



Stakeholder perceptions of the socio-ecological role of nature-based solutions in the Les Glòries Park, Barcelona

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ARTICLE INFO

Handling Editor: Dr Cecil Konijnendijk van den Bosch

Keywords:

Nature-based Solutions
Politics of parks
Socio-ecological relationships
Les Glòries Park, Barcelona
Stakeholder perceptions

ABSTRACT

The ongoing effects of the climate emergency and the recognition of the need to redesign cities to cope with future socio-environmental changes and increase the quality of life of urban inhabitants has pushed many cities to embrace the 're-naturalization' of public space through Nature-based Solutions (NbS). Les Glòries park (Barcelona) is an ongoing massive urban transformation project that incorporates NbS as a multifunctional tool. It attempts to respond to complex environmental, social, and economic urban problems while at the same time mitigating and adapting to hazards, such as floods and droughts, both predicted to increase in the Mediterranean region due to climate change. While NbS are also expected to improve environmental quality, not much attention has been given to how those strategies would intersect with citizens' expectations and visions of public space and the uneven socio-environmental relations they can enforce. Through a case of urban development of a new large green area in Barcelona, this article aims to discern different perceptions by the local community and planners on the socio-ecological role of NbS and the implications this has for sustainable urban transitions. In-depth interviews were held with 25 key stakeholders and users, complemented by the analysis of secondary data from the town council of Barcelona about the perception of the space by residents living in the surrounding neighborhoods of the park. The results of this paper show that perceptions around NbS are strongly divided into three groups: the *believers*, the *opposers* and the *skeptical*s. These results contribute to nuance NbS, as they do not provide universal benefits, neither for nature nor for society, and that they are subject to urban tensions derived from inequities, conflicts, tradeoffs, and particularly from divided visions of what the 're-naturalization' of cities should look like.

1. Introduction

By 2030, it is forecasted that at least 60 % of the world population will live in urban areas (UN, 2018), putting cities at the center of the debates around sustainable transitions (Millington, 2016; Mahmoud et al., 2022) and more extensively relationships with non-human nature (Dignum et al., 2020; Hodson and Marvin, 2010). Both the climate crisis (IPCC, 2018) and the global pandemic of COVID-19 (Honey-Rosés et al., 2021) have accelerated sustainable urban transition processes. In this context, policymakers and planners are interested in 're-naturing' cities (Keeler et al., 2019), through Nature-based Solutions (NbS) following urban regeneration, rehabilitation, and sustainable development agendas (Haase, 2017; Wolch et al., 2014) that create livable and healthier cities (Wu et al., 2022).

NbS are defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al., 2016, p. xii). These systems constitute the modification of the environment through natural processes, such as capture, filtration, retention, and infiltration that govern stormwater (Karvonen, 2011; Meilinger and Monstadt, 2022) and foster urban biodiversity (EC, 2015; Noiva et al., 2016). NbS emerge as socio-ecological interventions that may foster social cohesion (EC, 2019) –specially in parks (Peters et al., 2010)–, while providing multiple Ecosystem Services to citizens including esthetics, recreation, and sense of place (Kabisch et al., 2016; McCormick and Kiss, 2019).

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<https://doi.org/10.1016/j.ufug.2023.127966>

Received 7 February 2023; Received in revised form 27 April 2023; Accepted 9 May 2023

Available online 10 May 2023

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However, while new, horizontally driven governance schemes (Kabisch et al., 2016; Nóbrega-Carriquiry et al., 2020) tend to characterize NbS projects, little attention has been paid to the unequal outcomes of NbS, in the greening of cities (Haase, 2017; Nóbrega-Carriquiry, 2022; Turnhout et al., 2021) and in the prospects toward transformations of the public space. This article contributes to existing literature on the politics of urban public parks, as it attempts to critically engage a discussion about how human-nature relationships differ in public space and the implications of this for sustainable urban transitions. This is performed by studying the diverse perceptions of the socio-ecological role that NbS play for different stakeholders. We depart from the premise that public space is the product of social relations, and that these are always uneven (Massey, 2005; Millington, 2016). Hence, arguments praising NbS as an ideal outcome for the reconciliation between humans and nature with benefits for all should be seriously put to scrutiny. This article explores the following research questions:

- i. What types of human-nature relationships do NbS foster in public space and how do these relate (or not) to each other?
- ii. How do the different perceptions of the NbS condition their implementation in cities?

The case study of Les Glòries (Glòries) park in Barcelona, as a major infrastructural ongoing project that incorporates NbS through biodiversity nodes, green roof, water retention gardens, and a significant central pervious green area, is used to understand the stakeholders' perception of NbS. Our fieldwork includes an assessment of surveys undertaken by the City Council of Barcelona between 2015 and 2021 on the perceptions of urban environmental changes in the area, site visits to the park, and structured interviews to different stakeholders involved in or affected by the project.

This first section sets the research objectives. In the second section, the theoretical framework is covered, exploring literature on the unequally shifting socio-ecological relationships and stakeholders' perceptions of NbS. The third section discusses the methods, followed by the background information of the case study of Glòries. The fifth section presents the findings and discussion, with three distinctive understandings of the socio-ecological role of NbS. The final section presents conclusions and policy implications.

2. Socio-ecological relationships in NbS and stakeholders' perceptions

2.1. NbS unequally shifting socio-ecological relationships

From an academic and research perspective, NbS are typically included in the literature on socio-ecological transformations (Westley et al., 2011) that situates these strategies as a sustainable tool to transform social, ecological, and technological relationships. However, this literature tends to downplay the social, political, and economic aspects that produce inequalities and unevenness in the urban environment (Cousins, 2021; Haase, 2017; Kabisch et al., 2022; Nóbrega-Carriquiry, 2022). Questions around social justice and socio-spatial inequality may be overlooked in NbS (Cousins, 2021; van der Jagt et al., 2021).

It is assumed that NbS may lead to socially just results (Haase, 2017) and to 'safe spaces' that ensure reflexivity, co-create knowledge, and transform learning, acting as boosters for more just cities (Andersson et al., 2015; Amorim Maia et al., 2020). However, what actually emerges is the 'urban green space paradox' (Wolch et al., 2014), where place-specific impacts such as displacement and gentrification (Angelovski et al., 2018; Kabisch et al., 2016), social segregation, inequality in access to green space (Cousins, 2021; Wolch et al., 2014; Wu et al., 2020), and unequal distribution of benefits and tradeoffs (Haase, 2017; Nóbrega-Carriquiry et al., 2022), create uneven public spaces. On the other hand, NbS are usually portrayed as politically neutral, thus misrepresenting the different social values appearing in the contradictory

status of sustainability inserted in a market-led political economy (Kotsila et al., 2021). Re-naturing of cities might not entail an urban paradigm change but rather a sign of urban neoliberal environmentalism whereby nature is commodified through 'sustainability fixes' (Keil, 2007; Nemes et al., 2022; Cook and Swyngedouw, 2012; Pirro and Angelovski, 2017).

