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Review Article

Tracing and building up environmental justice considerations in the urban ecosystem service literature: A systematic review

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ABSTRACT

The concept of ecosystem services (ES) has mainstreamed as an interdisciplinary framework in the urban sustainability and resilience agenda. While the uptake of ES in urban areas is deeply entangled with multiple values, trade-offs, institutions, management and planning approaches, there is still a lack of a comprehensive and systematic framework to address environmental justice (EJ) in urban ES assessments. This article presents a systematic literature review to examine what factors are critical for the effective inclusion of an EJ lens in urban ES appraisals. More specifically, we assessed how distributional, procedural and recognitional EJ dimensions have been addressed, and in relation to which types of urban ES. Our results reveal that EJ considerations are currently focused on the (un)equal distribution of ES and the associated green and blue infrastructure with regard to socioeconomic groups, with special attention to income and race/ethnicity as the main mechanisms of social stratification. There is also a predominant focus on regulating and cultural ES, analyzing their role on resilience and adaptive capacity on one hand, and recreational values, social cohesion and place-making on the other. In this review, we also evaluate the interconnected dimensions of justice and their constraints, and lay out pathways for new research into intersectional and restorative approaches to justice in ES assessments. Finally, we interrogate what the role of urban ES-based planning might be in making more inclusive and just cities and explore its implications for policy and practice.

1. Introduction

Over the last decade, the concept of Ecosystem Services (ES) has been mainstreamed as an interdisciplinary guiding framework in urban sustainability and resilience agendas (Gómez-Baggethun & Barton, 2013; Haase, Frantzeskaki, & Elmqvist, 2014; Raymond et al., 2017). Cities worldwide are increasingly incorporating ES-based approaches to inform decisions over green and blue infrastructure (see Box 1) planning and management (Demuzere et al., 2014; Hansen et al., 2015) with the aim to become *inclusive, safe, resilient and sustainable* (UN, 2015). Nevertheless, the development of urban ES assessments has so far not fully integrated an Environmental Justice (EJ) perspective (cf. Ernstson, 2013; Langemeyer & Connolly, 2020; Enssle and Kabisch, 2020). As a result, decisions and interventions that do not include a broad range of urban EJ issues might perpetuate or even exacerbate environmental inequalities around benefits from nature and ecosystem services among economically, socially and racially disadvantaged groups (Haase et al., 2017; Wolch, Byrne, & Newell, 2014).

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The ES framework has recently been criticized for reflecting an anthropocentric understanding of human-nature relationships and for privileging economic valuation approaches (Schröter et al., 2014; Sikor, 2013), which may lead to the commodification of ecosystem processes and structures. This is already illustrated by the green branding tools that cities tend to increasingly incorporate in their greening projects (Garcia-Lamarca et al., 2021; McDermott, Mahanty, & Schreckenberg, 2013). Furthermore, ES assessments are often underpinned by prescriptive and normative assumptions (Kotsila et al., 2020) expressed in broad claims like, for example, that all social groups will derive equal health and well-being benefits from the ES provision of a new greening intervention. These aspects may neglect values embedded in social structures and perpetuate the unidimensional and techno-economic framing of ES approaches (Lele, Brondizio, Byrne, Mace, & Martinez-Alier, 2018; Lele, 2013). At the same time, researchers increasingly acknowledge that the translation of ES into human benefits is deeply entangled with multiple perceptions, institutions, and infrastructures, especially in urban areas (Andersson et al., 2019; Elmqvist, Gómez-Baggethun, & Langemeyer, 2018; Ernstson, 2013). These factors intervene in the co-production of ES benefits and therefore need to be carefully dissected in order to avoid unequal distribution of and access to ES for marginalized groups, their exclusion from the decision-making processes and the disregard of their specific needs, values, demands and identities (Anguelovski et al., 2020).

We acknowledge that some of the literature on ES has considered questions previously examined by the longstanding EJ scholarship (Dawson et al., 2017; Mohai, Pellow, & Roberts, 2009; Walker, 2011), such as concerns over unequal access to environmental resources and decision-making power (Costanza, 2003; Heynen & Lindsey, 2003; McAfee, 1999; Tschakert, 2007; Wilson & Howarth, 2002). These early ES analyses broadly explored the links between ES, well-being, poverty alleviation and sustainable environmental management, mainly in rural livelihoods and natural reserves. For instance, Payment for Ecosystem Services (PES) —a policy of compensatory market-based tools for ecosystem protection— has been widely critiqued in communities of the Global South for their inability to give proper acknowledgement to issues of inclusion and poverty alleviation while creating conflicts of land use (Chaudhary & McGregor, 2018; Chaudhary, McGregor, Houston, & Chettri, 2018; Kosoy & Corbera, 2010; Pascual et al., 2014; Schreckenberg, Mace, & Poudyal, 2018; Sikor, 2013). On a similar line, the current IPBES framework has integrated different worldviews and types of knowledge into its assessments through the Nature's Contribution to People approach, emphasizing the need for a combination of generalized understandings and localized, context-specific perspectives of nature's benefits vis-à-vis conservation policies (Díaz et al., 2018; Kadykalo et al., 2019; Martin et al., 2016). However, while these efforts demonstrate a greater incorporation of plural views of nature in decision-making, ES research regarding processes of urbanization and development remains relatively new, and there is still a lack of systematic incorporation of urban EJ concerns (Haase et al., 2017; F. Marshall et al., 2018).

Recently, researchers have been calling for a greater focus on EJ in the urban ES scholarship in order to integrate broader conceptions of justice (See Box 1) into a better diagnosis of urban environmental and health inequalities (Aragão, Jacobs, & Cliquet, 2016; Berbés-Blázquez, González, & Pascual, 2016; Ernstson, 2013; Langemeyer & Connolly, 2020; Marshall & Gonzalez-Meler, 2016) while fostering more representative and legitimate decision-making processes (Andersson et al., 2019; Langemeyer, Gómez-Baggethun, Haase, Scheuer, & Elmqvist, 2015; Maes, Burkhard, & Geneletti, 2018). Furthermore, some urban ES researchers are increasingly incorporating social dimensions within their assessments, which opens new terrain for EJ analysis, including novel socio-economic and non-monetary valuations of ES (Amorim Maia et al., 2020; Camps-Calvet, Langemeyer, Calvet-Mir, & Gómez-Baggethun, 2016; Depietri, Kallis, Baró, & Cattaneo, 2016; Langemeyer, Calcagni, & Baró, 2018), analyses of ecosystems trade-offs (Turkelboom et al., 2018), ecosystem disservices (Escobedo, Kroeger, & Wagner, 2011; Von Döhren & Haase, 2015), and broad recognition of the diverse socio-cultural values held by different groups (Bertram & Rehdanz, 2015; Fischer et al., 2018; Jacobs et al., 2016; Swapan, Iftekhar, & Li, 2017).

These efforts towards a more comprehensive urban ES-based application framework that systematically incorporates justice in the urban greening governance partially originates in the recent EJ scholarship which has traditionally highlighted existing inequities in access to ES provision as part of green infrastructure interventions (Byrne & Wolch, 2009; Meerow, 2020; Shokry, Connolly, & Anguelovski, 2020; Wolch, Byrne, & Newell, 2014). Put differently, environmental amenities and greening policies in urban planning are not exempt from trade-offs and potential social and racial inequities in the way new green infrastructure is being deployed (Connolly, 2019; Nesbitt, Meitner, Sheppard, & Girling, 2018). They can intensify social-spatial inequities by triggering processes of social exclusion while leaving historical grievances untouched (Anguelovski, Connolly, Garcia-Lamarca, Cole, & Pearsall, 2018; Connolly & Anguelovski, 2021; Gould & Lewis, 2017; Rigolon & Németh, 2019; Safransky, 2018; Schlosberg, 2013; Wolch, Byrne, & Newell, 2014)

Consequently, there is a scholarly need for a greater confluence —both conceptual and practical— between EJ and urban ES. Such an endeavor is needed to bring new light to our understanding of the diverse environmental relations of different population groups, regarding questions of unequal access, perceptions, and responsibilities vis-à-vis urban ES-based agendas. This agreement would also serve as the foundation for ensuring that plural values and demands are recognized in the political and institutional schemes that shape the ES-based environmental governance model. In turn, such ES research that bridges interdisciplinary EJ concepts and methods can challenge the vision of EJ as a static and idealistic concept rather than a dynamic and pluralistic one, which urban communities actively construct in their specific contexts (Brand, 2015). Thus, expanding the conception of urban green and blue infrastructure in this way is required to account not only for (un) equal material distribution but also for the actual delivery of benefits and embedded values, and the participation of different social groups in the co-production of ES —or lack thereof (Andersson et al., 2019; Anguelovski et al., 2020; Safransky, 2018).

