



Novel Solutions or Rebranded Approaches: Evaluating the Use of Nature-Based Solutions (NBS) in Europe

Feorghus O'Sullivan^{1*}, Ian Mell¹ and Sarah Clement²

¹ Department of Planning & Environmental Management, University of Manchester, Manchester, United Kingdom,

² Department of Geography & Planning, University of Liverpool, Liverpool, United Kingdom

OPEN ACCESS

Edited by:

Stephan Pauleit,
Technical University of
Munich, Germany

Reviewed by:

Sonja Gantioler,
Eurac Research, Italy
Ana Catarina Luz,
University of Lisbon, Portugal

*Correspondence:

Feorghus O'Sullivan
feorghus.osullivan@manchester.ac.uk

Specialty section:

This article was submitted to
Urban Greening,
a section of the journal
Frontiers in Sustainable Cities

Received: 14 June 2020

Accepted: 16 September 2020

Published: 27 November 2020

Citation:

O'Sullivan F, Mell I and Clement S
(2020) Novel Solutions or Rebranded
Approaches: Evaluating the Use of
Nature-Based Solutions (NBS) in
Europe.
Front. Sustain. Cities 2:572527.
doi: 10.3389/frsc.2020.572527

The Nature-Based Solutions (NBS) concept is the most recent entry to discussions around how “nature” can be mobilized to render urban areas more resilient to the threat of climate change. The concept has been championed by the European Commission (EC) as a tool that can transform contemporary environmental, social and economic challenges into opportunities for innovation, bolstering Europe’s position as a leader in climate change mitigation and adaptation. With its current research and innovation programme—Horizon 2020—the EC looks to position itself as the global NBS frontrunner, providing funding to cities to act as NBS demonstrator projects across the continent. These are expected to provide best-practice examples that can be replicated globally. This paper focuses on three Horizon 2020-funded NBS demonstrator projects: *Connecting Nature*, *URBAN GreenUP* and *Grow Green*, each of which brings together a suite of urban partners from both within and outside the European Union (EU). It examines the internal “politics” i.e., the aims and internal governance and implementation issues associated with these projects, and analyses how partners perceive the NBS concept. To engage with these aims, interviews were conducted with a diverse set of NBS “practitioners” working within the three projects. Analysis showed that the projects aim to influence climate-change resilient and sustainable urbanism through the process of retrofitting cities with small-scale green and blue interventions, as well as help the EU secure stronger diplomatic relations with neighboring non-EU countries and key international trade partners. It also illustrated that for many project partners, NBS is perceived to be a novel concept, because it re-frames pre-existing terms such as Green and Blue Infrastructure (GBI) and Ecosystem Services (ES) in a way that makes principles of urban greening more understandable to lay audiences and more politically palatable for urban governments. However, partners also warn that this framing of NBS has led to a narrow and idealized representation of nature; one that simultaneously undervalues biodiversity and oversells the capacity of natural processes to provide “solutions” to urban climate vulnerability and broader patterns of unsustainable urbanism.

Keywords: nature-based solutions, urban greening, horizon 2020, climate change resilience and adaptation, sustainable urbanism, urban experimentation, green infrastructure (gi), environmental governance

INTRODUCTION

During the late Nineteenth and early Twentieth centuries, urban planners and designers including Ebenezer Howard and Frederick Law Olmsted promoted the use of nature as a tool to sanitize the city (Kaika, 2005). Drawing on a “romanticized” view of nature as pristine and inherently good, they proposed using green and blue spaces to simultaneously tackle environmental issues such as pollution, as well as social ills such as high levels of crime. Evolving out of these early examples of “urban experimentation” (Caprotti and Cowley, 2017:1422), the concept of “Nature-Based Solutions” (NBS)—defined as “living solutions underpinned by natural processes and structures that are designed to address various environmental challenges while simultaneously providing economic, social and environmental benefits” (Frantzeskaki et al., 2017:67)—has increasingly gained traction in the last decade within discourse surrounding sustainable and climate resilient futures (Mell and Clement, 2019).

Endorsed by organizations such as the European Commission (EC, 2015) and the International Union for Conservation of Nature (International Union Conservation of Nature, 2014) as a way of making natural ecosystems an “integral part of sustainable development” (Laforteza et al., 2018:431), NBS aims to “integrate the ecological dimension alongside traditional planning concerns” (Scott et al., 2016:267). Viewed as a cost-effective alternative to gray or ‘man-made’ infrastructures, it is also believed that NBS interventions such as rain gardens or green walls can more effectively protect urban dwellers, infrastructures and business interests from climate change hazards when compared to engineered approaches (International Institute for Environment Development, 2018).

NBS entered the mainstream scientific literature in the 2000s, originally in the context of providing solutions to agricultural problems e.g., pest management (Potschin et al., 2014). However, from approximately 2009 onwards the term became increasingly embedded within literature related to how nature could be used “to tackle major societal challenges such as climate change” (Eisenberg and Polcher, 2018:1). Due to the relative newness of the concept and its broad scope, definitions of NBS have been vague and divergent (Pauleit et al., 2017) which has hindered its conceptual development and uptake in practice (Cohen-Shacham et al., 2016).

Questions have also arisen around whether NBS represents a “novel” approach to re-naturing urban areas (EC, 2015). This is because the relationship between NBS and pre-existing concepts, namely green and blue infrastructure (GBI) and ecosystem services (ESS), is ambiguous (Potschin et al., 2014; Dorst et al., 2019). Whilst the relationship between these terms has received attention within the academic literature (cf. Pauleit et al., 2017), it has been theoretical in nature (although this is changing via the growing number of academic publications associated with EU funded NBS projects). Therefore, there is a clear need to study how the organizations practically involved in the implementation of NBS perceive the nascent term and the vision of “nature” it mobilizes. Moreover, unlike other forms of “urban experimentation” (Frantzeskaki et al., 2017), such

as “smart cities” (see Viitanen and Kingston, 2014), there has been no analysis of the “politics,” i.e., drivers, interests, risks and pressures (Karvonen et al., 2014), associated with how NBS projects are governed.

In an attempt to explore these research gaps, this paper focuses on three current NBS projects: *URBAN GreenUP*, *Grow Green* and *Connecting Nature*. Funded by the EU’s current research and innovation programme—Horizon 2020—these are demonstration projects that aim to increase climate resilience through the delivery of innovative NBS in cities. The aim of this paper is to examine the role of these projects in promoting NBS by (1) investigating the politics of Horizon 2020-funded NBS projects i.e., their overarching aims, scope and the issues associated with their governance structure(s); (2) to analyze whether actors working within these projects perceive NBS to be a “novel” urban greening concept; and (3) interrogating the way in which “nature” is being framed within the NBS concept and discuss what the potential impacts of this are.

Rise of NBS in the Contemporary “Risk Society”

Modern societies have increasingly become concerned with risk, borne out a preoccupation with the future and safety (Giddens, 1998). Global problems such as climate change and economic uncertainty present qualitatively different problems from those societies evolved to confront, creating the “cosmopolitan imperative” and requiring them to either cooperate or fail (Beck, 2011). In an increasingly urbanized world under the myriad threats posed by climate change, cities are sites of immense importance, as both drivers of change that generate climate risk and the expected victims of it (Dulal, 2016).

Cities currently produce 70% of global waste, consume 60% of global energy, and emit 75% of world-wide greenhouse gas emissions (Nature, 2018). These extensive urban “metabolisms” (Swyngedouw, 2006) endanger global health and wellbeing (World Health Organisation, 2010), deplete “stocks” of natural capital both within and beyond urban ecosystems (Grunewald et al., 2018; EC, 2019), and significantly contribute to climate change threats that disproportionately impact the lives and businesses of urban-dwellers (Dulal, 2016; Harvard Business Review, 2017). It is within this context of urban climate risk-factors that the NBS concept has gained increased traction, especially within Eurocentric discourses.

The EC As the NBS Frontrunner

Though the NBS concept has gained significant interest from organizations including the IUCN and the World Bank, it is the EC that has shown the greatest ambition to position itself as the global leader in the innovation and implementation of NBS (Nesshöver et al., 2017). Defining NBS as interventions that “harness the power and sophistication of nature to turn environmental, social and economic challenges into innovation opportunities,” the EC (2015:2) believes that the concept can help to:

1. Enhance sustainable urbanization whilst also stimulating economic growth and enhancing human well-being.

2. Restore degraded ecosystems and improve their resilience.
3. Develop climate change adaptation and mitigation.
4. Improve risk management and resilience.

Moreover, NBS is framed as a tool that can stimulate new business opportunities and bolster Europe's position as a leader in world markets (EC, 2015). However, the EC also recognizes that, at present, standards and guidelines for NBS design are limited and implementation is still in an experimental phase (Kabisch et al., 2016). The EC has leveraged the power of funding, through its current research and innovation programme (Horizon 2020), to deliver extensive urban NBS demonstrator projects across Europe with the aim of addressing this knowledge gap. Practical projects such as *Connecting Nature*, *URBAN GreenUP* and *Grow Green* aim to provide a “repository of best-practice examples” (Faivre et al., 2017:513) by collecting “valuable information on appropriate designs, implementation techniques and cost benefit analyses for NBS” (ibid:512) that can guide future sustainability projects and urban policies. But how did NBS become framed as an instrument for climate adaptation and resiliency?

