compounds, which add words to the lexicon, can be one or two words, one-word compounds are easy to distinguish from noun phrases (Verhoeven & van Huyssteen, 2013). As such, we concentrate on the one-word compound to be explicit about the focus on the modern use of the term, 'greenspace'.

A number of reviews on single aspects of greenspace have been published, including a synthesis of 219 research papers that focus on human-environment interactions in urban greenspace (Kabisch, Qureshi, & Haase, 2015), a review of 25 studies concerning the health benefits of greenspace (Bowler, Buyung-Ali, Knight, & Pullin, 2010), and a review of 50 studies that measure social-ecological values associated with greenspace (Hunter & Luck, 2015). Attempts have been made to define various greenspace features; for example, as unsealed or 'soft' surfaces (Swanwick, Dunnett, & Woolley, 2003). Green infrastructure is a related term used in the literature to refer to a network of greenspace, where the scale is city- or landscape-wide and its function is in relation to urban inhabitants (Tzoulas et al., 2007). Other closely associated terms include: open space, urban vegetation, parks, remnant patches, residential gardens or yards, and road verges or streetscapes. These terms and definitions all assume human interaction or an urban context. These terms are applied at multiple scales (e.g., landscape, city, neighborhood, or parcel), not all include vegetation (for example, open spaces or residential yards may be paved), and the accessibility can vary (for example, streetscapes might be public or, in the case of streets on private property, private). They do not reflect the operational use of greenspace in the recent literature, which also includes literature on agricultural land and other landscapes. As with many other common terms, such as 'urban', the meaning of the term greenspace is often assumed and therefore unclear (McIntyre et al., 2000).

A clear conceptual usage of greenspace is critical to a robust multidisciplinary or comparative study (Cooper, Hedges, & Valentine, 2009). The necessary integration required in order to take the literature about greenspace beyond a collection of individual studies is impossible with the current lack of clarity around the term and how it is used. To continue to research greenspace without adequately defining it potentially undermines the research performed and adds to the challenges of management. Our aims were to investigate how greenspace is used in recent literature, and propose suggestions to enable integration between studies, regardless of the scale, methodology, or disciplinary focus.

2. How greenspace is used in recent literature

In order to determine how researchers use or define greenspace, a search of all ISI Web of Science databases was performed on 17 April 2015, including the core collection, CABI, BioSIS Previews

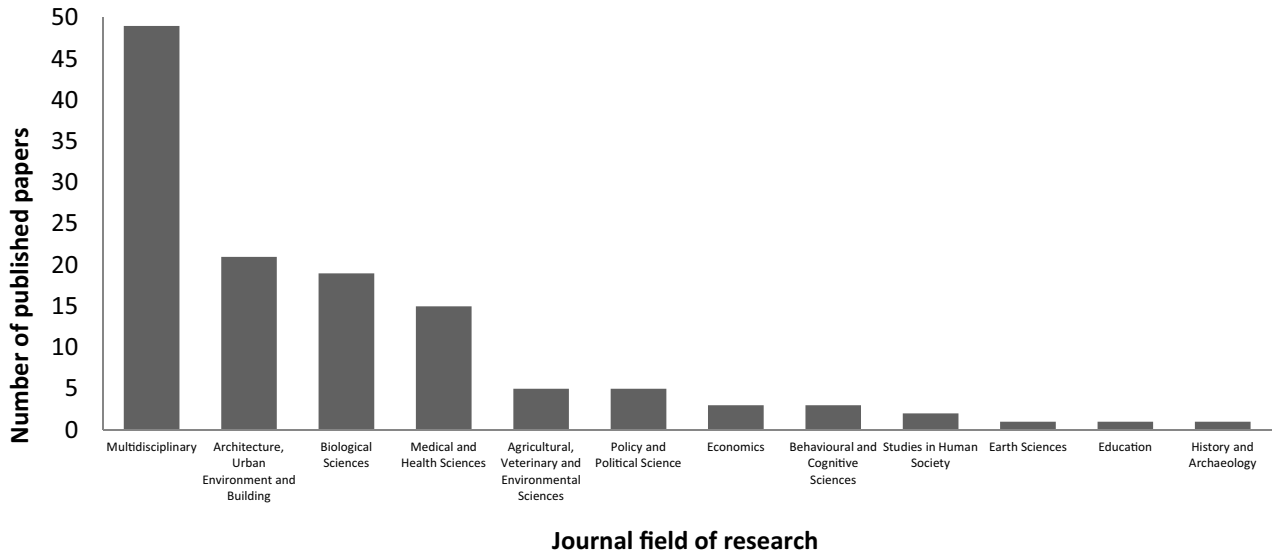

Fig. 2. The research focus of journals that published papers about greenspace varied, with most papers being published in journals that were explicitly multidisciplinary.