This systematic review paper takes a step toward a combined ES-EJ perspective by examining how questions of EJ are currently being incorporated into urban ES studies and proposes new directions to bring urban EJ and ES together in ways that can foster more inclusive, sustainable, resilient and healthy cities. Our goal is to identify potential intellectual alliances through the incorporation of the EJ lens into the assessment of urban ES and to highlight the two fields' complementarities, knowledge gaps, points of conflict, and areas of confluence.

2. Material and methods

In order to identify and analyze the scientific literature relevant to our research objectives, we carried out a quantitative systematic review, similarly to prior ES reviews on factors of urban greenspace provision and governance (Boulton, Dedekorkut-Howes, & Byrne, 2018; Breen, Giannotti, Flores Molina, & Vásquez, 2020), biodiversity and ecosystem functioning in cities (Haase et al., 2014), ES and human-wellbeing (Cruz-Garcia et al., 2017) and the conceptualization and involvement of stakeholders in urban ES research (Luederitz et al., 2015). The novel contribution of our review is that it interrogates the operationalization of environmental justice within urban ES assessments, which has not been previously completed nor addressed in the literature. The process of data gathering, screening and analysis followed the widely used protocols of the PRISMA Statement for systematic reviews (Moher et al., 2009), as depicted in Fig. 1. We first gathered potentially relevant papers using the ISI Web of Science and Scopus, two well-recognized and widely deployed databases. We performed a search of peer-reviewed articles and reviews published in English. The search string used is available in Table S1 of the Supplementary data. We obtained (on 8th January 2020) 136 records from the Scopus database and 189 from the

Box 1
Glossary of major terms relevant to the key topics of discussion of this review.

Urban Ecosystem Services (UES) — Benefits that humans obtain from urban ecosystems and their components (Gómez-Baggethun & Barton, 2013; Mader, Patrickson, Calcaterra, & Smit, 2011; Millennium Ecosystem Assessment, 2003).

Green and Blue Infrastructure (GBI) — A strategically planned network of green and blue spaces in urban areas, designed and managed to deliver a wide range of ecosystem services and other benefits at various spatial scales (Hansen, Rall, Chapman, Rolf, & Pauleit, 2017).

Environmental Justice (EJ) — Plural set of conditions related to the fair distribution of resources, inclusive political processes, and institutionalized recognition of communities that allow for full human flourishing (Schlosberg, 2013).

Equity — Used here as the just distribution of environmental goods and burdens.

Fairness — Used here as individuals' perceptions of justice arising from a judgment process (Graham et al., 2015).

Distributional Justice — Also known as distributive justice, it refers to the equitable allocation of and access to material costs and benefits for all social groups in both spatial and temporal terms (Schlosberg, 2013).

Procedural Justice — Also known as participatory justice, it refers to participatory and inclusive decision-making processes and it is linked with transparent and meaningful citizen involvement (Schlosberg, 2013).

Recognitional Justice — Also known as interactional justice, it is related to interpersonal interactions that allow people to express themselves in their own way, provision and access to information, and respect for different needs, values, preferences and identities (Langemeyer & Connolly, 2020).

Restorative Justice — Also known as reparative justice, it is based on acknowledging histories of social trauma and taking recovery measures (Aragão, Jacobs, & Cliquet, 2016; Draus, Haase, Napieralski, Roddy, & Qureshi, 2019; Draus, Lovall, Formby, Baldwin, & Lowe-Anderson, 2019).

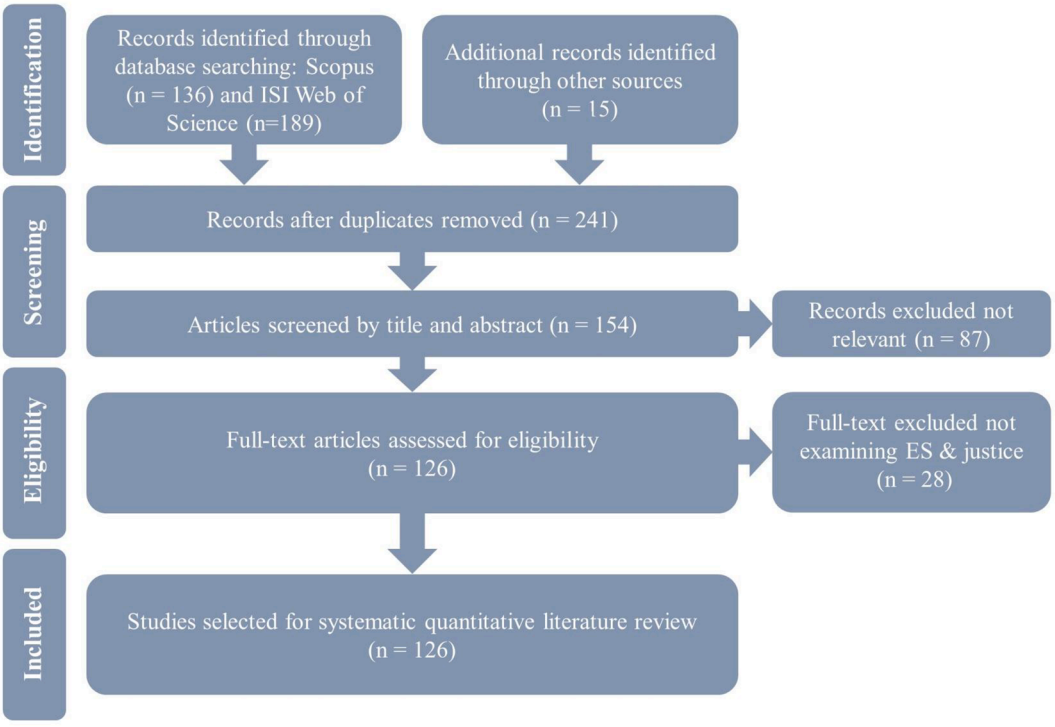

Fig. 1. Diagram of search and data selection based in PRISMA Statement steps.

ISI Web of Science. Following the database search, 15 additional papers that referred to urban ES and EJ but not as the main part of their analysis (and thus were not identified in our search string) were suggested by authors with expertise in this area and, after confirmation of relevant content, added to our list. We finally obtained a merged database of 241 identified unique records. From these initial search results, we screened the abstracts for their relevance to the research goal, using the following criteria: 1) Explicit mention and examination of ES; 2) Explicit relation of the ES framework to EJ, social equity or perceptions of fairness; 3) Focus on the urban context, including also rural-urban gradient and peri-urban studies. During the screening of abstracts, we discarded non-relevant papers that did not meet these criteria. Examples of excluded papers include those that broadly mention justice or equity implications of ES but without further analysis, papers only mentioning ES as a potential indicator of environmental sustainability, and other articles obtained due to identification errors from database algorithms. Abstracts of the retrieved articles were examined by the first two authors, and doubts regarding the inclusion or exclusion of studies were discussed by

all co-authors until an agreement was reached. After the first selection, the first author reviewed the full-text to confirm eligibility and proceed to the analysis.

We eventually included 126 relevant papers and carried out an in-depth analysis of these papers following a codification protocol of pre-defined possible entries, shown in Table 1. The final review categories were obtained iteratively by clustering closely related concepts to avoid redundancy and by dividing categories to avoid ambiguity. This classification facilitated the subsequent analysis and data visualization and was agreed upon in consensus with all co-authors. We selected categories that allowed us to obtain the bibliographic information and scope of the article (i.e. authors, title, keywords, abstract, journal, year of publication, category of article, country, continent). We then included information about the nature of ES analyzed, by groups (i.e. provisioning, regulating, supporting and cultural), and by the ecological structures (e.g. allotments, parks, blue spaces, etc.) that produce them. We dissected the types of urban ES to better examine the benefits provided relative to how they are operationalized in relation to an EJ perspective, following well-established classification frameworks used in previous research (see Elmqvist et al., 2018; Gómez-Baggethun & Barton, 2013), such as those from the Millennium Ecosystem Assessment (MA), The Economics of Ecosystems and Biodiversity (TEEB) and the Common International Classification of Ecosystem Services (CICES). We also included ecosystem disservices because trade-offs and negative outcomes can have potential EJ ramifications and are especially relevant in urban areas (Von Döhren & Haase, 2015). Although we did not code the specific disservices considered in our sample, we contend that a holistic approach of ES should include the wide range of disservices derived from urban green infrastructure, including for instance, tree pollen allergy, damage to infrastructure, and lack of perceived safety and harassment (Langemeyer & Gómez-Baggethun, 2018). We also identified the EJ approach or dimension used by relevant articles, the social stratifications at stake in the production of (in)justices, and the types of stakeholders responsible for addressing or producing injustices. We selected the social stratification variable to account for the social mechanisms of power that have historically privileged some social groups among others (i.e. by income, educational attainment, age, gender or race/ethnicity) in the access and vulnerability to environmental benefits and hazards.