Evolution of NBS Into an Urban Policy Term

As the introduction elucidated, the NBS concept was initially envisioned as a “nature-based” approach to agricultural and water management issues (Potschin et al., 2014). In the late 2000s, however, the World Bank and the IUCN began to mention “nature-based solutions” within a similar remit to that of ecosystem-based adaptation (EBA); the extent to which biodiversity conservation can contribute to climate change mitigation and adaptation efforts (Pauleit et al., 2017). Two key documents emerged at this time: “Biodiversity, Climate Change, and Adaptation: Nature-Based Solutions from the World Bank Portfolio” (MacKinnon et al., 2008) and “No time to lose—make full use of nature-based solutions in the post-2012 climate change regime” (International Union for Conservation of Nature, 2009). Both use the term NBS, but fail to offer a clear definition if it, or a discussion of how it differs from EBA. Shortly after the publication of these reports—namely at a European conference held in Brussels in 2014—NBS was re-framed as a tool that could simultaneously make EU cities more climate change resilient, whilst also providing benefits to human health and well-being (EC, 2014).

Re-modeled as such, NBS has increasingly become deployed as a concept that can aid “urban sustainability transitions” (Frantzeskaki and Rok, 2018). To test the potential of NBS, the EU, under the FP7 funding package—the precursor to Horizon 2020—began to fund urban “transition initiatives,” which are described as “actor collectives led by public, civic, business or partnerships of those, who put in place new ways of doing, thinking and organizing and transform current systems of provision with the aim to actively contribute to environmental sustainability” by Frantzeskaki et al. (2017:66). The ARTS (Accelerating and Rescaling Transitions to Sustainability) project, that ran from 2013 to 2016, was one of these initiatives. The consortium consisted of 10 partners from 10 European countries and focused on how sustainability transitions could be accelerated through the use of NBS interventions such food

gardens, urban forests and urban beehives (Frantzeskaki et al., 2017, ARTS). *Connecting Nature*, *URBAN GreenUP* and *Grow Green* can therefore be understood as the next wave of these EU-funded “transition initiatives.”

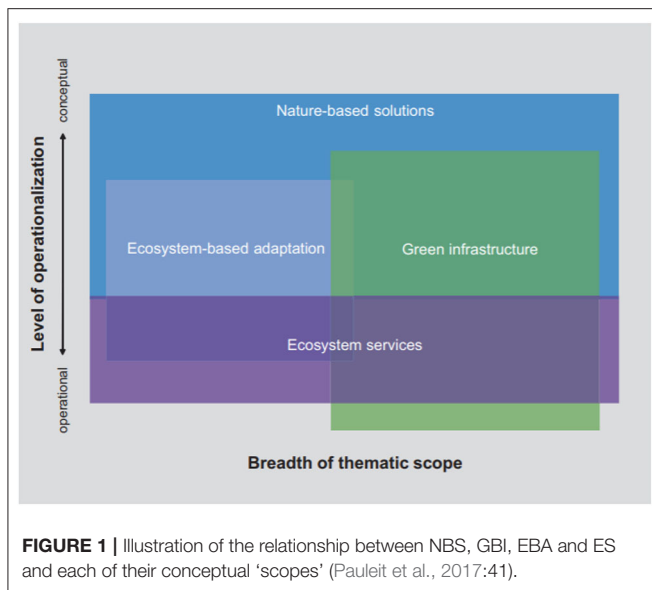
NBS Projects As Urban Sustainability “Experiments”

ARTS aimed to provide a forum for experimentation with context-specific solutions to environmental issues in ways that that restore, mimic, or extend natural processes (Frantzeskaki et al., 2017). Though urban experimentation is not a novel phenomenon (Karvonen et al., 2014), cities across the globe are increasingly being viewed as urban living labs where novel modes of governance can be tested. Different forms of urban experimentation such as “smart cities” and “transition initiatives” are envisaged as solution-oriented alternatives to “business as usual” government-led approaches to sustainability that can steer urban society toward a more liveable, prosperous and sustainable future (Bulkeley and Castán Broto, 2013; Frantzeskaki et al., 2017). What makes these experiments attractive is that they are “provisional, risky and dynamic” (Karvonen et al., 2014:104); i.e., they have a high risk of failing, but also “high rates of return if they are successful” (ibid:105). However, is this gamble worth it? Such urban experiments are questionable sources of alternative solutions that will generate transformative change, and may instead reinforce pre-existing practices and dominant interests, whilst being spatially limited (Evans et al., 2016). An experiment is, after all, predicated upon one party or group being the “experimenter,” and the other being the “experimented upon.” The scale of experimentation also poses questions about their efficacy as a strategy to provide tangible sustainability outcomes. There is a danger that under the appealing label of “innovation,” small-scale experiments may replace comprehensive planning strategies with one-off interventions (Karvonen et al., 2014:105).

Is NBS a “Novel” Urban Greening Concept?

Though the discussion above illustrated how the evolution of NBS can be traced, it remains unclear how it differs from pre-existing urban greening concepts. This is because typical examples of NBS, such as sustainable urban drainage systems (SUDs) and green roofs are also commonly referred to as GBI interventions and ES providers. Nonetheless, multiple authors are beginning to critically unpack the relationship between these interrelated terms.

With its explicit focus on providing innovative “solutions” to sustainability issues in a predominantly urban setting, the NBS concept shifts away from the broader concept of ES (Nesshöver et al., 2017; Pauleit et al., 2017). The line between NBS and GBI, however, is perceived as being more ambiguous. When compared to GBI, Dorst et al. (2019:4) assert that NBS provides “more focus and immediacy as a planning approach.” Again, this can perhaps be attributed to the former's overt aim to provide direct “solutions” to sustainability problems. For Mell and Clement (2019), a subtle difference between the two approaches is that NBS places “nature” at the very center of development debates. They suggest that the NBS approach “concentrates on the inclusion of ‘nature’ in its widest sense and promotes its



ecological value as being of equal importance to socio-economic benefits" (ibid:3).

Despite these differences, there is a broad consensus that NBS overlaps significantly with these "foundational" concepts (Sekulova and Anguelovski, 2017). Pauleit et al. (2017) puts forward a view of NBS as an "umbrella" term that includes or "sweeps up" (Dorst et al., 2019) GI, ES, and EBA within it (see **Figure 1**). In this model, these concepts are conceptualized as sub-sets or components of NBS (Mell and Clement, 2019). Laforteza et al. (2018) support this vision of NBS, stressing that the "umbrella" term model illustrates how NBS cannot be considered an isolated concept because its own existence is contingent upon these other "foundational" concepts.

What Does NBS "Add" to the Urban Greening Discourse?

With its focus on providing multi-functional, cost-effective benefits, Mell and Clement (2019:3) argue that utilizing the NBS concept can integrate "ecological concerns alongside traditional planning activities." The concept's holistic nature can allow NBS to overcome the "traditional structures of city departments" (Sekulova and Anguelovski, 2017:18), namely the "sectoral language" that traps knowledge into silos. This in turn can help to mainstream environmental targets into sectors such as policy, business and practice "that might not traditionally consider or value the environment" (Nesshöver et al., 2017:1224), and aid urban adaptation "by providing planners, developers and architects with ecologically sensitive choices that can be used to reverse some of the cost, maintenance and delivery issues associated with engineered solutions" (Mell and Clement, 2019:4). Observations such as these have led authors to characterize NBS as a "boundary concept"; "a loose concept, which has a strong cohesive power" (Allen, 2009:35). As Dorst et al. (2019:5) put it, NBS offers "interpretive flexibility with scope

for reflection yet provides a solid enough foundation for different actors previously lacking a common language to work together."

As a "boundary concept," the NBS approach may also be a more accessible measure for actors less familiar with ecological thinking or working with nature in general (Dorst et al., 2019). Unlike GI which stresses the importance of connectivity between natural areas, the NBS approach "more readily includes 'detached' measures" (ibid:5) such as the implementation of singular interventions. This approach may be more attractive and suitable for companies or small citizen-led organizations who want to implement a single green roof or green wall. It may also make NBS a more adaptive approach to urban greening in comparison to GI and EBA. This is because cities are defined by "fragmented land ownership" (ibid), which makes "connecting green space more difficult to achieve." However, the isolated implementation of small-scale NBS interventions also runs the risk of failing to provide any tangible ecosystem service benefits (Savard et al., 2000; Dorst et al., 2019).

(Re)representations of "Nature" Within NBS

Nature is a normative and highly contested term, with little consensus on meaning, reference state, or application (c.f. Castree, 2013). Due to its breadth and ambiguity, nature is commonly conceived as a ubiquitous "other" that is unable to represent itself. Rendered "mute" (ibid:54), he suggests that "nature" is therefore "free to be represented in all manner of different ways in a variety of arenas, media and genres" by different "epistemic communities" i.e., coalitions of professionals from different disciplines and backgrounds that possess a united set of beliefs (Haas, 1992:3). Crucially, representations mobilized by these communities don't reflect reality, but take on specific meaning(s) and value(s) within them (Shapiro, 1988). Analyses such as these have led authors like Conesa-Sevilla (2018, p. 3) to label the term "nature" an empty or floating signifier; a word that, despite being indispensable, possesses "elusive, ever-shifting and multi-value signification." With this in mind, how has this signifier been mobilized within NBS discourse?

Despite its relative youth as a concept, multiple academics have registered their concerns over how "nature" is represented within NBS. Much of this stems around how the NBS term serves to present a simplified framing of nature, a by-product of representing it as a singular entity, as opposed to an amalgam of entities and enmeshed processes (Conesa-Sevilla, 2018). What, for example, is the "nature" in NBS? Does it refer to only biotic life-forms e.g., plants and trees, or does it also include abiotic nature; non-living parts of the environment, e.g., sunlight and water, that have a significant influence on biotic factors? This type of analysis is currently missing within the NBS literature. Engaging in "pluralistic reflection about alternative framings and conceptualisations" (Nesshöver et al., 2017:1220) of nature is sorely needed within the NBS literature to advance the concept.