Table 1
A number of terms were used interchangeably with greenspace across all disciplines.

Discipline of Journal	Papers	Key term	Other terms used
Biological, Earth, and Environmental Sciences	25	Greenspace; green space; public greenspace; urban greenspace; urban green space	Greenspace; green space; public greenspace; urban greenspace; urban green space; garden; ecological garden; urban forest; urban parks; urban habitat; urban green areas; greenery; green belt
Architecture, Urban Environment and Building	21	Greenspace; green space; urban greenspace; productive urban greenspace	Greenspace; green space; productive urban greenspace; urban greenspace; forest; green area; green environments; green network; green infrastructure; greening project; productive greenspace; working greenspace
Medical and Health Sciences	15	Greenspace; green space	Greenspace; green space; green area; greenery; natural environment; parkland; walkable area
Social sciences *(including history, education, economics, policy and political science, sociology, and behavioral sciences)*	15	Greenspace; green space; urban greenspace	Greenspace; green space; green area; urban greenspace; natural environment; nature; blue space; green environments
Multidisciplinary	49	Greenspace; green space; green-space; public greenspace; urban greenspace; urban green space; green areas	Greenspace; green space; public greenspace; urban greenspace; urban green space; blue space; garden; greenery; green environment; nature surroundings; green areas; green patches; green infrastructure; multifunctional greenspace; green elements; green roof; urban green; greenness exposure; greenness; open green space; greenbelt; informal urban green-space; nature; public greenspace; riparian greenspace; sky garden; urban forest; trees; urban garden; urban farm; urban greenspace ecosystem; tree cover; urban ecosystem; landscape; urban trees; vegetated area; water bodies; woodland

and Medline, across all years. A TOPIC search for "greenspace" was performed, returning 367 publications published between 1975 and 2014 (Fig. 1). We decided to draw from papers returned by a "greenspace" search because a) the search results represent a sample of both uses of the term ("greenspace" and "green space"), b) the search was less likely to return results not relevant to the intentions of our study (for example, about spaces that are green in colour or described as 'green' in an environmental sense), c) the compound reflects the use of the lexicalized term that is most likely to be intended, and d) "greenspace" as a single-word compound has emerged after the emergence of the two-word compound "green space", as terms that become lexalized often do (Verhoeven & van Huyssteen, 2013), suggesting the development of the term.

The most recent 125 journal papers at the time of download with the topic 'greenspace', during 2009–2014 (Appendix A), were reviewed. The number of papers reviewed represent more than one-third of papers returned in the 'greenspace' TOPIC search. Conference proceedings, reports and planning documents were omitted but informed the research.

The key terms used by journal article authors were noted, as were any definitions provided. In many cases, examples of greenspace were included in lieu of a definition, so examples were also captured. The study location and, where applicable, country was noted. Given that papers were from multiple disciplines, specific aspects of greenspace, such as biodiversity, were not always measured or reported; for example, a study focused on the physical activity of children may not mention biodiversity, but an ecological study might. As such, findings relevant to what the author or authors perceived as *quality* of the greenspace were noted, where *quality* refers to one or more aspects of a site that researchers highlight and that might differentiate them from other sites or prove significant in how the greenspace functions.

Publications with the TOPIC greenspace were found as early as 1975. An increase in the number of publications in the last decade (Fig. 1) suggests that greenspace is an emerging area of research. A seminal paper by de Vries and colleagues (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003), with 230 citations across all databases, has been cited considerably more than the next most-

Table 2
Six types of definitions identified from the literature were used to describe 'greenspace'.

Definition type	Description	Example
Acknowledged range (n = 5)	A definition that acknowledged the range of what can be considered 'greenspace'	"greenness describes level of vegetation, ranging from sparsely-landscaped streets to tree-lined walk-ways to playfields and forested parks."(Almanza et al., 2012)
Definition by examples (n = 17)	Examples were provided to illustrate what is meant by greenspace	"combined areas of open land, cropland, urban open land, pasture, forest, and woody perennial" (Tavernia & Reed, 2009)
Ecosystem services (n = 3)	Examples that embody ecosystem services, such as urban agriculture, and/or a reference to serving human needs	"a type of land use which has notable contributions to urban environments in terms of ecology, aesthetics or public health, but which basically serves human needs and uses" (Aydin & Cukur, 2012)
Green areas (n = 4)	A reference to 'green' and/or 'natural' areas without further explanation	"the area investigated included substantial green elements"(Gentin, 2011)
Land uses (n = 6)	Generic land uses described as greenspace	"recreational or undeveloped land" (Boone-Heinonen, Casanova, Richardson, & Gordon-Larsen, 2010)
Vegetated areas (n = 21)	Areas that feature vegetation	"green in the sense of being predominantly covered with vegetation" (Heckert, 2013)