Table 1
Review categories and possible entries for each one. These variables served to code the 126 analyzed papers.

Review categories	Possible entries	References
Category of article	Case study, review, conceptual paper.	
Country	Name of the country of the study, multiple, not applicable.	
Continent	Name of the continent of the study, not applicable.	
Ecological structure	Allotments and community gardens, parks, blue spaces (rivers, lakes, coast, wetlands), agricultural land, forests, other *peri*-urban lands (including *peri*-urban areas and urban–rural gradient), brownfields, green space connected to grey infrastructure (green roofs, street trees and façades), not specified (when talking of urban green infrastructure in general).	Modified from Haase et al. (2014); and Hansen, Rall, Chapman, Rolf, & Pauleit, 2017
Groups of ES	Provisioning, regulating, supporting, cultural, not specified (when talking of ES in general terms).	Mader, Patrickson, Calcaterra, & Smit, 2011
ES examined	Provisioning: food supply, water supply, raw materials. Regulating: runoff mitigation, air purification, global climate regulation, urban temperature regulation, noise reduction, waste treatment, moderation of extreme events, erosion prevention and maintenance of soil fertility. Supporting: habitat provision for biodiversity. Cultural: aesthetic benefits, recreational and mental and physical health, sense of place and social cohesion, tourism. Ecosystem disservices (if mentioned). Not specified.	Based on Elmqvist et al. (2018); and Mader, Patrickson, Calcaterra, & Smit, 2011
EJ dimension examined	Distributional, procedural/participatory, recognitional/interactional, not specified.	Schlosberg, (2007), Schlosberg (2013)
Social stratification related to EJ	Income, educational attainment, age, gender, race/ethnicity, not specified.	Agyeman et al. (2016); Martínez-Alier et al. (2014)
Stakeholders involved	Policy makers (including EU-policy makers and analysts), NGOs, land owner/landlords, scientists, firms/industry, farmers, foresters, public/residents, tourists, various-local public authorities (including city council and municipal agencies and administrators), various-regional public authorities (including regional and national agencies and administrators and government), no (when there is no stakeholder involved in the research process of the article).	Haase et al. (2014)

We acknowledge that our review has likely omitted some relevant literature as it has been limited to peer-reviewed articles already published and written in English and available in the search databases. Additionally, our search terms greatly delimit the bounds of the studies we examine, as the ES framework is often not used by (urban) EJ researchers and vice versa. ES research often addresses poverty alleviation, distribution of resources, governing systems (Sjöstedt, 2012; Suich, Howe, & Mace, 2015) and trade-offs in human well-being (Daw et al., 2015) but may not be self-identified or labelled as research related to EJ. On the other hand, there is a large body of literature on EJ, encompassing disciplines such as political ecology and critical geography, which addresses the topic of urban greening without referring to the ES framework (Heynen, Kaika, & Swyngedouw, 2006; Ranganathan & Bratman, 2019; Tzaninis, Mandler, Kaika, & Keil, 2020; Wachsmuth & Angelo, 2018). However, the objective of this review was to identify the state of the field in terms of the explicit intersection between ES and EJ in urban areas among the afore-mentioned bodies of literature with an approach that could be transparent and repeatable. For this reason, despite the bias and limitations expected in systematic reviews, we are confident that the number and diversity of the articles we have reviewed here is representative of the emerging EJ trends within the urban ES literature and therefore provides a rigorous picture of the state-of-the-art.

3. Results

A detailed list of the final reviewed articles is available as Supplementary data. The 126 articles identified and analyzed covered the time period 2009–2020 with a consistent increase, especially in the last 4 years (Fig. 2). Despite the fact that the seminal paper on urban ES dates back to 1999 (Bolund & Hunhammar, 1999), the earliest articles included in this review were not published until 2009 (Byrne & Wolch, 2009). From the 126 papers in our analysis, 14 were theoretical/conceptual articles, 12 were literature reviews and 101 were empirical case studies. Review articles focused on a particular geographical scope or ecological structure (e.g. Davies & Lafortezza, 2017; Dobbs et al., 2019; du Toit et al., 2018; Ordóñez-Barona et al., 2019), on a specific ES group (e.g. Chen et al., 2019) or on other emerging aspects related to urban

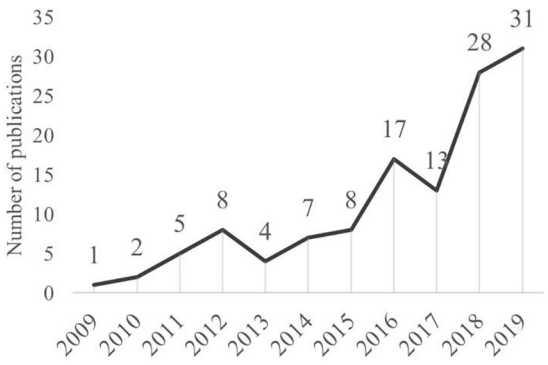

Fig. 2. Number of publications analyzed from 2009 to 2019.

green spaces such as human health, ecosystem-based adaptation, and factors affecting the value of urban nature-based solutions and green-space provision (e.g. Boulton, Dedekorkut-Howes, & Byrne, 2018; Brink et al., 2016; Jennings, Floyd, Shanahan, Coutts, & Sinykin, 2017; Keeler et al., 2019). However, none of these reviews systematically addressed EJ aspects in urban ES assessments as an overarching topic. The most frequent journals of publication of the reviewed articles were *Landscape and Urban Planning* (15 articles), *Urban Forestry and Urban Greening, Ecological Economics, Ecology and Society,* and *Urban Ecosystems* (6 articles each). The majority of analyzed articles were case studies with a geographical scope focusing on the Global North (Fig. 3). Nevertheless, 19 conceptual and review articles did not focus on any country/continent in particular and are therefore not represented in the map.

Almost half of the reviewed papers addressed regulating ES (60 out of 126), closely followed by cultural ES (Fig. 4). However, 18 articles considered exclusively cultural ES in their analysis, while regulating and provisioning ES were more often examined in combination with the rest of the groups of ES. Supporting ES were the focus in only 21 articles and 30 articles did not highlight any group of ES, but rather addressed the concept in broader terms, without a specific examination or quantification of a certain group. Note that some ES classifications such as CICES (Roy Haines-Young, by, & Potschin, 2018) do not include supporting ES as these are considered as ecological functions.

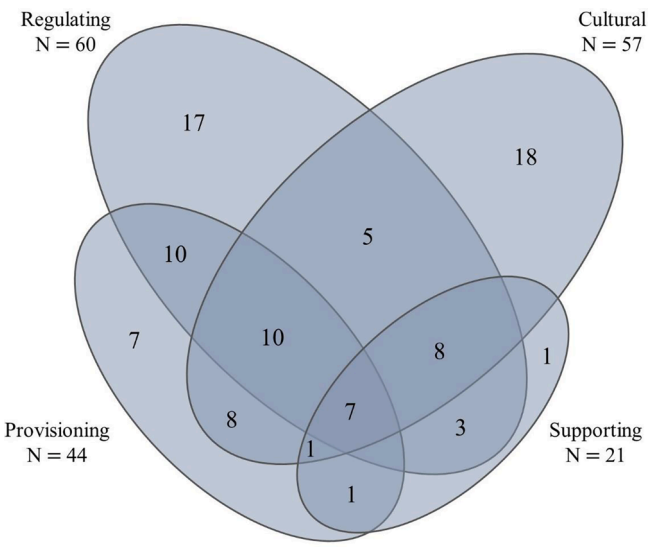

Fig. 4. Venn diagram with overlapping bubbles representing the four groups of Ecosystem Services (i.e., Regulating, Provisioning, Cultural, Supporting) considered in the reviewed articles (N = 126). Each number within the figure represents the number of articles that have examined one or more groups of Ecosystem Services simultaneously. Additionally, 30 articles did not examine any group of Ecosystem Services in particular but rather employed a general approach to the topic.