The over-simplification observed thus far risks "romanticizing" nature and over-selling what it can do (Sekulova and Anguelovski, 2017). Green interventions such as increasing tree cover are limited in their power, e.g., they can ameliorate air pollution to a limited extent (Baró et al., 2014). At a certain threshold, "nature-based" strategies are not the optimal

approach (Sekulova and Anguelovski, 2017). A more directed way of dealing with high levels of air pollution would be to effect change through a non-“nature-based” intervention, e.g., banning vehicles within certain parts of a city, thus focussing on the root(s) of the problem. Therefore, is it problematic to suggest nature as an abstract entity possesses the capacity to solve urban ills. For Nesshöver et al. (2017:1220), “there may not even be an agreement about the problems to be solved, let alone the type of solutions needed.”

MATERIALS AND METHODS

Research Approach

This paper employed a qualitative research programme. With the aim of providing an exploratory case study of how NBS has been mobilized, twelve semi-structured interviews were conducted with partners engaged within the *Connecting Nature*, *URBAN GreenUP* and *Grow Green* projects. These projects were selected because they are amongst the first to specifically test the NBS concept in a practical, “on-the-ground” sense. Research at this stage of the concept’s development was deemed crucial because, even in these early stages, 66% of Paris Agreement signatories now include NBS¹ within their Intended Nationally Determined Contributions (INDCs) to climate change action (International Institute for Environment Development, 2018). Thus, if the concept, and the projects that mobilize it, are not unpacked there is a risk that future research may be uncritically rolled-out without an evidenced understanding of what the NBS concept truly offers the discourse around unsustainable urbanism and urban climate change resiliency.

Each project is composed of a mixture of organizations from different, predominantly EU countries. The members of these epistemic communities can be divided into four broad groups: *city partners*, *academic partners*, *civil society partners* (predominantly from the environmental sectors in partner countries) and *small-medium sized enterprises (SMEs)/business partners*. Unlike the other, more bounded partner groups, city partners within these NBS projects are split into two tiers:

- **Tier 1:** “Frontrunner” city partners, which act as the demonstration sites where NBS intervention design and implementation will be trialed first.
- **Tier 2:** “Follower” city partners, who will utilize the lessons learnt from the “Frontrunner” cities to design their own NBS interventions. Tier 2 cities are predominantly in EU countries, but there also are several non-EU cities involved, e. Colombia, Bosnia-Herzegovina and Vietnam.

Table 1 outlines a full list of the “frontrunner” and “follower” cities in each project, as well as the other types of partners and the EU-funding each project received.

The approach taken in support of this research was to shortlist at least one partner from each institutional background in each project for interview. This aimed to provide a broad and variegated analysis of how different stakeholders perceive their projects and the NBS concept itself. In practice, this

¹In this context, they are often called ‘natural climate solutions’ rather than NBS.

proved difficult, as many shortlisted partners, especially business partners, were either unavailable or unwilling to participate. Ultimately, interviews were secured with five partners in *Connecting Nature* (two city and three academic partners), two in *URBAN GreenUP* (one city and one civil-society partner) and five in *Grow Green* (two city, two civil-society and one business partner). **Table 2** presents the partners interviewed. To ensure participant confidentiality and allow for differentiated analysis between types of partners, each interviewee has been ascribed a specialized code. The code pertains to the “type” of partner they are; “city partners” are coded as CP, “academic partners” as AP, “civil society partners” as CSP, and “business partners” as BP.

Interview Design and Data Analysis

As NBS is a relatively new concept that, akin to GBI, resists clear and concise definition, the interview process was structured to allow interviewees space to discuss how they perceive and value the concept. Semi-structured interviews were selected, as they provide flexibility and allow the topics that emerge “organically” to transition from discussion to in-depth exploration (Drever, 1995; Brinkmann, 2013). Interview questions were kept predominantly open-ended to encourage respondents to examine their own working practices and opinion on NBS. Despite coming from different practical and epistemological backgrounds, all partners were asked a set of core key questions to facilitate discussion. The aim of this was to build a consistent foundation from which both convergent and divergent themes could be detected and analyzed. However, each individual interview contained further “probes” that aimed to symbiotically clarify interviewee responses and facilitate a more conversational style of interview. Of the 12 interviews, 6 were conducted face-to-face and the other 6 were conducted via Skype.

Interviews were transcribed and analyzed via an “open coding” system. Each transcript coded to allow for a deep and broad immersion into qualitative datasets. Through this coding process, themes and “analytical categories” (Schmidt, 2004:255) emerged from each individual interview which were cross-analyzed with each other. The aim of this was to find uniting nodes of analysis, as well as meaningful disparities between the data sets collected.

RESULTS

Overarching Aims of NBS Projects Retrofitting Cities With NBS

As stated above, *Connecting Nature*, *URBAN GreenUP* and *Grow Green* can be understood as “transition initiatives.” In AP3’s words, they are “concrete steps we can take now to realize that [sustainable] transition.” The overarching aim of all three projects is to use NBS interventions to render cities more resilient to the impacts of climate change, illustrated by CP3, who stated that “the project [URBAN GreenUP] is about testing solutions that will tackle the future predicted impacts of climate change... [e.g.] impacts to air quality, air pollution, water quality, water volume, surface water flooding.”

But through what “pathway” do these partners envision using NBS to catalyse this sustainable transition? The most common

TABLE 1 | NBS project actors.

Project	Frontrunner cities	Follower cities	Academic partners	Civil society partners	Business partners	Funding
Connecting nature	Glasgow (UK) Genk (Belgium) Poznan (Poland) La Coruña (Spain)	Bologna (Italy) Burgas (Bulgaria) Ionnina (Greece) Malaga (Spain) Nicosia (Cyprus) Sarajevo (Bosnia & Herzegovina) Pavlos Melas (Romania)	Trinity College Dublin (ROI) Erasmus University Rotterdam (Dutch Research Institute for Transitions) (Netherlands) Humboldt University of Berlin (Germany) Adam Mickiewicz University of Poznan (Poland) University of East London(UK) University of A Coruña (Spain) West University of Timisoara (Romania) University College Dublin (ROI) Center for Ecological-Noosphere Studies (Armenia) GIS and RS Consulting Center Geographic (Georgia)	Local Governments for Sustainability (ICLEI) (EU) Horizon NUA (ROI) Osmos (EU) Urban Planning Institute of the Republic of Slovenia OPPLA (EU) Greenspace Scotland (UK) Climate Alliance (EU)	BioAzul (Spain) Helix Pflanzen (Germany)	€12 million
URBAN GreenUP	Liverpool (UK) Valladolid (Spain) Izmir (Turkey)	Mantova (Italy) Ludwigsburg (Germany) Medellin (Colombia) Chengdu (China) Binh-Quy Nhon (Vietnam)	The University of Liverpool (UK) Università Bocconi (Italy) Ege Universitesi (Turkey) Izmir Yuksek (Turkey) RMIT University (Vietnam/Australia)	The Mersey Forest (UK) Fondazione iCons (Italy) The Center for New Water Technologies (CENTA) (Spain) Chengdu High-Tech Investment (CDHT) (China) Leitat (Spain)	CARTIF (Spain) Singular Green (Spain) ACCIONA (Spain) Demir Enerji (Turkey) GMV (Spain) Sociedade Protugeusa de Inovacao (SPI) (Portugal) Bitnet (Turkey)	€14 million
Grow green	Manchester (UK) València, (Spain) Wrocław (Poland) Wuhan (China)	Modena (Italy) Brest (France) Zadar (Croatia)	University of Manchester (UK) University of Cambridge (UK) Wrocław University of Environmental and Life Sciences (Poland) Polytechnic University of València (Spain)	International Union for Conservation of Nature (IUCN) Greater Manchester Combined Authority (UK) Leitat (Spain) Tecnalia (Spain) Wrocław Agglomeration Development Agency (Poland) Manchester Climate Chance Agency (UK)	Bipolaire Arquitectos (Spain) Paisaje Transversal (Spain) Trinomics (EU) The Guinness Partnership (UK)	€11 million

answer was through urban retrofit; a term that “implies providing something with a component or feature not fitted during manufacture or adding something that it did not have when first constructed” (Eames et al., 2014:2). AP2 expressed that, from the outset of *Connecting Nature*, the project was expected to answer the following questions: “*how do we innovate with our cities? How do we retrofit them?*” Similarly, CP3 stated that *URBAN GreenUP* “*is about testing nature-based solutions in urban city areas... a lot of that is about retrofitting green or blue infrastructures because cities obviously are well established; we don't have large areas of space to put [in] big grand schemes.*” Due to the issue of limited urban space, projects have predominantly taken a small-scale

approach to NBS interventions. *The URBAN GreenUP* project in Liverpool, for example, takes “*a very localized approach*” (CP3), focusing on creating “*small demonstrator*” interventions such as floating gardens, green walls and green roofs in designated zones across the city.

However, despite taking a small-scale approach to biogenic infrastructural retrofit, NBS projects do not bypass issues associated with fragmented urban land ownership. As CP3 of the *URBAN GreenUP* project states, “*I might say 'I'd love a green wall here, it'd be brilliant' but if I can't get landowner permission, I can't deliver it as an output... I may have to compromise on location where I can get landowner permission to deliver the green wall*”

TABLE 2 | Interviewee profiles and codes.