cited paper by Fuller and colleagues (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007), with 161 citations across all databases. Both of these papers link greenspace to human health and/or well-being.

The studies were conducted across 22 individual countries, with three papers focused on collections of counties (such as the UK or north-western Europe). As has been reported by other reviews (such as Kabisch et al., 2015), the majority of papers were published in the northern hemisphere, including Europe, Asia and North America. Eight papers were reviews or presentations of theoretical frameworks, and thus were not located in any specific country. Two papers focused on the virtual environment: a virtual gardening application (Shwartz, Cheval, Simon, & Julliard, 2013) and a virtual interface for training agricultural workers (Luecke, 2012).

2.1. Disciplinary patterns

The discipline areas for each journal were derived from either the title or the aim of the journal and aligned with the Australian Standard Research Classification (ASRC) (Fig. 2). The majority were from journals with an explicit multidisciplinary aim. A large number of papers were published in journals relating to architecture, the urban environment and building classifications, biological sciences and medical and health sciences classifications. Given the scope of each classification code, there were a range of topics included; for example medical and health sciences papers included studies in nutrition and obesity, public health and epidemiology, and preventative medicine. Almost one-fifth of the papers were from scientific journals focused on conservation biology and ecology. In addition, there were papers from journals with specific multidisciplinary foci, such as science and medicine (such as *PLOS One*) and medicine and society (such as *Social Science and Medicine*).

There were no observable patterns in how papers published in different discipline areas referred to greenspace. For example, ecological papers variously described greenspace as parks (Ikin et al., 2013), undeveloped land (Dallimer et al., 2011), and vegetation and water (Lindemann-Matthies & Marty, 2013). Similarly, papers concentrating on urban planning described greenspace as functioning to provide ecosystem services (Yokohari & Bolthouse, 2011), publically accessible vegetation (Lachowycz & Jones, 2013), and open land or forest (Tavernia & Reed, 2009). Table 1 demonstrates that a range of terms were used interchangeably with greenspace across all disciplines.

2.2. Greenspace context

A majority of papers (102) considered greenspace in the urban environment, the most common context of greenspace. Some papers (8) had a general focus, across human populations. Five papers focused on urbanization gradients or comparisons with rural or other area types. It was unclear whether some papers (6) focused on urban or non-urban environments; for example, one paper focused on public forests which could be located in either or both urban and non-urban environments (Doick, Atkinson, Cordle, & Giupponi, 2013). Two papers focused on coastal environments, one on virtual gardens, and one on virtual training for workers in the context of the rural environment.

2.3. Terminology and definitions

Most papers used the key term 'greenspace' (101), with the remaining papers primarily using the key term 'green space'. Where the key word 'green space' was the main term used, 'greenspace' appeared in the paper, for example, in references (e.g., Diaz-Porras, Gaston, & Evans, 2014), or keywords (e.g., White, Alcock, Wheeler, & Depledge, 2013). In some instances, papers used both formatting of the terms 'greenspace' and 'green space'; for example, 'green space' might be the keyword, but throughout the paper 'greenspace' is used (e.g., Morris & O'Brien, 2011). A range of adjectives qualified the term, such as 'urban greenspace', 'public greenspace', 'open greenspace' and one paper used the phrase 'productive urban greenspace' (Yokohari & Bolthouse, 2011). This creates another layer of ambiguity as while in some cases the qualifying adjective describes a type or subset of greenspace, many papers did not use such a description. It is not clear whether a more descriptive term more accurately describes what is meant by greenspace, or whether it describes a subset of greenspace. Furthermore, of those research papers that did not use an adjective to qualify what was meant, it is unclear whether they were referring to a more general definition of greenspace or whether they failed to adequately describe the object of their study. Many papers used secondary terms to describe the location or object of their study with more detail, for example 19 of the papers that used the term 'greenspace' also used 'blue space', 'green area', 'greenery', 'green belt', 'green environment', 'green network', 'green infrastructure', 'green roof', 'urban green', 'nature', 'parkland', 'urban forest', 'urban parks', 'urban garden', 'urban farm', 'walkable area', and 'woodland'. Table 1 lists more terms used across all disciplines.