The relationships between NbS and society have been understudied, specifically when considering governance and the impacts of human-nature interactions with direct consequences on lifestyles and beliefs (Kabisch et al., 2016), or examining the changes NbS produce in institutional practices and in imaginaries of nature (Kull et al., 2015). Taking this into consideration, it can be noted that transdisciplinary in sustainability (Hirsch Hadorn et al., 2006) and environmental (Kim et al., 2022) research has become more common and opened new horizons into how social sciences may provide play important insights in environmental research (Strang, 2009) as reflected in their methods, and particularly in their holistic approach to understanding of socio-ecological relations.

2.2. Understanding stakeholders' perceptions of NbS

Based on the aforementioned observations, there is still a need to relate NbS debates on inequalities and injustices (Haase, 2017; van der Jagt et al., 2021) specifically in the urban context, where NbS acts as both, enablers and constrainers of the urban form (Monstadt, 2019) and affect directly socio-ecological relations, resulting in unequal tradeoffs and outcomes (Kabisch et al., 2016; Nóbrega-Carriquiry et al., 2022; Cousins, 2017, 2021; Karvonen, 2011).

Shedding light on how communities of stakeholders perceive the impacts on NbS and their preferred urban futures offers a possibility to study this issue from a critical perspective. Linking greening in cities as a response to sustainable urban transitions with perception studies has been approached from diverse angles, for example, by looking into public perception of spontaneous vegetation in brownfields (Mathey et al., 2018), biodiversity perception in cities (Botzat et al., 2016), public preferences for river restoration (Chen et al., 2017), or by analyzing perceptions of parks and urban derelict land (Hofmann et al., 2012). With some exceptions (Bernello et al., 2022; Chen and Hua, 2017; Han and Kuhlicke, 2019; Yuen and Hien, 2005), there is limited research specifically on the social perceptions of NbS or umbrella terms such as Blue-Green Infrastructures or Green Infrastructures, among others.

Little is known regarding how different stakeholders perceive the socio-ecological role of NbS in cities. As socio-ecological interventions produce uneven outcomes (Cousins, 2017, 2021; Karvonen, 2011), it is likely that perceptions of NbS in green public spaces may diverge among stakeholders (Hofmann et al., 2012). Understanding perceptions of NbS in public spaces is critical to understanding how these spaces are and will be conceptualized, used, and experienced by diverse stakeholders (Yuen and Hien, 2005). These include actors that share the management and/or use of NbS in public space, from government officials, technical and academic spheres to citizens and NGOs.

Our paper contributes to this regard by eliciting collective understanding of NbS development in the most important recent green development project in the city of Barcelona, Glòries park. This case deals with sustainable inner city regeneration projects that, due to its urban complexity, involve numerous stakeholders with conflicting perceptions on sustainable urban transitions through the implementation of NbS. The results in this research may be scaled out to similar NbS urban renewal projects that follow horizontal governance processes which aim for more socially inclusive and just urban transformations (Zanoni and Jassens, 2009).

3. Methodology

The methodology used in this study involves a triangulation approach, where qualitative and quantitative methods are

complementary to each other, bringing more robust insights into issues being examined (Ali et al.,2020; Lynam et al., 2007; Plieninger et al., 2013).

The central empirical work to elucidate perceptions around the deployment of NbS in the public space of Glòries park was developed through in-depth interviews held with 25 key stakeholders and users (see Table 1) between September and November 2022, in person and online, lasting approximately 45 min each and audio-recorded with the consent of the participants. The interview sample is constituted by key actors in the development of Glòries park. These actors were selected according to different views and perspectives on the project and its process of development. To do so, we created a stakeholder map, built following gradually a snowball method. The first interviewees identified were mainly stakeholders linked to the more technical areas of the City Council of Barcelona and academics, who recommended specialists from the private sector, government officials, and neighborhood associations that were involved in the project since the beginning. Neighborhood associations were vital for selecting the last participants (park users), as they could better identify different demographic profiles of park users and had a greater understanding of who would have the time and motivation to participate in our research. When the saturation of data was achieved and no new insights were brought into discussions (Hennink and Kaiser,2022; Glaser and Strauss, 1967), the interview phase was finalized.

We asked participants 17 questions through the interview, around the topics of sense of place, socio-natural interactions, public space and stormwater management, and the preferred vision of the park and its surroundings. These topics and questions were chosen from the literature review in Section 2, and, while emphasis on the blue-green dichotomy of NbS and its multifunctionality was implicit, questions focused mainly on the blue-green aspects of NbS, such as stormwater management due to the design of the park (see Section 4). Although several topics regarding the multifunctionality of NbS, such as its capacity to deal with heatwaves were not explicitly mentioned during the interviews, the strong connection between these two (blue-greening and heatwaves) was not ignored and needs to be further researched in the future. To avoid leading questions and wording bias (Gendall and Hoek, 1990), the guideline was refined after one round of testing to achieve the adequacy, transparency, and balance of the fieldwork, intending to remain objective as possible as advised in qualitative research (Zahle, 2021).

Interviews were systematically and manually transcribed, and content analysis was examined using the ATLAS.ti software. This tool allowed to explore qualitative outputs through coding (Smit, 2002; Woolf and Silver, 2017), by taking elicit qualitative meaning from the data rather than looking into the quantitative aspects. Only phrases and paragraphs that made sense on their own were coded (Kuckartz, 2013; Friese, 2019). We acknowledge that in the analysis with ATLAS.ti, researcher bias was still existent, but we made every effort to be the less biased as possible.

Two different coding phases or categorizations based on Miles and

Huberman (1994), were developed. First, open coding took out the first aggruppation of similar patterns and thoughts shared by participants by analyzing snippets and labeling them as codes (Glaser and Strauss, 1967). We obtained 40 codes such as *participation process* and *futures of NbS in cities*, among others. In this round, several codes were manually merged due to conceptual repetition, resulting in the final 31 codes. Second, codes were compared with each other in the linking or axial coding through the constant comparison method that finds connections and distinctions from which category codes are created (Smit, 2002; Friese, 2019). After numerous rounds of coding and interpretation of the transcripts, in the axial coding phase, three extra codes were created to find direct relations between all codes: these codes were named respectively *positive*, *negative*, and *neutral aspects*. Transcripts were analyzed once more, coding then *positive*, *negative*, and *neutral aspects* that were mentioned in the interview's transcripts.