Organization	Type	Code
Connecting Nature:		
Glasgow City Council	City partner	CP1
Glasgow City Council	City partner	CP2
Humboldt University of Berlin	Academic partner	AP1
Trinity College Dublin	Academic partner	AP2
DRIFT—Erasmus University Rotterdam	Academic partner	AP3
URBAN GreenUP:		
Liverpool City Council	City partner	CP3
The Mersey Forest	Civil Society partner	CSP1
Grow Green:		
Manchester City Council	City partner	CP4
Manchester City Council	City partner	CP5
Local Governments for Sustainability (ICLEI)	Civil society partner	CSP2
IUCN	Civil society partner	CSP3
Trinomics	Business partner	BP1

(CP3). Moreover, even when an intervention is implemented, risks pertaining to upkeep remain: “there’s also a trust issue with the person whose property you’re placing this wall on, in that that they are going to commit to it financially in the longer term” (CP3).

Enhancing EU Climate Change Leadership

The EU’s ambition to be a global leader in the innovation and implementation of NBS came through clearly in interviews. CSP2 of *Grow Green* expressed that “the European Commission would like to see itself... as a global leader in the nature-based solutions market. So global leadership is something that essentially all projects need to answer to.” This was echoed by AP3 of *Connecting Nature*, who stated that “the EU wants to brand itself as the front runner in nature-based solutions... That’s really the goal of the European Union with these projects; to really become the nature-based solutions ‘brand’ as such.”

AP2 of the *Connecting Nature* project discussed how the multi-level structure of the project—with its set of frontrunner EU cities, and several non-EU follower cities—facilitates the expansion of the EU’s influence beyond its external borders. Speaking on how Yerevan (Armenia) and Tbilisi (Georgia) were included within the project, they state that:

“we’ve chosen some of the unusual subjects for our project and they [the EU] were very delighted about that... Europe wishes to engage on a more physical level with the agencies and institutions [in Armenia and Georgia] in order to assist in whether they want to become part of the EU or not... they [the EU] wants to start the type of cohesion that we’re starting to see sort of falling apart in parts of Europe” (AP2).

As well as engaging emerging nations at the European periphery, the same interviewee discussed how the *Connecting Nature* project also helps the EU to strengthen its relations with non-European nations. They state that:

“we [Connecting Nature] found solutions for dealing with problems that the commission can’t solve. So, we’re helping the EU-Brazil and the EU-China delegation... we’ve been able to help provide insights into how we deal with them on a city level” (AP2).

Scope(s) of NBS Projects

Though funded from the same source and expected to deliver the outcomes and aims described above, the way in which *Connecting Nature*, *URBAN GreenUP* and *Grow Green* have approached the design, scale and scope of their NBS interventions differ. For CP4 of the *Grow Green* project, this is a product of the EU being “such a flexible funder.” Indeed, outside of being “prescriptive in terms of the call text,” AP3 states that project partners had “one hundred percent freedom” over the trajectory and design of their respective projects. This ability to design interventions without restriction from the EU was seen as crucial to the success of the projects by stakeholders. As AP2 put it, “the issues we’re trying to tackle are local in nature, therefore we need locally adapted solutions.”

Connecting Nature

Of the three projects, *Connecting Nature* takes the most expansive and dynamic approach to implementing NBS. In the words of AP3, *Connecting Nature* aims to create “innovation action projects... across entire cities” as opposed to focusing solely on “neighborhood areas.” According to CP2, because the three frontrunner cities have “very different kind of makeups,” each is deploying a “bespoke” set of NBS interventions at “very different scales.” CP1 expands upon this, stating that Poznan has ambitions to create a “green network across [a] quarter of the city.” This network is to be composed of natural playgrounds within local kindergartens which look to tackle the lack of green space available to local schoolchildren. Genk has taken a more micro-approach to urban re-naturing through NBS. The city aims to “de-culvert” (CP1) much of the polluted Stiemer valley, regenerate the “vacant, derelict land around it” and ultimately create a new park that “would stimulate growth and new development” in the locality, whilst also mitigating the risk of flooding.

Akin to Poznan and Genk, Glasgow is utilizing practical NBS interventions, such as a community-run wildflower nursery. Run in Pollok Park, ‘Flower Power’ looks to “reverse the decline of meadow and insect species” (Glasgow City Council, 2019) whilst simultaneously providing social benefits to local communities. However, running in tandem to this, Glasgow is also developing an “open space strategy” (CP1) that looks to provide a methodology or guide for how “nature-based solutions allow us [Glasgow City Council] to make better asset management decisions.” Thus, within *Connecting Nature*, the NBS concept is being applied at a local level (Genk and Glasgow), network level (Poznan) and at a “strategic level” (CP1) (Glasgow).

URBAN GreenUP

Unlike *Connecting Nature*, the three frontrunner cities in *URBAN GreenUP* are deploying NBS in similar ways and scales. They are primarily targeting the implementation of singular NBS interventions located in multiple sites across the urban landscape, as well as networked green and blue spaces. However, the

extent of these green and blue networks is less than that of Poznan's approach in *Connecting Nature*. As mentioned prior, the *URBAN GreenUP* project in Liverpool focuses on creating small demonstrator interventions such as floating gardens and green walls that are expected to sequester carbon and mitigate climate change impacts such as the UHI effect. In all three front-runner cities, these singular interventions are to be used alongside more connected forms of NBS, such as new green cycle and travel routes, as well as the "re-naturing" of pre-existing ones (*URBAN GreenUP*, 2019). Alongside increasing localized resiliency to climate change, both these stand-alone and interconnected forms of NBS intervention are expected to "regenerate areas [and] attract other business" (CP3), whilst also helping to tackle "big issues around mental health and well-being."

Grow Green

In contrast to the other projects, *Grow Green* favors a neighborhood-level approach to NBS implementation in each of its demonstrator cities. NBS interventions are being utilized within historically socio-economically deprived communities. The project team in Manchester are focusing "all resource and energy" (CP4) into the neighborhood of West Gorton. In the words of CP5 "it is an area of regeneration... part of that regeneration is building a whole load of new homes, quality homes, and as part of that regeneration progress, we've [Manchester City Council] incorporated this new park which will form the hub of the community between the old and new." Incorporated within this community park are NBS interventions such as "swales, rain gardens, bio-retention [basin/pond], tree-pits and permeable pavements" that look to render the neighborhood resilient to urban flooding, whilst also improving air and water quality, and enhancing cohesive and active community lifestyles.

This neighborhood-scale is mirrored in Valencia, where the City Council is focusing on the Benicalap-Ciutat Fallera district which "has high levels of immigration and unemployment, as well as an aging population and deteriorating infrastructure" (*Grow Green*, *Grow Green*) and in Wrocław, which is implementing NBS in the Olbin/Plac Grunwaldzki district of the city; "a dense, multi-use neighborhood that ranges from wealthy to socially deprived" (*Grow Green*, *Grow Green*). For Valencia, the focus is on providing interventions that reduce heat stress and increase connectivity between green spaces within the "demonstrator" neighborhood. Thus, the type of NBS that have been selected are vertical gardens, micro-forest and green corridors (ibid). In Wrocław, the city council is utilizing interventions such as pocket parks and green streets to mitigate the city's risk of flooding (ibid).

Governance Dynamics Within NBS Projects

Operating beyond national government jurisdiction and composed of stakeholders from city council, academic and SME backgrounds, NBS projects are contemporary examples of decentralized and "polycentric" environmental governance i.e., they contain multiple nodes of "semiautonomous decision making" (Carlisle and Gruby, 2019, p. 2). Polycentricity stands in opposition to monocentric forms of governance, where one entity or actor possesses a monopoly on power or authority over

the governing of a 'common' resource or issue; in this case urban vulnerability to climate change (Termeer et al., 2010).

Though each NBS project does have a coordinating partner² that is expected to "manage us [the other partners] and set our deadlines" (CP3), be "the financial and legal administrators to the project" (CP5) and operate as "the first port of call if people have a query in relation to the project" (ibid), power is spread horizontally through a system of work-packages (WPs) that guide each project. Multiple interviewees remarked on how the horizontal governance of these NBS projects makes them more effective than past EU-funded projects. Referring to a past EU-funded project they worked on, CSP1 stated that "the way that this project [*URBAN GreenUP*] is managed is very, very different... [it's] very egalitarian." The prior project allowed for less autonomy, with an academic partner acting as the sole hegemon. This top-down approach did not allow the other partners to contribute their specific skillsets and knowledge(s), which ultimately served to undermine the project. As CSP1 states, "when we went into the first partner meeting... they [the lead academic partner] could not have been more dismissive... we were invisible because we weren't in academic papers."

Whilst the power dynamics amongst partners within NBS projects appear egalitarian, multiple interviewees raised concerns about the dynamic between the projects and the communities the projects look to 'serve'. Public participation with these communities has undoubtedly been encouraged within all projects. As CP5 of *Grow Green* stated:

"Part of the process for developing the demonstration sites has been stakeholder engagements... there's been an awful lot of community consultation with young and old businesses... and there's also been input from local residents and stakeholders in terms of the final design [of NBS interventions] that will be built."

However, CSP1 suggests that levels of community participation were superficial within *URBAN GreenUP*. They state that:

"It's a tricky thing when you've got European funding because the way the funding works is that when you put in the bid, you have to know exactly what you're doing [in reference to specific NBS interventions] and where you're going to do it... So you don't have the luxury of being able to consult with people to say, 'what is your problem and how can we provide the solution'... [this is] because you almost have to get the solution up front in order to get the funding" (CSP1).