Just over half of the papers reviewed (69) failed to provide any definition of what was meant by the term 'greenspace' or 'green space'. This is consistent with similar reviews of other common terms (e.g., McIntyre et al., 2000). Most papers that did not provide a definition provided examples of what was meant by greenspace, such as "woodlots, parks, gardens, road strip corridors, golf courses, and cemeteries" (Carbo-Ramirez & Zuria, 2011). Where examples were given, they could not be relied upon to provide a consis-

Table 3
Examples show how the two different interpretations of greenspace are used.

Greenspace as nature	Greenspace as urban vegetated space
"[Greenspaces] broadly encompass publicly accessible areas with natural vegetation, such as grass, plants or trees [and may include] built environment features, such as urban parks, as well as less managed areas, including woodland and nature reserves." (Lachowycz & Jones, 2013)	"Greenspace is defined as any vegetated land adjoining an urban area . . .and includes bushland, nature reserves, national parks, outdoor sports fields, school playgrounds and rural or semi-rural areas immediately adjoining an urban area." (Chong et al., 2013)
"The conceptualisation of greenspace in this review includes both urban and nonurban green, from natural and semi-natural landscapes to the countryside and urban parks." (Kloek, Buijs, Boersema, & Schouten, 2013)	"urban green spaces – that is forests, trees, parks, allotments or cemeteries – provide a whole range of ecosystem services for the residents of a city" (Bastian et al., 2012)
". . .daily lives involve and take place in parks, allotment gardens, cemeteries, at lakes and beaches and in other green and blue areas. . ." (Petersen, 2013)	". . . we defined a garden as the private spaces adjacent to or surrounding dwellings.(Lindemann-Matthies & Marty, 2013)
". . .'natural' green space environments such as woodlands, parks and gardens. . ." (White et al., 2013)	". . .vegetated areas located within built-up areas, including natural and planted trees, grass, shrubs and flowers.(Lo & Jim, 2012)
"Our main focus is on land cover (including green and blue space types)." (MacKerron & Mourato, 2013)	"[The] sum of all woody and associated vegetation in and around dense human settlements" (Strohbach & Haase, 2012)

tent description of what is meant by greenspace. For instance, some examples included domestic gardens (such as Dallimer et al., 2011) while others specifically excluded domestic gardens (such as Cummins & Fagg, 2012). Of those that did provide a definition, there was no discernible pattern of how the term was used in different disciplines. For example, of the eight papers from urban planning journals, five used a variant of vegetation to define what was meant – although that varied from vegetation and water (Guzy, Price, & Dorcas, 2013), and vegetation and publicly accessible space (Dinnie, Brown, & Morris, 2013) – two provided a definition by example (Moseley, Marzano, Chetcuti, & Watts, 2013; Tavernia & Reed, 2009), and one referred to ecosystem services (Yokohari & Bolthouse, 2011). Just over 7% (9) of the papers reviewed did not provide a definition or provide examples to illustrate what greenspace means in the context of the research.

Of the papers that provided a definition of what they meant by greenspace, six types of definitions were identified (Table 2). The most common definition of greenspace described vegetated areas. The second most common definition involved explicit examples of what was considered 'greenspace' as the definition, for example "urban green spaces – that is forests, trees, parks, allotments or cemeteries" (Bastian, Haase, & Grunewald, 2012). Land uses, such as recreational areas or undeveloped land, are the next most common definitions provided. Five papers acknowledged that there is a range of different kinds of vegetative complexity. Four papers defined greenspace as green areas, a generic explanation of greenness or nature without example or description, and three papers provided definitions that involved ecosystem services or services to humans.

The evidence suggests that even work within disciplines refers to different meanings of greenspace. Greenspace is commonly discussed in multidisciplinary journals, such as *Landscape and Urban Planning* and *Policy and Health*. Given that no single definition of greenspace is employed in disciplines or journals that focus on disciplinary niches, references to greenspace in multidisciplinary journals become less cohesive still. In a paper about whether there is a coastal effect on wellbeing in *Policy and Health*, greenspace is defined as 'natural' environments, including parks, woods, gardens and coastal areas (White et al., 2013). In a paper about the physical activity and design of communities, 'greenness exposure' is measured via normalized differentiation vegetation index (NDVI) (Almanza, Jerrett, Dunton, Seto, & Pentz, 2012), focusing on all live vegetation. Whether greenspace is used as a series of land-use types, includes water or 'blue space' as with coastal areas, or is considered generally as 'greenness', the understanding differs in the literature. Of greater concern are the papers that fail to define what is meant by the term.