Limitations of the methodology selected include the unequal involvement of participants, even though qualitative saturation was achieved (Hennink and Kaiser,2022; Glaser and Strauss, 1967). A larger part of the interviewees belonged to the government, academia, and technical sectors, while neighboring communities were underrepresented. For this reason, interviews were complemented by the analysis of secondary data about the perception of the space by inhabitants living in the surrounding neighborhoods of the park. After the interviews were held, we analyzed an existing dataset from surveys on citizen perception developed by the Opinion Research Center of the City Council of Barcelona from 2015 to 2021 with the participation of 670 citizens (Ajuntament de Barcelona, 2015; 2016a; 2017b; 2019b; 2022). These surveys accommodate to a stratified random sampling procedure, following the census tracts of the surrounding neighborhoods of the park (Ajuntament de Barcelona, 2015; 2016a; 2017b; 2019b; 2022). In the years in which the survey was conducted, the sampling error had the same confidence level = 95.5 % (2σ), under the assumption of maximum indeterminacy (P = 50 % and Q= 50 %); however, the entire sample error slightly differed each year. Thus, it was ± 3.8 % in 2015 and 2016, ± 3.9 in 2017 and 2022, and ± 4.0 in 2019 (Ajuntament de Barcelona, 2015; 2016a; 2017b; 2019b; 2022). The analysis of the surveys consisted of the evaluation of the change in response patterns from 2015 to 2021 in questions related to perceptions of the social improvements of the area, the use of the different areas in the park, ecological aspects, opinions on the project outcomes, and expected future dynamics. This step was developed manually by entering the data included in the annual surveys for each relevant category. Microsoft's Excel software was used to identify statistically relevant changes in patterns.

4. Background: NbS in Glòries park, Barcelona

4.1. Glòries park project in transition

In the city expansion and modernization plan of 1856 (*Pla Cerdà*), engineer and planner Cerdà designed Glòries square as the central node in Barcelona, where three main avenues acting as city axes converged: *Diagonal*, *Gran Via*, and *Meridiana* (Cerdà, 1991) (Fig. 1). However, the square failed as the central reference of Cerdà's plan due to complex mobility dynamics, poor connection with the rest of the city, and the existence of a railroad that physically divided the surrounding neighborhoods (Roca Blanch et al., 2011). To promote fast mobility in the city for the Olympic Games of 1992, two rings were created surrounding the square, aiming to facilitate rapid transit entrance and exit (Roca Blanch et al., 2011). The two levels of highway rings created an unused center space, which became a brownfield frequented by informal vendors (Xalabarder, 2007).

Glòries renewed project was born after the demonstrations that started in the early 2000 s, forcing a dialog between the city council and the neighbors. This resulted in the signature of a document called *Compromís per Glòries* (Ajuntament de Barcelona, 2007). In 2013, the city council of Barcelona called for an international competition for the

Table 1
Total number of interviewees and its identity numbers by stakeholder type.

Type of stakeholder	N° of Participants	Identity numbers per interviewees
Government	2	#6; #8
Public entity (technician)	8	#2; #3; #10; #14; #15; #17; #18; #20
Private sector (technician)	4	#4; #5; #7; #13;
Academia	3	#1; #12; #16
NGOs / Schools	1	#19
Neighborhood associations	2	#9; #11
Park users	5	#21; #22; #23; #24; #25
Total n	25	

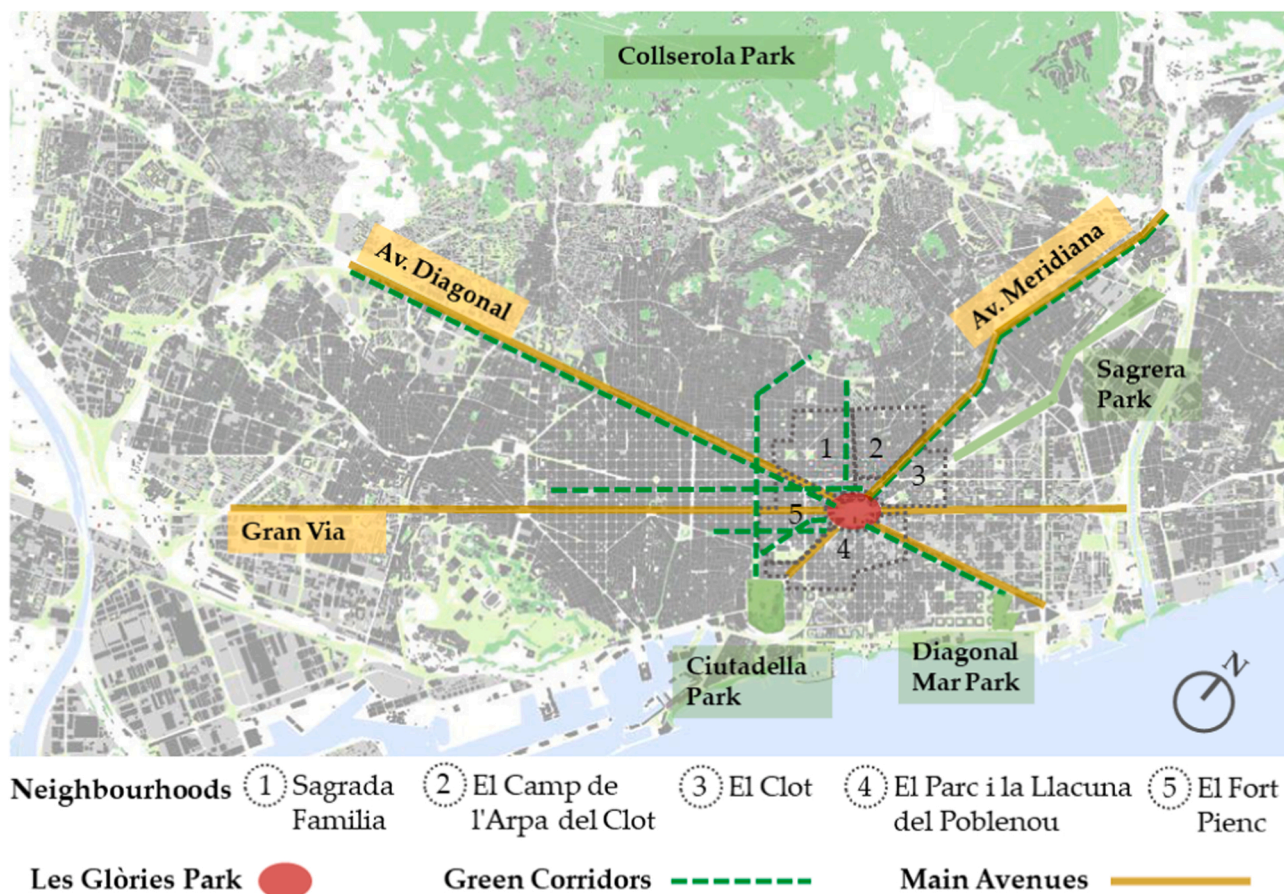


Fig. 1. Location of Glòries and connections to green corridors.