CSP1 argues that although local communities were consulted, they cannot be considered true 'co-designers' of the planned NBS interventions because the process failed to "ask people if they have a problem" (CSP1) in the first place. Local people perceived the process of engagement as "almost imperialistic" (CSP1), and questioned "what do you mean solution? I haven't got a problem. Why are you giving me a solution? What makes you think you know the answers to our problems?"

²Trinity College Dublin in *Connecting Nature*, Cartif in *URBAN GreenUP* and Manchester City Council in *Grow Green*.

Relationship Between NBS and Other 'Foundational' Concepts

Many interviewees expressed the view that the difference between NBS and other 'ecosystem-based' terms—especially GBI—is ambiguous. This is exemplified by CSP1's statement that *"on the ground, it's quite confusing not just for practitioners, but for people we engage with to try and explain [the difference between NBS and GBI]"* and CP3's view that NBS is *"part of a whole green space and green infrastructure discussion... they're all part of the jigsaw."* This perceived ambiguity has led many practitioners to use the concepts synonymously; *"I tend to use them almost interchangeably depending on who I speak to..."* (BP1). Echoing this, CSP3 suggests that creating concrete distinctions between the terms is unnecessary; *"I think, in practical terms, what matters is that we use the terms that people understand... so that might be green infrastructure for admin planners in the UK for example... it's better to use what people are already using than to teach them a whole concept."*

Does this mean that NBS adds nothing 'novel' to the field of urban greening? For multiple interviewees, the answer is a resounding no. Whilst the 'meaning' of NBS closely mirrors that of GBI, the concept's framing is the point of differentiation. Encapsulated by AP3's statement that NBS *"is not so much a scientific term as it is a policy term,"* interviewees expressed the opinion that the NBS concept makes the ideas and tenets of GBI and ES more palatable for policymakers and urban governments. Building on the argument of AP2 that *"if you take green infrastructure and ecosystem services and stick them in a blender, you've got nature-based solutions,"* AP1 claims that NBS re-imagines these terms in a way that makes them *"more handy for urban governments that need to show success."* Transformed into *"small packages"* that are geared toward providing solutions to urban ills, GBI and ES are molded into NBS through a process of what AP1 calls *"project orientation."*

By being rendered more politically "useful," NBS appears to lose some of the central tenets of GBI and ES on which it is originally based. This is discussed by BP1, who perceives NBS as lacking the focus on connectivity and biodiversity that is so central to GBI. They state that, with GBI:

"You need to connect natural areas in order to give biodiversity the chance to flourish and therefore enhance the delivery of ecosystem services, whereas nature-based solutions you can see it as a bit more low scale... whereas the one [NBS] places emphasis on the 'solution' aspects of tackling some problem, the other [GBI] is larger scale because you're talking about a network connecting several elements to enhance multiple ecosystem services" (BP1).

Mirroring AP1's concern, CSP2 argues that the NBS concept falls *"a bit short"* because it lacks the holistic outlook of GBI. On the favoring of singular or stand-alone interventions within NBS demonstrator projects, they state that: *"one-off solutions; one green roof in a city is of course good, but essentially it's not going to help that much. So essentially you need this sort of network thinking, which I think is really brought across in the term green infrastructure."*

Despite these criticisms of the concept, most interviewees stressed that the NBS term is more accessible for a lay audience in comparison to GBI and ES. BP1 asserts that framing green or blue interventions as 'nature-based' makes NBS *"more intuitive than something more technical like ecosystem services,"* thus rendering it *"quite understandable and simple to the citizens."* Interviewees also expressed how the NBS term allows practitioners to communicate the principles of sustainable urbanism more effectively to key actors involved in urban design e.g., architects and engineers. In the words of CP4; *"getting better at telling the story [of sustainable urbanism] is what NBS helps us to do."* By stressing the co-benefits of NBS interventions, NBS helps practitioners *"make that compelling case without us being like eco-fascists where we're banging the people over the head with it"* (CP4).

Mirroring this view, CP1 explains how utilizing the NBS term in discussion with other urban actors in different sectors can galvanize understanding and cooperation. They claim that using NBS *"wakes up"* (ibid) stakeholders who previously would have been alienated by terms like *"green networks, green infrastructure, ecology and biodiversity."* This line of argument is summed up by CSP2 who states that NBS has the potential to *"integrate many sectors, many themes, many needs and also departments within the planning context of green spaces."* Whilst this silo-busting capacity of NBS is undoubtedly positive, it appears to come with the cost of neglecting GBI's and ES' focus on biodiversity. CSP3 argues that:

"One of the risks of the NBS concept is that the place of biodiversity... is somewhat ambiguous... it doesn't really say anywhere in the definitions or criteria that these solutions should also be beneficial to biodiversity. So, there is a risk [that] if you're not careful to see this [NBS] agenda as complimentary to the more traditional biodiversity protection/conservation agenda. There is indeed a risk that biodiversity gets a bit lost in this [NBS discourse]."

This trade-off played out in other interviews, where the economic and social co-benefits of NBS interventions were stressed at the expense of "environmental" benefits e.g., increased biodiversity. CP3, for example, stated that the *URBAN GreenUP* project looks to use "nature" to increase footfall and local business revenues; *"the café across from the green wall will get a lot more people sitting outside to enjoy their coffee... they might take on more staff, they might move into the building next door and double the size of their floor space."* For AP1, the anthropocentric instrumentalization of 'nature' within NBS is problematic because it is grounded in *"a simple understanding of how nature works"* (AP1) and reduces "nature" to a fixed "solution" provider, practically synonymous with *"technological gray" solutions* (ibid) such as flood drains. In the words of AP2, *"the nature-based solution approach essentially looks at nature as a technology."* For AP1, this representation fails to recognize that *"nature is open and flexible, and all the systems are always in transition"* and that unlike "ordered" man-made infrastructures *"nature is not 'fast' in delivering solutions."*

For AP1, this framing serves to romanticize "nature." This is seen as a "dangerous" (AP1) limitation of the NBS concept, as the framing serves to "oversell" the concept's capacity to solve

socio-environmental ills. AP1 argues that “NBS is not something that is solving or tackling anything. It is just [focusing] on a small part of the big problems” (AP1). For them, the use of “solutions” in the NBS term could give rise to the naïve belief that “well if we do A, B and C [in reference to certain NBS interventions] then climate change can be defended from; climate change will not come; it's all safe’. But this is not at all true” (AP1). Utilizing the same logic, they also criticize how the concept frames “nature” as a panacea to socio-economic issues such as health inequalities and urban deprivation, stressing that “social deprivation is a structural problem, not a problem that can be solved by nature”.

DISCUSSION

Can Small-Scale Retrofit of NBS ‘Solve’ Urban Sustainability Issues?

Interviews illustrated that NBS projects aim to retrofit biogenic infrastructure into urban areas to render them more climate change resilient. This vision for urban sustainability has gained increased attention in recent years (Dixon and Eames, 2013; Eames et al., 2013). Within this discourse, the question that the three NBS projects raise pertains to what scale green space retrofitting should take place at. Eames et al. (2013:505) state that city-wide urban retrofit can help to “envisage a systemic transition in the existing built environment; not just to zero carbon, but across the entire ecological footprint of cities and the regions within which they are embedded”. Retrofit at this scale is seen to provide more comprehensive and integrated sustainability solutions than local-scale interventions for two key reasons.

Firstly, small scale retrofit runs the risk of overreliance on individual building owners to get interventions “in the ground” (Eames et al., 2014). The capacity for small-scale retrofit projects to carry out their plans and provide their deliverables can be precariously predicated upon external forces. For example, if a previously compliant landowner changes their mind about allowing an intervention to be built on their property, a project can quite quickly lose momentum. This vulnerability speaks to CP3’s testimony about how the capacity of the *URBAN GreenUP* team to deliver interventions in Liverpool has been hamstrung by fragmented land and building ownership within the city. It appears that the project’s reliance on the permissions of individual land owners has curtailed how innovative the “Research and Innovation” project can be with regard to the design and location of its NBS interventions.

The second risk associated with local-scale retrofit pertains to their use of micro-level interventions, which risk having negligible impacts on sustainability outcomes (Eames et al., 2013). What does this mean for the capacity of NBS projects to effectively bring about tangible sustainability outcomes? Whilst projects will undoubtedly increase green and blue space across cities, their focus on small demonstrator interventions means that, alone, they will be unable to transition urban spaces to a more sustainable future. Should these projects therefore be understood as tokenistic forms of “business as usual” urban development, as Evans (2011) warns? By framing “nature” as

something that can be mobilized at the local level to solve socio-environmental issues at the city-scale, are these projects unwittingly off-staging (and perpetuating) the macro capitalistic drivers that continue to shape patterns of unsustainable, climate-vulnerable urbanism?

Predictably, the answers to these questions are not clear. What is crucial to stress, however, is that these projects are frontrunner experiments; they are devised to “design, test and learn from social and technical innovation in real time” (Fuenfschilling et al., 2019:219). With their short funding window, they were never genuinely expected to provide transformative solutions to unsustainable urbanism. Nonetheless, if the NBS concept is to carve itself out as a novel and effective tool for urban greening, those mobilizing it, e.g., the EU or the World Bank, must attend to this scalar dilemma. If left unaddressed, NBS risks being superseded in favor of a new term or buzz-word that carries greater political clout or, at least on paper, appears to better encapsulate the shifting dynamics of urban unsustainability.

NBS As the EU’s Latest Hegemonic ‘Environmental’ Tool?