2.4. Two interpretations of greenspace

Failing to provide a clear picture of what is meant by greenspace within and between disciplines, there are two possible interpretations of greenspace that could provide a more functional understanding when definitions are provided. The first is that greenspace refers to bodies of water or areas of vegetation in a landscape, such as forests and wilderness areas, street trees and parks, gardens and backyards, geological formations, farmland, coastal areas and food crops. This interpretation refers to an overarching concept of nature, or natural areas in general. Where general land cover is a dichotomy of either urban or natural areas (McIntyre et al., 2000), this macro understanding of greenspace could be a synonym of nature and antonym of urbanization.

The second interpretation represents urban vegetation, including parks, gardens, yards, urban forests and urban farms – usually relating to a vegetated variant of open space. This interpretation could be described as a subset of the overarching concept of greenspace that is confined to the urban environment and a subset of open space. This reflects the predominant focus of the reviewed papers on the urban landscape and therefore the necessary human influence (and reliance) on urban greenspace. This understanding describes a human-focused land-use that requires human involvement and planning in order for it to be successful, even if only to ensure its conservation (Kumar, Mukherjee, Sharma, & Raghubanshi, 2010). In papers that explored perceptions and usage of greenspace, elements that accommodate human usage, such as park benches and footpaths, make the spaces valuable to urban residents (e.g., Lo & Jim, 2012; Petersen, 2013), underscoring the importance of human and non-human interactions. Examples in Table 3 illustrate how the two interpretations are used.

2.5. Language and culture

It is worth noting that the papers reviewed do not include all research concerning vegetation, only those that use the term greenspace. Other terms might be used to represent greenspace, and these may vary from country to country. For example, despite there being seven papers representing Australia that are about greenspace, other papers about research in Australia that concerns vegetation have been published during the same timeframe. Other terms include remnant vegetation (White, Fitzsimons, Palmer, & Antos, 2009), urban forest (Doody, Sullivan, Meurk, Stewart, & Perkins, 2010), and patch (Miller, Possingham, & Fuller, 2011). Searching for every possible descriptor of vegetation and/or natural area for a comparison of findings might be possible, if unwieldy. The different terms used by different cultures makes this more dif-

ficult. If an understanding of greenspace was shared, this would make literature searches easier and links between studies more readily found, as greenspace could be a common term in the title, abstract or keywords.

Describing an urban environment as a 'human-dominated ecosystem' omits the land-use, demographic, ecological and social details that might be the focus of that environment for a range of disciplines (McIntyre et al., 2000). The term greenspace has similar difficulties and, while the meaning is often assumed, this work demonstrates that the definition varies. Even when defining what is meant by greenspace, the language used can be ambiguous; for example, do "street trees" (Jack-Scott, Piana, Troxel, Murphy-Dunning, & Ashton, 2013) and "streetscape greenery" (van Dillen, de Vries, Groenewegen, & Spreeuwenberg, 2012) mean the same thing? Is a "sky garden" (Tian & Jim, 2012) the same thing as a "green roof"? By referring to *urban* greenspace, it might further be implied that there is also *rural* greenspace. And when Seaman et al. (2010) refer to "local parks or greenspaces", it becomes unclear what is meant by a park if it is not greenspace?

The use of the word 'green' to describe the space could be considered a synonym for vegetation. For example, one paper defines 'urban green' as "all kinds of vegetation that give the street a green appearance" (de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013). The simplest definition would be that greenspace is any space with a "green appearance", although this is problematic as it suggests associations with colour, rather than vegetation. Although there are suggestions that the colour green does contribute to positive effects of greenspace (such as, Akers et al., 2012), colour psychology and colour therapy should be treated with caution as colour associations may vary depending on context and culture, among other things (O'Connor, 2011). Further, if greenspace has benefits for humans and provides resources such as habitat and food to non-human life, then concrete painted green, or synthetic grass, are not going to perform the same function as vegetation. So while one simple definition would be useful, it could be misleading and ultimately unhelpful.