Source: adapted from ©L'Institut. Cartogràfic i Geològic de Catalunya (<https://visors.icgc.cat/contextmaps/#11.26/41.4009/2.1123> accessed. on July 5, 2022).

design of the park, choosing 10 finalists and creating afterwards the *Jornades ciutadanes* where open debates and workshops were held to obtain input from residents (Baró-Planella, 2019). Sustainability was a core concept residents advocated for, asking for more blue-green and less gray infrastructure and terms such as natural infiltration and stormwater management emerged (Ajuntament de Barcelona, 2013).

Finally, in 2014, the project *Canòpia Urbana* was chosen through a jury by 11 architects and 2 members of the neighborhood associations, and later, participatory sessions ensued the refinement of the project (Baró-Planella, 2019).

The project for Glòries entailed a major modification of the General Metropolitan Plan of Barcelona, as it involved large transport

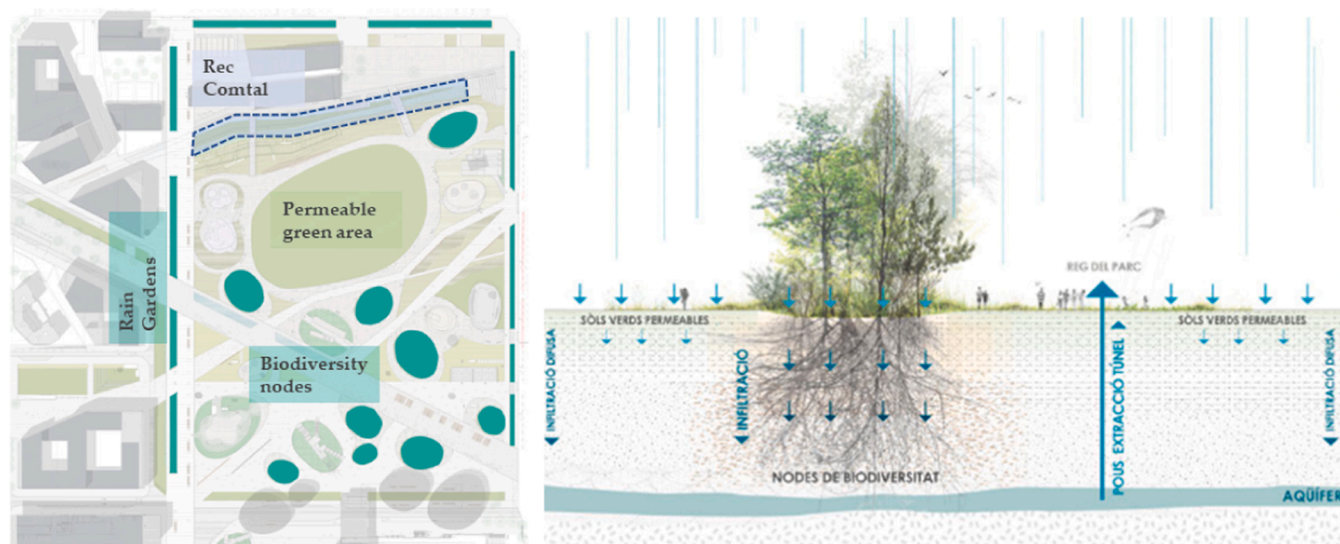


Fig. 2. Nbs in Glòries.

Source: adapted from ©Agence Ter – Ana Coello (reproduced with permission).

infrastructure, alterations in the urban form, and the creation of new residential areas (Roca Blanch et al., 2011). The project started in 2014 and is expected to be finished in 2025. It is sequenced in 4 stages: stage 1 (2014): demolition of the two rings; stage 2 (2014–2015): construction of provisional urban infrastructure; stage 3 (2014–2019): construction of a park and surrounding housing areas, and stage 4 (2017–2025): construction of road tunnels underneath the park (Ajuntament de Barcelona, 2021). Given our interest in the green dimension of the project and the subsequent implementation of NbS, this paper only focuses on the development of the park in stage 3. The park was partly finished in 2019, consisting of a clear green core (called *Gran Clariana*) combined with surrounding program nodes, including a playground, a sports area, and a dog park, as well as NbS such as stormwater retention gardens, a green roof, and biodiversity nodes (Fig. 2) (Agence ter, 2017; Ajuntament de Barcelona, 2017a).

The project for Glòries consists of a 130,000 m² green park housing different uses and activities, and prioritizing natural atmosphere through pedestrian paths, bike lanes, and NbS (Ajuntament de Barcelona, 2019a). Les Glòries is part of the Green and Biodiversity Plan for Barcelona 2020, as a green corridor that connects the *Colserolla* Park –in the North of Barcelona–, to three main points: the *Ciutadella* Park through *Meridiana* Avenue and *Passeig Sant Joan*; the linear park of *La Sagrera* –under construction–; and with the *Diagonal Mar* Park through *Diagonal* Avenue (Fig. 1).

The project was conceived as a massive empty green core, surrounded by biodiversity nodes with tree-based vegetation adapted to the climatic and environmental conditions of the Mediterranean, such as *Pinus halepensis* and *Celtis australis* (Ajuntament de Barcelona, 2019c). Biodiversity nodes, including a vast tree and bush-based vegetation, are conceived as ‘steppingstones’ in the network of biodiversity linking Glòries, with other green parks of the city (Ajuntament de Barcelona, 2019c). Even the Superblock project has found synergies with Glòries through its green corridors in the *l'Eixample* district (Ajuntament de Barcelona, 2016b). The project also follows the Urban Green Infrastructure Action Plan, which aims to add 1 m² of green area/resident and sustains that citizens play a major role in the management of the city’s NbS (Ajuntament de Barcelona, 2017a).