Project actors confirmed that the EU has consciously modeled itself as the global NBS frontrunner, and looks to use the concept to expand its sustainability hegemony both within Europe and beyond. However, NBS is not the first concept the organization has mobilized to strategically elevate its position within discourses surrounding environmental stewardship. Since the 1980s (Rayner and Jordan, 2013), the EU has been widely viewed as an “international agenda setter” (Schreurs and Tiberghien, 2007:19) within the sphere of climate change governance (Jordan et al., 2010; Rayner and Jordan, 2016). Actions that contributed to this position include the emergence of the EU’s emissions trading scheme (ETS) in 2000 (Rayner and Jordan, 2013). Rayner and Jordan (2013:5) describe how, in the late 1980s, a major “frame-shift” occurred in the EU’s environmental policy. The institution transitioned away from perceiving “the economy” and “the environment” as two separate entities and toward a “new ‘sustainability frame’ which integrated the two domains” (ibid).

Advocating strong environmental policy therefore became seen by the EU as an economically beneficial means to simultaneously promote European integration whilst also giving the Union “a stronger global diplomatic identity” (Rayner and Jordan, 2013). From interview analysis, it became clear that NBS is the latest tool mobilized by the EU to pursue these same goals. By offering its “environmental” expertise to countries such as Georgia and Armenia, it can expand its hegemony within countries at the European periphery that have been either considered for EU membership (Armenia in 2002) or have expressed a desire for membership in the past (Georgia in 2011). Operating at the city level, as opposed to the supranational, NBS projects have been utilized by the EU as ways to troubleshoot and hurdle issues experienced within strategic partnerships with other global and regional hegemony, namely China and Brazil. What this illustrates is that NBS is not an apolitical concept, nor is it favored just for its merit as an urban greening tool.

This latter point poses a troubling question. What is truly catalyzing the rollout of the NBS concept? Is it because the concept adds practical value to discourses surrounding urban greening and environmental stewardship? Or is it because it consolidates the EU's position as a global leader and innovator within the remit of environmental, and especially climate change, governance? Regardless of the answer, it is crucial to recognize that concepts such as NBS are not politically inane concepts that are brought into existence solely for their practical merit; they are “signifiers” that embody, privilege, and elevate a certain type of knowledge and “expertise” over others.

Tokenistic Public Participation Within NBS Projects?

From the interviews, community engagement within the NBS projects—namely *URBAN GreenUP* and *Grow Green*—appears somewhat tokenistic. For Momtaz and Gladstone (2008, p. 223) the objectives of public participation include “sharing information, involving the community at an early stage of decision making, taking community aspirations into considerations and giving the community the ability to influence the outcome of decision making.” Thus, on Arnstein (1969) “ladder of participation,” the level of community participation in both projects would be termed “placation.” This describes a situation where communities possess a voice within decision-making, but the power-holders—in this case the partners within the projects—retain the “continued right to decide” (ibid, p. 217). This speaks to CP5's statement that local input was encouraged at the “*final design*” phase of the project, and begs the question as to what capacity local people had to actually shape the approach of the projects and intervention design. It also illustrates how, despite their aim to design local solutions that reflect local problems, techno-managerial epistemologies were privileged over less quantitatively grounded or standardized ‘local’ knowledge systems.

CSP1's statement that *URBAN GreenUP* failed to actually diagnose local issues before designing solutions supports this sentiment. Working “backwards” in this manner risks depoliticising the urban greening process. Instead of being given, from the outset, a platform to air concerns or suggestions about the approach of projects, the majority of local dissent was likely off-staged and filtered out (Kaika, 2017). This speaks to, and expands upon, (1) Nesshöver et al. (2017, p. 1220) concern that the “solutions” element of NBS is problematic because it gives the false impression that the “problems” NBS interventions aim to solve are clear and agreed upon, and (2) Evans's et al. (2016, p. 1) question as to whether urban experiments truly provide empowering alternatives to how urban issues are governed, or whether they are, once again, “captured by a familiar cast of dominant interests.”

However, does this necessarily mean that NBS project practitioners purposefully delivered shallow public participation programmes aimed at uncritical consensus-building? As alluded to by CSP1, the issue seems to be less with the conduct of project partners and more with the way in which NBS projects were rushed to decide upon their intervention designs without being given the necessary time to consult local people in any meaningful way. This pressure can be understood as an outcome

of the high level of competition between budding NBS projects to attain EU funding (Baroni et al., 2019). Moreover, it is crucial to recognize that the three projects are first and foremost “Research and Innovation” projects. Whilst this fact should not excuse the issues of disempowerment discussed above, it perhaps does help to explain why their public engagement exercises appear shallow.

Overselling “Nature” Whilst Undervaluing Biodiversity: The Paradox of NBS?

The results presented above illustrate how the NBS term renders the concepts of urban greening more politically palatable for urban governments and more accessible to the general public. Thus, NBS can be seen as a term that both unpacks and even democratizes the tenets of these concepts. However, this demystification has come at a clear cost. It appears that some of the central facets on which NBS is built upon—namely the focus on interconnectivity and biodiversity within GBI—have been watered down. Potentially this is due to an issue that CP4 raises—the fear city councils and other knowledge holders have about coming across as “*eco-fascists*,” and thus losing their influence over the general population, as well as businesses. Nonetheless, whilst Mell and Clement (2019, p. 3) assertion that NBS can help contribute to the sectoral “*silo-busting*” necessary to integrate “ecological concerns alongside traditional planning activities” appears correct, it is unclear whether the view of NBS having a more “nature-centric” approach than other concepts holds. Herein lies the paradox of NBS. Whilst the idea of nature is undoubtedly central to the NBS concept, actual nature, e.g., biodiversity and ecological resources, appears to be undervalued, especially in comparison to GBI.

A source of this paradox relates to the way in which “nature” is valued extrinsically within the NBS discourse. “Nature” is perceived as “good” or “useful” if/when it brings about positive outcomes, predominantly within the spheres of the social and economic. To borrow the words of Kaika (2017, p. 91), “nature” is (re)presented “as if it were something that could be injected into cities in the form of parks or green roofs” and ultimately help urban governments “immunize” their citizens from the threats of climate change (Esposito, 2013), whilst stimulating economic growth (EC, 2015). This instrumentalization of nature speaks to what Kabisch et al. (2016, p. 8) term the “growth obsession” of cities, which posits that the promise of economic growth is the dominant driver for urban green and blue space provision. Due to this focus, Sekulova and Anguelovski (2017, p. 6) argue that “finding a balance between economic growth, social equity and environmental concerns in the operationalisation of NBS” will almost inevitably result in the “environmental” losing out at the expense of the other two.

As CP1 elucidated, reducing “nature” to a socio-economic “solution” provider risks simplification and romanticization. The trope is by no means indigenous to the NBS discourse, however. Swyngedouw and Kaika (2014, p. 468) point out that the broader “sustainability” discourse itself is predicated upon a “fantastical scripting of a particular ‘scientific’ nature as singular, ordered and inherently dynamically balanced.” This insight begs the question as to how far we've truly come from Ebenezer Howard's ideas where, as shown in the introduction, “nature” was also

romanticized and reduced to a tool that could sanitize socio-economic ills. As AP1 shows, “nature” is not only still being mobilized as a solution to social deprivation, but is now held up as a panacea to the fallouts associated with climate change.

Akin to Howard's era, this current form of nature fetishization risks overselling its “solutionist” capacity and could feasibly detract or distract attention from more systemic strategies to reduce pertinent socio-economic and environmental issues. After-all, Howard's prescription of “nature” was evidently unable to provide “solutions” to the prescient crises of his time. As Kaika (2017:98) writes, whilst “nature” “can perhaps mediate some of the consequences of global socio-ecological inequality... [it does] little toward alleviating inequality *per se*”. This speaks to Sekulova and Anguelovski (2017) point that whilst nature can help to tackle the symptoms of issues we face, it cannot address their roots or drivers. Does this mean that AP1's statement that there is distinct danger in framing NBS as “solutions” is valid? By championing the concept, are institutions such as the EU unwittingly sowing a false belief, or even hope, that an amorphous “nature” can “save us” from climate change? The answer appears unclear.

What is clear, however, is that both the “nature” and “solution” aspects of NBS need to be addressed. As Nesshöver et al. (2017, p. 1220) have stated, those working within the NBS discourse must engage in “pluralistic reflection about alternative framings and conceptualisations” of “nature,” instead of consistently conceptualizing it as a unified and fixed solution provider. If this is not addressed, there is likely to be a reputational backlash for projects that champion urban greening for climate resiliency. If stakeholders in both private and public sectors, as well as the general public, observe that a contemporary project has failed to “solve” the issues it purported to possess the knowledge and expertise to do so, how will they appraise the next project that aims to do the same? Will the trust of these stakeholders automatically regenerate? Will businesses want to help finance or support these new projects if their predecessors failed or performed sub-optimally? Though these projects must “sell themselves” to attain funding and recognition, marketing “nature” as a “solution” crosses the threshold of what is possible and, in reality, what is logical.

CONCLUSIONS

This paper has investigated three knowledge gaps within the NBS literature. The first gap pertains to the “politics” of Horizon 2020-funded NBS projects i.e., their overarching aims and governance arrangements. Data collected from interviews with NBS practitioners within *Connecting Nature*, *URBAN GreenUP* and *Grow Green* illustrated that these projects aim to influence climate-resilient and sustainable urbanism practice through the process of small-scale biogenic infrastructural retrofit. This approach was problematized on the grounds that retrofit at this scale risks having a negligible impact on urban sustainability. Enhancing the EU's reputation as a leader within the arena of climate change governance and strengthening its diplomatic relations with neighboring non-EU countries and key international trade partners were shown to be the broader aims of these projects.