Fig. 5 displays the specific ES analyzed in the articles in percentages. Note that data source categories are not mutually exclusive, as one article might have analyzed more than one ES. Percentages in the following bar graphs have been quantified in the same way. Cultural ES such as outdoor recreation and contribution to mental and physical health are by far the most frequently assessed ES (45.2%). Beyond cultural ES, regulating ES are analyzed in our articles mainly through runoff mitigation (27%) and articles addressing provisioning ES focus mostly on food supply (24.6%). However, 28.6% of our articles considered some of the previous ES groups but did not fully examine nor quantify any specific ES type. Additionally, 17.4% of the articles mentioned

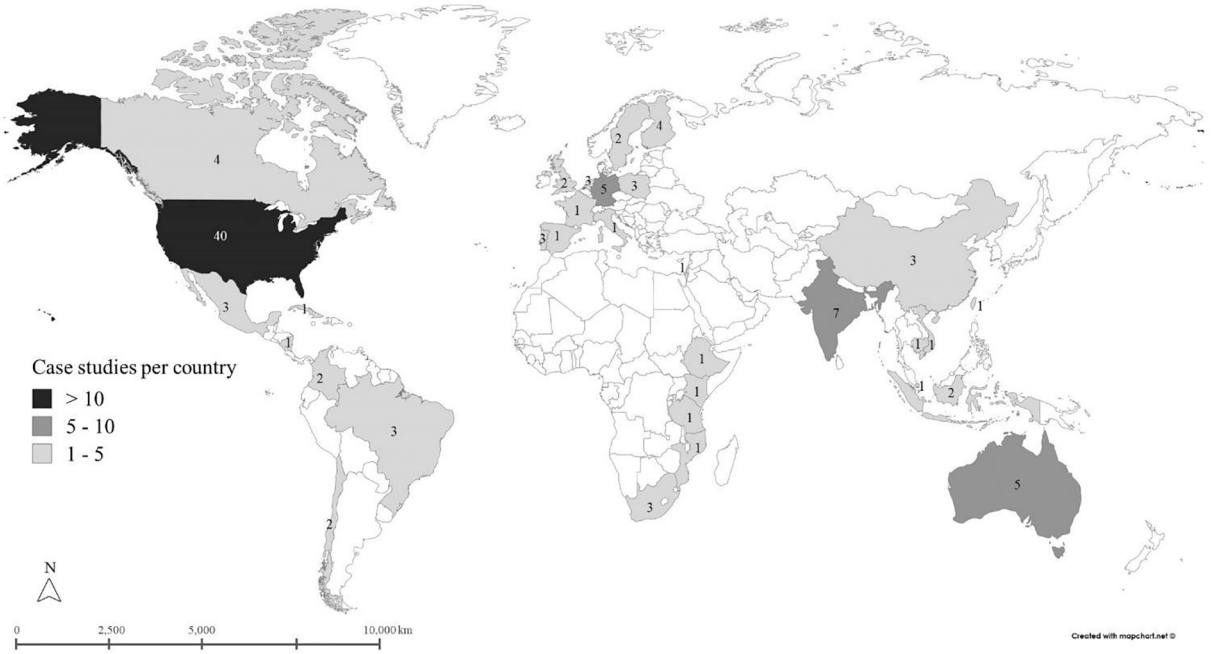

Fig. 3. Geographical distribution of the reviewed articles with specific case study areas (n = 107).

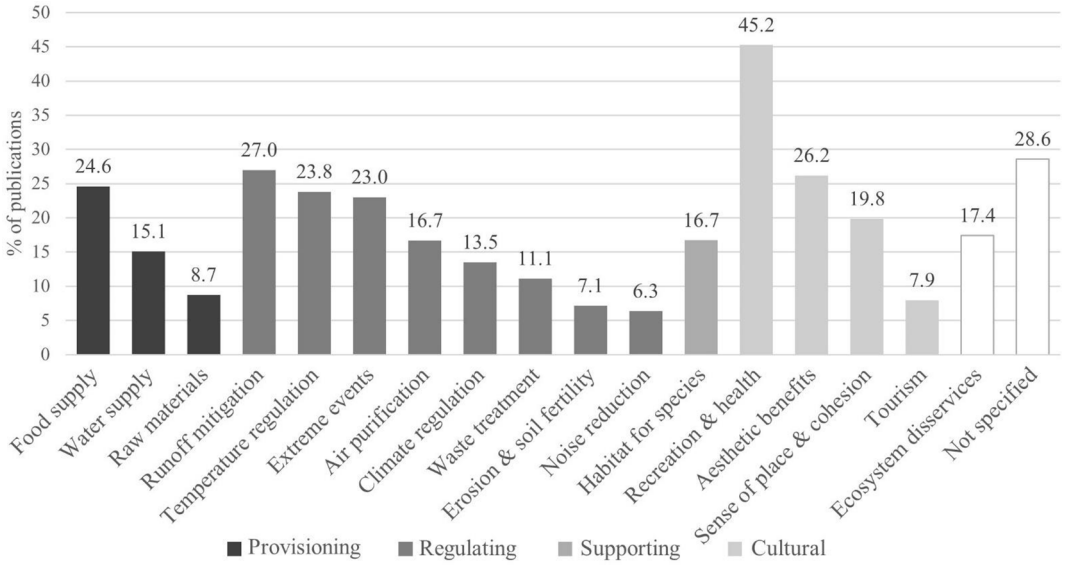

Fig. 5. Types of ES examined sorted by frequency and clustered by ES group (% of 126 articles). Data categories are not mutually exclusive.

ecosystem disservices but with an uneven degree of detail, alluding for instance to spread of diseases, safety perception, social exclusion and green gentrification.

The provision of urban ES derives from the institutional arrangements and implementations of the ecological structures of the green and blue infrastructure and their interconnection with the grey infrastructure (Andersson et al., 2019; Kontogianni, Luck, & Skourtos, 2010; Luederitz et al., 2015). Our results show (see Fig. 6) that most studies (46.8%) did not focus on a specific ecological structure. The category "not specified" was applied to articles framing an ecological domain of analysis in terms of green infrastructure, green spaces, or canopy cover in general. This does not mean that the authors did not refer to specific urban green spaces, but that they aggregated different components of the green infrastructure indistinctively. On the other hand, blue spaces are the ecological structure that has received the most attention within our articles (40.5%), followed by urban forests (23.8%) and parks (16.7%).

Distributional justice clearly dominates the EJ approach in urban ES studies, with most articles analyzing this one aspect of justice exclusively (65 out of 126 articles) and others in combination with other dimensions (Fig. 7). Distributional considerations included spatial distribution of ES provision, often in comparison with the distribution of income and/or racial segregation, and also the distribution of intergenerational and intragenerational justice, in the sense of temporal justice as characterized in Langemeyer & Connolly, 2020. Such examples of temporal justice include future generations facing climate

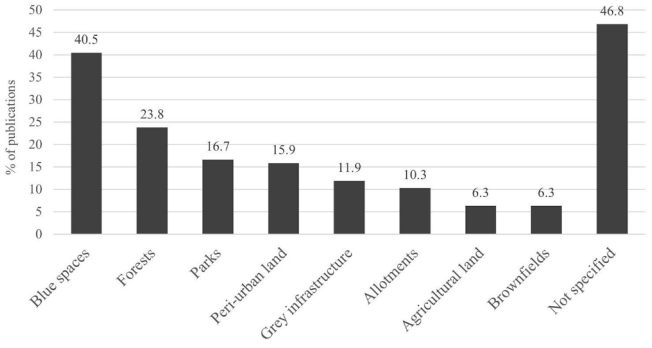

Fig. 6. Ecological structures considered in the articles sorted by frequency (% of 126 entries).