In Glòries, the *Gran Clariana* allows for evapotranspiration of water, whereas the biodiversity nodes and stormwater gardens were designed to provide infiltration, drainage, and lamination of runoff as well as producing thermal comfort and reducing air and noise pollution (Agence ter, 2017; Ajuntament de Barcelona, 2019a). While the green grass area of the *Gran Clariana* –with very few shade– demands large quantities of water for irrigation, the park contains an underground groundwater deposit –the biggest built so far in Barcelona (Ajuntament de Barcelona, 2019a)– which is connected to the local aquifer, serving as a natural storage for irrigation (Agence ter, 2017).

5. Results and discussion

After coding the interviews to key stakeholders and park users with ATLAS.ti, we created a co-occurrence table analysis (Table 2) that allows to graphically understand the relationship between codes (Friese, 2019). While some codes specifically fitted one category, e.g., *Tradeoffs* found strong associations with *negative aspects*, others shared *positive* and *negative aspects* e.g., *NbS and gray infrastructures as complementary*, and these were associated with *neutral aspects*.

When analyzing the results from ATLAS.ti complemented by the analysis of the surveys run by the City Council of Barcelona, three different political understandings of the socio-ecological role of NbS based on what stakeholders consider as probable and preferable for NbS in public space became evident: the *believers*; the *opposers*, and the *skeptical*s.

Table 2

Cooccurrence table. Adapted from ATLAS.ti.

	Positive aspects	Negative aspects	Neutral aspects
Complexity in Glòries case	n/a	8 – 0.09 *	5 – 0.06 *
Dichotomy of park or dry plaza	1 – 0.01 *	n/a	3 – 0.04 *
Ecological design aligned to Med. Climate	7 – 0.09 *	n/a	1 – 0.01 *
Ecological consequences of NbS	8 – 0.11 *	n/a	n/a
Futures of NbS in cities	2 – 0.02 *	4 – 0.04 *	6 – 0.07 *
Existence of green corridors	10 – 0.13 *	2 – 0.02 *	1 – 0.01 *
Green gentrification	n/a	9 – 0.1 *	2 – 0.02 *
Greening public spaces as a trend	3 – 0.03	11 – 0.11	8 – 0.09
Need to green Barcelona	8 – 0.10	5 – 0.05	2 – 0.02
Glòries as a pioneer in NbS	14 – 0.18	3 – 0.03	4 – 0.04
Local vs. city scale of NbS	6 – 0.08 *	9 – 0.10 *	5 – 0.06 *
Maintenance of NbS	2 – 0.02 *	9 – 0.10 *	n/a
Multifunctionality of NbS	3 – 0.03	12 – 0.13 *	3 – 0.03
Nature-city relationship	8 – 0.09	7 – 0.07	6 – 0.06
Nature-people relationship	9 – 0.11	4 – 0.04	5 – 0.05
NbS and gray infrastructures as complementary	1 – 0.01 *	2 – 0.02 *	3 – 0.04 *
New governance models through NbS	4 – 0.05 *	2 – 0.02 *	2 – 0.02 *
Participation process of Glòries	4 – 0.05	11 – 0.11	4 – 0.04
People’s reaction to ‘ugly’ natures	1 – 0.01	1 – 0.01 *	11 – 0.13 *
Public space design in Glòries	n/a	10 – 0.11 *	n/a
Public space: space for nature vs. people	3 – 0.03	12 – 0.13	4 – 0.04
Sense of belonging	5 – 0.06 *	1 – 0.01 *	5 – 0.06 *
Sensitivity toward stormwater	9 – 0.11	n/a	5 – 0.06 *
Shortage of rains in the Mediterranean climate	1 – 0.01 *	4 – 0.04 *	3 – 0.04 *
Skepticism on the final image of Glòries	n/a	1 – 0.01 *	5 – 0.06 *
Stormwater management and public space	18 – 0.23	2 – 0.02	6 – 0.06
Tradeoffs	n/a	21 – 0.24	1 – 0.01
Visual impact of stormwater through NbS	2 – 0.02	1 – 0.01 *	13 – 0.16

Notes: the first number (whole number) in each cell indicates the number of cites shared by both codes. The c-coefficient *c* (decimal number from 0 to 1) specifies the strength of the relationship between the codes. *c* is based on quantitative content analysis: $c = n12 / (n1 + n2 - n12)$; where *n12* = number of co-occurrences for code *n1* and *n2*. n/a= no relation found. The color of the cells illustrates the relation among codes (the darker, the higher relation it presents). The * in *c* represents unequal quotation frequencies, meaning that the ration between the frequencies of the code and row code exceeds the threshold of 5 (Friese, 2019).

5.1. The believers: NbS will bring humans and nature together

The first group acknowledged that NbS are already interacting synergistically with the more environmentally friendly urban features around the city. This promising success opens the possibilities for a more sustainable future. Proof is provided by the 96.6 % of the population valuing the new park as satisfactory (Ajuntament de Barcelona, 2022). Proponents of this view sustain that NbS are of vital need in a city such as Barcelona, where green is in short supply (Interviewees #5; #7; #10; #14; #15; #19; #20). In 2013, 56.3 % of the citizens who participated on the City Council’s surveys argued that the main positive aspect of Glòries project was that it will provide a significant green area for citizens (Ajuntament de Barcelona, 2015); this same answer for 2021 when the park had already opened for partial use, rose to 69.4 % (Ajuntament de Barcelona, 2022).

Regarding the social impacts of NbS (Peters et al., 2010), for the *believers*, the park already promotes social interaction by offering social and cultural activities that create a more just city (Interviewees #7; #10): “this park is already a magnet for people, it promises a space where people can develop activities while enjoying the outdoors” (Interviewee #24). In the report of the urban improvement plan for the Glòries planning sector, the City Council of Barcelona sustains that

Glòries follows the Urban Law, which states that sustainable urban developments must favor social cohesion –as aligned to the [European Commission \(2019\)](#)– and urban rehabilitation by bringing a wider and more efficient land management approach ([Ajuntament de Barcelona, 2021](#)). People now actually choose to go to the park, contrarily to what happened previously, where citizens avoided passing through it (Interviewees #9; #21). If we analyze the perceptions on social improvements through the years, percentages are stable in general (between 63 % and 71 %) and expected to remain so in the future (64.4 % in 2021) ([Ajuntament de Barcelona, 2015; 2016a; 2017b; 2019b; 2022](#)).