It would be accurate to define greenspace by acknowledging that multiple meanings exist and individual authors could be referring to different things, for example, noting that greenspace definitions are "subjective and vary widely, but broadly encompass publicly accessible areas with natural vegetation, such as grass, plants or trees" (Lachowycz & Jones, 2013). While this example excludes private gardens and would therefore not be ideal for some studies, the definition allows other interpretations. Including a list of terms and concepts (e.g., Thornton, Pearce, & Kavanagh, 2011), or at least providing details of consistent measures would construct a qualitative definition of greenspace and enable it to be broadly understood.

It is not just the language that can be ambiguous, but meaning can also differ between cultures. Allotment gardens are common in parts of Europe and refer to small plots of land provided to individual households for the purpose of recreational gardening and particularly for growing food. Not all countries use allotment gardens, or may use another term (for example, a community garden is a similar term, but it would normally be tended by a group of neighbouring people rather than one household). It would not always be obvious that greenspace includes allotment gardens (e.g., Groenewegen, van den Berg, Maas, Verheij, & de Vries, 2012) unless an explicit definition is provided. When defining greenspace as "urban parks and woodlands" (Doick et al., 2013), it may be unclear whether 'woodlands' refers to urban woodlands (a small patch of trees in an urban area), or native woodlands on the urban fringe or removed from the urban area. It may be that readers from that local area share the cultural assumption about what 'woodland' refers to, however this understanding is not always shared across cultures. Relying only on common land use types, such as park, is problematic because they could be culture-specific (Catterall, 2009). Furthermore, government zoning labels are not consistent around the world, nor do they describe environmental features that are critical to assess if the greenspace is going to support human and non-human life (Catterall, 2009). The uncertainties associated with multiple cultural contexts underscore the importance of including quantitative information so that when qualitative information is not understood by researchers from different cultures, measurements or explicit criteria can increase the chances of understanding.

2.6. Greenspace quality

A number of the papers reviewed referred to the quality of greenspace. As urban ecologists, we might have assumed that quality refers to ecological integrity; however it was evident that quality is subjective. For example, in a paper by geographers concerned with an anthropocentric understanding of greenspace, the quality of greenspace was measured by perceptions of 'naturalness' or lack of litter (Groenewegen et al., 2012). In a paper linking physical activity, children and greenspace, parents nominated quality greenspaces as those with good lighting around play areas and paths (Lachowycz, Jones, Page, Wheeler, & Cooper, 2012). Some ecological papers may consider quality in terms of the subject of their study, for example, the types of greenspace preferred by birds are "unmowed or not landscaped" (Vallejo et al., 2009). In a paper about urban cooling, the best quality greenspaces comprise forest vegetation as it is most effective at cooling (Kong, Yin, James, Hutyra, & He, 2014). The disciplinary focus is relevant, but quality is not unique to discipline. For example, two papers concerning physical activity identified quality in different ways: one noted that 'formal' greenspaces that were well maintained and included paths represented 'quality' of greenspace that was associated with physical activity (Cummins & Fagg, 2012), whereas another identified that what was considered good quality greenspace differed for various social groupings, such as adolescents who wish to 'hang out', or parents with dependent children (Seaman, Jones, & Ellaway, 2010).

There are numerous social nuances in how people perceive 'quality' and, where relevant, these should be carefully defined to study participants. Some studies referred to the quality of 'greenness' (van Dillen et al., 2012) or 'green' (de Vries et al., 2013), without differentiating between kinds of vegetation or biodiversity. Greenspace is commonly considered to be uniform, but the ecological complexity is critical to consider (Shwartz et al., 2013). For example, in a study on semi-aquatic turtles, it is noted that the turtles move between both terrestrial and aquatic habitats without discrimination and, therefore greenspace should refer to both habitat types (Guzy et al., 2013).

Patterns are difficult to find in current research about perceptions of quality or how greenspace impacts humans (Sadler, Bates, Hale, & James, 2011). Ecological integrity and species richness has been found to be aesthetically pleasing (Lindemann-Matthies & Marty, 2013). An association with *perceived* species richness and self-reported wellbeing, perhaps due to poor biological knowledge and biodiversity-identification of park visitors, has been found, but there is no consistent association between the species richness of plants, birds and butterflies and self-reported wellbeing (Dallimer et al., 2012). In a study where participants choose the species they would like in their ideal garden via a virtual tool, those who had higher levels of education or who were older tended to create gardens with greater biodiversity and included more native species than other participants (Shwartz et al., 2013). Given that there is a relationship between time spent in greenspace in Australia and incidence of skin cancer (Astell-Burt, Feng, & Kolt, 2014), the type of vegetation in public greenspace is important. For example, shade trees might be more important to include at temperate locations than others. Furthermore, people generally prefer the presence of trees, and forests have been found to have a range of benefits

Table 4
Case studies demonstrate the different topics associated with greenspace.