The results also showed that although the projects aim to be participatory, the extent and depth of the community consultation conducted around NBS design could be construed as superficial. Partners within *URBAN GreenUP*, for example, described how local communities were never consulted on what “solutions” they desired, or even the “problems” they wanted solved. This adds credence to Nesshöver et al. (2017) statement that the “solutions” aspect of NBS gives the false impression that the “problems” NBS interventions are ostensibly solving are clear and agreed upon. However, this research suggests that this exclusionary aspect of the projects is closely related to the design of the Horizon-2020 funding system, which appears to rush project partners to decide upon their planned “solutions” before the specific “problems” have been identified and unpacked.

Although the relationship between NBS and other urban greening concepts such as GBI and ES has been discussed in the literature, there has been little analysis on how NBS practitioners perceive the NBS concept. This was the second research gap this paper aimed to address. NBS was perceived by many interviewees as a “novel” urban greening concept. This is because it renders pre-existing terms such as GBI and ES more politically palatable for urban governments and understandable to a lay audience. This is “achieved” through a filtering process, which sees central tenets of GBI, namely green space connectivity and biodiversity becoming side-lined in favor of a more central focus on the socio-economic benefits of green and blue space provision.

This process of simplification renders NBS a “boundary concept,” allowing it to engage stakeholders who would have been alienated by urban greening terminology in the past. This accessibility is seen as the greatest strength of the NBS concept and re-affirms Mell and Clement (2019) view of the concept possessing the capacity to integrate ecological concerns into the traditional planning agenda through the process of sectoral “silo-busting.” However, these “ecological concerns” overwhelmingly center on what impact an amorphous “nature” can have on socio-economic urban ills. Issues surrounding biodiversity protection and provision were perceived to be missing within the NBS discourse.

This undervaluing of biodiversity coincides with an overselling of a specific representation of “nature,” forming what this paper has termed an “NBS paradox.” This speaks to the third gap in the NBS literature that this paper aimed to fill; how is “nature” imagined within the concept? Multiple interviewees argued that the “nature” enshrined within NBS is over-simplified, singularized, and romanticized to the point to which it risks becoming unscientific. Akin to Ebenezer Howard's ideas in the early Twentieth Century, NBS (re)presents “nature” as a prophylactic technological “fix” that can solve our civilizational problems. This view was problematized by project partners, who argue that whilst NBS interventions may be able to address the symptoms of unsustainable urbanism e.g., the UHI effect, when used alone they cannot tackle the systemic metabolisms that have formed and perpetuate these issues. Moreover, for some interviewees, positing “nature” as a solution-provider risks overselling its capacity and gives the false impression that nature can protect us from climate change threats if it is just mobilized in the “right” or “optimal” way.

Future research must look at how the NBS concept can re-integrate a focus on biodiversity. A solid starting point would be for present and future projects to adopt the IUCN's definition of NBS, which is broader than the EU's definition and crucially stresses the importance of biodiversity: "[NBS are] actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Momtaz and Gladstone). Nonetheless, changing the definition of the term alone will not resolve the paradox of NBS. Until the environmental trade-off that typifies the "growth obsession" of cities is addressed, biodiversity benefits of green and blue interventions will likely always be undervalued. Whilst this point applies to all concepts within the urban greening discourse, it is particularly pertinent for NBS.

With this in mind, though all eyes (and funding-budgets) appear to be focused upon NBS, we must not cast pre-existing urban greening terms aside and uncritically label them defunct. Though perhaps not as appealing to urban governments and businesses, or attractive to supranational entities looking to bolster their standing within global environmental governance spheres, the GBI concept has consistently championed the connectivity of green space and overtly stressed the importance of making provision for biodiversity. If NBS is uncritically sold as a replacement to GBI and ES, what will happen to these two tenets? Questions such as this are for future research on the mobilization of NBS to wrestle with.

REFERENCES

- Allen, D. (2009). From boundary concept to boundary object: the practice and politics of care pathway development. *Soc. Sci. Med.* 69, 354–361. doi: 10.1016/j.socscimed.2009.05.002
- Arnstein, S. R. (1969). A ladder of citizen participation. *J. Am. Institute Plan.* 35, 216–224. doi: 10.1080/01944366908977225
- ARTS (2019). Welcome to Accelerating Transitions. Available online at: <http://acceleratingtransitions.eu/> (accessed August 15, 2019)
- Baró, F., L., Chaparro, E., Gómez-Baggethun, J., Langemeyer, D. J., and Nowak, J., Terradas (2014). Contribution of ecosystem services to air quality and climate change mitigation policies: the case of urban forests in Barcelona, Spain. *Ambio* 43, 466–479. doi: 10.1007/s13280-014-0507-x
- Baroni, L., Nicholls, G., and Whiteoak, K. (2019). Grow green: approaches to financing nature-based solutions in cities [Draft]. Available online at: http://growgreenproject.eu/wp-content/uploads/2019/03/Working-Document_Financing-NBS-in-cities.pdf (accessed August 22, 2019)
- Beck, U. (2011). Cosmopolitanism as imagined communities of global risk. *Am. Behav. Scientist* 55, 1346–1361. doi: 10.1177/0002764211409739
- Brinkmann, S. (2013). *Qualitative Interviewing Understanding Qualitative Research*. New York, NY: Oxford Scholarship Online. doi: 10.1093/acprof:oso/9780199861392.001.0001
- Bulkeley, H., and Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Trans. Institute British Geograph.* 38, 361–375. doi: 10.1111/j.1475-5661.2012.00535.x
- Caprotti, F., and Cowley, R. (2017). Interrogating urban experiments. *Urban Geography* 38, 1441–1450. doi: 10.1080/02723638.2016.1265870
- Carlisle, K., and Gruby, R. L. (2019). Polycentric systems of governance: a theoretical model for the commons. *Policy Stud. J.* 47, 927–952. doi: 10.1111/psj.12212

DATA AVAILABILITY STATEMENT

All datasets generated for this study are included in the article/Supplementary Material.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Manchester and University of Liverpool. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FO'S wrote the original draft. IM and SC provided in-depth feedback and the final copy was re-written by FO'S. All authors contributed to the article and approved the submitted version.

FUNDING

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 730426. Support was also received from the University of Manchester via their Open Access funding agreements.

- Castree, N. (2013). *Making Sense of Nature*. Routledge. doi: 10.4324/9780203503461
- Cohen-Shacham, E., Walters, G., Janzen, C., and Maginnis, S. (2016). *Nature-Based Solutions to Address Global Societal Challenges*. Gland: IUCN, 97. doi: 10.2305/IUCN.CH.2016.13.en
- Conesa-Sevilla (2018). "Nature: an empty signifier," in *Advances in Psychology Research*, ed Alexandra M. Columbus. New York, NY: Nova Science Publishers.
- Dixon, T., and Eames, M. (2013). Scaling up: the challenges of urban retrofit. *Building Res. Inf.* 41, 499–503 doi: 10.1080/09613218.2013.812432
- Dorst, H., van der Jagt, A., Raven, R., and Runhaar, H. (2019). Urban greening through nature-based solutions—key characteristics of an emerging concept. *Sustainable Cities Society* 49:101620. doi: 10.1016/j.scs.2019.101620
- Drever, E. (1995). *Using Semi-Structured Interviews in Small-Scale Research. A Teacher's Guide*. Edinburgh: Scottish Council for Research in Education.
- Dulal, H. B. (2016). Making cities resilient to climate change: identifying 'win-win' interventions. *Local Environ.* 22, 106–125. doi: 10.1080/13549839.2016.1168790
- Eames, M., Dixon, T., Lannon, S. C., Hunt, M., De Laurentis, C., Marvin, S., et al. (2014). Retrofit 2050: Critical Challenges for Urban Transitions. Working Paper. Cardiff University. Available online at: <http://www.retrofit2050.org.uk/retrofit-2050-criti>
- Eames, M., Dixon, T., May, T., and Hunt, M. (2013). City futures: exploring urban retrofit and sustainable transitions. *Building Res. Inf.* 41, 504–516. doi: 10.1080/09613218.2013.805063
- EC (2014). Debrief: European Conference "Ren-naturing Cities: Addressing Environmental Challenges and the Effects of the Economic Crisis through Nature-Based Solutions. Available online at: https://ec.europa.eu/research/environment/pdf/renaturing/debrief_renaturing_last_version.pdf?view=fit&pagemode=none (accessed August 21, 2019).
- EC (2015). Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities. Available online at: <https://publications>