Additionally, the group considers that Glòries will have a major socio-ecological impact in the neighborhood due to its connection with diverse green corridors (Interviewees #5; #9; #10; #12; #15; #17; #19). In 2021, 43.5 % believed that once the park is finished, the urban environment will improve ([Ajuntament de Barcelona, 2022](#)). From an ecological perspective, several interviewees highlighted the benefits of the biodiversity nodes (Interviewees #7; #10; #11) as enhancers of urban biodiversity ([EC, 2015; Noiva et al., 2016](#)). “If there is something of Les Glòries that I find to be absolutely in point, it is the serious and rigorous tone that the ecological elements have in this square with the problems that we are obviously facing in cities (...) around 25 species of birds are nesting in the park and a vast number of insects around the stormwater gardens and biodiversity nodes have been identified, and so on. This is something new for a central area in the city” (Interviewee #14).

This group sees that the construction of the tunnels was a key point for bringing beneficial socio-ecological consequences in terms of transport, noise, and pollution (Interviewees #9; #11; #22), as an extra ES that NbS can offer ([McCormick and Kiss, 2019](#)). This was also supported by a 48.4 % of citizens that participated in the surveys in 2021 ([Ajuntament de Barcelona, 2022](#)). The perspectives on future environmental improvements have increased since 2015. In that year, 71.6 % of respondents believed that Glòries would bring mainly positive environmental changes, while in 2021, these expectations were shared by 78.2 % of respondents ([Ajuntament de Barcelona, 2022](#)).

When describing the park, interviewees acknowledged that the vegetation conformed to Mediterranean climate patterns (Interviewees #7; #10; #15), demanding less water, which calls for unchanging nature ([Kull et al., 2015](#)) and is more resilient to climate change. Proponents of this view argue that building the park under sustainability criteria was very innovative for the time when it was planned (Interviewees #14; #20) as NbS were not well-known by then. In this aspect, sensitivity toward stormwater management and its introduction in public space design are valued to be positive for a large part of participants (Interviewees #1; #4; #7; #10; #13; #14; #15; #16; #17; #18; #19; #25). They valued the direct connection between water and greening as elements displaying life (Interviewees #7; #9; #17). Some respondents pointed out that already Cerdà in the mid-19th century manifested a compelling interest in collecting stormwater on site to be reused for watering trees (Interviewee #6).

These actions demonstrate the importance of ‘going back’ to our origins and reconcile city with nature (Interviewees #4; #10; #14; #18; #20; #25): as one person said, “we need to ‘re-nature’ the city in ways where we can breathe and develop a healthy life” (Interviewee #9). The city is conceived as a living system that needs more natural elements to survive (Interviewees #10; #14): “We [the firm] understand that the city is a type of ecosystem and that humans are animals and I mean...we don’t even understand that the city is something else or separated from nature, but we understand that the city is a type of ecosystem with very peculiar characteristics” (Interviewee #10).

This group pointed out that by introducing NbS in public spaces, a sense of curiosity emerges from visitors that are not used to have direct connections with nature through water retention gardens or biodiversity nodes (Interviewees #7; #14). Facilitating educational information as in the existing signs that explain how and why these elements were chosen and the natural processes behind them were well received (Interviewee

#7; #10; #15). In sum, for the believers, NbS elements bring nature and people closer in urban environments through a change of paradigm.

5.2. The opposers: There is and will not be space for NbS developments in the city

On the opposite side, the second group believes that the socio-ecological role NbS can play and will play in the future is conditioned by existing urban pressures. To begin with, they argue that the urban context in which NbS are implemented can overshadow positive impacts. Interviewees highlighted that the urban regeneration project should have focused mainly on urban mobility, conceiving Glòries as a city node where multiple avenues converge, although these are by no means green corridors (Interviewees #4; #6). With this perspective, the design of Glòries would not be related to NbS or greening, but to rapid transit as a roundabout that improves mobility (Interviewee #4). According to this group, the new park deflects attention toward an ecological discourse, putting aside the problems that the park entails, especially its failure as an unsolved urban mobility node adding more pressure to traffic flows in the surrounding areas (Interviewee #4). In fact, several interviewees argued that “this is a great, remarkable project, but located in the wrong place” (Interviewee #1; also #2; #5; #8; #17). This brings the question: what is nature the solution to? ([Cousins, 2021; Kotsila et al., 2021](#)).

Proponents of this view believe that the negotiation process and the tradeoffs ([Haase, 2017; Nóbrega-Carriquiry et al., 2022](#)) that resulted and will result from this project are very imbalanced (Interviewees #1; #3; #6; #17). Although public participation in Glòries was a very extensive and integral process, the *Compromís per Glòries* was negotiated 12 years before the park was conceived, encompassing therefore a long period of urban evolution (Interviewees #1; #2; #3; #7; #8; #12; #15): “This means that several agreements such as the construction of the tunnel do not make much sense today. Due to its complexity, consisting of 4 levels, including metro and train tunnels at a cost for the city the city of 200 million of euros... in the end, the real cost of the park was 200 million euros plus the cost of the park project. It was way too costly for whatever social and environmental advantages it might bring” (Interviewee #6).

Also, issues of green gentrification ([Anguelovski et al., 2018; Kabisch et al., 2016](#)) were often mentioned when expressing future negative challenges for the area. According to some, processes of green gentrification have already affected the surrounding neighborhoods with the development of the 22 @ project (Interviewees #16). While some interviewees believed that gentrification was an issue beyond greening cities (Interviewees #7; #10; #15), the vast majority showed concerns on the actual socio-economic changes that Glòries will bring to the area (Interviewees #9; #11; #14; #16; #18; #19; #23; #24). As part of the project, new residential housing is under construction, 80% of which, according to the demands of neighborhood groups, needs to be rent controlled. However, negotiation processes are still going on with the City Council of Barcelona (Interviewees #9; #11). From the surveys, 27.9% believe that housing will be one of the most contested issues once the park is finished ([Ajuntament de Barcelona, 2022](#)). And who will make use of the park and might afford to live nearby is yet to be seen (Interviewees #16; #19; #25).

Second, the multifunctional and ambitious character of NbS overshadows their capacity to tackle the problem that Glòries was intended to solve, namely mobility (Interviewees #3; #8). Many remained pessimistic about the impact that NbS in Glòries will have, as they thought that the only real innovation the park can bring is esthetic (Interviewees #3; #6; #14), with no real incidence on human-nature interactions, biodiversity enhancement, or climate change mitigation. In terms of biodiversity, it was argued that these types of systems are only successful when conceived at a bigger scale (Interviewees #1; #2; #4), questioning the paradigm shift that this type of intervention can bring ([Kotsila et al., 2021](#)). Regarding climate change mitigation, the

development of NbS to manage stormwater in a Mediterranean climate is questioned since annual episodes of extreme rainfall concentrate in just a few days (Interviewees #8; #14). Furthermore, the amount of stormwater that can be collected at the scale of projects such as Glòries is insignificant in comparison with the needs of Barcelona in this regard (Interviewees #8; #16; #20).