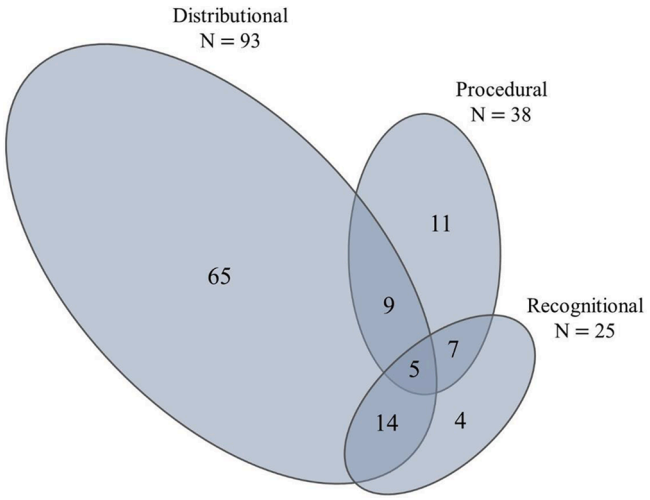

Fig. 7. Venn diagram with overlapping bubbles representing the three dimensions of justice (i.e., Distributional, Procedural and Recognitional justice) considered in the reviewed articles (N = 126). Each number within the figure represents the number of articles that have examined one or more dimension of justice simultaneously. Additionally, 10 articles did not examine any dimension of justice in particular but rather employed a general approach to the concept.

change-related hazards and historical legacies derived from prior patterns of inequities. Fewer articles focused on the procedural aspects of justice, examining participatory processes, stakeholders and policy-making. Recognitional and interactional dimensions of EJ are an emerging issue and were only considered in 25 articles, where the emphasis was on the different needs, values, and preferences of diverse social groups. A few articles (10) did not focus on any one dimension of justice, instead using the concept as a broad concern without going deeper into how environmental inequalities are specifically manifested.

Social stratification mechanisms (Fig. 8) showed that income is the most common variable used when examining differences in ES assessments (43.7%), closely linked to educational attainment (26.2%). Race/ethnicity, including migrants and indigenous groups, was also widely considered (30.2% of the publications). We found that very few studies examined race, age or gender as the only EJ variable of their study and we found a lack of in-depth analysis on the social determinants and mechanisms of exclusion

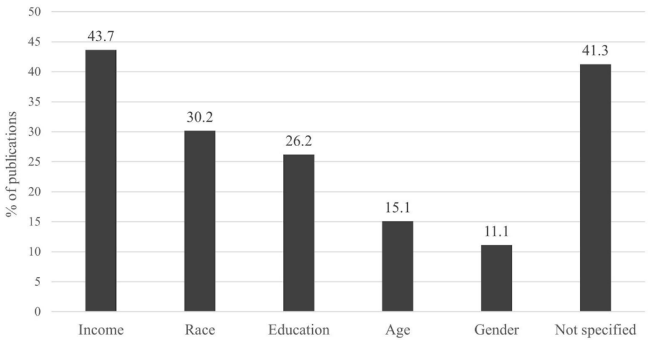

Fig. 8. Social stratification related to the considerations of justice sorted by frequency (% of 126 entries).

related to those other variables (for exceptions see Byrne & Wolch, 2009; Fortnam et al., 2019; Kabisch & Boschvan, 2017).

A wide majority (74.6%) of the reviewed articles included a stakeholder assessment as part of their study (Fig. 9). Local residents and the general public were frequently involved in ES assessments (38.1%) along with various public local authorities (32.5%). Policy-makers (29.4%) and various public regional authorities (22.2%) were also often considered, either participating in surveys, interviews and workshops or as mediators facilitating maps and other data.

Fig. 10 shows a cross-tabulation of ES groups and EJ dimensions. This overview allows us to identify the extent to which distributional justice dominates across ES groups, consistently followed by procedural and recognitional dimensions. This distributional focus is especially pronounced in regulating ES studies, with 45 articles in total. On the other hand, procedural justice is mostly considered in cultural ES studies (18 articles). Recognitional aspects emerge mainly in cultural ES assessments (10 articles) but also in regulating and general ES assessments. To better illustrate the different intersections among ES groups and EJ dimensions, Table 2 displays some key and illustrative examples of articles included in our review and how they approach EJ in a similar cross-tabulation table.

4. Discussion

4.1. Prevailing justice dimensions in the urban ecosystem service literature

The trilogy of now-classic categories for understanding the dimensions of social justice including distribution-procedure-recognition has been widely used in EJ research (Bustos, Folchi, & Fragkou, 2017; Holifield, 2012; Paloniemi et al., 2015; Whyte, 2011) and is starting to spread throughout ES research. Our analysis reveals that, as might be expected given its predominant role in EJ studies, the distributional dimension of justice is the most covered with regard for EJ approaches

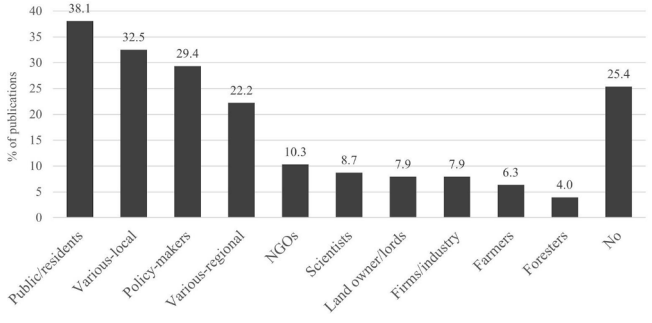

Fig. 9. Stakeholders involved in the ES assessments sorted by frequency (% of 126 entries). The bar labelled "No" means that no stakeholder was assessed in the reviewed article.

taken up by urban ES assessments. Procedural justice and analyses of participatory processes are receiving increasing attention, especially vis-à-vis decision-making and governance structures for the operationalization of ecosystem services in policy or planning, for instance. Nevertheless, the existing scholarship still barely considers recognitional justice: The diversity of needs, values and identities that different social groups hold vis-à-vis urban ES has been generally overlooked, despite the rich literature on plural values in ES research, both from a theoretical (Arias-Arévalo et al., 2018; Dendoncker et al., 2013; Kenter, 2016) and an applied perspective (Langemeyer, Gómez-Baggethun, Haase, Scheuer, & Elmqvist, 2015; Martín-López, Gómez-Baggethun, García-Llorente, & Montes, 2014; Turkelboom et al., 2018).

Given the scope of papers in this review, in order to expand and refine analyses of distributional justice, ES researchers should consider expanding their socio-spatial analysis in terms of methods, temporality and scale (cf. Ernstson, 2013; Langemeyer & Connolly, 2020). For instance, besides comparing urban green infrastructure and the socio-economic profile of nearby residents (which is also necessary), new research should combine quantitative and qualitative methods at different temporal and geographical scales while striving for more ambitious analyses of access, power and institutional structures (Lehmann, Martin, & Fisher, 2018). Studies like Connolly & Anguelovski (2021) and Nardone et al. (2021) are an example of how to examine prior historical processes such as the practice of redlining in the US and how they continue to influence the distribution of green spaces and contribute to racial health inequities. Moving beyond residential metrics of access to green amenities and considering the multiple geographies of where urban residents work, play or study (see for instance Baró, Camacho, Pérez Del Pulgar, Triguero-Mas, & Anguelovski, 2021) can also contribute to a better understanding of ES distributional inequalities.

The common view within ES research that EJ concerns can be reduced to distributional aspects may reflect a biased emphasis on the specific geographic location of ES (e.g. socio-spatial analysis of residential green areas), and sometimes generates a justice-blind, de-politicized analysis of ES provision (Dikeç, 2001; Perreault, Bridge, & McCarthy, 2015; Soja, 2015; Swyngedouw & Heynen, 2003). Indeed, the emphasis on the equitable spatial distribution of ES is seen as less relevant for certain aspects of ES that can (or cannot) be enjoyed regardless of the proximity to the place of production (Baró et al., 2019; Fisher, Turner, & Morling, 2009). For instance, while street trees regulates temperatures at a local scale by diminishing the urban heat island effect (Mueller et al., 2019), carbon sequestration mitigates climate change at a global scale, and nearby residents have no privilege in perceiving such benefits. Furthermore, exclusively distributional approaches can be rendered incomplete, and even misleading, by the enduring presence of urban dynamics of inequality and exclusion, which are driven by complex and multi-scalar processes, such as historic segregation, housing discrimination, inter-racial wealth gaps, or the broader political economy of uneven urban development (Pulido, 2000).