Aim	Country of study	How 'greenspace' is defined or used	Other terms used	Type of greenspace	Ownership	Ref-erence
The study investigates policy and management of greenspace in an urban area via a literature review, stakeholder interviews, and document analysis.	Malaysia	Greenspace is described by existing definitions that include forests, parks, water bodies, recreational and sports grounds. (*Vegetation*)	Green infrastructure; multifunctional greenspace; green elements; urban greenspace	Greenspace can include a range of vegetation, including parks, forests, and street trees.	Greenspace is municipally owned land, however it is noted that much land thought to be public is in fact private, and discussion of the private sector creating greenspaces near their premises or sponsoring public greenspaces.	Akmar, Konijnendijk, Sreetheran, and Nilsson (2011)
This study aims to determine whether there is an association between greenness exposure and children's physical activity.	USA	Green space and greenness refer to a range of vegetation. (*Range*)	Greenness exposure; normalized difference vegetation index (NDVI); greenness; open green spaces; greenbelts	Green space includes sparsely-landscaped streets, tree-lined walk-ways, playfields, and forested parks.	Ownership is not relevant; children and green space are tracked remotely via GPS or NDVI – so interactions may be on public or private land.	Almanza et al. (2012)
The study aims to determine the economic value of public greenspace in relation to urban residents' life satisfaction.	Australia	Greenspace is defined with examples: "public parks, community gardens, cemeteries, sports fields, national parks and wilderness area." *(Defined by examples)*	Public greenspace	The type of greenspace is not discussed. Greenspace is determined via GIS.	The focus on this paper is public greenspace, and there is discussion that the results support the "compensating hypothesis": residents without private greenspace will compensate by using public greenspace.	Ambrey & Fleming (2014)
This paper proposes a method for planning that takes into account the oxygen and carbon balance of urban areas.	Turkey	While greenspace and green space are both used in the manuscript, the key term, green areas' are defined as those that make contributions to the ecological, aesthetic or public health needs of the urban environment. *(Ecosystem services)*	Open green spaces; urban green areas; green areas	The focus is on oxygen production, particularly trees.	Ownership of trees at the city scale is not discussed.	Aydin & Cukur (2012)
This paper promotes productive urban greenspaces that allow 'serious leisure' for residents, including urban agriculture and woodland management.	Japan	Productive greenspaces include urban farms and peri-urban woodlands, where urban residents can partake in 'serious leisure' by producing food or wood. (*Ecosystem services*)	Productive urban greenspace; working greenspace; greening projects; forestry; urban agriculture	Examples of productive greenspaces discussed include urban agricultural land, farms, and peri-urban woodland	Whether the agriculture occurs on public or private land is not explicit, although a farm household denotes private land. Urban forestry on the 'commons' occurs on public land.	Yokohari & Bolthouse (2011)
This study explores urban residents' views of current and desired greenspace.	China	Urban greenspace requires vegetation, such as trees, grass and flowers, situated in a built-up area. (*Vegetation*)	Green sites; greenery; urban nature; urban park; urban greening; open space	Parks, natural and planted trees, grass, shrubs, and flowers.	The implication is that this paper refers to public greenspace.	Lo & Jim (2012)
This study uses a virtual tool to measure the biodiversity that people choose to put in their ideal garden.	N/A (virtual reality)	Nature or green spaces are gardens or green roofs. *(Defined by examples)*	Nature; green roof; garden; urban green spaces; biodiversity	Public or domestic gardens, or green roofs.	People can use the tool to design public or private green spaces.	Shwartz et al. (2013)

Table 5
Using multiple criteria to define greenspace creates a meaningful definition that a reader can understand, apply in a meta-analysis, or replicate.

Examples of criteria	Examples of how the criteria might be defined	Category of criteria	Example discipline
Definition	Greenspace refers to urban parks and wetlands that comprise some vegetation.	Qualitative	Urban ecology
Examples	Greenspace refers to small urban parks, including public parks, street verges, cemeteries, and sports grounds.	Qualitative	Urban planning
Size	The greenspaces had an area of 2 ha or less.	Quantitative	Public health
Ownership	The greenspace is located on public land that is maintained by the local government or council.	Qualitative	Geography
Landscape	The greenspace is calculated across the full extent of the city, as defined by the GIS boundaries and zonal statistics.	Qualitative and quantitative	Psychology
Ecological information	All greenspaces had a minimum biodiversity of at least 10 different tree species, 8 shrub species, lawn, and 5 bird species had been counted there during one site visit.	Quantitative	Ecology
Access	All greenspaces were located within 10 km of the participants' homes.	Quantitative	Public health
Amenities	Greenspaces were chosen because they had amenities that made them accessible to low-mobility residents, requiring paths, flat surfaces, and numerous benches for frequent rests.	Qualitative	Sociology
Tree cover	In order to reduce urban heat, greenspace considered in this study includes vegetated land comprised of >40% mature tree cover.	Quantitative	Cooling and carbon sequestration