Third, in this view, it is understood that public space design in the park prioritizes nature, reducing recreational areas for people (Interviewees #2; #3; #6; #16; #17; #19), something very common in new urban developments that should make room for nature to grow (Randrup et al., 2020). The result is a fractured park where 'nature' is designed in a controlled way through fences surrounding the biodiversity nodes, enclosed stormwater retention gardens, and regulated entrances to *La Clariana*. All these restrictions not only set rules on how to interact with nature, but also limit its relationship with people (Interviewees #6; #14). This is what Monstadt (2019) will refer to with 'nature as a constrainer' of the urban form. "With its restricted use, *La Clariana* represents the opposite of public space in the 21st Century. The same happens with all natural elements that the park has, being un-touchable and unapproachable" (Interviewee #6). Introducing nature also involves high maintenance costs, considering in addition that the city is developing more NbS and expanding its green areas, but with the same resources than before (Interviewees #5; #9; #10; #11; #17; #25). A 41.3 % of neighbors understand that the cleanliness of public space is one of the main topics where the neighborhood has worsened (Ajuntament de Barcelona, 2022).

Last, in this category prevails the view that city and nature are separate from each other. Some believe that nature in cities does not exist (Interviewees #1; #3); that the integration of natural elements such as stormwater reuse in public space depends too much on human beings (Interviewee #2), justifying the need to speak about an anthropized nature (Interviewees #5; #13); that the idea that nature will guide our future cities is unreal "it is just utopic to believe that the *Collserola* park will take through Barcelona" (Interviewee #11). Others, finally, sustain that the only way to become more 'natural' is by using more natural materials to build new developments, but not through pure nature or natural processes per se (Interviewee #13).

5.3. The skepticals: NbS might pursue the statu quo

The third group appears to have a more skeptical position of the role of NbS. One of the main claims of this group was the need to go back to the debate occurring in Barcelona in the 1970s about the design of public space and plazas and whether these spaces should be deprived of green areas (Interviewees #3; #15). According to some, the very first concept to be discussed in planning concerns 'green' features. They argue that the city was conceived prioritizing very solid gray infrastructure, and that, therefore, it is contradictory to follow a transition toward more 'sustainable' futures by implementing NbS if the process of renaturing the city involves a high expenditure of natural and socio-economic resources (Interviewees #3; #13), what some call 'sustainability fixes' (Keil, 2007; Pirro and Anguelovski, 2017). As an example of this, the contradictions between the construction of a tunnel underneath the park requiring the pumping of millions of cubic meters of groundwater and the park philosophy of implementing NbS to reuse water were highlighted (Interviewees #6; #8).

Proponents contend that a combination of gray-blue-green infrastructures might be the more sensitive one (Interviewee #4), and that even public entities and professionals within the local administration are technically supporting this idea (Interviewee #15). Systems that manage stormwater in a city such as Barcelona make sense when connected to each other, as a network of NbS and gray infrastructures rather than isolated stormwater projects (Interviewees #8; #16; #20). They understand that too much pressure is put to follow more 'sustainable' and 'green' urban developments introducing NbS to solve all problems related to mobility, climate change, and socio-economic aspects

(Interviewee #2). And, while Barcelona is one of the main cities in Europe that follows this regime, these norms are imposed by the EU and the city never actually pioneered the incubation of such concepts (Interviewee #20; #25).

In comparison to the first group, this group argues that the sense of belonging in public space is created by other elements rather than just by nature and NbS at the disposal of citizens (Interviewee #5). In Glòries case, the sense of belonging is to be seen as most buildings (residential and services) are yet to be built (Interviewee #8; #9; #11). Regarding new governance models that NbS entail (Haase, 2017; Kull et al., 2015), visions are very unclear: some might argue that the case of Glòries is a remarkable example of a participatory process where citizens had a say in the topic, and actually support the preservation of green areas within the park (Interviewees #12; #19), but others believe that still most of the technical and actual decisions were made by the City Council, bringing no significantly new perspectives on governance schemes (Interviewees #15; #16; #20).

Last, this group also remains skeptical on the influence that the very first images of the project will have on the perceptions of the socio-ecological role of Glòries. This means that the *skepticals* question the different imaginaries of esthetics in nature (Kull et al., 2015). At first, the images of the park included mass vegetation of trees and very green areas that were not conceived as such (Interviewees #6; #16): "Perhaps there is too much marketing around it, too much desire to prove something that in the end will fail. The whole series of slogans and of statements around eco-green are intended to be true, but in the end, what we [citizens] want, is to understand the resulting space and not raise false expectations" (Interviewee #8). Most likely, green vegetation will change to yellowish and brownish with the current dry periods that the city of Barcelona is facing, and it is yet to be determined how much people accept this type of 'ugliness' or natural environments that escape from unrealistic images (Interviewees #15; #16; #20). "In the less bright, less colored, and dark places of the city is where conflict and security issues are prone to arise, as less people usually pick these places to go to. I still have my doubts on how people will react to a less green and poorly maintained Les Glòries" (Interviewee #5).

Stakeholder perceptions conditioning NbS implementation.

Considering these three discording visions and the political aspects in NbS portrayed in Section 2, several reflections can be highlighted regarding how perception studies might contribute to critically understanding NbS practices.

First, far from enhancing social cohesion and place attachment (Noiva et al., 2016), the implementation of NbS in Glòries case has evidenced that a divided community of stakeholders differently understands the needs of the area, the demands and values of nature, and the preferable urban futures. Different social values toward how NbS may represent a shift in sustainable urban transformations (Kotsila et al., 2021) are prominent in Glòries. Debates on which is the most sustainable way to design parks in Barcelona from an environmental perspective are not new (Parés-Franzi et al., 2006), but still part of the discussions. Furthermore, perceptions on the different imaginaries of nature (Kull et al., 2015) represented a constraint, as a divided community was identified regarding the final public image of the park. For some, the nature of the park will respond positively to climate change trends, while for others, non-green nature will condition its future success.