In recent research, recognitional justice has begun to be addressed in a broad manner, emphasizing individual needs and perceptions (e.g. Assmuth et al., 2017; Graça et al., 2018; Nesbitt et al., 2019) and pointing out the lack of consideration of specific socially vulnerable groups (e.g. Koh et al., 2017; Suhren et al., 2014). However, we found that urban ES assessments examining recognitional aspects of justice often lack a deeper analysis of how individual perceptions are translated into environmental inequities and related with sociopolitical arrangements and structural exclusion processes. For instance, one overlooked question is whose values are prioritized in greening policies, given the differential access of communities to green space within the mechanisms that create and maintain inequality among them. Another one concerns which specific identities, needs and practices of socially vulnerable groups are being neglected in a way that deprives them of such benefits.

However, we did find that recognitional justice research dealing with historical and racialized legacies of unequal access to urban greening interventions and ES in more context-specific approaches is emerging (e.g. Anderson et al., 2020; Draus, Lovall, & et al., 2019). However, the ES

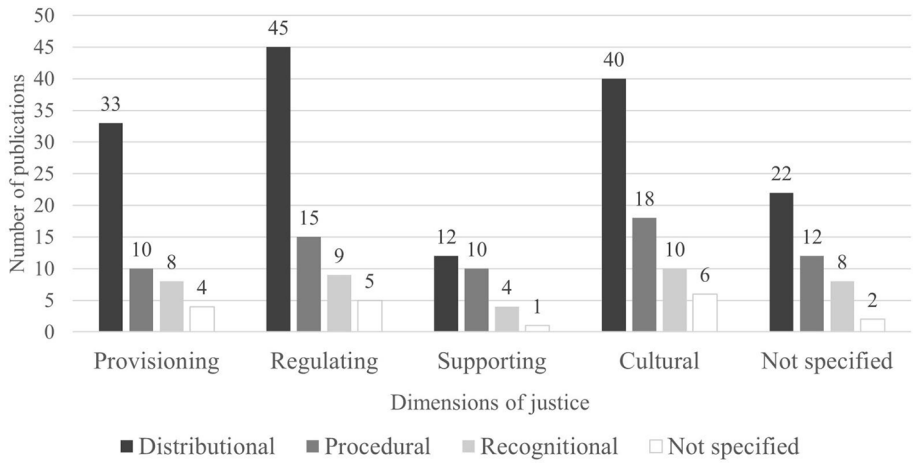

Fig. 10. Cross tabulation of group of ES by dimension of EJ (showing number of publications). Each column represents the number of entries that considered one ES group and EJ dimension at the same time. Note multiple hits per entry were possible.

scholarship can further refine both conceptualization and operationalization of the recognitional implications of ecological structures. For instance, this research path has been explored by EJ research through the interrogation of legacies of violence, exclusion and trauma experienced in urban green spaces by racialized and gendered minorities (Anguelovski et al., 2020; Brownlow, 2006; Finney, 2014; Rigolon & Németh, 2018).

While we found few cases focused exclusively on recognition (Fortnam et al., 2019; Graça et al., 2018), recognitional and procedural EJ perspectives usually play complementary roles in the way they are addressed in ES research (Assmuth et al., 2017; Nesbitt et al., 2019). This link might be explained by the common use within ES studies of participatory processes as a legitimate tool for effectively recognizing diverse preferences and values within and among social groups. In contrast, distributional assessments seem to have a privileged epistemic position in which there is no need to build legitimacy in alliance with the other dimensions of EJ, implying that the ultimate operationalization of justice of most urban ES researchers is articulated around the fair distribution of and access to ES across different social groups. This epistemological assertion implied by the trends within ES research is one that has been long debated with EJ research and social justice scholarship more widely (Fraser, 2009).

Meanwhile, even while the tridimensional approach to justice used in EJ literature is mobilized in limiting ways within the ES literature, we found that the conceptualization of justice within the reviewed ES studies is deeply anchored into one or into a combination of the distributional, procedural and recognitional dimensions. However, in order to avoid imposing boundaries that close off a broad range of potential urban injustices and how they are experienced by the studied communities (Anguelovski et al. 2020), it is necessary to expand the research on broader and novel analytical approaches of (in)justice within ES literature.

4.2. *Environmental justice across ecosystem service types*

Our findings show that assessments of regulating and cultural ES are those that address EJ concerns the most. These are the ES groups that are in general more often addressed in urban ES assessments, as seen in previous reviews (Haase, Larondelle, & et al., 2014; Luederitz et al., 2015). The regulating ES assessments we examined primarily focused on climate change adaptation, resilience, and mitigation of environmental risks (e.g. Baró, Calderón-Argelich, Langemeyer, & Connolly, 2019; Finewood, Matsler, & Zivkovich, 2019; Jenerette, Harlan, Stefanov, & Martin, 2011; Kabisch, Korn, Stadler, & Bonn, 2017). These assessments discuss, among other topics, the unequal distribution of environmental health threats and propose more participatory governance and the implementation of ES to mitigate the higher exposure of vulnerable populations. Similarly, EJ research has already taken an increasing interest in climate issues, and has pointed out the unequal distribution of climate change risks, which disproportionately affect the urban poor (Anguelovski et al., 2016; Chu, Anguelovski, & Roberts, 2017; Shi et al., 2016; Thomas & Twyman, 2005).

Regulating ES assessments have the potential to support climate justice claims by identifying which ES can be more climate-responsive so as to build urban adaptive capacity without exacerbating environmental inequities (Byskov et al., 2019). This approach would require accounting for social and structural inequalities vis à vis climate change impacts and their adaptive interventions. It would also call for effectively including the needs of disadvantaged and vulnerable populations in urban green infrastructure programs (Schlosberg, 2013) and ensuring that they are not displaced by them, as the recent EJ scholarship discusses (Anguelovski et al., 2019; Connolly, 2018; Shokry, Connolly, & Anguelovski, 2020). Yet, it remains to be seen whether ES assessments will fully incorporate climate justice perspectives in urban resilience and climate action programs.

EJ considerations are also frequent in cultural ES assessments, with recreational opportunities (and the related physical and mental health improvements) included in almost half of the reviewed articles. This heterogeneous group of urban ES assessments addresses the different uses of green spaces and related public health outcomes, and the incorporation of perceptions and preferences into decision-making processes (e.g. Chen et al., 2019; Cochran et al., 2019; Jennings, Larson, & Yun, 2016; Wolch et al., 2014). Recently, cultural ES assessments have explored new research approaches for the analysis of recreational opportunities in cities, like participatory mapping (Rall, Hansen, & Pauleit, 2019), use of social media data (Amorim Maia et al., 2020; Langemeyer, Calcagni, & Baró, 2018) and structured observations (Winter et al., 2019). We contend that the use of mixed methods combining these novel approaches with social science approaches of qualitative and participatory methods and interviews (e.g. Derkzen et al., 2017), has potential to advance towards a more effective consideration of plural values and experiences of (in)justice departing from cultural ES.

Additionally, novel conceptualizations related to cultural ES are gaining momentum through the relational values approach (e.g. Bremer et al., 2018; Calcagni et al., 2019), which offers new channels of connection with the dimensions of EJ that are currently underrepresented in urban ES literature. Cultural ES can contribute to building out a recognitional and procedural justice analysis by incorporating plural cultural identities, knowledge systems and social interactions in policies and decision-making processes (Gómez-Baggethun & Barton,

Table 2
Cross-table of key examples from our sample (N = 126) showing how articles have considered EJ dimension for each ES group.