(McDonnell & Kendal, 2015). In addition to the quality of the vegetation, the quality of the space and attributes of the park might be important determinants for how and how frequently people or non-human animals use a greenspace (Frumkin, 2003). Measuring associations between biodiversity and human wellbeing, although complex, is a critical area for further research.

We included references to quality in this study because we found an absence of consistent aspects of greenspace in the sample. For instance, we initially tried to categorise the biodiversity of greenspaces, or their accessibility. Because these aspects were not mentioned in all or even most of the papers reviewed (for example, only 28 papers mentioned biodiversity as an aspect of greenspace), we looked instead for subjective references to quality. Even so, only half (n. 63) of the papers reviewed mentioned quality. Examples of the differing foci of papers are included in Table 4 to illustrate the wide variation.

3. Creating definitions of greenspace

The papers reviewed demonstrate that current definitions of greenspace are broad and complex. A number of patterns were identified, such as six operational definition types and two overarching interpretations, but these patterns fail to uncover a single unifying definition. Furthermore, many cases often assume a single understanding of greenspace, but neglect to articulate one. We acknowledge that greenspace will be used in varying disciplines, cultures and contexts. Like other researchers (e.g., Hunter & Luck, 2015; McIntyre et al., 2000), we suggest that it is not useful to try and impose a single definition for common terms such as greenspace across all contexts. Instead, we suggest that by providing a meaningful definition of what the term means for each study, greenspace might be understood across disciplines, cultures and contexts.

Depending on the interpretation of greenspace used, such as nature in the urban context, we might be able to expect patterns of environmental structure or function that could be compared globally (Catterall, 2009). Wildlife assemblages and vegetation structure, for example, might be similar in different types of urban greenspace (such as described in McKinney & Lockwood, 1999). This would enable researchers to employ the ecology of cities, utilizing multiple scales and disciplinary methods (McDonnell, 2012).

In order for studies concerning greenspace to be broadly constructive, operational definitions of greenspace should be both qualified and quantified. Similar to the definition model used to define *urban* (McIntyre et al., 2000), we suggest that researchers provide multiple aspects that explain what they mean by the term *greenspace*. A qualitative description of the greenspace is, of course, useful, but that should not be the extent of a definition. For example, in a study about urban cooling, a generic description of a greenspace as an urban forest is unlikely to be specific enough to portray that in order to make a difference in urban temperatures, the shape and size of a greenspace and the tree cover it provides are critical (Kong et al., 2014). However, rather than suggesting or supporting a detailed typology for such a wide range of disciplinary research, we suggest that by both qualifying and quantifying the greenspace, researchers will be able to form a meaningful definition that is both applicable to their work and that enables comparison and multidisciplinary application.

Table 5 provides examples of how greenspace might be defined in different contexts. We highlight that the more detail is provided (that is, using more than one criterion), the more useful the definition will be.

4. Conclusion

The existing approach of tacitly describing greenspace, if continued, will ensure that the literature remains scattered and disparate. We found that most published research fails to provide a definition of greenspace. We found that when a definition is provided, there is variation in what is meant by the term 'greenspace'. The current lack of consensus about what greenspace is should not deter researchers from using the term, but researchers should provide a meaningful definition that both qualifies and quantifies what they meant by the term. Future publications should employ clear operational definitions based on measurable criteria in order to progress greenspace research.

It is likely that the lexicalization of the one-word compound, greenspace, will continue. In that respect, we recommend that *greenspace* is used as well as or instead of other terms that involve either of the identified interpretations found; that is, greenspace as natural areas or urban vegetation. This will allow the literature to be more distinct and meanings to be more widely understood.

By using common terms and defining them well, an opportunity for meta-analyses presents itself. The term, greenspace can be meaningfully used across disciplines, fostering multidisciplinary and interdisciplinary research and syntheses. This will improve the otherwise disparate nature of research concerning greenspace that spans multiple discipline areas.

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Appendix A.

Papers reviewed

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