- europa.eu/en/publication-detail/-/publication/fb117980-d5aa-46df-8edc-af367cddc202 (accessed March 03, 2019).
- EC (2019). Nature-based solutions. Available online at: <https://ec.europa.eu/research/environment/index.cfm?pg=nbs> (accessed July 12, 2019).
- Eisenberg, B., and Polcher, V. (2018). 'Nature Based Solutions – Technical Handbook'. [online] Available at: <https://www.unalab.eu/flipbook/view/1240> (accessed July 12, 2019).
- Esposito, R. (2013). *Terms of the Political: Community, Immunity, Biopolitics*. New York, NY: Fordham Univ Press.
- Evans, J., Karvonen, A., and Raven, R. (2016). "The experimental city: new modes and prospects of urban transformation," in: *The Experimental City* (Routledge). doi: 10.4324/9781315719825-1
- Evans, J. P. (2011). Resilience, ecology and adaptation in the experimental city. *Trans. Institute British Geograph.* 36, 223–237. doi: 10.1111/j.1475-5661.2010.00420.x
- Faivre, N., Fritz, M., Freitas, T., de Boissezon, B., and Vandewoestijne, S. (2017). Nature-Based Solutions in the EU: innovating with nature to address social, economic and environmental challenges. *Environ. Res.* 159, 509–518 doi: 10.1016/j.envres.2017.08.032
- Frantzeskaki, N., Borgström, S., Gorissen, L., Egermann, M., and Ehner, F. (2017). "Nature-based solutions accelerating urban sustainability transitions in cities: lessons from Dresden, Genk and Stockholm Cities," in *Nature-Based Solutions to Climate Change Adaptation in Urban Areas*, (Cham: Springer). doi: 10.1007/978-3-319-56091-5_5
- Frantzeskaki, N., and Rok, A. (2018). Co-producing urban sustainability transitions knowledge with community, policy and science. *Environ. Innovation Societal Transitions* 29, 47–51. doi: 10.1016/j.eist.2018.08.001
- Fuensschilling, L., Frantzeskaki, N., and Coenen, L. (2019). Urban experimentation & sustainability transitions. *Eur. Plann. Stud.* 27, 219–228 doi: 10.1080/09654313.2018.1532977
- Giddens, A. (1998). *Conversations With Anthony Giddens. Making Sense of Modernity*. Stanford, CA: Stanford University Press.
- Glasgow City Council (2019). Glasgow's flower power. Available online at: <https://www.glasgow.gov.uk/article/19879/Glasgows-Flower-Power> (accessed July 13, 2019).
- Grow Green (no date). Frontrunner cities. Available online at: <http://growgreenproject.eu/city-actions/frontrunnercities/> (accessed July 11, 2019).
- Grunewald, K., Li, J., Xie, G., and Kümper-Schlake, L. (2018). "Towards green cities: urban biodiversity and ecosystem services in China and Germany," in *Cities and Nature*, (Springer International Publishing). doi: 10.1007/978-3-319-58223-8
- Haas, P. M. (1992). Introduction: epistemic communities and international policy coordination. *Int. Organ.* 46, 1–35. doi: 10.1017/S0020818300001442
- Harvard Business Review (2017). If You Think Fighting Climate Change Will Be Expensive, Calculate the Cost of Letting It Happen. Available online at: <https://hbr.org/2017/06/if-you-think-fighting-climate-change-will-be-expensive-calculate-the-cost-of-letting-it-happen> (accessed March 13, 2019).
- International Institute for Environment and Development (2018). Nature-based solutions: delivering national-level adaptation and global goals. Available online at: <http://nbspolicyplatform.org/wp-content/uploads/2019/02/17484IIED.pdf> (accessed March 11, 2019).
- International Union Conservation of Nature (2014). Renaturing Cities – Using nature based solutions to address urban challenges. Available online at: <https://www.iucn.org/content/renaturing-cities-using-nature-based-solutions-address-urban-challenges> (accessed March 12, 2019).
- International Union for Conservation of Nature (2009). "No time to lose: Make full use of nature-based solutions in the post-2012 climate change regime," in *Fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 15)*. (Gland, CH: International Union for Conservation of Nature).
- Jordan, A., Huitema, D., Van Asselt, H., Rayner, T. and Berkhout, F. (eds) (2010). *Climate Change Policy in the European Union: Confronting the Dilemmas of Mitigation and Adaptation?* Cambridge: Cambridge University Press. doi: 10.1017/CBO9781139042772
- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., et al. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecol. Soc.* 21:39. doi: 10.5751/ES-08373-210239
- Kaika, M. (2005). *City of Flows: Modernity, Nature, and the City*. London: Routledge. doi: 10.4324/9780203826928
- Kaika, M. (2017). Don't call me resilient again!: the New Urban Agenda as immunology or what happens when communities refuse to be vaccinated with 'smart cities' and indicators. *Environ. Urban.* 29, 89–102. doi: 10.1177/0956247816684763
- Karvonen, A., Evans, J., and van Heur, B. (2014). "The politics of urban experiments: radical change or business as usual?" in *After Sustainable Cities?* (London: Routledge), 116–127.
- Lafortezza, R., Chen, J., Konijnendijk van den Bosch, C., and Randrup, T. (2018). Nature-based solutions for resilient landscapes and cities. *Environ. Res.* 165, 431–441 doi: 10.1016/j.envres.2017.11.038
- MacKinnon, K., Sobrevila, C., and Hickey, V. (2008). *Biodiversity, Climate Change and Adaptation; Nature-Based Solutions from the World Bank Portfolio*. Washington, DC: World Bank.
- Mell, I., and Clement, S. (2019). "Rethinking Urban Nature: The Rise and Value of Nature-Based Solutions (NBS) in Europe," in *Proceedings of the Fábos Conference on Landscape and Greenway Planning*, Vol. 6, 31.
- Momtaz, S., and Gladstone, W. (2008). Ban on commercial fishing in the estuarine waters of New South Wales, Australia: community consultation and social impacts. *Environ. Impact Assessment Rev.* 28, 214–225. doi: 10.1016/j.eiar.2007.03.001
- Nature (2018). Six research priorities for cities and climate change. Available online at: <https://www.nature.com/magazine-assets/d41586-018-02409-z/d41586-018-02409-z.pdf> (accessed March 13, 2019).
- Nesshöver, C., Assmuth, T., Irvine, K., Rusch, G., Waylen, A., Delbaere, B., et al. (2017). The science, policy and practice of nature-based solutions: an interdisciplinary perspective. *Sci. Total Environ.* 579, 1215–1227 doi: 10.1016/j.scitotenv.2016.11.106
- Pauleit, S., Zölch, T., Hansen, R., Randrup, T. B., and Konijnendijk van den Bosch, C. (2017). "Nature-based solutions and climate change – four shades of green," in *Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions*, eds N. Kabisch., H. Korn., J. Stadler., and A. Bonn. (Cham: Springer). doi: 10.1007/978-3-319-56091-5_3
- Potschin, M., Kretsch, C., Haines-Young, R., Furman, E., Berry, P., and Baró, F. (2014). "Nature-based solutions," in *OpenNESS Ecosystem Service Reference Book*, eds M. Potschin and K. Jax EC FP7 Grant Agreement no. 308428. Available online at: <http://www.openness-project.eu/library/reference-book>
- Rayner, T., and Jordan, A. (2013). The European Union: the polycentric climate policy leader? *Wiley Interdisciplinary Reviews* 4, 75–90. doi: 10.1002/wcc.205
- Rayner, T., and Jordan, A. (2016). "Climate change policy in the European Union," in *Oxford Research Encyclopedia of Climate Science* (Oxford: Oxford Research Encyclopedias). doi: 10.1093/acrefore/9780190228620.013.47
- Savard, J. P. L., Clergeau, P., and Mennechez, G. (2000). Biodiversity concepts and urban ecosystems. *Landscape Urban Plann.* 48, 131–142. doi: 10.1016/S0169-2046(00)00037-2
- Schmidt, C. (2004). "The analysis of semi-structured interviews," in *A Companion to Qualitative Research*, 253–258.
- Schreurs, M. A., and Tiberghien, Y. (2007). Multi-level reinforcement: explaining European Union leadership in climate change mitigation. *Global Environ. Politics* 7, 19–46. doi: 10.1162/glep.2007.7.4.19
- Scott, M., Lennon, M., Haase, D., Kazmierczak, A., Clabby, G., and Beatley, T. (2016). Nature-based solutions for the contemporary city/Re-naturing the city/Reflections on urban landscapes, ecosystems services and nature-based solutions in cities/ Multifunctional green infrastructure and climate change adaptation: brownfield greening as an adaptation strategy for vulnerable communities?/Delivering green infrastructure through planning: insights from practice in Fingal, Ireland/Planning for biophilic cities: from theory to practice. *Plan. Theory Pract.* 17, 267–300 doi: 10.1080/14649357.2016.1158907
- Sekulova, F., and Anguelovski, I. (2017). The Governance and Politics of Nature-Based Solutions. Available online at: https://naturvation.eu/sites/default/files/news/files/naturvation_the_governance_and_politics_of_nature-based_solutions.pdf (accessed August 13, 2019).
- Shapiro, M. J. (1988). *The Politics of Representation: Writing Practices in Biography, Photography, and Policy Analysis*. Milwaukee: University of Wisconsin Press.

- Swyngedouw, E. (2006). Circulations and metabolisms: (Hybrid) Natures and (Cyborg) cities. *Sci. Culture* 15, 105–121 doi: 10.1080/09505430600707970
- Swyngedouw, E., and Kaika, M. (2014). 'Urban political ecology. *Great promises, deadlock... and new beginnings?* *Documents danàlisi geogràfica*, 60, 459–481. doi: 10.5565/rev/dag.155
- Termeer, C. J. A. M., Dewulf, A., and van Lieshout, M. (2010). Disentangling scale approaches in governance research: comparing monocentric, multilevel, and adaptive governance. *Ecol Soc.* 15:29 doi: 10.5751/ES-03798-150429
- URBAN GreenUP (2019). About URBAN GreenUP. Available online at: <https://www.urbangreenup.eu/about/about.kl> (accessed August 23, 2019).
- Viitanen, J., and Kingston, R. (2014). Smart cities and green growth: outsourcing democratic and environmental resilience to the global technology sector. *Environ. Plan. A* 46, 803–819. doi: 10.1068/a46242
- World Health Organisation (2010). Urbanization and health. Available online at: <https://www.who.int/bulletin/volumes/88/4/10-010410/en/> (accessed March 02, 2019).

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2020 O'Sullivan, Mell and Clement. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.