	Distributional	Procedural	Recognitional
Provisioning	Exploring spatial inequities and vulnerability in access to water (Favarodo et al., 2016), food (Bozeman, Ashton, & Theis, 2019), and resources (Balbi et al., 2019).	Examining participatory processes, policies, stakeholder involvement (Dennis, Armitage, & James, 2016) and community organization and mobilization (Porter, 2018) in gardens, and ES values for coastal management (Atkinson et al., 2016).	Accounting for needs, aspirations (Fortnam et al., 2019) identities, perceptions, social interactions and trust (Bremer et al., 2018; Juntti & Lundy, 2017) in relation to farming, fishing and water resources.
Regulating	Socio-spatial analysis of the distribution of ES provided by street trees, green roofs and drainage systems across urban areas (Baró et al., 2019; La Rosa & Pappalardo, 2019; Sanchez & Reames, 2019).	Evaluating urban climate change adaptation planning processes (Hughes, 2015) engagement, governance and political actors of green stormwater infrastructure (Finewood, Matsler, & Zivkovich, 2019) and management policies and decision-making in abandoned areas (Gulachenski et al., 2016).	Considering the influence of historical legacies of private and public green spaces (Anderson et al., 2020) and cultural heritage, local perceptions and awareness of a forestry program by urban–rural communities (Caro-Borrero et al., 2015; Suhren et al., 2014).
Supporting	Distribution and access to habitat and biodiversity provided by green areas across socio-spatial data (Dobbs, Nitschke, & Kendal, 2014; Escobedo et al., 2015) and strategic spatial plans (Wilkinson et al., 2013).	Analyzing participatory processes and programs (Cohen et al., 2019; Pearson et al., 2010) and policies enhancing community participation (Gregory, Leslie, & Drinkwater, 2016) of land use scenarios frameworks providing habitat for biodiversity.	ES perceptions across socioeconomic gradient of street trees (Graça et al., 2018) and cultural rights and preferences of minority groups doing home gardening (Koh, Hahn, & Ituarte-Lima, 2017; Raymond et al., 2019) for biodiversity conservation.
Cultural	Examining uneven access and use of cultural ES such as recreation and place attachment through spatial distribution and availability of residential water and green areas (Fleischer, Felsenstein, & Lichter, 2018; Łaszkiewicz, Kronenberg, & Marcińczak, 2018; Viinikka, Paloniemi, & Assmuth, 2018).	Exploring public participation for urban green infrastructure planning (Rall, Hansen, & Pauleit, 2019), water governance, planning and management (Paloniemi et al., 2018) and institutions, policies and democratic processes in diversified farming systems (Bacon et al., 2012).	Analyzing how experts recognize citizen demands, obstacles and opportunities for recreation in blue spaces (Assmuth et al., 2017) as well as individual needs, expectations and preferences regarding urban green space management and governance (Biernacka & Kronenberg, 2018) and the significance of environmental education (Wolsink, 2016).

2013). More specifically, relational values, that is, preferences, principles, and virtues associated with the relationships between people and nature (Chan et al., 2016) can play an important role in extending the ES framework beyond narrow and techno-economic utilitarian framings and towards more inclusive and pluralistic decision-making (Chapman, Satterfield, & Chan, 2019) and consideration of the relations and perceptions of vulnerable communities with respect to urban nature (Himes & Muraca, 2018).

In relation to provisioning ES, our results show that this group has been mainly linked to EJ through food provision from urban gardens and allotments (e.g. Dennis et al., 2016; Egerer et al., 2018; Gregory et al., 2016; Porter, 2018). The minor role of provisioning ES in the literature can be explained by the perception of many urban gardens as sources of cultural ES rather than solely food production, leaving their provisioning role as secondary (Langemeyer, Camps-Calvet, Calvet-Mir, Barthel, & Gómez-Baggethun, 2018). Another area of research addressing provisioning ES found in our review is the analysis of Payment for Ecosystem Services (PES) programs (e.g. Abebe et al., 2019; Bremer et al., 2018; Caro-Borrero et al., 2015; Kovacs et al., 2016; Moreno-Sanchez et al., 2012; Van Hecken, Bastiaensen, & Vásquez, 2012). These analyses examined perceptions over watershed and forestry PES schemes and their potential conflict for water supply between urban and rural–urban residents. Although it is controversial whether PES schemes can aggravate environmental inequalities in rural areas (Calvet-Mir, Corbera, Martin, Fisher, & Gross-Camp, 2015; Kosoy & Corbera, 2010; McDermott, Mahanty, & Schreckenberg, 2013; Pascual et al., 2014), interactions between PES and urban environments and their implications for EJ remain unexplored through cross-scale approaches (Scholes et al., 2013) and may offer important pathways for understand the ES-EJ link of cities and their surroundings.

4.3. *Moving the field of urban ecosystem services forward*

While this review demonstrates the still narrow and uneven link between urban ES assessment and different aspects of EJ, we argue for the inclusion of an expanded analysis of dimensions of justice within the ES framework, including restorative, reparative and intersectional aspects of justice as it is being explored by EJ researchers (Agyeman et al., 2016; Anguelovski et al., 2020; Aragão et al., 2016; Draus, Haase, & et al., 2019; Draus, Lovall, & et al., 2019) and tentatively suggested in some of our reviewed articles (e.g. Anderson et al., 2020; Fortnam et al., 2019). Restorative justice highlights the need to acknowledge past experiences of violence, oppression and exclusion and the extent to which green interventions can address historical trauma and promote the inclusion of specific neighborhoods and communities (Draus, Haase, & et al., 2019). Intersectional justice can help to understand how multiple identities (such as gender, class, race/ethnicity, sexuality or disability, among others) interact and are (un)recognized in the green infrastructure planning processes (Anguelovski et al., 2020; Jerneck, 2018). In short, the new frontier of EJ research offers ES scholarship an opportunity to not just catch up in terms of justice considerations, but also to leap forward and help shape that frontier.

While research on urban ES has been geographically biased towards US, China and Europe (Haase, Larondelle, & et al., 2014; Luederitz et al., 2015), our review shows a pattern with a predominance of US and European studies and a meager presence of Chinese assessments. The reason behind this pattern is probably related to the historical urban-oriented focus of the EJ scholarship, which developed in the US (Anguelovski, 2013) and to the bias due to the use of English as the language of publication in our inclusion criteria. Additionally, our results show a clear preponderance of household income as the main indicator of social vulnerability. Although income is widely used in the stratification of environmental inequalities, other forms and drivers of exclusion and alterity coexist in subtler or often fully visible but overlooked ways (Gregory, Johnston, Geraldine, Watts, & Whatmore, 2009). Several EJ studies have pointed out that race is often the primary driver

of injustice (Mohai & Saha, 2015; Pulido, 2000). Assessments addressing race/ethnicity are mostly from North American cases (accounting for 22 out of the 36 articles examining race/ethnicity as a social stratification mechanism), which is likely explained by the importance of EJ movements and the relevance of environmental racism both as a field of activism and a field of study in the US (Pulido, 2000). However, they are the not the only places where race-driven environmental inequities or inequities in ES manifest in practice. For example, the exclusion, marginalization, and racism directed at racialized immigrants in Europe is also shaping access to environmental amenities (Antypas et al., 2016; Harper, Steger & Filčák, 2009).

Furthermore, we detect that gender-specific barriers have been especially overlooked in the general ES literature (Brown & Fortnam, 2018; Cruz-Garcia et al., 2019; Fortnam et al., 2019; Yang, Passarelli, Lovell, & Ringler, 2018). From the articles covered in this review, only 2 included gender as a central part of the study (Fortnam et al., 2019; Suhren et al., 2014) and 12 other articles treated it as one of many other demographic variables, giving it a relatively limited relevance. Some studies, for instance, accounted for the differences in the way that men and women perceive and value urban ES (e.g. Abebe et al., 2019; Asah & Blahna, 2019; Graça et al., 2018; Keith et al., 2018; Winter et al., 2019), but only gave rather brief explanations concerning the environmental attitudes attributed to women (Zelezny, Chua, & Aldrich, 2000). This trend implies that most articles including gender as a variable did not further explore the justice implications of gendered mechanisms of exclusion in green infrastructure planning processes. We contend from our results that there is lack of analysis focusing into how gender interacts with urban ES and how gendered perceptions of the public space translate into unequal access to green and blue infrastructure, institutions and decision-making power. Environmental and sustainable development urban agendas have already been explored in gender-focused urban planning research (Buckingham, 2020; Hayden, 1980; Sánchez de Madariaga & Roberts, 2012; Spain, 2014) and gender mainstreaming policies (UN Women, 2020). However, we argue that adding the gender and intersectional justice perspective into the ES framework can offer crucial and novel insights when designing greening and sustainability agendas.