Second, the different perceptions of the socio-ecological roles of NbS in Glòries were highly influenced by issues of social justice and spatial inequalities (Cook and Swyngedouw, 2012; Cousins, 2021; Wolch et al., 2014). As new schemes of socio-natural assets are reconfigured in space, some stakeholders lose, while others succeed in defending their own interests (Guerrin, et al., 2021; March and Swyngedouw, 2022; Nóbrega-Carriquiry et al., 2022). In Glòries, tradeoffs were a concern for stakeholders, exposing the negative consequences that NbS might bring through the 'green paradox' (Wolch et al., 2014), such as how the housing market will respond once the park is finished. Moreover, and

building on [Randrup et al. \(2020\)](#), reflecting on whether urban nature in Glòries should be given space to expand or not, represents a political decision, as there is limited room to grow, and numerous interests are confronted through the high demand on space in contemporary cities.

Considering that there is still uncharted territory about how NbS relates to issues of politics and conflict, studying perceptions of the socio-ecological role of NbS may be of special interest, since there is yet too much pressure on nature as a solution, when it may, somehow paradoxically, be part of the problem if NbS are “too narrowly and apolitically defined – or made invisible” ([Kotsila et al., 2021](#), p. 256). Interactions with NbS in space shape individual perceptions of NbS ([Han and Kuhliche, 2019](#)), unveiling the different wants and needs of stakeholders for current and future problematic scenarios related to climate change. Integrating the debate of NbS perceptions with the debate on park policies that investigate diversity, inequalities, capabilities, and injustices may bring important political insights ([Haase, 2017](#)) as to how human-nature relationships can be reformulated in more just and sustainable ways.

6. Conclusions

NbS currently guides the design of numerous urban public spaces, which may not benefit all users or stakeholders equally, but, contrary, may expose unexpected and uneven outcomes ([Beichler et al., 2017](#)) because of existing uneven social relations ([Massey, 2005](#); [Millington, 2016](#)). By applying a critical perspective on discerning and destabilizing hegemonic visions of NbS in the public space and bring stakeholder voices to the discussions, it becomes explicit that divergent views clash and question NbS implementation in cities. Glòries park represents a clear example of an integral urban regeneration process that introduced NbS in a critical urban central area. The study has shown how three stakeholder groups named the *believers*, the *opposers*, and the *skepticals*, perceive the socio-ecological role of NbS very distinctively. When analyzing the reasons for such discrepancies, it became evident that the different understanding of the existing urban tensions in the context where the park was developed, the divided visions on tradeoffs and imbalances, and the diverse opinions on the real purpose and impact of implementing NbS conditioned perceptions on NbS in public space.

6.1. Embracing divergent and legitimate stakeholder visions for NbS in cities

From these three views, we conclude that NbS produces different types of socio-ecological interactions, which can compromise sustainable urban transitions. While NbS implementation will continue to grow like the *believers* long for, so will the high expectations placed on these solutions to face multiple urban constraints and uncertainties associated with the coexistence with existing gray infrastructures, as the *opposers* and *skepticals* claim. Therefore, how can we reconcile such divided perceptions toward a realistic paradigm shift with NbS?

1. Be cautious on raising expectations that nature will solve existing urban tensions.

Usually, NbS in urban contexts imply complex processes of urban development that aim to bring improvements to the urban environment, but, in the end, tend to be over-ambitious obscuring the real improvements that NbS may bring to cities. In this way, questions regarding how much are we asking NbS to solve result critical, which makes us reflect on this statement: “Wind turbulence and excessive heat can be moderated by vegetation, but the basic perspective is that nature is being used to alleviate planning mistakes” ([Randrup et al., 2020](#), p. 923). Existing urban tensions are present in cities, and the multifunctional character of NbS might not be the ultimate quick fix to such problems that may be the result of many years of urbanization dynamics.

2. Acknowledge tradeoffs and provide redeeming or regulatory measures to address them.

Some authors have already questioned if ES are reaching its limits in the urban world and how compatible they are to each other ([Beichler et al., 2017](#)), as the ‘urbanization’ of nature involves a socio-physical process characterized by environmental (in)justice and socio-environmental inequalities ([Cook and Swyngedouw, 2012](#)). It is important to understand who will lose and who will win as NbS guide future urbanization processes, and who is willing to cede public space for nature at the cost of recreational activities for humans. Given that NbS are still associated with the green paradox and gentrification issues, several measures such as the creation of housing policies with nature-based urban development projects should be considered to bring more just outcomes.

3. Avoid the commodification of nature

NbS follows neoliberal ‘sustainability fixes’ that respond to private and privileged interest at the cost of natural resource exploitation ([Kotsila et al., 2021](#)). This implies that NbS follows a market-led political economy and that, therefore, new urban regeneration projects do not create a paradigm shift in existing governance structures and human-nature relationships, but rather follow the *statu quo*. NbS might point at new governance models ([Kull et al., 2015](#)), but still in these cases, technology and techno managerial actors are the ultimate arbiters of human-nature relationships ([Karvonen, 2011](#)). Also, unrealistic visions of NbS greening the city circumvent the fact that human-nature relationships will not always be straightforward. Nature will become brownish and yellowish, will be costly to maintain, will captivate new forms of unwanted biodiversity in the city such as insects or plagues and capture exclusive public space, as opposed to the idealized views of nature as unchangeable and manipulable.

By analyzing through a transdisciplinary lens the case study of Glòries, the paper has attempted to reflect on the complexity that urban regeneration projects entail when including numerous stakeholders in the topic of NbS and blue-greening cities. While more integral research is needed in terms of how people perceive NbS contribution to reduce heatwaves, our research offered empirical evidence that perception studies provide useful information of different understanding of stakeholders, bringing greater sensitivities toward cultural issues ([Chan et al., 2011](#)) as well as toward spatial inequities regarding tradeoffs and benefits ([Plieninger et al., 2013](#)). Only when these three previously mentioned arguments are fully considered, a more real, just, and pragmatic NbS prospective may be achieved.

Funding

This work was supported by the Secretaria d’Universitats i Recerca, del Departament d’Empresa i Coneixement de la Generalitat de Catalunya, grant number 2020FI_B 00160 for the first author. This publication is also part of the 2021 SGR 00975 and 2021 SGR 00214 projects funded by the Departament de Recerca i Universitats de Catalunya. Open Access Funding was provided by Universitat Autònoma de Barcelona.

CRedit authorship contribution statement

Andrea Nóbrega: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing - original draft, visualization, funding acquisition, project administration. **Hug March:** conceptualization, writing - review and editing, supervision project administration. **David Sauri:** conceptualization, writing - review and editing, supervision project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

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