Our review confirms that examining the participation of different stakeholders in decision-making effectively enhances the identification, valuation, and management of context-specific urban ES (Luederitz et al., 2015) and is therefore a useful tool when considering the EJ implications of accessibility to urban green infrastructure and its benefits. The high degree of stakeholder involvement within the reviewed articles explains their emphasis on policy-making and participatory processes in the design, allocation and management of green and blue infrastructure. Actually, green infrastructure, green spaces or canopy cover in general is the main focus in almost half of the empirical studies of the reviewed literature. Nevertheless, our results point to the particular importance of blue infrastructure in building the climate adaptation capacity of cities (BenDor & Stewart, 2011; Favarodo et al., 2016; Garcia-Cuerva, Berglund, & Rivers, 2018) as well as its recreational opportunities (Assmuth et al., 2017; Derkzen, van Teeffelen, & Verburg, 2015; Suhren et al., 2014; Unnikrishnan, Manjunatha, & Nagendra, 2016). A more nuanced classification of ecological structures, as already extensively used in ES literature (i.e. green, blue and grey infrastructure such as street trees, green roofs, coastal areas, lakes, rivers, wetlands) would greatly benefit EJ literature in pushing its scope beyond parks and urban forests, which have received most of its attention so far (Heynen, Perkins, & Roy, 2006; Nesbitt, Meitner, Sheppard, & Girling, 2018; Walker, 2011). Thus, ES research can develop a more complete analysis of the connections between environmental injustices and different ecological structures while acknowledging the current uncertainties and knowledge limitations regarding issues of ecosystem interactions, climate-change effects, decision making and management (Solé & Ariza, 2019).

4.4. Implications for policy and practice

An EJ perspective has the potential to make ES assessments more effective at contributing to the good quality of life for all in urban areas. Policy-makers cannot assume that ES-based greening strategies in cities will always reach historically disenfranchised neighborhoods or include the needs and values of their unprivileged residents (Anguelovski, Argüelles, & et al., 2018). Urban planning agendas need to acknowledge the interconnections between different needs, in order to achieve greener, healthier, more climate-responsive, and inclusive cities. For this reason, we propose three guidelines for urban policy and practice towards an effective inclusion of social equity and justice considerations in urban ES-based assessments and interventions.

1) Provide explicit considerations of EJ with clear operational definitions.

Urban ES assessments should not only mention but rather fully integrate a clear operational definition of how justice is being conceptualized and examined. This would also help to reveal biases, implicit assumptions and instrumental motivations (Friedman et al., 2018). Thus, it is necessary to provide clear indicators of environmental inequities in ways that allow for standardization and comparison, and to further discuss the links between ecological structures, social stratification processes and their political and economic context. Urban greening strategies should clarify the indicators that will measure not only the preexisting forms of environmental inequity and social exclusion in the context of their interventions, but also those that may arise from the intervention itself. Further, social inequities should be examined in both the process and the outcome of planning, implementation and management of greening strategies and projects. ES scholarship should also scrutinize the different priorities behind ES-based plans and strategies, the negotiation of their benefits and trade-offs, and the general political agendas that they serve (Kotsila et al., 2020). This involves answering questions like in which proportion men and women access a given urban green space, how its design and implementation takes into account people with disabilities or how representative the participatory process was in regard to migrant communities, among other examples.

2) Incorporate new methodologies and cross-sectoral collaboration

The ES scholarship should engage and co-evolve with the EJ research agenda in a mutual dynamic of developing interdisciplinary methods, theoretical framings and practices vis-à-vis urban environmental inequities (Berbés-Blázquez, González, & Pascual, 2016; Langemeyer & Connolly, 2020). ES assessments now have the opportunity to fully develop their own analyses of procedural and recognitional justice and assimilate the perspectives of stakeholders from different backgrounds (Charoenkit & Piyathamrongchai, 2019; Fortnam et al., 2019). Embracing contrasting views and perspectives of different stakeholders is a necessary step in achieving a more representative and legitimate decision-making process for green interventions and governance model of cities. Multiple methods have been developed within EJ and other social disciplines, which may broaden our understanding of ES by capturing different dimensions of value (i.e. relational, intrinsic, non-monetary, etc.) and valuation methods (Langemeyer & Connolly, 2020). For instance, feminist urban researchers have explored qualitative methods such as photovoice, participatory research and further mixed praxis as effective strategies to increase women's participation in urban planning (Hesse-Biber, 2012; Kindon, 2003; McIntyre, 2003; Ortiz Escalante & Gutiérrez Valdivia, 2015). The incorporation of such qualitative methods in ES assessments opens a promising path of novel research practices, especially those that can uncover recognitional dimensions of injustice.

As stated in target 11.7 of the SDG, cities are places of encounter and must "*provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities*". However, lack of access to environmental benefits is only one of the several drivers of injustice that surround cities. Urban green infrastructure will follow global trends of gendered and ethnically exclusionary urban planning unless policies and governance institutions

explicitly coordinate against this. To achieve this end, local and regional level governments need to include civil society organizations in a multi-actor model of governance and take a cross sectoral approach to coordinate the work of departments like urban green planning, public health, social affairs, housing, gender equality and others.

3) Consider trade-offs, conflicts, and deep inequalities across different dimensions of justice and ES

It is indispensable that environmental and planning policies incorporate trade-offs and complexity into their analyses, so as to reflect potential disservices related to urban green infrastructures (Anguelovski, 2016; Berbés-Blázquez et al., 2016; Wolch et al., 2014). Urban planning interventions that promote green branding discourses involve trade-offs between ecological and social processes that can ultimately exacerbate unaffordability and social inequalities, and constitute a form of green gentrification (Garcia-Lamarca et al., 2021; Wolch et al., 2014). For instance, green intervention that might seem inclusive and/or equity-driven might in fact involve the short- or mid-term displacement or exclusion of the most socially vulnerable groups (Anguelovski, Connolly, Garcia-Lamarca, Cole, & Pearsall, 2018; Cole, Lamarca, Connolly, & Anguelovski, 2017; Curran & Hamilton, 2012; Wolch, Byrne, & Newell, 2014).

Further, there is a need to better understand the consequences of privileging one dimension of justice above others in urban green planning (Friedman et al., 2018). Focusing exclusively on the distributional aspects of ES can mask injustices in green planning procedures and historical privileges imposed by past planning decisions and policies such as racial residential segregation (Nardone et al., 2021; Yi, Kreuter, Han, & Güneralp, 2019). Still, procedural and recognitional approaches have not yet been widely incorporated in ES-based urban green interventions. In fact, inadequate institutional structures, exclusionary participatory processes and limited citizen participation hinder distributional just outcomes (McDermott et al., 2013). Likewise, acknowledging recognitional concerns can help to expand our knowledge of the needs and values of urban communities, thereby encouraging their participation and stewardship. Finally, restorative concerns in green interventions need to be addressed as well (Draus, Haase, & et al., 2019) by acknowledging the exclusionary effects of previous land use policies in disinvested spaces, to then effectively promote corrective and restorative, emancipatory measures for marginalized groups (Anguelovski et al., 2020).

5. Conclusion

The urban ES literature has generally taken a normative and prescriptive approach to green and blue spaces by assuming that everyone will benefit equally from their services, but without properly problematizing and contesting the urban greening agenda that is being implemented in many cities worldwide (Anguelovski, Argüelles, & et al., 2018; Haase et al., 2017). However, current research on urban ES is increasingly taking into account the EJ implications that arise from the planning, implementation and management of urban green and blue infrastructure. In this paper, we have systematically reviewed how urban ES assessments have incorporated EJ perspectives, accounting for the operationalization of different justice dimensions, social groups and stakeholders. We found that the literature on urban ES explicitly addressing EJ issues is still nascent, raising many possibilities for further research in new theoretical, empirical, and geographical directions. Distributional analyses of regulating and cultural ES are the most frequent studies within the literature so far, especially focusing on recreational opportunities and climate change adaptation benefits.

We contend that the urban ES literature has followed a similar pattern to that of EJ in its progressive incorporation of justice dimensions and social groups into its analysis. The prevailing focus on distributional justice might be hindering the conceptualization of other drivers of environmental inequalities, such as historical legacies and power imbalances across socio-spatial scales. The next step in this development of synergies between EJ and ES assessments will require a broader incorporation of procedural and recognitional dimensions of justice. This can be achieved by expanding current methodological approaches with more qualitative methods, and by involving stakeholders with contrasting needs and perspectives. It is crucial to take an intersectional approach in analyzing the perceptions, preferences, and identities of historically unprivileged social groups, in order to understand and ultimately overcome their specific social-ecological vulnerabilities. Likewise, ES-based urban green interventions have yet to tackle broader conceptions of justice, such as restorative justice related the historical trauma faced by social groups that may have suffered oppression under past policies and land uses.

Finally, the ES framework can enrich the assessment of urban environmental inequalities, in providing both conceptual and practical tools to better understand the benefits, disservices and trade-offs that are at stake within urban green and blue infrastructure interventions. Conversely, EJ can support the empowerment of local communities in the co-production of urban ES and ensure the creation of greener and more just cities.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2021.104130.

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